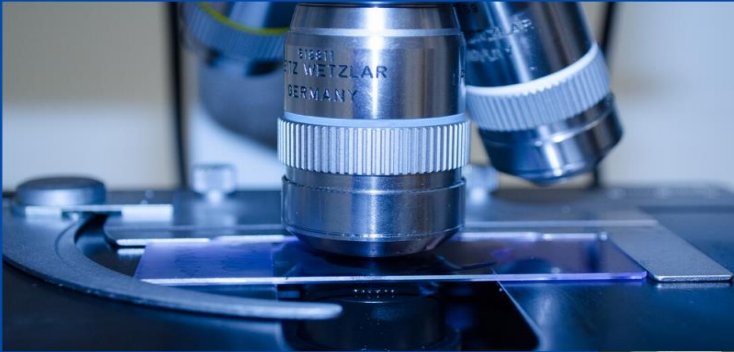


INTRODUCTION TO FORENSIC MEDICINE AND PATHOLOGY



FIRST EDITION



DR. G.Z MUTUMA

Introduction to Forensic Medicine and Pathology



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Introduction to Forensic Medicine and Pathology

First Edition

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Preface

Over the past few decades, the field of Forensic Medicine has expanded enormously, with the rapid emergence of new autopsy and laboratory techniques, and the identification of many new markers for specific pathological conditions.

Forensic pathology has become a treasure trove of research assets including population-based epidemiologic data, a window on unnatural deaths, and the only remaining significant source of autopsy tissues.

Leading national and international forensic pathologists provide cutting-edge reviews of many of the key recent medical and legal advances in the field. These critical surveys concentrate on common pathological entities likely to be encountered in daily forensic routine, as well as on specific pathological conditions rarely seen in the autopsy room.

Complementing rather than replacing the classic textbooks in forensic pathology, the author explores avenues for analyzing the pathology of burned bodies, traumatic brain injury, deaths by drug abuse, sudden cardiac death, sudden infant death and neonaticide, and fatalities resulting from kicking and trampling. Other areas of interest include accidental autoerotic deaths, hypothermia fatalities, injuries from resuscitation procedures, the interpretation of alcohol levels in different

specimens, and the forensic differential diagnosis and interpretation of iliopsoas muscle hemorrhage in the light of autopsy.

Forensic pathologists play a significant role in cases of suspicious and non-suspicious deaths. In cases of sudden deaths, they establish the exact cause of death, while in criminal cases, their opinion is vital to the delivery of justice. Besides, a forensic pathologist has to attend courts of law as an expert witness, provide valuable opinion on the cases, and thus, help in the administration of justice.

Where appropriate, the author also discusses the proper procedures for giving expert testimony in a death investigation. A comprehensive review of the international literature that is otherwise difficult to assimilate is given for each chapter.

Cutting-edge and concise, It is pleasant to record that this volume offers forensic investigators a rich demonstration of how the latest medical and scientific advances are being applied to solve current problems of high interest to forensic pathologists today. In view of the importance of forensic pathology as a specialty, its development is essential in modern society and needs to be addressed and emphasized on.

Acknowledgements

I owe a deep debt of gratitude to World Health Organization for giving me a chance to advance my studies inI also would like to thank whose excellent stewardship of this book has made my job far easier and far stimulating. I am also grateful for a number of friends and colleagues in encouraging me to start the work, persevere with it and finally publish it, all of whom never stopped challenging me and helping me develop new ideas.

I would like to thank my family and friends who may have noticed a degree of introspection and preoccupation during the inception, development and delivery of this book.

I have reviewed and updated this book, discovering as I did so many the pearls of knowledge within its covers.

Writing this edition inspired my own interest and subsequent career in Forensic Medicine. I hope that this edition will inspire others in turn.

Chapter one

Pathology

WHAT IS PATHOLOGY

Pathology is the study of disease and injury.

Pathology can be subdivided into several sections.

1. Anatomical Pathology, (Histopathology),
2. Forensic pathology
3. Haematology,
4. Microbiology,
5. Parasitology,
6. Clinical pathology,
7. virology, and
8. Immunology.

Injury due to disease is the displace death with pathogen while forensic pathology deals with violent injury and the sudden unexplained death.

HUMAN PATHOLOGY

Human pathology is the study and knowledge about all diseases and injuries including their etiology, diagnosis, general principles of treatment, and prognosis or outcome.

Pathology has several subspecialties which include

1. Anatomic pathology (surgical, cytology and autopsy pathology);
2. Clinical chemistry,
3. Clinical haematology including blood banking,
4. Microbiology (including parasitology)
5. Forensic pathology and
6. Immunology.

The three-year program at the University of Nairobi for pathologists provides training in all of the above special areas. After graduating as a "general"

pathologist there are opportunities to do further specialized training in the various departments of Pathology.

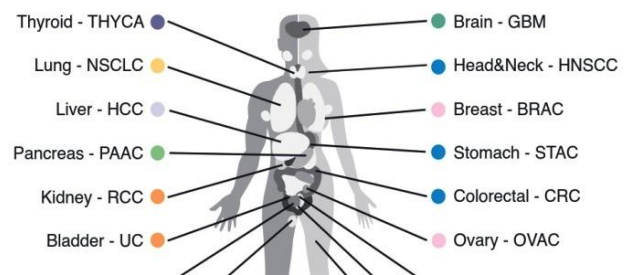


Figure 1. Human Pathological Representation

THE PRACTICE OF PATHOLOGY

Many undergraduates (and I guess postgraduate students) see the practice of pathologists as being isolated, having little to do with living patients, spending time looking down microscopes, or working at the bench doing various tests and of course working in a smelly mortuary doing autopsies on practically decomposed bodies. Working in isolation, rarely going to the hospital wards may indeed be the way some pathologists choose to practice but it need not be that way. Pathologists are indispensable in any health care system and truly much needed medical consultants for other doctors and the patients. How they wish and can best serve as consultants is primarily their own choice.

- The Author pathologist who has practiced pathology for less than ten years chose to become involved with living patients, to be an active consultant on the wards, seeing

patients, and being in the operating room during operations.

- The author was trained both as a general pathologist and subspecialized in Forensic pathology has worked both in the medico-legal department doing only forensic cases and currently involved in research and as a hospital laboratory consultant pathologist.

This integration apart from making a pathologist make an informed opinion in all fields of pathology also breaks the monotony of post mortem and thus a pathologist becomes an integral part of patient management.

Pathologists spent many hours looking down a microscope making diagnoses on surgical and cytological biopsies. Pathologists do a lot of medico-legal autopsies. Some of these cases are very unpleasant to do, but they were also a challenge (such as a suspected murder case) in which the pathologist was a very important witness to help achieve legal justice. No health care system can properly function without the help of laboratory services and consultations.

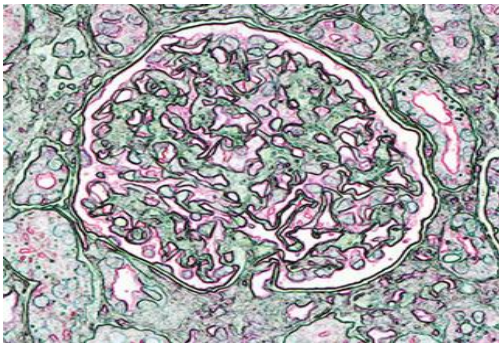


Figure 2. Human Pathology- microscopy

Pathologists have an important role in the diagnosis and treatment of most sick patients.

A few examples in anatomic pathology have been mentioned but all areas of the practice of pathology can become involved with patients on the wards, and in the clinics.

ANATOMICAL PATHOLOGY

Various descriptive terms are applied to the skills encompassed within anatomical pathology. There

are indeed distinct semantic differences between these terms, but for most practical purposes the type of professional specialization and skill involved is the same.

Some of these terms include anatomical pathology, histopathology, surgical pathology, and morbid anatomy.



Figure 3. Anatomical Pathology

Pathologists practicing in these areas have skills in the macroscopic or naked-eye examination of disease organs and tissues, and microscopic examination of human organs and tissues.

Microscopic pathology examination sometimes referred to as surgical histopathology forms the bulk of the work of anatomical pathologists in a hospital setting.

- Pieces of human tissues removed either at the surgery or in sampling techniques such as biopsies are processed in the laboratory.
- Thin sections are cut, placed on glass microscope slides, and stained to reveal the nature of their cellular components.
- These sections of tissue are then examined by a pathologist under a microscope to identify whether there are any abnormalities present in the tissue and if there are abnormalities, what type of disease is involved. The accurate determination of disease type is important for the future management of the patient and short-and long-term prognosis.
- In addition to examination of biopsy material, large portions of organs that are removed during surgical operations as

parts of a curative surgical procedure are also examined by pathologists to ensure that the surgery has included the removal of all of the diseased tissue.

- In the case of operations for the removal of tumours, the pathologist also looks to see whether lymph nodes adjacent to the main tumour site are free from tumour or contain secondary deposits.

In addition to this surgical pathology work, the anatomical pathologist also performs autopsies in a hospital setting where consent has been obtained from families and next of kin.

Most forensic pathologists have completed full anatomical or surgical pathology training and therefore they are experienced in the performance of hospital autopsies as well as forensic pathology autopsies. Also, they are skilled in the areas of microscopy of human tissues and the identification within those tissues of various types of human disease. The surgical pathology training gives the pathologist experiences of a wide variety of other medical specialties. A surgical pathologist may have experience in dealing with biopsy material involving the disease of children and the elderly. Obstetrics and aspects of maternal pathology and gynaecology, together with medical specialty areas such as thoracic or cardiac surgery, are other areas in which the hospital pathologist provides surgical pathology services. As a result, the hospital anatomical pathologist is exposed to a wide variety of medical and surgical material from many clinical sub-specialties.

In some cases, an anatomical pathologist with a particular interest in diseases of the skin works closely with dermatologists and gain considerable dermatological knowledge. As a result of the variable backgrounds of surgical pathologists with regard to training and experience, the lawyer must accurately identify the extent of the knowledge and experience of an anatomical pathologist in any given sub-specialty. Similarly, a surgical pathologist or forensic pathologist who is writing medico-legal reports should state their

additional areas of experience in the preamble of the report so that the true extent of their expertise is made known to the court dealing with the case.

1. Neuropathology

Neuropathology is a discrete sub-specialty within anatomical pathology.

A **neuropathologist** is usually an anatomical pathologist who specializes in the organs and tissues that comprise the central nervous system, the peripheral nervous system, and muscles. In a hospital setting, the neuropathology staff is involved with the clinical disciplines of neurosurgery and neurology.

Neuropathologists deal with diseases of the brain, the spinal cord, the peripheral nerves, and the muscles of the body. A large part of the work of neurosurgeons is the management of trauma to the head and central nervous system. Neuropathologists also deal with traumatic damage to the tissues for forensic pathology concerning the processes involved in head injuries.



Figure 3. Neuropathology

Whilst all anatomical pathologists are trained in aspects of neuropathology, forensic pathologists have a particular interest in traumatic neuropathology. A few forensic pathology centers include specialist forensic neuropathologists amongst their staff to deal

with cases involving damage and injury to the central nervous system.

The investigation of deaths from head injuries can involve;

- Identification of the type of forces applied to the head by reference to the pattern of skull fractures,
- The resulting damage to the brain, and
- The nature and extent of bleeding inside the skull.

2. Cytopathology

The process of identifying diseases of the body involves the examination of whole organs, specific tissues, and the cells that go to make up those tissues. The histopathologist or anatomical pathologist, who examines microscopic sections of tissues under the microscope, looks at tissues of the body where the cells are arranged in their normal anatomical configuration.

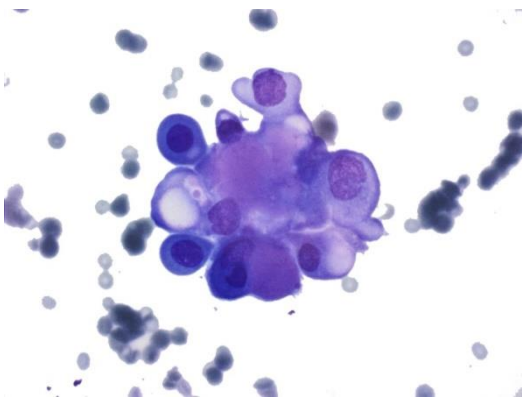


Figure 4. Cytopathology

Cytopathologists examine the cells of the body in isolation or in small clumps where the cells do not form part of an intact tissue structure.

The cells are obtained through a variety of sampling processes;

- Scraping of the surface of tissues, as in the examination of the cervix or neck of the uterus; spatula or like object is used to scrape the surface of organs whereas a needle is used to aspirate cells or fluids containing cells from the body.
- The specimen or sample is usually

concentrated and spread on to slide, and then stained and examined under screening samples collected from people who have no obvious disease or illness. Screening attempts to discover diseases that have not yet made their presence known, so treatment can be started at an early stage. In the case of some diseases, particularly certain cancers, such early detection can result in effective cures.

The role of cytopathology within forensic pathology is limited.

However, a wide variety of cytological techniques are employed within forensic pathology and some tests for drowning and identification of spermatozoa employ procedures similar to those used in cytopathology.

3. Haematology

Haematology involves the diagnosis and treatment of diseases of the blood and includes the examination of peripheral blood and the blood precursor cells found in the bone marrow.

Blood and bone marrow can be examined using techniques similar to those of cytopathology. Several other tissues and organ systems are closely related to the blood and are often included in examinations performed by haematologists. Lymph nodes, the spleen, the thymus, together with the bone marrow, are some of these additional tissues and organs that are examined by haematologists.

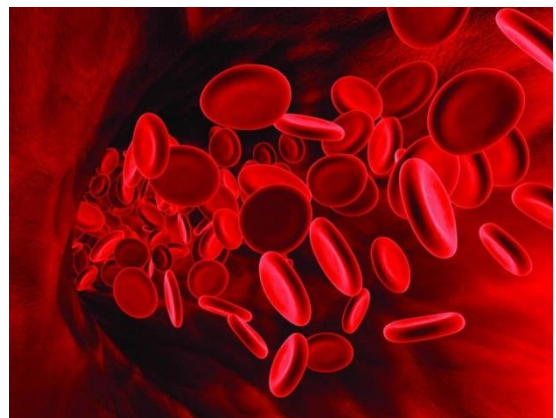


Figure 5. Haematology

Haematology is a specific sub-specialty of pathology, and many practitioners do not have an extensive background in anatomical pathology.

Haematologists are often divided into two types of practitioners;

- Those that deal with blood transfusion services together with the laboratory examination of blood and related tissues as part of diagnostic service, and
- Those that practice as physicians treating individuals with diseases of the blood and related organ systems.
 - Some haematologists practice in both areas and some undertake specialized work on areas such as bone marrow transplantation and blood transfusion.

Whilst the clinical aspects of haematology do not impinge greatly on the work of the forensic pathologist, many of the principles of the identification of blood and the determination of blood grouping used in forensic science and forensic medicine involve the same laboratory techniques and procedures.

4. Microbiology

Microbiology is the branch of pathology that deals with the identification of micro-organisms that cause disease. Bacteria, viruses, and fungi are just some of the agents which are dealt with by microbiologist.

Like other pathologists, the **microbiologist** deals with samples taken from the human body but also, their work can involve the analysis of specimens taken from the environment. These samples are examined to determine which micro-organisms are present, and often the organisms are tested to see whether they are sensitive or resistant to antibiotics and other drugs. Like haematology, microbiology is a pathology discipline in which most practitioners have little training in anatomical pathology.

Like haematologists, microbiologists can be divided into two types of practitioners:

- Those who do laboratory work and
- Those who do clinical work as infectious disease physicians.

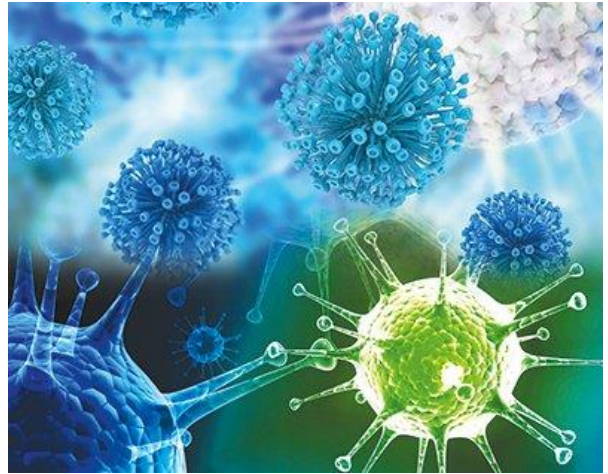


Figure 6. Microbiology

Microbiology has a specific role to play,

- Not only in the diagnosis of infectious diseases,
- But also in the monitoring processes that take place in a hospital,
- Looking for sources of hospital-acquired infection and ensuring that equipment and
- Clean areas are free from significant numbers of potentially infectious agents.

Whilst microbiology has limited application in the field of forensic pathology, all forensic pathologists understand basic microbiology principles and incorporate the results of microbiological testing into their medico-legal reports.

Microbiological diseases play a part in several deaths investigated by forensic pathologists and many of the individuals whose deaths form the subject of forensic pathological investigation have life-styles that involve current or previous infection with particular agents. A good example of this is death associates with an overdose of intravenous drugs, where there is often prior infection with

Hepatitis B, Hepatitis C, or HIV.

5. Immunology

Immunology has emerged in recent years as a key discipline within pathology. Immunological principles are applied in many of the other branches of pathology, including microbiology, haematology, and anatomical pathology. Immunology has grown as a division of pathology and is now recognized as a major sub-specialty.

Immunologists study and test the function of the immune system of the body and the disease that is associated specifically with immune system dysfunction.



Figure 7. Immunology

Many diseases involving the immune system present with symptoms that are relevant to other branches of pathology. For example, autoimmune diseases that attack the blood are often managed by haematologists, and immunological diseases affecting the skin are diagnosed in association with anatomical pathologists. Many of the techniques used to identify infectious micro-organisms rely on immunological principles. Understanding the body's immune defense mechanisms has resulted in the identification of a number of specific disease processes involving the immune system alone.

The overlap between molecular biology and immunology is considerable, and many people working in clinical immunology have close links with specialists dealing in the analysis of tumours and genetic diseases.

With the advent of tissue transplantation and the matching of tissues between donors and

recipients, the skills of the immunologist have come to the fore. There are a number of specific disease processes associated with individuals who have had tissue or organ transplants, and immunologists play a major part in the management of these diseases.

From the perspective of forensic pathology, many of the techniques of immunology are used in forensic testing processes. The serological tests and blood grouping tests that are a feature of forensic science and forensic medicine are based on immunological principles. In some difficult forensic pathology cases involving the identification of biological material and drugs, professional immunological expertise may be required.

6. Chemical Pathology and Toxicology

Chemical pathology sometimes referred to as medical biochemistry, can also encompass the field of toxicology. There are **chemical pathologists** who specialize in the area of toxicology, but most doctors working in chemical pathology deal principally with biochemical testing of human samples.



Figure 8. Chemical pathology and toxicology

Like haematologists and microbiologists, chemical pathologists tend to practice in one of two areas, diagnostic services or clinical practice in the field of metabolic diseases. In clinical practice, chemical pathologists provide therapeutic advice and treatment for enzyme and hormonal disorders and for the management of individuals with complex biochemical abnormalities, including patients who require treatment in intensive care units. Many of

the techniques and the chemical pathologists have an important role to play in neonatology and paediatrics by providing screening tests for a variety of genetic disorders.

The field of toxicology uses many of the techniques of analysis that are found in the chemical pathology laboratory. The toxicologist does not generally measure natural body substances but analyses human tissues for the presence of drugs and other chemical agents that may have been taken into the body.



Figure. 9. Toxicology

Many hospital chemicals provide a limited toxicology service, usually to support medical treatment and diagnosis of poisoning or adverse drug effects.

Many aspects of advance toxicological analysis and interpretation lie outside the everyday work of the chemical pathologist. However, all pathologists have been trained in basic toxicology in relation to therapeutic and non-therapeutic drugs.

From the perspective of forensic pathology, chemical pathology and toxicology is an important related discipline.

The toxicological analysis is a routine part of most forensic autopsies.

- Homicides, suicides, and motor vehicle accidents are perhaps the most common cases in which drug analysis is involved.
- However, there is a wide variety of apparently accidental deaths, including

those associated with work and recreation, where toxicology and drug analysis are important in analyzing the circumstances of the death.

As a result of this, forensic pathologists are regularly required to incorporate the results of the toxicological analysis in the conclusions that they reach regarding the autopsy findings and cause of death. The professional forensic toxicologists are often found working in the same organization. The integration of these two disciplines, with a high level of communication, provides an ideal environment for the investigation of problematic suspicious deaths.

THE PRINCIPLE TYPES OF MEDICO-LEGAL SYSTEMS

Medico-legal systems differ from state to state. In well-developed countries, this is given a very low profile given the magnitude of unmet basic needs.

- No official comparable to the coroner or medical examiner exists to investigate or supervise the handling of deaths in the community.
- Most countries have a rigid criminal code, which defines the procedure for the investigation of criminal or suspicious deaths.
- No inquiries into deaths comparable in most Countries outside the criminal trial.
- Medico-legal experts exist to assist the police in their investigation. Have no or little power to initiate an investigation in most of the Legal systems.
- The application of legal medicine is normally frustrated by the absence of any stimulus.
- Suspicious deaths referred by the police to legal medicine institutes for examination
- If the criminal activity is excluded the case is dropped
- When criminality is suspected or evident

police will request an autopsy and report the matter to the public prosecutor or District Attorney or the case may apply then pathologist will be in most countries required to give expert evidence in a court of law.

- The Standard of medical medicine respected.
 - ❖ Autopsy report signed by two doctors. 20% autopsy rate.
 - ❖ Germany: Prosecutor office 18% Autopsy rate.
 - ❖ The Autopsy rate varies from 20% - due to very poor mortuary.
 - ❖ Most if not all the Autopsy is mere fail inspection.
 - ❖ Most mortuaries have no rate of inspection
 - ❖ Most of the mortuaries have no running water, no enough emphasis given to safety, hygiene of the staff, and most if not all the bodies are decomposed either due to poor conditions of storage chambers or overcrowding of the mortuary.
- Forensic medicine commonly referred to as police surgery in most countries if filled by medical officers with no training. The examination room if any may have poor lighting, with no proper examination material.
- Most of the rural medico-legal cases are poorly handled with a high rate of poor presentation in the courts of law with poor evidence to prove/ or disapprove any medical or legal facts.

THE ROLE OF FORENSIC PRACTITIONER IN INDIVIDUALS FITNESS TO BE DETAINED

DETENTION

Detention is a state whereby individual police or prison warden keeps under strict surveillance without appearing in court or his/her crime explained to him. Detention can be for a short time or indefinite. Detention can in prison, police cells, detention camps, or even at one's house. There is a lot of anxiety associated with detention both to the victim and the community at large because the outcome is not usually known and there is no organized system of caring for the detainees, unlike prisoners.



Figure 10. Detention

There is more maltreatment including torture of all kinds that may cause serious injuries and even death. It is the role of the forensic practitioner when called to examine a detainee either during or before detention to determine his/her fitness both physically and mentally.

TYPES OF DETAINEES

In general, there are three types of detainees;

- BAD in the sense that they are murderers, rapists, political activists, terrorists (they use violence for political ends), or robbers.
- MAD. These are the ones who are mentally

incapable of understanding the nature of their misdeeds.

- SAD. These are socially inadequate, unskilled, uneducated, unemployed, and alcoholic.

Most of the detainees belong to the BAD type in contrast to the prisoners who belong to the SAD type.

Factors that may make a detainee unfit for detention

There is much evidence that it is rarely an effective mechanism for ensuring that the interests of those unfit for detention, or whose continued detention would be injurious to their health, can be safeguarded. Vulnerable detainees whose health is likely to be injuriously affected by continued detention or any conditions of detention. They are generally assessed to have the following health conditions;

1. Any acute medical illness.

- a. Acute infections e.g. pneumonia, malaria, meningitis, infected wounds and gastritis with or without diarrhea
- b. Recently sutured laparotomy, craniotomy, or any other exploratory surgery.
- c. Pyrexia of unknown origin. (P.U.O)
- d. Fractures with or without plaster casts (P.O.P).
- e. Hemorrhage from a recent injury.
- f. Severe drug withdrawal symptoms.
- g. Female with "abdominal pain" while pregnant either accompanied by bleeding or not

2. Chronic medical illness.

- a. Any known medical case without drug e.g. Asthmatic, Diabetic, Hypertensive, or Epileptic.
- b. Chronic renal failure.
- c. Hypertension in malignant or accelerated phase.
- d. Uncontrolled diabetics.

- e. Epileptic or Asthmatic infrequent attacks despite taking prescribed drugs.
 - f. Malignant conditions e.g. carcinomas.
 - g. H.I.V infection in full-blown AIDS.
 - h. A pregnant female with bad obstetric history (B.O.H)
 - i. Paralysis.
3. Any genuine mental illness
 - a. Psychosis
 - b. Personality disorders
 - c. Dementia

THE FEATURES FOR FITNESS

Health issues among arrestees are a worldwide concern for which only local policies have been established. Physicians attending detainees in police custody are expected to decide whether the detainee's health status is compatible with detention in a police station and make any useful observations. International standards recommend that a detainees' right to medical care be equivalent to that available to the general community. However, as conditions in police stations for detainees under custody are often demeaning, any underestimated health damage can have critical consequences, including death. As a result, the following features are considered when it narrows down to detention of an individual;

1. Fitness To Be Detained

- Physically ill Diabetes mellitus, Hypertension, Epilepsy.
- Mentally ill
- Drug addicts
- Know their right (chronic prisoners)
- Malingering

2. Fitness To Plead Guilty

- Unfit to plead (under disability) i) Drugs ii) Alcohol iii) Psychosis iv) Severe anxiety v) Epilepsy
- "Unfit to Plead"
 - Unable because of mental illness or disorder to understand the nature of the court proceedings or follow

evidence presented in court.

- Unable to understand what he is being accused of or the nature of the charge and why he was there.
- Unable to challenge any of the jurors as his normal right.
- Unable to instruct the lawyers acting in his defense.

The persons are often diluted, confused, or in profound depression bordering on stupor "diminished responsibility".

3. Fitness To Stand Trial

- Understand the proceedings and capacity for rational understanding
- Mute by malice or not
- Plead to the indictment or not
- Sufficient intellect to comprehend the cause preceding on the trial to make a proper defense.
- Comprehend the details of the evidence

4. Fitness To Be Interviewed

- Fully aware of his surroundings
- In fit conditions to cope with a stressful interview
- Drug misuse currently under drugs or evidence of withdrawal symptoms.

FACTORS TO BE CONSIDERED IN DECIDING WHETHER A PERSON IN POLICE CUSTODY IS "FIT TO BE INTERVIEWED."

INTRODUCTION

Fitness to be interviewed, like, for example, fitness to plead and stand trial, is a capacity issue. The Mental Capacity Act 2005 has given a statutory basis to capacity being approached in terms of function rather than status or outcome. The functional approach is already adopted by the Code of Practice of the Police and Criminal Evidence Act 1984 where Annex G of Code C states:

"... it is essential health care professionals who are consulted, consider the functional ability of the

detainee rather than simply relying on medical diagnosis, e.g. a person with a severe mental illness can be fit for interview ..."

It is not the case that someone lacks capacity just because they have a mental disorder. What is critical is the effect of that disorder on the ability to participate in the interview process.

In carrying out an assessment of fitness to be interviewed, Annex G of Code C suggests the following considerations:

- How the detainee's physical or mental state might affect their ability to understand the nature and purpose of the interview, to comprehend what is being asked and to appreciate the significance of any answers given and make rational decisions about whether they want to say anything;
- The extent to which the detainee's replies may be affected by their physical or mental condition, rather than representing a rational and accurate explanation of their involvement in the alleged offense;
- How the nature of the interview, which could include particularly probing questions, might affect the detainee.

The Code states that the assessing health professional is required to also advise on the need for an appropriate adult to be present (which should always be the case), advise whether or not a reassessment of fitness to be interviewed may be necessary if the interview lasts beyond a specific time and advise on further specialist opinion. When the potential risks concerning fitness are identified, Annex G requires the healthcare professional to quantify these risks and the custody officer must be informed of them along with any advice or recommendations. Advice and recommendations have to be made in writing and are to be recorded (in the custody record if the detainee is in police custody or the clinical notes if on the ward). Annex G also provides for the additional safeguard, if indicated, of having an appropriate healthcare professional present in addition to the appropriate adult, "in order constantly to monitor the person's condition and how it is being affected by the interview".

FACTORS TO BE CONSIDERED

- a. **Physical:** Conscious, hearing system, pain, and age.
- b. **Psychological:** Hallucinations, Interpretation of questions

Orientation in person, places and time, Depression or Aggressiveness, Intelligent argument or instruction to his/her Lawyers or council and memory.

- If a detainee is unfit for an interview on physical grounds he is usually not fit for custody
- Discharge from the hospital and thus not fit for the interview.
- Patients on drugs may require further medication of the dose being judged under care.
- Alcohol Blood level above that set by the state as the limit for driving is unfit for interview. Alcoholics may require a minimal level of alcohol to overcome

Physical Withdrawal Symptoms.

- Drug addicts fit only for valid short time interview, not delayed or unduly prolonged.
- Addicts to opiates should not be given further. Opiates in case it is suggested that admissions were the result of the drug's euphoric effects:

Medical illness

- Such as diabetic assessment of blood sugar levels before certifying fitness for interview.

Mental illness.

- Disturbed personality mentally ill or disoriented -mental handicapped,

Physically handicapped

- E.g. for deafness or speech disorder, both deaf and dumb interpreters needed for an interview.

Sexual assault

- These are frequently unfit for an interview

during the hours immediately after the assault due to post-assault confusion a day or two required for them to settle.

The police surgeon has to ask the prisoner to answer the Kipling's "five Men" who, what, why, how, and where they lastly "do you consider yourself fit for the interview"?

CONCLUSION

Considering a detainee's fitness to be interviewed involves a judgment that must be made as to the likely impact of the symptoms of the disorder on the Police interview and reliability (the functional test) rather than assuming that a diagnosis alone renders a person unfit (the status test). At the end of the assessment, the psychiatrist should record the main findings in the custody record including an opinion on fitness to be interviewed, along with any recommendations. These might include the provision of an appropriate adult, the use of simple language in the interview, checking that the suspect understands the questions put to them, shorter interview sessions, and longer breaks. An opinion should be given as to the likely duration or permanence of a detainee being unfit for an interview and an appropriate time for re-examination should be suggested. The psychiatrist should also state whether any medical or psychiatric treatment is needed, how soon it might be effective, and whether a further assessment of fitness to be interviewed by another specialist, for example, a learning disability consultant is indicated.

DEATH IN CUSTODY

Death in custody is death which occurs when a "person held in care" of police in police cells or prison. The death might have occurred while in custody or 72 hours after the release from custody or mental health care center or death in hospital following a transfer from a police station. Deaths in custody are rare but receive extensive publicity because they frequently raise suspicions of ill-treatment on the part of custodians.



Figure 11. *Death in custody*

- This type of death raises a lot of complaints from relatives and the public at large.
- A meticulous autopsy is necessary to confirm or dispel allegation that an act of commission or omission as the part of custodians has led to or contributed to death and political issues may be suspected as the cause of death
- The death is reportable to the coroner; An Inquest held with jury even when the cause of death is natural after post mortem.
- The meticulous post mortem search for evidence of injury is the paramount consideration in objectives Investigation (pelvic and detailed examination)
- Detection and evaluation of hidden subcutaneous hemorrhages facilitate the reconstruction of ante-mortem circumstances. This involves PM technique, X- shaped incision of the back and limbs, and reflecting the skin.

CIRCUMSTANCES OF DEATH IN CUSTODY

1. Death -During or soon after arrest by the police
 - Struggle of the victim when resisting police arrest.
 - The physical struggle by the police officer trying to control or overpowers the resisting victim.
 - The victim may threaten the police with a knife or gun leading to the use of riot sticks, truncheons, or firearms.
 - Drugs, Alcohol, Cannabis, Amphetamines, Opiates group.
2. Criticism

- Lack of care of prisoners
- Employment of paramedical staff to take care of prisoners
- Police brutality

CAUSES OF DEATH

1. During and after arrest (per arrest)
 - Traumatic asphyxia, Chest compression, and prevention of death.
 - Arm-locks or neck holds. Compression of the front or side of the neck-death from reflex cardiac arrest during carotid compression or asphyxia.
2. Blunt injury
 - Use of fist arm, leg, or weapons (truncheons, riot sticks, and pistons).
 - Head injuries -punch over the nose may cause nasal pharyngeal bleeding then can block the airway passage especially when drug- masking of the clinical signs of intracranial hemorrhage.
 - Torture suffocation and drowning in sewage.
 - Airway occlusion or later developed pneumonia.
 - An electric chair can cause fatal cardiac arrhythmias.
3. Alcohol

Cause of death in custody.

- Acute alcohol poisoning. Inhalation of gastric contents. "Somebody thought to be sleeping it off" in police cells. 350mg/100mls can cause coma and or central respiratory depression. Mistaken intoxication -Vomiting and Hypoglycemia. Any person taken into custody thought to be under the influence of alcohol and/or drugs MUST be taken directly to the nearest hospital.
 - Accidents - Fall to ground, stairs, run over by traffic. This can be before or after the arrest.
4. Suicide
 - Common and always leads to

accusations by the relatives over lack of supervision.

- Hanging is the most common and any material can be used like strips of bedding material, sleeves of clothing, handkerchiefs.
 - Traction of the neck can be at low levels e.g. chairs, beds, door handles, and lamb heads.
5. Death from natural causes
- Cardiac disease e.g. myocardial infarction, ruptured aneurysm or myocardium, atherosclerosis, cardiac arrhythmias.
 - Epilepsy, Asthma, Diabetes, Stroke, Hunger strikes
 - Dehydration due to medical condition e.g. diarrhea, HIV, TB
 - Poor food
 - Overcrowding.

EXTERNAL EXAMINATION

Any death that meets the definition as stated above requires an investigation into the facts and circumstances surrounding the death to ensure that the evidence is consistent with the story provided.

An external and internal examination of the body should be performed by, or be directly supervised by, an experienced forensic pathologist

The external examination of the body should include

- A description of post-mortem changes including the degree of rigor mortis, livor mortis, and algor mortis should be recorded.
- An inspection of the eyes, oral cavity (i.e., labia, frenula, cheeks, and tongue), scalp, facial bones, neck, torso, genitalia, anus, and extremities including the wrists, hands, ankles, and feet should be performed.
- Descriptions of the decedent's apparent age, height, weight, sex, nutritional status, body habitus, skin color, scalp and/or facial hair length and color, marks, scars, tattoos
- Evidence of medical intervention, anatomic anomalies, and injuries in terms of type, location, size, shape, pattern, and color
- Descriptions of wounds from projectiles

should include the presence or absence of soot, stippling, gunpowder particles, singeing, and retained projectiles or projectile fragments; whether the skin defects are entrance or exit wounds; and the path and direction of the wound track. If any projectiles, projectile fragments, weapon fragments, or foreign bodies are recovered from the body, they should be described, photographed, and retained as evidence. Injuries should be documented by a combination of modalities including narrative description, photographs, and diagrams.

❖ Head Examination

The examination of the head should include the external and deep layers of the scalp with documentation of the number, type, location, and size of injuries. A formal face dissection may be necessary for situations where there is a concern for facial injuries that cannot be documented on external examination or by radiography. Any fractures of the skull should be documented in terms of location, type (e.g., linear, depressed, comminuted), and dimension. If there are epidural, subdural, or subarachnoid haemorrhages, they should be described in terms of location, size (e.g., volume, weight, 3-dimensional measurements), color, effects on the brain (e.g., compression, herniation, midline shift), and degree of organization.

If an autopsy is indicated, a layered anterior and posterior neck dissection may be considered to document the presence or absence of injuries.

❖ Examination of the neck region

It is recommended that the neck examination take place after the brain and thoracic organs have been removed to allow the vessels of the neck to drain. It may be prudent to retain the hyoid bone, larynx, and cricoid cartilage, especially in cases of hanging or use of chokeholds. If chemical agents were used, the forensic pathologist may want to save portions of the airways for possible histologic examination.

❖ Examination of body tissues

- Any injuries of the mucosal surfaces, soft tissues, cartilaginous structures, or bony structures of the neck (including the cervical vertebrae and spinous processes) should be documented, especially for the presence or absence of deep tissue injury particularly in cases where history suggests physical contact with law enforcement or others at the time of demise.
- Any fractures of the torso or extremities should be documented.
- Collections of blood or other abnormal fluids in the pleural and peritoneal cavities should be documented and described in terms of volume.
- The internal organs of the head, neck, chest, abdomen, and pelvis (including the testes in male decedents) should be examined for the presence or absence of injury and natural disease.
- Appropriate specimens should be collected during the autopsy for pertinent ancillary studies (e.g., histology, toxicology, microbiology, and/or molecular genetics).

❖ Photography

Thorough and relevant autopsy photography should be performed to provide a visual record for correlation with the findings in the written report in case the pathologist, other experts (e.g., medical, criminal, legal), and jurors need to review them at a later date. High-quality color digital photography is recommended and preferred.

- All photographic series should include the case number and a measurement scale; duplicate views without a case number or movement of the case number may be helpful in fully documenting the body (i.e., no injuries behind the placard).
- The body should be initially photographed to document how the body was received and should include things such as clothing on the body, ligatures around the neck, evidence bags over the hands
- Evidence of medical intervention, and the presence of handcuffs, flex cuffs around the

wrists or ankles, and ankle bracelet monitors.

- Any personal property should be photographed, documented, and retained as evidence.
- Some injuries may need to be photographed "as is" or "dirty" to document pertinent information like soot surrounding a gunshot wound. It may be necessary to shave the hair surrounding a wound to adequately document the injury; these injuries should be photographed before and after the hair is shaved.
- It is recommended that the dorsal and palmar surfaces of the hands be photographed before and after cleaning if they are soiled with blood, dirt, or other debris. The body should be adequately cleaned to allow for proper photographic documentation of injuries or absence of injuries.

The body should be photographed from all views, including anterior, posterior, and lateral surfaces of the torso and extremities. Detailed close-up photographs should be taken of any external injuries with a ruler. Ideally, an American Board of Forensic Odontology (ABFO)-type ruler or any measuring device used that meets measurement traceability and calibration requirements of ISO/IEC 17020 should be used with any patterned injuries.

- Attempts should be made to eliminate bloody backgrounds and distracting items in the visual field so that photographs are not excluded from use in court.
- Digital photographs should be stored indefinitely and the database should be backed up on a routine basis.

FINDING IN AUTOPSY

1. This depends on the cause of death
 - Bruises, lacerations, haematomas, ligature marks, defense wounds, etc.
2. Investigations
 - Alcohol levels, drug screen, X-ray skull, inhalation of the stomach contents.
3. Preventive measures
 - Close monitoring of the victims
 - No place for sick in the custody

- Reduce the numbers of prisoners (decongest the custody).
- 4. The information relating to the circumstances of the death of a prisoner found dead in the cellblock at a rural police station-
 - Check other inmates and take statements from them.
 - Alcohol intake.
 - The last time the inmate was checked and seen alive.
 - Any suicidal tendencies.
- 5. The management of an insulin-dependent diabetic in police custody
 - Overdosage
 - Under dosage
 - Coma confused with alcohol, drug, and head trauma.
- 6. Meningitis

CONCLUSION

People who die in police custody are people who are at risk; alcoholics, drug addicts, and vagrants. The pathologist has to visit the scene to rule out hanging and/or mechanical trauma; any life is precious and needs saving. A thorough inspection of clothing, careful removal of garments gags, ligature and binding total body (or not less than the limbs) radiographs, close -up still photographs, and continuous video recording and ultrasound illumination is of importance. A post mortem procedure for the detection of blunt force injuries is done. Medico-legal investigation of death in custody should also be conducted.

Am J of Forensic medicine and pathology 17: 1996 392-314.

ENVIRONMENTAL OCCUPATION HAZARDS

Environmental occupation hazards are more than the industrial accidents and both general doctors practicing forensic medicine should have at least a basic knowledge of industrial diseases and relevant schedules of the regulations since they have

medical-legal implications as concerns compensation for damages and employers liability.



Figure 12. Occupational hazards

Hazards to the workers maybe

- Physical agents e.g. radiations, temperatures, barometric pressures, noise, and vibrations.
- Chemical agents, asbestos, soot in chimney sweeps, mercury poisoning, in matchmakers, lead, and coal.
- Biological agents, Well's disease in sewer workers, anthrax from handling animals skins, body fluids blood, semen in HIV or HBV.



Certain diseases are recognized as resulting from a special form of employment and persons in such occupation who suffer from them are automatically entitled to benefit i.e

- Mesothelioma in asbestosis.
- Pneumoconiosis in coal miners and quarry workers.
- Hypersensitivity pneumonitis.
- Lead poisoning from any occupation involving the use or handling of, or exposure to the fumes, dust or vapor of lead or its compounds.

MEDICO-LEGAL IMPLICATIONS OF INDUSTRIAL OCCUPATIONS.

The possible medical-legal complications of three industrial occupations include benzene poisoning, mercury poisoning, lead poisoning, pneumoconiosis, anthrax, leptospirosis, mesothelioma.

Where death is caused by, contributed to, or accelerated by an industrial injury or disease, the dependent relatives are entitled to benefits over and above those normally provided by the social security scheme.

Supplements

- Special hardships allowance
- Constant attendance allowance for bedridden patients
- Dependents allowance- Inability for a worker to continue with the employment.

TYPES OF INDUSTRIAL INJURY BENEFITS

a. Injury benefit

Injury benefit has a maximum period of 156 days. If after the 24th week of this benefit the injured person still suffers from a loose faculty he is entitled to disablement benefits.

b. Disablement benefit.

Pension awarded has an indefinite term or until medical examination reveals disablement has ceased.

c. Industrial death benefits.

POSSIBLE MEDICAL-LEGAL IMPLICATIONS

In all the industrial diseases the claimant must prove;

- Employment in an occupation listed in relation to the disease
- That the disease is prescribed
- That the disease was caused by the job
- That he has suffered the loss of physical or mental faculty.
- Suitable health surveillance including

biological monitoring e.g. measurement of agents or their metabolites in tissues, secrets, etc.

- ❖ Biological effect monitoring.
- ❖ Medical surveillance.
- ❖ Inquiries about symptoms, inspection, or examination of a qualified person.
- ❖ Review of records and occupational history during and after exposure.

In addition to the above implications, the following criteria should be demonstrated in each of the following specific industrial diseases.

- Mesothelioma and asbestosis
 - ❖ Physical signs and symptoms of intestinal lung disease (ILD).
 - ❖ Radiologist findings of ILD
 - ❖ Physiological evidence of ILD
- Histological evidence of asbestos obtained coincidentally (removal of lung tissue for carcinoma), on biopsy or at autopsy.
- Appropriate latency carcinoma does not occur in less than 5 years after the start of occupational exposure
- The working or handling of asbestos or any admixture of asbestos.
- The manufacture or repair of asbestos textiles or other articles containing or composed of asbestos.

Coal Workers Pneumoconiosis

- Careful and thorough gross and microscopic examination is done to determine whether coals workers pneumoconiosis is present and to what extent.
 - ❖ Special stains and polarized light microscopy are indicated
- The physician may be requested to state an opinion on the cause of the impairment in unequivocal terms.
- In case of death, the post mortem findings must be correlated with the clinical data, patient's occupation, medical and social history.
- The claimant must have worked for at least two years in aggregate in a relevant occupation.

THE PNEUMOCONIOSIS

Pneumoconiosis refers to a disease of the lungs due to inhalation of dust, characterized by inflammation, coughing, and fibrosis.



Figure 13. *Pneumoconiosis*

Symptoms of Pneumonitis?

Symptoms of pneumoconiosis often depend on how severe the disease is. Simple CWP may have no or few symptoms and show up only on an X-ray. PMF may cause mild to severe difficulty breathing. Symptoms may include:

- Cough
- Lots of phlegm
- Shortness of breath
- Silicosis -mine workers and sandblasters local inflammatory response followed by granuloma formation.
- Coal workers pneumoconiosis -coal dust carbon.
- Asbestosis-Interstitial lung disease inhalation of asbestos fibers human carcinogen mesothelioma.

HYPERSENSITIVIE PNEUMONITIS

Hypersensitivity pneumonitis (HP) or extrinsic allergic alveolitis (EAA) is a rare immune system disorder that affects the lungs. It is an inflammation of the alveoli (airspace) within the lung caused by

hypersensitivity to inhaled organic dust.

An attack of acute hypersensitivity pneumonitis usually occurs four to six hours after a short period of intense exposure to molds or fungal spores or heterologous proteins during work in Agriculture, horticulture, cultivation of edible fungi or malt working, caring for or handling birds, and handling bagasse which one is allergic to.

- Originated with employment and no pre-existing.
- Evidence of exposure to latency and progressive development.
- Demonstration of clinical features of hypersensitive pneumonitis.
- Histological changes compatible with HP in a lung biopsy specimen.
- Provocative inhalation challenge with reasonable care or caution before and during the inhalation challenge.

What Causes Hypersensitivity Pneumonitis?

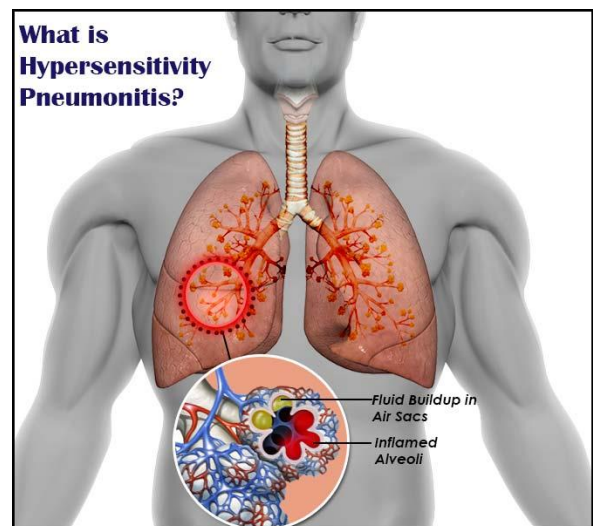


Figure 14. *Hypersensitivity pneumonitis*

There are more than 300 substances known to cause hypersensitivity pneumonitis. Some commonly seen problems are given specific names related to the source of the allergen, including:

- Farmer's lung: seen in farmers and cattle workers. This condition is caused by breathing in molds that grow on hay, straw, and grain.
- Bird fancier's lung: (also called pigeon

breeder's disease) caused by breathing particles from feathers or droppings of many species of birds.

- Humidifier lung: can develop by breathing in fungus growing in humidifiers, air conditioners, and heating systems, particularly if they are not well maintained.
- Hot tub lung: This condition may develop by breathing in bacteria that may be found in the water vapor coming from indoor hot tubs.

Diagnosis of Hypersensitive Pneumonitis

A physical examination is performed by a doctor to listen to the lungs with a stethoscope. Individuals with hypersensitivity pneumonitis may have abnormal lung sounds or crackles.

If the physician is unsure of your diagnosis, they may order additional tests. These include:

- Chest X-ray and CT scan which may be able to show early stages of the disease and if there is any scarring.
- Lung function tests to measure how well you breathe to see if the lungs are working correctly.
- Blood tests to find out if antibodies to any substances have developed that might be causing an allergic reaction.
- Bronchoscopy, which is when a bronchoscope (small flexible tube about the size of a pencil with a video camera attached at its end) is passed either through your nose or mouth. The scope is then passed into the vocal cords, windpipe, and the air passages. This tool can be used to collect tissue samples from the lungs for further testing.

Surgical lung biopsy, which is performed by a cardiothoracic surgeon under general anesthesia is another way to get lung tissue for further testing.

The relationship between exposure to industrial processes and

- Carcinoma of the bladder
- Bronchogenic carcinoma
- Carcinoma of the nasal cavity
- Leukemia

POLICE OCCUPATIONAL HEALTH

1. Atherosclerosis Heart disease.
2. Lung disease - Cyanoacrylate used in fingerprinting.
3. Cancer GIT - Esophagus (Alcohol) -stomach, large bowel, testicular tumor associated with the use of police 'radar' to detect speeders.
4. Back pain - Time spent in motor vehicles and a low level of fitness.
5. Violence - This is a reality of police work.

Assault may result in

- Arresting and/or controlling suspects
- Robbery in progress
- Domestic dispute.
 - ❖ Physical indications -Post-traumatic subdural haematoma.
 - ❖ Emotional indications- (Psychiatric) Posttraumatic stress disorder.

Risk factors include

- Physical inactivity,
- Poor nutritional practices,
- Cigarette smoking,
- Alcohol overuse.

Prevention

- Periodic medical check-up,
- Personal protection equipment,
- Regular exercise,
- Cholesterol monitoring.

INVESTIGATION OF DEATH OF AN EMPLOYEE AT THE PLACE OF WORK

The most common causes of deaths are;

- Falls
- Electrocutions
- Chemical exposure
- Falling material
- Excavations
- Asphyxiation and gassing
- Fires and explosives.

SAFETY AND HEALTH AT WORK

The general duty of employers is to provide a safe working environment for the employees. The workplace should be free from recognized hazards that are causing or likely to cause physical harm or death.

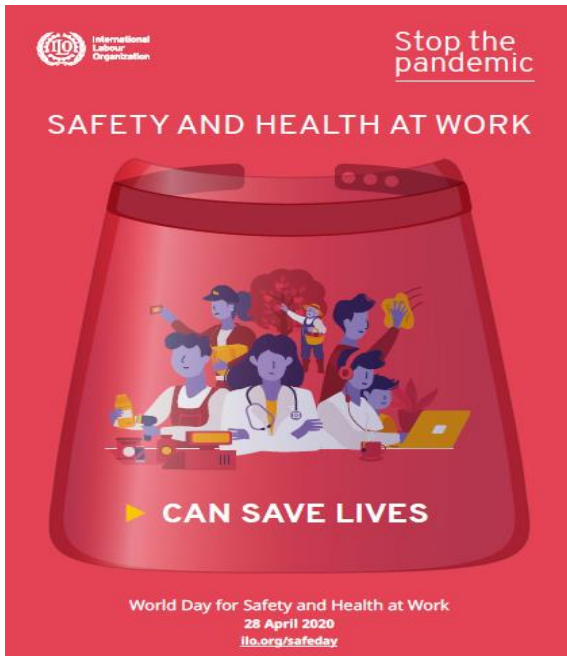


Figure 15. Safety and health at work

In a bid to provide a safe working environment the employer seeks to preserve resources.

This entail;

- Inspection of the job site - Compliance with the manufacturer's recommendation.
- Training and experience required for complex delicate maneuvers - experts safety training and education programs
- Use of protective devices - clothing, safety goggles, breathing apparatus, and shields from hazards.

Accidental deaths are more frequently encountered and associated with carbon dioxide and methane exposure in sewers, mines, wells, tunnels, silos, and storage tanks.

Volatile gases like hydrocarbon gases.

Mechanism of death in volatile compounds are

sudden cardiac arrhythmias or chronic hepatic dysfunctions.

- Rules out nature disease.
- Proof for criminal negligence or employer or employee recklessness.

AUTOPSY

- Conduct toxicology,
- Document the injuries, patterns, and major injury/is contributing to death.

Witness contributing to death

Health and safety policy advice mortuary staffs in terms of the current state of knowledge about possible risks from handling infected bodies in respect of the conduct of post mortem examination.

Diseases common in mortuaries

1. Tuberculosis
2. Creutzfeldt Jacob disease
3. Hepatitis

Substances hazardous to health;

1. Micro-organisms
2. Physical agents
3. Chemical agents

Employers and employees in a position of responsibility for others have to;

1. Assess the risk to health arising from work.
2. Introduce and monitor appropriate measures to prevent or control the risk.
3. Ensure that employers under their control are adequately informed about the risks and the precautions to be taken.

MEDICAL CONFIDENTIALITY

1. The relevance of the access to medical reports to the work of the forensic physician.

2. Disclosure of medical records for legal purposes.

- ❖ Records should not be allowed in the hands of a solicitor without prior consultation with the hospital administration.
- ❖ Records should not be given to employers, insurances, or their representatives without the written consent of the patient.
- ❖ Records should not be released to a layperson with a good course.
- ❖ In the hospital, notes belong to hospitals and not the doctors.
- ❖ GP records belong to the secretary of state for health via FHSA.
- ❖ Access and correction application can be made by
 - ✓ Patient or if <16yrs by guardian or parent.
 - ✓ A representative with the patient's written permission.
 - ✓ After death by a person who may have a claim on the estate. The record holder must give access within 40 days. If record holder (not author) feels that disclosure of all or part of the record would be likely to cause serious harm to the physician or mental health of the patient, he can withhold it.
 - ✓ The dead patient's wishes must be applied to his medical records.

Whatever the doctor sees or hears in the life of his patient must be treated as totally confidential except;

- With the permission of the patient.
- To other doctors
- To relatives.
- Statutory (legal) requirements
- In the court of law
- The police
- In the public good e.g. bus driver epilepsy

severe diabetes, Teacher with tuberculosis, food handler with an enteric infection, a pilot with angina.

- Disclosure to lawyers should apply to the court for 'disclosure.'



Figure 16. Medical confidentiality

The concept of confidentiality in respect of medical records applies;

- With the permission of the patient or interest.
- To other doctors.
- To relatives
- Statutory (legal) requirements
- In the courts of law-only disclose as much as is relevant to the proceedings.
- The police - with the patient's permission.
- In the public good when the doctor has an overriding duty to the society
- With disclosure to lawyers when legal processes require it.
- For medical research, teaching, and audit.

Various findings which are available to a coroner after an inquest and their significances include;

- Unlawful killing
- Accident
- Misadventure
- Killed self
- Natural causes
- Industrial disease
- 'Open' verdict
- Abuse of drugs
- Want of attention at birth

- Neglect
- Abortion.

CONFIDENTIALITY AFTER DEATH

- Respect secrecy even after death -Death does not absolve the doctor from the duty of confidentiality. Nobody can free the doctor from this obligation even the next of kin.
 - Protection of 'Incent Other'
- In legal terms, confidentiality dies with the patient e.g. familial hypercholesterolemia.
- Early disclosure leads to diagnosis, treatment, severe pain, suffering, and premature death.
- When a patient gave consent while still alive, the doctor has an obligation to disclose the information to interested third parties after death.
- The pathologist has no firm patient-doctor-relationship his role is to investigate only.
- Disclosure can be to the general practitioner -or family doctor who has the easiest access to the patient's family.
- Coroner's autopsy should be released by him or with his/her approval to the properly interested party.
- Confidentiality covers a potentially inheritable disorder of importance to relatives of the deceased.
- There is no ethical formulation

- The coroner or his approval to properly "interested party" close relatives even siblings may not qualify.



Figure 17. Confidentiality of medical records

THE EXCEPTIONS TO THE RULE OF CONFIDENTIALITY TO PATIENTS CONCERNING POLICE ENQUIRIES

Circumstances under which a doctor may offer contraceptive advice to a child (under 16) with the parents' consent and knowledge.

- ✓ This law differs from one country to another
- ✓ The law reform act (1969) provides that young people of 16 or above can give consent to treatment. it does not forbid younger children from doing so.
- ✓ If a young person under 16 is judged by a doctor to have sufficient maturity of mind to appreciate the significance and risk of the proposed procedure or treatment, then consent is valid though it is always good medical practice for the doctor to make every effort to involve the parents in the decision.
- ✓ When parents/guardian refuses permit for an urgent diagnostic or therapeutic procedure the doctors' position is governed by personal ethics and cumbersome mechanism of law Emergency court can be convened at the bedside and the magistrate may authorize the removal of the children's custody from the parent to a "Fit person" under children's Act.
- ✓ Family Law Reform Act (1969) gives

AVENUES WHERE MEDICAL CONFIDENTIALITY IS BROKEN;

- In the Court of law
- In the interest of the community overriding duty to society.
- To relatives for children or when the relative is taking care of the patient.
- As a statutory duty laid down by law.
- Written permission from the patient's interest.
- Special cases e.g. HIV and AIDS.
- For medical teaching, audit, and research.

autonomy to young people of 16 years and over in matters of medical consent-conviviality and the choice of a doctor, there seems little doubt that an adamant desire for independence and confidentiality must be respected above the age of 16, below 16 the issue is less clear.

- ✓ GMC view that if a person below 16 who in the doctor's judgment was sufficiently mature to appreciate all the circumstances it is desired that the doctor maintain secrecy concerning his/her parents, then this wish must be respected. Provision of contraceptive device a similar view is held but one lady Victoria Gillick brought legal action against a health authority in an attempt to restrain them from offering such advice etc to her daughters.

The Appeal failed but the House of Lords made it clear that doctors must take into account the rights of the parents as well as the needs of children. GMC offers the doctors a desecration both to refuse to supply the contraceptive or other advice and treatment and review the facts to the parents that the young person has made such a consultation. All parties stress that such cases will be uncommon.

MASS DISASTERS

AIRCRAFT DISASTERS



Figure 18. Aircraft disaster

THE ROLE OF A FORENSIC PRACTITIONER AT THE SCENE OF THE DEATH

No sooner they knew the reason, they sought the

remedy

The roles of the forensic practitioner at the scene of death are as follows;

1. Conduct medical treatment.
2. Confirm death
3. Examine the bodies.
4. Examine the scene.
 - Photography, sketch, and notes
5. Obtain medical and/or social history from the police, relatives, or eyewitnesses.
6. Communicate and/or record observation to the police/coroner for investigation.
7. Legal responsibilities and/or public health duties.
 - The death avoidable preventable or precautions.



Figure 19. Aircraft disaster site

Objectives:

1. Retrieve and reconstruct bodies' fragments
2. Personal identification
3. Determine the cause of death especially to the crew;
 - a. Pre-planning Phase; Mass casualty plans covering hospital, temporary medical facilities, and the mortuary.
 - b. The early acute phase of a major disaster; Liaise communication, procedures, treatment, and tagging-human remains.
 - c. Post-acute phase; External examination whereby the pathologist documents patterns of injuries among causalities and cause of death search for the bomb assessment, and autopsy diagnosis. Identification should be swift and

accurate with the involvement of the odontologist, dactylography, and radiologists by Photography, clothing, documentation, jewelry, and other personal effects.

4. Throughout the entire operations; Observation on hygiene, post-traumatic stress, relatives, medical help, absolute confidentiality, and security.
5. After completion of the operation; Further report for an inquest or judicial inquiry, Re-scrutinize the emergency plans.

The role of the Forensic Pathologist in the management of the response to a mass disaster involving multiple fatalities and the procedure involving in Disaster Victim Identification (DVI)

There should be more than 50 persons from a single incident.

Roles;

1. Removal of the dead
 - Use numbered wooden backboards
 - Obtain refrigerated trailer for body storage- i.e makeshift morgue
 - Autopsy, X-ray and Photography
2. Initial examination i.e Post -Acute phase.
3. Making descriptions of clothing
4. Documentation of injuries
 - Describing and documenting personal effects with photography. Blood and/or muscle samples for toxicology
5. Identification
 - Dental examination - Forensic Odontology
 - Photography
 - Fingerprints examination footprints for children
 - External description
 - Injury description
 - Tentative or positive identification; Name assigned and method of identification noted.
 - ❖ Re-assessment of plans.
 - ❖ Admission
 - ❖ Communication is vital and will not happen by chance. Security

- ❖ Location
- ❖ Site and property.

The equipment at the scene of death that explains the reasons for the choice. This consists of what is called "Murder bag".

- Apron/rubber gloves waterproof
- Thermometer/syringe needles swabs, strapping, and blood containers. Autopsy dissecting set and hand saw
- Cutlery needle and Formalin in a jar for histology specimen.
- Plastic bags, envelopes, paper, spare pen, and pencil
- Hand lens and electrical torch
- Camera 35 mm single-lens reflex with electrical flash
- Cutting needle and twine for body closure.
- Mini-tape recorder.

The procedures you would perform at the scene in investigating the death.

1. Take the temperature
2. Photography
3. Confirm death
4. External examination - Clothing, Blood smearing.
5. Preliminary identification
6. The obvious cause of death

SCENE OF DEATH

MEDICAL WITNESS

The medical witness is any person with medical or scientific knowledge and/or experience able to assist the court in performing its fact-finding function in matters relating to medicine.

❖ Types of Medical Witnesses

1. **Ordinary witness** - "witness as to fact" evidence of what a medical person saw some event e.g. RTA.
2. **Professional witness**- Purely factual

evidence of something a doctor did or saw during his medical work e.g. suture of scalp injury, Dx epilepsy in a driver.

3. **Expert witness** - This is a specialist or senior doctor who assists the law by giving an expert opinion on certain facts.

The same medical witness may give both professional and expert opinion in the same case, as to when a pathologist reports the factual findings of his autopsy, then goes on to give an opinion as to what type of weapon may have caused certain wounds and how much force was used.

THE ROLE OF A MEDICAL WITNESS

It starts long before an appearance in court.

- Prepare medical report or statement, familiarize with court procedures, facts of the case, and possession of the relevant medical documents before stepping into the box.
- In court, the medical witness should appear as a serious and authoritative person, face the judge or magistrate or jury when answering the questions.
- Dress appropriately for court.
- Evidence should be given in clear precise and as confident in your answer as the strength of your knowledge and views permits.
- The witness must never be hostile, angry, rude, evasive, or sarcastic. (Tolerance and courtesy)
- Be sensitive to questions and listen carefully before answering, if you cannot answer say so, and explain why confining oneself to one's field of competence.
- The medical witness should make sure that he is sufficiently aware of both the factual and legal issues that invite his expert involvement
- Convey the views using whatever aids to communicate one's beliefs will assist in giving evidence.

- Tell the whole truth and answer all questions as best as one can.
- The medical witness should be independent neither "for" nor "against" any party.

WHAT MEDICAL WITNESSES NEED TO AVOID

- Opinions are given at the edge of, beyond the expertise of an expert witness.
- Opinions based on false assumptions, incomplete facts, or inadequate scientific analysis
- Opinions are given on the results of scientific tests which were only at the experimental stage of development.
- Failure of communication between various expert witnesses, police, and lawyers.

EVIDENCE

Evidence refers to "something legally submitted in the court of law on a means of ascertaining the truth of any alleged matter of fact under investigation before it".

HEARSAY EVIDENCE

This is a statement made by a person other than the witness giving evidence and proffered to prove the truth of the matters stated is admissible.

APPLICATION OF HEARSAY EVIDENCE IN ENGLISH LAW COURTS.

Hearsay objects that the person whose statement is repeated or who document is produced were not under oath when he or she made the statement or document nor are they available to be cross-examined about what they have said or written. If the opposing party does not object to it hearsay evidence may be received generally by a court of law in a civil case.

OPINION EVIDENCE

To give evidence of opinion, the court must first be convinced that the witness is an expert in a field of knowledge outside the experience of the public.

- Expert opinion evidence in a court of law is restricted to areas in which the witness has true expertise
- Stepping outside these areas may lead to successful attacks on the quality of the evidence and its admissibility
- The damage of the credibility may result in previous evidence being thrown into doubt
- The court determines that a witness who is an expert for opinion is not permanent. Each time an expert witness appears in the court his or her expertise will have to be confirmed
- An expert witness gives an opinion on matters either within his knowledge or only on documentary or even hypothetical grounds.
- An expert attends voluntarily by accepting the task for a fee.
- A pathologist gives both factual and opinion evidence

SPORTS FATALITIES AND ITS MEDICO-LEGAL IMPLICATIONS

Sports fatality is any death during a sporting activity and/or recreational activities.

Nearly all the sports are associated with a certain degree of injuries, some of which can lead to death even with prompt medical treatment.



CAUSES OF DEATH IN SPORTS

Death in sports can be due to:

a. Medical conditions

- Rupture of spleen
- Rupture of middle meningeal artery producing extradural haematoma.
- Rupture of the vertebral artery at the C1 level.
- Blow in front of the neck may cause sudden death due to vagal inhibition of the heart.

b. Natural death;

- Ischaemic heart anomalies.
- Congenital cardiac anomalies e.g. hypertrophic obstructive cardiomyopathy.
- Viral respiration infection e.g. myocarditis
- Epilepsy
- Acute asthma precipitated by exertion
- Anabolic steroids, associated with myocardial infarction, stroke, hemorrhage due to induced tumors of the liver

c. Sporting

- Motorsports. The highest number of fatal accidents
- Mountaineering and climbing. The second in fatal accidents.

d. Ball games

- Third place in fatal accidents is football claiming the majority i.e Rugby union and rugby league football. The deaths are rare, and the few documented were due to extradural haemorrhage following injuries to the temporal region with rupture of the middle meningeal arteries. American football is the most dangerous game in the world. Injuries to the head and neck account for nearly all fatalities.

e. Combat sports

- Wrestling- The oldest sport. Despite its

violent nature, there were only 2 deaths reported in the UK in the last 40 years up to 1976. Causes of death are majorly IHD and intracranial hemorrhage.

- Martial arts e.g Karate, judo, Kung fu, and kendo. All martial arts techniques are dangerous if not properly taught and practiced under strict supervision; they were developed as techniques of offense as well as defense.

f. Aquatic sports

- Examples include swimming (drowning) diving and fishing.

g. Firearms

- Shooting is a popular sport. Sporting injuries due to firearms are of three types.
 - Air weapons
 - Small-bore pistols and rifles
 - Shotguns

h. Spectators

- Elderly spectators collapse as a result of ischaemic heart disease, cardiac arrhythmias, and cardiac failure.
- The risk of injury increases when disorder breaks out e.g. fights or rush when entering or leaving the stadium. A classical disaster occurred at a football match at Ibrox Park, Glasgow in 1971. 66 persons died and over 100 seriously injured.
 - A similar incident occurred at the Heysel Stadium, Belgium in 1985. 39 spectators died 400 sustained serious injuries. In 1989 April at Hillsborough Football Ground, Sheffield fans pushed their entry in full terraces and caused 94 deaths from crush asphyxia, 200 seriously injured.

i. Aerial sports, aviation

- Below is a flow of consent used in the examination of a detained person in police custody.
 - Age----> Under influence of drugs

---->informed---->signing

AVOIDING DEATHS IN SPORTS

Methods:

- Regular medical examination throughout their careers and examination carried out before each contest (Boxing) including electroencephalogram within 28 days.
- Efficient shielding and use of heavier gloves (boxing will never be 'safe')
- Regular advice on training, rule changes standards and design of protective clothing
- Rigorous crowd control in sports ground and the sale of alcohol both on the way and within the stadium

MEDICAL ETHICS

Contributory Negligence

This is where the plaintiff's condition is partly the result of the defendant's negligence and partly the result of the patient's negligence.

- The damages are reduced to such an extent as the court thinks just and equitable having regards to the claimant's share in the responsibility for the damage. E.g. ankle joint injury and high jump
- The plaintiff failed to take care of his safety, as a reasonable man would reasonably have expected to take in all the circumstances.
- The patients who are given drugs and warned about the foods to avoid choosing to neglect the advice; then the patient is the author of her misfortune.

Professional Misconduct

Professional misconduct is unethical or unprofessional behavior that falls short of the ethical or professional standards, guides, or codes of conduct, accepted by a particular profession.

It refers to Infamous conduct in professional

respect. It is easier to recognize than it is to describe "like an elephant".

- Medical man in the pursuit of his profession had done something that would be regarded as disgraceful or dishonorable by his professional brethren of good repute and competency.

CODE OF CONDUCT FOR MEDICAL PROFESSIONS

Abortion, Adultery, Addiction, Advertising, and Alcohol

1. Neglect or disregard to personal responsibilities to patients for their care and treatment.
 - a. Failure to visit or treat the patients.
 - b. Signing a prescription in black
 - c. The main aim is to protect the public than to punish the doctor.
2. Abuse of professional privileges and skills e.g. termination or pregnancy, adultery, use of addictive drugs, confidence emotional or sexual relationship with patients.
3. Personal behavior - conduct derogatory to the reputation of the medical profession e.g. alcohol, drugs, and dishonesty.
4. Advertising, conversing, and related professional offenses.
5. The access to medical reports act, 1988 to the work of a forensic physician. Doctors for employment and insurance purposes write the report. The subject must apply within 21 days of the report being made so that he can view it and request the doctor to correct or amend any incorrect or misleading statements. The doctor has the right to refuse if he thinks that the contents may cause serious harm to the physical or mental health of the subject.
6. Where there is doubt, the doctor contacts their medical protection organization.

Findings available to a concept of law at the conclusion of an inquest and its significance.

- Unlawful killing - murder
- Accident
- Misadventure
- Killed self - suicidal
- Natural causes
- Industrial disease
- Open verdict
- Abuse of drugs
- Want of attention at birth
- Neglect
- Abortion

THE LEGAL REQUIREMENTS OF A CORONER

1. To hold an inquest

Criminal cases, murder, manslaughter, infanticide, suicides, road, aviation, rail, and industrial accidents, industrial diseases, death in prison, police cells, neglect any other cases, the coroner feels that a public hearing would be beneficial.

2. To summon a jury

The coroner must sit with a jury consisting of at least seven and not more than eleven persons jury in cases where notice has been given to a government department e.g. deaths from accidents in industry, mines, quarries, railways, ships, aircraft where explosive fires or petrol are concerned in an industrial context and also all deaths in prison or police custody. The jury can retry a majority verdict, as long as no more than two members disagree.

MENTAL DISORDER

Mental disorder is a mental illness, arrested or incomplete displacement of mind and psychopathic disorder, and any other disorder or disability of mind.

The requirement in sections 2,3 and 4 of the Mental Health Act, must be completed before compulsory admission to hospital.

Section 2: Admission for Assessment

- Treatment can be given over 28 days period during which the patient is detained in the interests of his own health and safety or with a view to the protection of other persons.
- Two doctors examination required not more than five days apart.
- Admission may be applied for the patient's nearest relative or social worker.
- The patient can be discharged at any time during this period by the doctor in charge.

Section 3: Admission for Treatment

- Compulsory admission to hospital for treatment of the mental disorder.
- A person suffering from mental illness, severe mental impairment, psychopathic disorder.
- Two doctors application required or nearest relative or social worker.
- Treatment for six months.
- Discharge by a responsible medical officer, hospital manager, or the nearest relative.

Section 4: Admission in an Emergency

- Application by the nearest relative, Approved social worker, who must have seen him within 24 hours.
- One doctor needs to examine the patient (GP)
- The examination within 24 hours of the admission of application. Duration 72 hours unless a sound medical examination recommends for the admission under the terms of section 2 procedures.
- 'Holding powers' of the nursing staff to run for six hours until a medical opinion can be obtained.
- The Course of action in management and treatment of a police officer bitten by a

man "suspected of having AIDS".

SHORT COURSE

The examination with a full description of the site, sizes, shapes, and patterns.

- Take samples of saliva and blood if possible for later laboratory testing.
- Photograph if possible.
- Consult a forensic dentist for the dental imprint.
- Take the blood of the police officer and suspected man.
- Clean the area with an antiseptic solution.
- If the wounds are large dress and advice for follow up.
- In the case of superimposed infection cover with antibiotics.
- In case of pus do, culture and sensitivity and treat as per the laboratory results.
- Give the police counseling and refer to the counselor.
- Human bites are unlikely to result in HIV infection.

LONG COURSE

- Re-check the healing process if the scar or keloid formation or contracture.
- Do repeat testing after the recommended window period of six months to both the suspected man and the police officer depending on the initial results.
- Give the policeman counseling depending on the results.
- Consider compensation in case the policeman is positive.
- If the policeman is still negative advice for not testing.

CONSENT TO TREATMENT

- No adult person needs to accept medical treatment unless they so wish to do so. This permission for diagnosis and treatment

is essential, as otherwise, the doctor may be guilty of assault if she touches or even attempts to touch an unwilling person.

- In children, responsible relatives or guardians give consent treatment on their behalf.
- In mental disease or defect either the relative, the medical institution or legally appointed authority permits on behalf of the patient.
- In an emergency, no consent is required, as long as the medical intervention was made in good faith for the benefit of the victim.

TYPES OF MEDICAL CONSENT

a) Implied consent

This is where the person comes to visit a doctor or asks the doctor to visit him. This does not cover intimate examination such as vaginal and rectal examination, even using a stethoscope to examine the chest or measure blood pressure should be preceded by courtesy of speech.

b) Express consent

This is where more complex medical procedures are concerned specific permission must be obtained from the patient. All surgical procedures, any internal examination, consent can either be in written or in verbal form.

c) Informed consent

The patient should be explained all the facts of operation and drugs.

THE FORENSIC IMPLICATIONS OF 'ORGAN TRANSPLANT

Legal aspects vary greatly with tissue, national laws, ethnic and religious practices. There are several types of donations.

a) Homologous donations:

Moving tissue from one part of the body in the same patient - Informed consent is needed.

b) Live donations:

Blood and bone marrow donation (tissue) in some countries is unethical and illegal; i.e Britain ban donation of commercially obtained organs. Doctors guilty of serious professional misconduct are liable for criminal prosecution.

c) Cadaveric donation:

The cadaveric donation comprises organ donation—that is, taking organs (heart, lungs, kidneys, liver, pancreas) from brain dead people, as well as tissue donation, meaning taking tissues (skin, corneas, tendons, bone) from brain dead as well as heart dead people to ensure a minimal "warm ischaemic time".

LEGAL RULES OF OBTAINING ORGANS

Legal rules vary from country to country

- There is an absolute right for organs to be taken irrespective of the wishes of the relatives.
- The medical team can automatically take organs unless the next of kin register an objection "opting out"
- "Opting in" The authorities wishing to obtain organs to take active steps to ensure that either permission of the patient was given during life or then no close relatives object after death.
- Human Tissue Act 1961: States that: The person lawfully in possession of a body (usually the hospital authorities) may authorize the use of donor organs or tissues if having made such reasonable inquiries as may be practicable has reason to believe that
 - The deceased had indicated during life that he objected to donation.
 - The surviving husband or wife or any relative objects.

Cases reportable to coroners, medical examiners, or procurator fiscal as the case may be, their permission has to be obtained before removal of the organs.

THE MAIN PROVISIONS OR RECENT LEGISLATION REGARDING EMBRYO RESEARCH.

ABORTION

❖ The Abortion Act

Any person is guilty of an offense if he or she attempts to unlawfully procure a woman's abortion by administering any poison or other noxious thing or shall unlawfully use any instrument or any other means whatsoever.

❖ Charges

Exception granted if the act was performed "in good faith and to preserve the life of the mother. A person inevitably will not be guilty of a criminal offense in terminating a pregnancy if:

- a. A registered medical practitioner performs the termination.
- b. Two registered medical practitioners are of the opinion formed in good faith
- c. That the pregnancy <24th week and continuation of the pregnancy is of greater risk to the mother's physical and mental health.
- d. The termination is necessary to prevent grave permanent injury to the physical or mental health of the pregnant woman.
- e. That the continuation of the pregnancy would involve risk to the life of the pregnant woman greater than if the pregnancy were terminated.
- f. That there is a substantial risk that if the child were born, it would suffer from physical or mental abnormalities as to becoming seriously handicapped.

❖ Other Conditions

- a. Done in approved Health facilities
- b. An emergency; no second opinion is required.

The mini examination does not apply to approve

hospitals to decide on the need for termination. The termination must be notified in a prescribed manner to the chief officer of the ministry of health.

DIMINISHED RESPONSIBILITY"

HOMICIDE ACT 1952.

The defense applies only in homicide where one person kills or is a party to the killing of another. The defense is available where the accused was suffering from such abnormality of mind as to substantially impair his mental responsibility in doing or being a party to the killing.

- The defense of diminished responsibility results in the accused being convicted not of murder with or without offense he may be charged but on manslaughter.
- Applies only in murder.
- It must be shown that the accused was suffering from such abnormality of mind whether arising from;
 - A condition of arrested or retarded development of mind
 - Any inherent cause.
 - Induced by disease or injury to substantially impair his mental responsibility for his acts and omissions in doing or being a party to the killing.
- The degree of proof required in a "balance of probability" the civil standard not "beyond a reasonable doubt" which applies in criminal cases.
- The jury decides whether the accused is suffering from diminished responsibility.

❖ Case Study

McNaghten rules, He was a paranoid schizophrenic charged with shooting the Prime Minister's secretary. The Lord's held that he was entitled to be acquitted on the grounds of insanity if the accused labored under such a defect of reason, from the disease of the mind as not to know the nature and quality of what he did, or that he did not

know that it was wrong. The judges developed the doctrine that an accused's responsibility for homicide might be diminished to the extent that the men's reaction could no longer be imputed, yet a finding of insanity is not necessary. The accused would be convicted of manslaughter rather than murder if he/she suffered from an abnormality of mind (due to arrested development, disease, or injury) as to impair mental responsibility for the killing.

WILL

TESTAMENTARY CAPACITY.

The capacity to make a will. "Possession of a sound disposing mind".

1. What matters is whether at the time an individual is about to make his will;
 - He knows of what property he possesses and how he is able to dispose of it.
 - He knows what a will is.
 - He knows to whom he may reasonably give his possession and the nature of the formality he is about to carry out.
 - He has some good reason for his action and is not obsessed with some unreasonable dislike or affected by delusions, which prevents a sense of right and wrong. Nod or shake of his head may signify approval.
2. Allegations - Medical attendants around or aside the dying person have influenced him/her in their favor in the disposition of his property after death.
3. The doctor called to test the signing.
4. A valuable witness later - This will be signed by two witnesses who are present at the same time the testier signs his name.

WILL FUNCTIONS

- Medical register; List of all the doctors registered to practice in the UK.
- Medical education

- Registration provisional registration/full registration, limited, and visiting overseas specialists.
- Disciplinary functions
 - The most well-known from the view of the lay public and the media from the register; is any doctor convicted of any felony, misdemeanor, crime or offense, who was judged after due inquiry by the council to have been "guilty of infamous conduct in a professional respect" but changed to "serious professional misconduct."
 - The main aim is to protect the public.
- Fitness to practice- Physical or mental state makes him a risk either to his patients or himself.
- Professional competency and performance review.

MAIN CATEGORIES OF PROFESSIONAL MISCONDUCT

- SIX "A'S" and FIVE F'S.
- Abortion, Adultery, Alcoholism, (drunken driving causing death)
- Advertisement, (Undue advertisement)
- Addiction (Morphine, Pethidine).
- The doctor may retain personal responsibility and exercise effective supervision. Association. Unqualified assistance).
- Other practices carrying the risk of disciplinary proceedings.
- False certifications (Passport or sick notes) fee-splitting,
- Calling a socialist by a practitioner when consultation fees would be split between the two doctor's - Chemistry shops Failure to attend a patient,
- Fraud and financial falsification - Claims by doctors for remuneration and expenses. Force -Abuse and physical violence.
- Indecent behavior.

THE DECLARATION OF TOKYO OF 1975

Tokyo Declaration defines torture 'as the deliberate, systematic, or wanton infliction of physical or mental suffering by one or more persons acting alone or on the order of any authority, to force another person to yield information, to make a confession, or for any other reason.

- ✚ The declaration also lays down guidelines for doctors when faced with cases of torture.
- ✚ The methods employed during interrogation range from apparent 'beating up' to the more subtle use of threats and intimidation.
- ✚ Hooding, prolonged standing, use of continuous high-pitched sound have been used and subsequently condemned, as have attempted to disorient the prisoner by offering food at erratic times, frequently waking the person up after short intervals of sleep and by burning light in the cell twenty-four hours a day.
- ✚ A doctor in interrogation units must satisfy himself those methods such as these are not employed. Examining doctors should carry out a 'head-to-toe' examination.

The declaration states:

- ✚ The doctor shall not contact, Condon, or participate in the practice of torture or other forms of cruel, or degrading procedures.
- ✚ The doctor shall not provide any premises, instruments, substances, or knowledge to facilitate the practice of torture or other forms of cruel, inhuman, or degrading treatment or to diminish the ability of the victim to resist such treatments.
- ✚ A doctor shall not be present during any procedure during which torture or other forms of cruel or inhuman treatment
- ✚ A doctor must have complete clinical independence on deciding upon the care of a person for whom he/she is medically responsible his main duty is to alleviate the distress of his fellow man.
- ✚ The prisoner shall not be fed artificially

when he is able to make rational decisions. The decision as to be the prisoner -to form such judgment should be confirmed by at least another independent doctor.

- ✚ The world medical association will support and encourage fellow doctors in the face of threats or reprisals resulting from refusal to condone the use of torture.

DECLARATION OF OSLE: Therapeutic abortion.

DECLARATION OF SYDNEY: Statement of death, artificial respirator, and transplantation of organs.

DECLARATION OF HELSINKI: Biomedical research involving human subjects.

LEGAL TERMS

❖ Actus Reus

Guilty action e.g. Shooting or welding.

❖ Novus Actus Interveneus

The consequence of a defendant's action of which the law will take notice may come to an end because of some extraneous occurrence that has a material effect on the plaintiff's condition beyond which it is impossible to evaluate the continuing effect of any of the defendant's act. "A new act intervening".

Patient operation leg <--> Accident on the same leg.

Accident---->Tetanus---->Reaction to the injection with mental abnormality.

❖ Mens Rea

A guilty mind or some evil intent to do harm to another without a just cause or excuse knowingly, willfully, or maliciously. Intent must be proved. A child 10 years and below may not be held responsible for actions even if it is criminal. He cannot account for his antisocial acts.

❖ **Re Ipsa Loquitur**

The facts speak for themselves. It is not proof of anything – For example, the reaction of the swab in the abdomen.

❖ **Actus non facit reum nisi mens sit rea**

The act does not make a person guilty unless the mind is guilty.

ARRAIGNMENT



- Bring somebody before a court of law to face a charge. The clerk of the court calls the defendant by the name to the bar and asks the defendant to plead guilty or not guilty. Guilty or not guilty must be from the defendant himself to the counsel or lawyer.
- To call a prisoner to the bar of the court to answer the charge laid against him in the indictment. Called by name the indictment is read to him, he is asked whether he pleads guilty or not guilty and his plea is recorded.
- Mute jury to determine whether he is mute of malaise or mute by the visitation of God or he may plead that the court has no lawful indictment over him for the crime charged.
- Guilty plea. The defense counsel may then

make a speech in mitigation, pointing out circumstances mental depression personal accidents, which may be borne in mind by the court when fixing the sentence in the defendant.

DEPOSITION

- A declaration or statement of facts made by a witness under oath and reduced to writing for subsequently use in court proceedings.

CORROBORATION

- To support an opinion or claim with additional information or proof.
- Additional information to prove the previous testimony.

TORT

- Civil wrong (crooked or twisted)

PRECOGNITION

- This is an informal statement, not on oath, which could form the basis of the oral testimony to which a witness would give at any subsequent trial. It is taken by procurator fiscal or deputy at a private sitting and a person who fails to attend can be fined or imprisoned for contempt of court.

SAMPLE COLLECTION FOR MEDICO-LEGAL PURPOSES

❖ **Intimate Samples**

These are samples taken for forensic studies following an allegation of rape after the suspect's consent. This includes:

- A sample of blood, semen, or any other tissue fluid urine or public hair.
- A dental impression.
- A swab taken from a person's body orifice other than the mouth; that is a swab from the ear, nose, rectum, and vagina.

Intimate search; A search that consists of the physical examination of a person's body orifices other than the mouth.

❖ Non- Intimate Samples

These are samples that do not require consent.

- A sample of hair other than pubic hair.
- A sample is taken from a nail or from under the nail.
- A swab is taken from any part of a person's body including the mouth but not on her body orifice
- Saliva.
- A footprint or any similar impression of a person's body other than a part of the hand. This includes a sample taken from the auxiliary region, penis however the swab would become an intimate sample if the specific purpose were to obtain a sample of the suspect's semen by swabbing the penis.

Intimate samples can be taken without consent of the suspects and with the use of considerable force.

The difference between the non-intimate and intimate samples is not related to how the samples are taken from the body above or below the skin but to the area of the body from which it is taken.

CIRCUMSTANCES UNDER WHICH A DOCTOR MAY EXAMINE A PERSON WITHOUT CONSENT

1. Immigrant at the port or Airport
2. A person suffering from a notifiable disease TB Examination and treatment.
3. New admission to prison to exclude infectious disease
4. A court may order psychiatric examination and treatment.

5. Food handlers and dairymen.
6. Members of the armed forces
7. Medical emergencies.

MURDER AND OTHER FORMS OF UNLAWFUL KILLING

MURDER

Murder is a felony, unlawful killing of a reasonable creature in being and under the queen's peace with malice forethought express or implied, the death following with a year and a day.

MANSLAUGHTER

Manslaughter –Intentional, unintentional, unlawful killing of another person without malice aforethought.

PROVOCATION AND NEGLIGENCE

Provocation, negligence, Driver III defined crime; It lacks definition because of the variable intent, which ranges from something short of malice aforethought to negligence.

INFANTICIDE

Infanticide- This refers to the killing of an infant within one year giving birth when the mother is under the effects of childbirth or lactation.



Figure 20. *Infanticide*

ABORTION

Abortion – Refers to killing a fetus before 28 weeks of gestation; child destruction.



Figure 21. Diagrammatic representation of abortion

PROVOCATION AS A DEFENSE TO A MURDER CHARGE

Voluntary manslaughter; one person kills another upon a sudden heat, such as a fight caused by grave provocation by the deceased.

- Provocation is some act or series of acts done by the deceased to the accused which would cause any reasonable person as did cause to the accused a sudden temporary loss of self-control rendering him so subject to passion as to make him for the moment not the master of his mind.
- The sufficiency of the provocation should be left to the jury which shall take into account everything both said and done according to the effect which in their opinion would have on a reasonable man provocation must have immediately preceded the killing, there must be no cooling time.
- The perpetrator suffers from such abnormality of mind due to arrested development, disease injury as to impair mental responsibility for the killing.

SEVILLE MANIFESTO

This was committee held in Spain in 1989 on training in forensic medicine in Europe.

Recommendations given;

- The detailed undergraduate didactic course of a minimum of 60 hours with a written and practical examination to be applied in every medical school throughout the European community.
- Threatened to withdraw recognition of the degrees awarded by any medical school which failed to implement the recommendations.
 - **Quote from Bernard Knight**
 - **Surgeons - Teach consent**
 - **Psychiatrist -Teach drugs and alcohol**
 - **Physician -Teach Ethics**

INQUEST

An inquest is a public inquiry into the circumstances of a death.

FUNCTIONS OF INQUEST

The inquest seeks to discover the identity of a deceased and where, when, and how he or she came to be dead. It must not direct blame either of a criminal or neglect nature to any person or party. This is a matter of the criminal or civil courts. The coroner's inquest must arrive at a verdict that can be one of the following.

- Unlawful killing (murder, manslaughter, infanticide, or reckless driving)
- Accident
- Suicide
- Natural causes
- Industrial disease
- Open verdict (where the evidence is insufficient to arrive at a more definitive answer)

An inquest is done on any case that is reported to the coroner. In most cases, it is done only when the cause of death is unnatural to answer the following questions.

- Who is this who lies dead?
- When and where did he come to his death?
- How did he die circumstance surrounding?
- Determining the particulars requested by the registrar of deaths.

An inquest may be held in any place (e.g. a court or private house) and the proceedings are carried out informal manner. The public is admitted to the court except when this would be prejudicial to national security. The commonest verdicts of the coroner inquest are:

- Natural causes, accidental death, misadventure, industrial death, suicide, unlawful killing, and lawful killing, drug-related deaths are both dependent and non-dependent.

TYPES OF CASES THAT CANNOT BE DISPOSED OF WITHOUT AN INQUEST

- Criminal case (murder, manslaughter, infanticide)
- Suicides -road, aviation, domestic or other accidents.
- Industrial accidents and diseases. - Notifiable disease.
- Death in prison or police custody
- Death where neglect medical treatment is alleged.
- Deaths from neglect and any other case where the coroner feels that a public hearing would be beneficial.

CONCLUSION

The requirement of Establishment of a Medico-Legal Institute

- ✓ The population is 8 million and contains a metropolitan area of approximately 1 million.
- ✓ Assume that the crime rate is similar to that of the United Kingdom.

FORENSIC PATHOLOGY

Forensic pathology is the part of forensic medicine dealing with the examination of deceased persons. A common principle is that in the investigation of a possible or suspected criminal death, a forensic pathologist is engaged through a formal request from the police or the prosecutor. The main role of the forensic pathologist is to practice and to mediate a scientific approach to the medical issues raised in a legal context involving death. It is inherent in its very nature that the forensic pathologist, irrespective of principle, strives to assist with impartial assessments, based on "science and tried and tested experience."

Equally, forensic medicine also deals with the study of the diseases and injuries in the community.

Forensic pathology;

- Requires general knowledge in medicine to diagnose and treat.
- Requires understanding of the community folks, religion government, and society.
- Safeguard the health of the community, Prevents injuries and diseases in the community e.g. death at work, accidents, immunization, and prophylactic therapy.

Full-time forensic pathologists tend to work in large cities.

- 1% of the population die 20% require investigation one case investigated comes from a population of 500, so $8,000,000,000 + 1,000,000 = 9,000,000$ divide by 500 = 18,000 deaths 20% of these deaths = 3,600.
- A hard-working pathologist can investigate 500 cases per year 3,600 deaths needs investigation and 7 forensic pathologists needed at present.
- 250,000 people can support one full-time forensics pathologist.

Forensic autopsy is one of the quality assurance programs for all health care.

The approach in forensic pathology is expansive and bases the determination of the cause of death on the environment, historical, and circumstantial data.

Hospital and Academic pathologists focus on small parts of the individual patient preferentially microscopic or submicroscopic (i.e. such approach while appropriate for some problems is inappropriate to determine the cause of sickness, injury, and death). A community-based study is required.



Figure 22. Autopsy room

Forensic pathology is a better-called Community and public safety pathology. Pathologists have "house calls" at the wee hours of the night court hearings, studying electrical theory consoling family who lost their infant due to SIDS. No matter what activity man is involved in, things will always go wrong, death will result and the forensic pathologist will be expected to discuss why and what might be done to prevent needless deaths.

PUBLIC HEALTH AND CLINICAL AUDIT IN THE EXISTING CORONER SYSTEM

Clinical audit is the systematic analysis of the quality of patient care with the aim of identifying possible improvements.

AUTOPSY DATA

Autopsy data is a major component of clinical audit.

- Fatal outcome,
- autopsy findings,
- clinical diagnosis and
- Certified cause of death.

Effective audit demands;

- High autopsy rate, high standards, or autopsy performance and reporting.
- Low autopsy facts; low (few).
- Verification of clinical diagnosis
- Coroners autopsies especially when the deceased had attended a hospital or general practitioner. High percentage missed clinically 77% in spinal T.B. to 26% of lobar pneumonia. This was due to limited diagnostic methods poor clinical judgment and interpretation.

With advances in medical imaging, microbiology, and biochemistry, diagnostic discrepancies at autopsy attributed to culpable negligence.

A) Death certification and the autopsy

Accurate morbidity and mortality data is essential for monitoring a nations' health for earlier detection of environmental hazards and for planning the location of resources for health care.

B) Auditing perioperative deaths

Operation:

- ✓ The communication between pathologists and clinician is so poor that a useful lesson cannot be learned
- ✓ The quality of the information in post mortem examination records needs to be improved and the number of autopsies to increase.

C) Auditing diagnostic images

- ✓ X-ray examination
- ✓ Computerized axial tomogram (CAT) scan.
- ✓ Pangenetic resonance imaging.

D) Sampling and selection of cases of audit

- ✓ This should be done at random

E) Recording autopsy data for audit

This is done in disease categories, treatability of the autopsy diagnosis, and the quality and quantity of lost life expectancy which can be divided into minor or major.

F) Closing the autopsy loop

The paradoxical hypothesis that the emergence of managed care which threatens to accelerate the decline of the autopsy may offer an opportunity for its re-emergence as an important tool of quality and cost control. A simplified autopsy-based management information structure is proposed to close the loop where information currently gleaned from the autopsy is frequently unused or underutilized in medical decision making and managed care.

The autopsy is reverted to the clinical practice to effect improvement. Pathologists must avoid adversarial roles in morbidity meetings.

G) Auditing the autopsy

The process of auditing the autopsy involves;

- Recording measurements, weights, volumes of effusions, and histology correlation of the naked eye interpretations with histology.

Auditing of the autopsy requires accuracy, thoroughness, and timeliness.

THE ROLE OF INFORMATION TECHNOLOGY IN THE PRACTICE OF FORENSIC PATHOLOGY

Information technology is used by pathologists to deliver better health care to the needs of everyone in the world by providing the medium of exchange of information of ideas virtually and instantaneously. The Internet is the network of

networks.

It involves the exchange of information, documents, and interactive participation in discussions with fellow professionals worldwide. The disintegration of boundaries traditionally existed because of space, distance, time, and cultural differences. A pathologist needs to;

- Consult colleagues worldwide
- Draft a paper and get corrections from co-author/s the same day
- Read journals at no cost
- Reference information
- Engage in real-time discussions with researchers.

TELEPATHOLOGY

Telepathology refers to the process of sending digital pathology images over standard or integrated services (digital networks), telephone lines, or over a local/wide area networks. The images may either be transmitted in real-time or assail images.

Depending on date transfer, rate requirement and electronic consideration, images can be transmitted utilizing common telephone lines (twisted pairs of copper wire) digital phone line, coaxial cable, fiber optic cable, microwave, and satellite and t-l telecommunication



Figure 23. Telepathology

- **Local rules are publicized and are freely accessible to all workers.**

GENERAL PRINCIPLES OF RISKS

1. Recognition of risks

Involves the identification of hazards that give rise to risks.

2. Elimination of hazards

Where hazards can't be eliminated, barriers established.

HAZARDS

A hazard is any source of potential damage, harm, or adverse health effects on something or someone. Examples of hazards include Scalpels, saws, needles, etc.

RISKS BROUGHT ABOUT BY HAZARDS

Risk is the chance or probability that a person will be harmed or experience an adverse health effect if exposed to a hazard, eg HIV, HBV, TB, etc.

MEANS OF CURBING RISK

- Label infectious cases; post mortem prohibited of cases in category 4 infections, viral hemorrhagic fevers, encephalitis. Category 3 post mortem is non-routine but when the special need is agreed, staff limited.
- All trained in mortuary techniques and safety procedures.

Remember unknown risk is the greatest risk



Fig. 24.

EXPOSURE TO HAZARDS

1. Through Inhalation – Aerosols
2. By Ingestion -Salmonella Food eating and smoking in the mortuary
3. By Inoculation -Punctured gloves.
4. Entry through a cut, abrasion, conjunctiva, or mouth.

BARRIERS TO HAZARDS

❖ Primary barriers

Revolve around perceived hazards. They include physical autopsy room ventilation, movement, working procedures techniques gloves boots, shoes, autoclaving disinfectants glutaraldehyde, phenolates, hypochlorites, and formalin.

❖ Secondary barriers

Revolve around the worker. Examples include Protective clothing gloves, waterproof boots, and aprons, eye protection, preserved area for smoking, drinking, and eating. On employment, there is an assessment of emphysema, tetanus.

❖ Tertiary barriers

Revolve around the autopsy room. They include the community at large, waste disposal policies, transport of specimens, disposal of the bodies.

- ❖ **An approach is made to the coroner to enable the harvesting of tissues for transplantation purposes. The coroner seeks advice and outlines the medical and ethical considerations that influence the advice given.**

MEDICAL CAUSES OF DEATH, POSSIBLE TRANSMISSIBLE DISEASES, AND SUSTAINABILITY OF ORGANS

LEGAL

Will, loss of evidence, request of next of kin-person in lawful possession of the body, The powers of the coroner

ETHICAL

Age, organ requested, etc

- Minnesota Protocol

This was a document, which discussed the methods of doing an autopsy in cases of brain death. The method was long and unnecessary and was not worthy to be followed.

The description was detailed, and for a doctor to do an autopsy first he needed to know how to do a normal autopsy thus rendering the protocol useless and unhelpful.

SECOND AUTOPSY

1. Reasons

- Lack of information
- Undetermined COD,
- Suspicion of the relatives because of the above reasons,
- Involvement of lawyers
- Responsibility of the other disciplinary problems arising from information available from the attorney general.
- Relative prompted by an attorney or other "well-meaning friends"

2. Problems

- No viscera
- Embalming artefact
- Toxicology fluid composition
- Time delay and the desire of the relatives to "bury our loved one today"

EMBALMING ARTEFACTS

AUTOPSY ARTEFACT

Refers to any change or feature introduced into a body after death that is likely to lead to misinterpretation of medico legally significant antemortem findings.

NOTE:

The mistake of permitting a body to be embalmed before autopsy may be as disastrous as the performance of an incomplete autopsy. (Moritz, 1956)

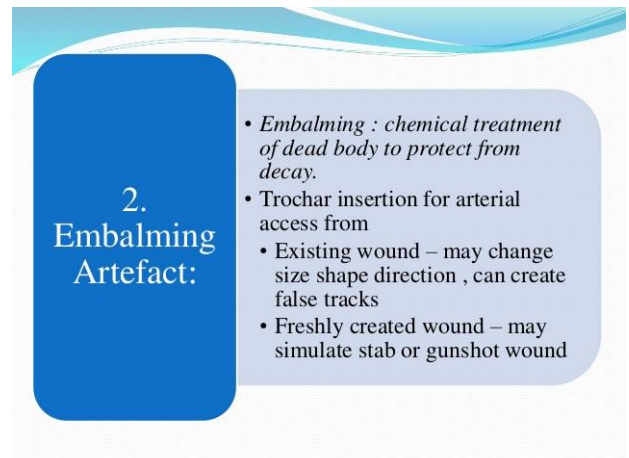


Figure 25. Embalming artefacts

- Removal of clothing
- Shaving and shampooing
- Cleansing
- Applying cosmetics
- Embalming Fluid
- Arterial Injection
- Cavity Embalming
- Building and Reduction
- Positioning and Binding
- Preparation of the Head and Face

EMBALMING ARTEFACTS

- **Removal of clothing;** Wounds, soot and powder deposits, the direction of a graze, electrical burns, electrocution, bandage.

- **Shaving and shampooing;** Abrasion in neck and mouth, shampooing & styling cover gunshots.
- **Cleansing;** Haemoptysis, Haematemesis, Skull fractures. Kerosine, Gas, oil destroy toxicological evidence.
- **Applying cosmetics;** Patechie on the face, superficial contusions, abrasions, and laceration can be disguised. A gunshot wound to the head is plugged with wax.
- **Embalming Fluid;** The bright red color simulates carbon monoxide or cyanide poisoning.
- **Arterial injection;** In carotid, femoral, and branchial arteries can cause postmortem haematoma.
- **Cavity Embalming;** Trocar punctures can be mistaken for stab wounds and shotgun wounds.
- **Building and Reduction;** Virtuous humor may be contaminated by the chemical composition of the tissue builder.
- **Positioning and Binding.** Presence of binding marks, Fractures are reduced in proper position detection of fractures that may be missed.
- Preparation of the Head and Face.

AUTOPSY ARTEFACTS OF IMPORTANCE IN FORENSIC PATHOLOGY

Resuscitation Artefacts

1. The external surface of the chest

- Bruises over the breast-bone and the skin markings of defibrillator paddles.
- Fracture of ribs after closed-chest cardiac massage in adults' patients. (Uncommon in children).

2. Head and Neck

- Nail marks around the neck, chin, and nostrils. (Strangulation)
- Sub-conjunctival petechiae. (No retinal hemorrhage)
- Bruising in the soft tissues and musculature of the neck in mouth-to-mouth ventilation, and when attempts

have been made to insert needles or cannulae into neck veins.

- Fracture of the hyoid bone, the thyroid cartilage, and mandible in resuscitation or laryngoscopy.

3. Gastro-intestinal tract.

- Perforation of the esophagus following the insertion of airways and Heimlich maneuver.
- Ruptures of stomach, jejunum, and mesenteric laceration.
- Parenchymal hemorrhage within the pancreas, injury to the liver.
- Acute and delayed ruptures of the spleen in the closed-chest cardiac massage.

4. Cardio-vascular system.

- Raptures of (a) right atrium either with or without previous myocardial biopsy (b) papillary muscle of the tricuspid valve and it ascending aorta.
- Formation of traumatic ventricular septal defects, a dissecting aneurysm of the left coronary artery.
- Thrombosis of the abdominal aorta.
- Defibrillation and administration of beta-adrenergic catecholamines during prolonged resuscitation acts synergistically to produce a characteristic pattern of myocardial necrosis comprising of epicardial coagulation necrosis, focal hemorrhag, and randomly-distributed 'contraction band necrosis'
- Identical to ischaemic damage of myocardium.

5. Respiratory System

- Pneumocephalus, pneumoperitoneum
- Necrotizing tracheobronchitis, bronchiectasis
- diffuse alveolar damage (ICU)
- Aspiration of vomit.
- Bone marrow emboli in the pulmonary arteries.
- Hepatic tissue within the pulmonary arteries, bronchial mucosal emboli

within the cerebral arteries, and intracranial air embolism in mechanical ventilation in very low birth weight infants.

6. Central Nervous System.

- Subarachnoid hemorrhage as a complication of raised intracranial pressure during the external cardiac massage.
- Hemorrhage from tears in the vertebral-Basila arteries following prolonged backward bending of the head.
- Intracerebral hemorrhage may complicate mask ventilation in low birth weight infants.

(NB: History of attempted resuscitation must be obtained before an autopsy to determine what lesions may require cautious interpretation).

ASSAULT AND BATTERY IN LAW

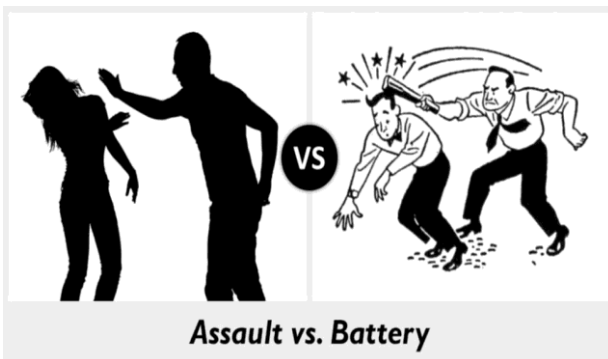


Figure 26. Assault vs. Battery

ASSAULT

Assault is an attempt or threat to apply unlawful force to the person of another whereby that person is put in fear of violence. e.g.

- Striking at another with a stick or fist (even though the party misses his aim)
- Drawing a sword or throwing a bottle.
- When person A points a firearm at person B, which A knows to be unloaded though B

does not and is so near that it might produce injury if it loaded and went off. This constitutes assault.

Mere words do not constitute assault. The intent must be shown in the act, not just in speech.

BATTERY

Battery consists of applying force however slightly to the person of another hostile or against his/her will. The charge of the battery is usually combined with assault. E.g. Assault and Battery, throwing water at someone, giving a man a black eye, splitting in the face, or holding him by the arm.

PROVOCATION AS A DEFENCE TO A CHARGE OF MURDER

Provocation is some act or series of acts done by the deceased to the accused which would cause in any reasonable person as did cause to the accused a sudden and temporary loss of self-control rendering him so subject to passion as to make him for the moment not the master of his mind.

The sufficiency of the provocation should be left to the jury which shall take into account everything both said and done according to the effect which in their opinion would have on a reasonable man. Provocation must have immediately preceded the killing, there must be no cooling time.

This is voluntary manslaughter one person kills another upon a sudden heat, such as a fight caused by grave provocation by the deceased. Suffer from such abnormality of mind due to arrested development disease injury as to impair mental responsibility for the killing.

THE ROLE OF A FORENSIC PATHOLOGIST

The role of the clinical forensic pathologist in the examination of a case of (apparent) suicidal hanging in police custody occurs in the first 3 hrs after booking, in sentenced, unmarried, convicted of theft, and serving the first month of prison time. The pathologist has to;

- Confirm if the person is alive or dead.
- Preserve the remains to allow photography of the scene

- Get history from the police
- Inform the relatives and inform the coroner.

SCENE

Attempted resuscitation has a potential risk of interference with or destruction of important evidence in the scene of a suspicious death.

POST MORTEM

The Pancreas

This is one of the first organs to undergo autolysis. The autolyzed organ is often hemorrhagic and can be mistaken for acute pancreatitis.

Patches of Haemorrhage

This may be quite large and confluent in the tissue behind the neck. This haemorrhage can be confused with deep neck bleeding in strangulation (and sometimes with spurious neck fractures)

Autolytic rapture of the stomach

This so-called 'Gastro-Malaysia' appears as a slimy brownish-black disintegration of the fundus with the release of the stomach contents into the peritoneal cavity or chest when the left leaf of the diaphragm is perforated.

Heat fractures of bones

This can occur in victims of severe fires. 'Heat hematoma' in the burned skull can resemble an extradural hemorrhage of antemortem origin.

The bloating, discoloration, and blistering of a putrefying body.

These may be misinterpreted as disease or injury and incision into the tissue to seek blood in the dermis is advised. Where the body is badly decomposed special stains for the pigment in the histological sections may assist. Gases caused by

putrefaction may mimic air embolism

Blood or bloody fluid issuing from the mouth

This may be due to putrefaction, even if the body surface is not overly decomposed.

Dark red discoloration of the posterior part of the myocardium

This is usually due to post-mortem gravitational hypostasis, not early infarction. Similarly, segmental patches of dark red or purple discoloration in the intestine are hypostases not in fact.

Large petechiae or ecchymoses

These are often seen in the dependent skin of persons who have died a congestive death or where the part of the body has been hanging down after death.

Damage by predators

This includes ants, rats, foxes, dogs, hyenas, tinger, blue-bottles, monitor lizards, etc. The degree of damage depends on the size of the predator.

Anal dilation

The anus may appear significantly dilated after death, and more so as the post-mortem interval increases. Anal interference depends upon the demonstration of abrasions, bruises, laceration, and oedema.

ARTEFACTS INTRODUCED BY AUTOPSY PROCESSES

1. Diffusion of blood into the perinephric tissues as a consequence of the removal of the abdominal organs may simulate antemortem hemorrhage.
2. Forceful disruption of rigor mortis. This may cause rupture of the biceps muscle, with seepage of blood from the site of rupture
3. Pulmonary collapse. This lung can collapse

rapidly after opening the chest at autopsy, and unless radiology and/or the demonstration of air in the pleural cavity by opening underwater, it can be difficult to refute the suggestion that the observed pulmonary collapse was, in fact, an artefact.

4. Neck dissection is-situ before releasing the thoracic organs below the thoracic inlet to allow the blood to drain from the neck maximizes artefactual crusting during the neck dissection.

Chapter Two

Determination of Death

DEFINITION OF TERMS

CAUSE OF DEATH

This is the disease or injury responsible for initiating the train of events brief or prolonged that produces fatal results.

MANNER OF DEATH

Manner of death:

This is the fashion or circumstances in which the COD death occurred or came into being. These include Natural and Unnatural Accidents, Homicides, Suicide, and undetermined.

MECHANISM OF DEATH

This is the physiological derangement or biochemical disturbance produced by the COD which is incompatible with life. These include Asystole, Ventricular fibrillation, hemorrhagic shock, severe metabolic acidosis and alkalosis, sepsis, toxemia, respiratory depression, paralysis.

BRAIN DEATH

Brain death is the damage to the centers of the medulla causing the respiratory motor system to fail.

The brain stem is damaged followed by the irreversible loss of consciousness and irreversible loss of brain-stem reflex responses and respiratory center function or irreversible cessation of intracranial blood flow one of the legal definition Irreversible cessation of all functions of the brain.



Figure 27. Brain death

The time of death is when the first doctor (6 hrs) completed certificate of brain death following the second confirmatory examination by the second doctor (6hrs)

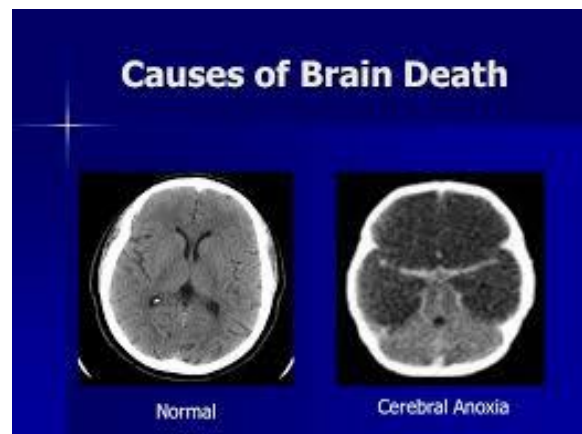


Figure 28. X-Ray- Brain Death

Causes of brain death include trauma, cerebral edema, hemorrhage, hypoxia, and infections.

Effects include both respiratory control and damage to the ascending reticular activating system, and permanent loss of consciousness.

❖ **Brain death equal to legal death.**

❖ Criteria for diagnosis of brain death

- a. The patient must be in a deep coma, which is not due to depressant drugs.
- b. The patient must be on mechanical ventilation due to absent or inadequate spontaneous respiration.
- c. A firm diagnosis of the basic pathology must be available and must be known to be the cause of irreversible brain damage.
- d. Diagnostic tests for brain death must be unequivocally positive (done by two doctors registered at least five years of experience.
 - All brain stem reflexes are absent with fixed pupils, unreactive to light, corneal reflexes absent.
 - Vestibular-ocular reflex negative when ice-water is introduced into ears.
 - No motor responses in any cranial nerves on response to painful stimuli
 - No gag reflex to a catheter introduced into the larynx and trachea
 - No respiratory movements when the patient is disconnected from the ventilator $P_{CO_2} < 50$ mm Hg.
 - Testing must be carried out with a body temperature not less than 35° C. Different systems of the body do not necessarily die at the same time the following criteria are useful in the diagnosis of death.
 - Cessation of circulation
 - Absence of breath sounds on auscultation
 - The dilated pupil does not react to light
 - Segmentation or "railroading" in the retinal vessels.
 - ECG or EEG for the final proof.

EUTHANASIA

Administering medication or performing other intervention/s to cause a patient death (mercy killing). This is a form of assisted suicide.



Figure 29. Euthanasia

"PERSISTENT VEGETATIVE STATE"

- The clinical condition of unawareness of self and environment in which the patient breaths spontaneously, has a stable circulation and shows a cycle of eye closure and eye-opening which may stimulate sleep and wake.
- Or a state when the higher cerebral activity is lost selectively with the survival of the brain stem such that there is spontaneous breathing but the person has no awareness of the surrounding. "Deep coma". Cerebral hemispheres are non-functional.



Figure 30. Patient in a persistent vegetative state

CONTINUING VEGETATIVE STATE (CVS)

Vegetative state for more than four weeks. It is rendered permanent when the diagnosis of irreversibility can be established with a high degree of clinical certainty in a patient with CVS for more than 12 months or after head injury for 6 months after another cause of brain damage.

PERMANENT VEGETATIVE STATE

Examination by two independent physicians and take into account the observations of other medical staff nurses and other cares who spend time with the patient. This occurs when the higher levels of cerebral activity are selectively lost, either from a period of hypoxia, trauma, or toxic insult. The survival of the brain stem ensures that spontaneous breathing will continue and therefore cardiac function is not compromised. The victim can remain in a deep coma almost indefinitely -certainly for years -though debilitating complications may shorten their life.

Such vegetative patients are not considered "dead" by most standards, though some medical professionals claim that because of the irreversible loss of awareness of themselves and the world around them they can no longer be considered 'human beings'.

In the present, no jurisdiction would consider a patient who was breathing spontaneously and whose heart was beating as 'dead'.

The doctor withdrawing treatment in such a patient may follow legal litigation because the patient does not meet the criteria of a diagnosis of death i.e. the patient is not in mechanical ventilation and the brain stem reflexes are present. The timing of death is when the patient stopped breathing and the heart stopped beating. Brain stem death is one of the legal criteria of death without which a diagnosis of death cannot be made and a doctor withdrawing treatment before this liable to be charged with negligence.

COMA AND BRAIN STEM DEATH

Locked-in syndrome: Severely impaired motor output that limits the ability to alert pertinent

communication.

TIME SINCE DEATH

Determination of time since death is very inaccurate and should be done with a lot of care.

- This is a common question pathologists are asked in courts of law and should be carefully answered since there are several factors and methods used but none can give the hours since death accurately.
- The range should be given in hours; i.e 2-4 hrs or less than 24 hrs.
- For anybody who has been refrigerated, the time of death should not be attempted since rigor mortis, and temperature are affected by refrigeration

RIGOR MORTIS

Rigor Mortis or postmortem rigidity is the third stage of death. It is one of the recognizable signs of death, characterized by stiffening of the limbs of the corpse caused by protein changes in the muscles post mortem caused by the action of acid metabolites.

It depends on

- Activity before death
- Temperature

Stiffening of muscles starts in small muscles; commences for 6-hours, Takes 6 hours to develop - Remains for 12 hours and Passes off 12 hours.

- Warm Flaccid < 6hrs
- Cold Flaccid > 2 days



Rigor mortis

Condition of body	Time since death
If body feels warm and flaccid	Dead less than 3 hours
If body feels warm and is stiff	Dead from 3-8 hours
If body feels cold and is stiff	Dead from 8-36 hours
If body feels cold and flaccid	Dead more than 36 hours

- Eyelids, lower jaw, face.
- Muscles of the back of neck and trunk
- Muscles of the abdomen and lower limbs

Factors which may influence the rates of development and disappearance of rigor mortis

1. Rates of development

Physical exertion, exhaustion, old people and infants absent or hardly testable, occurs first in small muscles or eye and mouth temperature hot quick to develop.

2. Rates of disappearance

Temperatures, cold stays for a long time, and vice-versa. The significance of rigor mortis and cadaveric spasm.

3. Cadaveric Spasm

Instantaneous rigor occurs immediately on death usually being manifest by the gripping of objects in the fingers sudden violent death (fall into water) Where objects may be clutched in a desperate attempt to save a life common also in battlefields.

dissociates from the hemoglobin, changing it to purple-colored deoxyhemoglobin. This color change can be variable depending on the circumstances of death and the environment. Cold temperatures will delay the dissociation of oxygen from the hemoglobin, delaying the color change from red to purple.

Lividity may not be seen in bodies that are very anemic at death. Initially, it is not fixed, that is if pressure is applied to a skin area the red color changes to white as the blood is returned to the capillaries due to the pressure. Bodies lying on a hard surface will also show white blanching in the areas making contact with the surface for the same reason. Lividity is said to become fixed in 4–6 hours, that is, the red color no longer disappears on pressure because, with the cooling of the body, the fat surrounding the capillaries solidifies, constricting the capillaries and preventing the return of blood into them

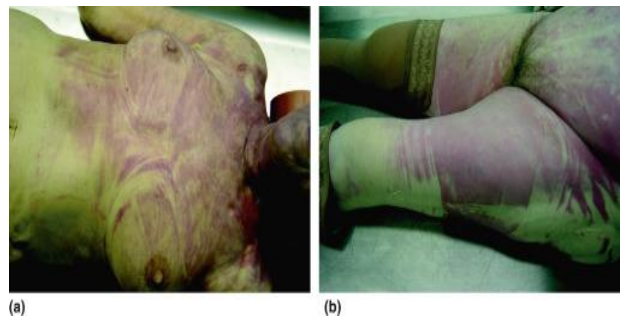


Figure 32. *Livor Mortis*

LIVOR MORTIS

POST-MORTEM LIVIDITY

Livor mortis or lividity is the gravitational pooling of blood in the dependent parts of the body, both externally in the skin capillaries and venules but also in the internal organs. Its onset is variable but it is usually most evident about 2 hours after death, although it is stated to occur as soon as 15 minutes after death (Clark et al., 1997). Initially, the color is red but it later becomes purple as oxygen

FORMATION AND INTERPRETATION OF HYPOSTASIS (POST-MORTEM LIVIDITY)

Hypostasis occurs when the circulation ceases, as arterial propulsion and venous return then fail to keep blood moving through the capillary bed and the associated small afferent and efferent vessels. Gravity then acts upon the low now stagnant blood and pulls it down to the lowest accessible areas. The red cells are most affected, sedimenting through the lax network, but plasma also drifts downward. The arrival of erythrocytes in the lower areas is visible through the skin as bluish-red discoloration.

INTERPRETATION

The pattern of hypostasis depends on the position of the body after death. In electrocution, hypostasis is sharply limited to a horizontal line corresponding to the level of water. The bluish-red variation depends on the state of oxygenation at death.

Cyanosis indicates asphyxia. Cherry-red indicates increased oxygen concentration as in carbon monoxide poisoning.

- Pink is commonly seen in Hypothermia.
- Blue-pink hue is seen in cyanides poisoning.

THE VALUE AND SIGNIFICANCE OF VARIOUS METHODS OF ESTIMATING THE TIME OF DEATH

Demonstration of time of death and the post mortem interval is one of the most important tasks of the forensic pathologist.

a) Methods

- Decomposition –putrefaction
- Body temperature
- Measurement of electrolytes and enzymes
- Presence of maggots
- Mummification
- Adipocere
- Lividity
- Salivary glands -Secretion granules glycogen decrease with 3 hrs, lipofuscin granules and mitochondrial reduce within 6 hrs, cell membrane alteration appears in 9 hrs, nuclear alteration appear within 24 hrs, Immunoperoxidase (S-100, Actin smooth muscle, and CEA) remain constant in 12 hrs, Alcian blue and PAS 3 hrs and H/E 6-12 hrs.
- Potassium levels in the vitreous humor
- Skeletalization complete dissolution unless fossilized.

Effects of variations and the factors involved.

- The temperature of the surrounding
- Humidity

- Clothing

THE APPEARANCE OF THE VARIOUS STAGES OF DECOMPOSITION, AND INDICATION OF THE TIMING OF EACH STAGE

Green discoloration → marbling → petrification → adipocere → mummification → skeletonization.

DECOMPOSITION DUE TO BACTERIAL GROWTH SPREADING

Decomposition is faster in hot humid conditions due to bacterial activity.

ADIPOCERE

This is a chemical change of body fat that converts it by hydrolysis to a waxy compound similar to soaps. It is a grayish, greasy, or brittle compound that retains the shape of the body. It takes many weeks to develop but can occur in as little as 3 weeks.



Figure 33. Adipocere

MUMMIFICATION

This is when a body desiccates instead of undergoing most putrefaction. In non-desert conditions, its common in newborns. The

mummified tissue is dry, leathery, and brown. The tissues are dehydrated and skin stiffened and stretched over the face like a mask. The body is usually dead for several days. Note the color change and the reduction of size.



Figure 34. Mummified body

SKELETONIZATION



Figure 35. Skeletonized body

EXHUMATION

Exhumation may refer to the digging up of a body post burial;

Exhumation in the forensic pathology is the act of lawfully bringing out a buried dead human body for medicolegal purposes (Williams and Davison 2014). This process most times is followed by performing a post mortem examination on the body, to find out the pathogenesis and pathophysiology of events that lead to death. Apart from finding out the cause

and manner of death, other circumstantial evidence can be seen from a well-performed exhumation and post mortem examination (EPME). It is also performed for the establishment of identity, belated suspicion of unnatural death, or due to medical insurance problems.



Figure 36. Body exhumed for criminal investigation

THE VALUE OF EXAMINATION OF AN EXHUMED BODY

- The site of the burial has to be moved.
- Repeated autopsy needs to be performed.
- Concealed homicide suspicious death (under disguised by fire) Identification and verification, medical liability (malpractice) Time of death, child abuse, determine the cause of death.
- Illegal burial

LEGAL PROCEDURES FOR DISPOSAL BY CREMATION

Cremation is subject to stringent control to avoid both destruction of evidence of a crime and also cremation against the wishes of the family or the stated objection of the deceased.

A registrar's disposal certificate following coroner's autopsy must be issued before cremation.



Figure 37. Cremation of human remains

Also, several forms are used.

- ❖ **Form A:** Application for cremation.
- ❖ **Form B:** Signed by the registered medical practitioner. (Attending, certified death, or saw the body after death)
- ❖ **Form C:** Confirmatory certificate signed by a medical practitioner unrelated personally or professionally to the first doctor of 5 years standing.
- ❖ **Form D:** Certificate of death after an autopsy
- ❖ **Form E:** Issued by the coroner following autopsy replaces forms B and C but not F
- ❖ **Form F:** The written authority to cremate the body issued by the medical referee. This is a practitioner of five years standing appointed by the cremation authority or community physician. Following cremation, a certificate of disposal is again sent to the registrar.

POST MORTEM ANIMAL INJURIES (PREDATION- Not Insects)

THE ROLE OF MAMMALS IN POST MORTEM PREDATION

Animals' predators are a common cause of post mortem injuries ranging from ants to tigers. These may include dogs, rats, mice, foxes, reptiles, birds, fish, crustaceans, birds, and scavengers. The degree of injury depends on the size of the pet, with uneven injuries and some signs or early

decomposition.

- Insect bites may mimic ligature strangulation, create a pattern in the skin similar to abrasion or bruise, alter the appearance of the wound.
- Rodents favor the flesh around the face thus called "Rodent Ulcer".
- Crocodiles, sharks, alligators can mutilate bodies in water or near the water source.
- Dogs and cats are common in domestic circumstances; when one is alone in a house where there is a pet



Figure 38. Animal bite resembling stab wounds

Post mortem injuries lack active bleeding, redness, or early inflammatory reaction in the wound edges.

PREDISPOSING FACTORS AND CHARACTERISTICS OF ANIMAL INJURIES

The victims characteristically live alone and somewhat are socially isolated i.e pets dogs or cats live together with the victims in the house, in which they move freely with no available source of food present in the house. Most of these episodes are common in winter months possibly because there is a higher chance of isolation during these months when people spend more time indoors.

Death in most cases is due to natural causes or accidental or suicidal. Common household pets usually present little danger to the living although in unusual cases of pets (dogs and cats) devour their masters after their deaths¹⁷.

Usually, the nature of the injuries is quite obvious.

- There is minimal bleeding, which suggests

postmortem injury, and a few bite marks at the edges of the injury are present to suggest the culprit.

- The presence of pets in the house either alive or dead and knowledge of the circumstances will furnish a correct interpretation.
- If the body is skeletonized, tooth mark artifacts by the animal may be seen on the bones.
- The edges of the injuries can be analyzed for the levels of histamine, serotonin, and cathepsins. Post-mortem injuries show low levels of these inflammatory mediators and enzymes^{17,18,19}

MEDICO-LEGAL ASPECTS

It is not uncommon for the body with postmortem injuries of animal origin to arouse suspicion of criminal activity, especially when the scene is examined in dim light at night, and besides, the pets may drag some parts of the body at the scene.

IDENTIFICATION OF PERSONS

The discovery of human skeletal remains presents a Forensic pathologist or coroner with a technical and logistical challenge. The evaluation of skeletal remains must be as careful and detailed as death investigations involving recently deceased persons. Meeting the responsibilities of recovery, processing, documentation, identification, storage, and release of skeletal remains is often considerably more complex than handling the "routine" Medico-Legal case¹

Decomposed bodies tend to present in one of the two ways;

- Either the body is found in a secured house, death has been due to natural causes but not been discovered for several weeks, or else it is found establishing the cause of death and the identity of the deceased².
- In the bush or concealed in an outbuilding or part of a house.



Figure 39. Skeletonized body for identification

The latter situation is more likely to arouse suspicions of a possible unnatural cause for death and therefore may require more elaborate procedures for investigation. In either case, the principal problems for the pathologist are concerned with establishing the cause of death and the identity of the deceased².

METHODS OF IDENTIFICATION

The methods of identification used in the living and the dead vary.

❖ Causes among the living

Coma, amnesia, infants, mental defect, and severe language barriers.

❖ Causes among the dead

Criminal, suspicious death, decomposition, mass disasters.

MORPHOLOGICAL CHARACTERISTICS

Height, Weight, pigmentation, hair, eye color, clothing, jewelry, sex, race, occupation, tattoos, surgical scars, old injuries, congenital deformities, tribal scars, birthmarks, circumcision, moles, warts, hair color – beard or mustache body hair distribution, photography for comparison, age senile hyperkeratosis and moles.

In the dead ossification and epiphyseal union in living radiology used.

❖ FINGERPRINTS

Fingerprints can be obtained from desquamated skin or underlying epidermis. The pattern or prints comprises arches, loops, whorls, or composites. 16 points of similarity required before declaring prints identical chances of identical fingerprinting one in sixty-four billion palm and sole prints are equally identifiable. Lip crease patterns, ear-shape, and the vein pattern on the dorsum of the hands.

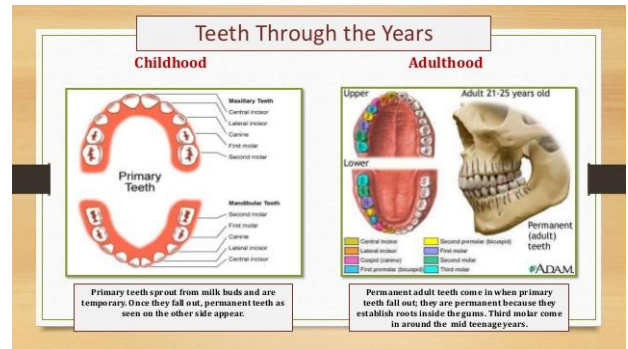


Figure 40. Fingerprint identification process

❖ DENTAL IDENTIFICATION

Forensic Odontology

Bite marks confirm or exclude a person as the perpetrator of a bite, and comparing the definition with known records.



In living persons, the estimation of age for purposes of immigration, adoption, and civil matters. In dead persons, Identification is done e.g. for mass disaster since teeth are the hardest and most resistant tissues in the body and can survive total decomposition even fire, of actual cremation. Dental charts for comparison in decomposed corpse are used. It is best to remove the mandible and lower maxilla put in formalin for later examination.



Figure 41. Skeletonized remains showing mixed dentition

Dental identification mostly may give;

- The age of the person
- A clue as to sex and race. Mongoloid show concavity 'shovel-shaped', the palate in Negroid people is deeper U-shape.

❖ TATTOOS

Certain patterns and sites on the body indicate homosexual or prostitute implications.

- Tattoos inside the lips, such as a number '13' may identify hard drug pushers.
- The bluebird between the base of the

thumb and index finger is common among homosexuals. Names of sexual partners especially boy-friend names, in decomposed bodies' tattoos, may still be visible on the underlying epidermis.



Figure 42. Body tattoo

IDENTITY OF DECOMPOSED OR SKELETALIZED REMAINS

The forensic pathologist aids from -Anatomist, Anthropologist, Radiologist, and Serologist.

1. Are they remaining bones? (May be stones or wood.)
2. Are the remains human? (Some animals may have bones similar to human e.g. bear.)
3. What sex are the bones? Skull and pelvis through the femur and sternum can assist.
4. What is the age of the person? The fusion of ossification centers epiphyses by eye or radiology arthritic damage, osteoporosis, and osteophytes as an indication of age.
5. What is the height (stature) of the person?
6. What is race?
7. Can a person be discovered? This includes dental records, medical evidence, of injury disease affecting bones like Paget's disease,

osteomas, foreign bodies like Paget's disease, osteomas, foreign bodies like bullets, metallic fragments, and old fractures.



Figure 43. Decomposed body

a) FACIAL RECONSTRUCTION FROM SKULLS

- ❖ Computerized reconstructions.
- ❖ Photo superimposition.



Figure 44. Facial reconstruction

EXAMINATION OF THE SCENE

The examination of the scene by a pathologist is of paramount importance and the recovery of human skeletal remains is more complex than the same work with an intact body¹. There may be no real suspicion of foul play, but by seeing the body as it lies before being disturbed the pathologist may be enabled to explain unusual marks that have been produced by contact with adjacent structures, by tight clothing surrounding vegetable evidence of bloodstains due to bleeding from wounds and the insects present which may give a rough time since death¹⁻³.

COLLECTION OF THE SKELETONIZED BODY

This is the most important procedure and standard techniques should be applied search and recovery¹.

- Shoulder to shoulder walk though and grid search patterns are recommended.
- Soil from around the skeletal remains is screened to look for loose teeth, small bones, and small items of physical evidence.
- Special knowledge of both animal and human skeletal anatomy and patterns of decomposition, weathering, disarticulation, and animal scattering of bones can provide for a more efficient and successful search.
- For relatively complete skeletons found in one locale, the skeletal material is parceled and labeled as whole if still articulated or if already disarticulated by anatomical region (e.g. head, right upper extremity, pelvis, etc.).
- When the remains have been scattered over a large geographical area, they are packaged and labeled sequentially by the specific site of recovery and cross-referenced with grip maps.
- After packaging, the pathologist transports the remains to the central facility for further examination.



Figure 45. *Completely skeletonized remains with no identification.*

IDENTIFICATION

This requires a multidisciplinary approach involving pathologists, forensic anthropologists, radiologists, forensic odontologists, and to some extent Forensic entomologists.

The pathologist best examines the skeleton first and to consult the relative specialist according to skills needed.

Depending on the degree of decomposition he/she should address a broad range of questions which might include:

1. Do all bones belong to one individual?
2. Was the individual right-handed?
3. Did the individual have children?
4. Are there any indications that the individual's medical history?
5. Are there any indications that the individual performed certain body movements regularly?

6. What did the individual look like?
7. How long has the individual been dead?
8. Is there evidence of trauma or violence at or near the time of death?
9. What happened to the body after death?
10. What races, sex ages, and the approximate height of the individual? The determination of sex requires a careful examination because very occasionally, an incompletely converted transsexual can cause difficulty, particularly where the body if fragmented.

During the gross examination, the pathologists dictate a detailed overall description, which includes approximate measurements.

- Special attention is given to any evidence of ante or postmortem injury, natural disease, developmental anomalies, and the degree and extent of decomposition and weathering changes.
- Summary statements providing a general assessment of age, race, sex, height while alive and estimates of postmortem interval should be included in the pathologist's report.
- After consulting with Forensic anthropologist some bones may be selected and individually cleaned to aid examination and measurement.
- After the initial pathological examination, the skeletal material is placed in an anatomical arrangement within the examination box and photographed.
- Under the direction of the examining pathologist, additional photographs may be taken of individual bones to demonstrate specific features or injuries.
- The bones maybe then radiographed to provide an additional means of detecting and documenting injuries or disease and referred to as a consultant radiologist for such features.
- When complete or partial maxilla or mandible is part of the skeletal remains, full sets of dental radiographs are taken.
- When antemortem radiographs are available, efforts are made to duplicate the same angles and views in the postmortem films. Forensic Odontologist examines the

teeth, bones, and radiographs and makes formal standardized dental charts for comparison.

TOXICOLOGY

In most cases, there is no obvious cause of death and full toxicology is required to rule out any poisoning either incidental or suicidal.

Accurate interpretation of postmortem toxicology results is very dependent on the understanding of the processes that take place after death. Postmortem degradation of drugs and poisons is one process that is little understood but that may significantly affect our interpretation of post-mortem toxicological results⁴.



Figure 46. Infestation by bluebottle maggots. The body is well-positioned and clothed. There together with other documents in the pocket can be used for identification.



Figure 47. *Decomposed body*

Post-mortem blood concentration for many drugs is site-dependent and this becomes more important in decomposing cases because unless an uncontaminated femoral vein blood sample is analyzed, interpreting the results is difficult. The drug concentration is site-dependent, and heart blood contains much higher concentrations of drugs than femoral vein blood. There is also a tendency for the concentration of a basic drug in a specimen to increase with post-mortem interval. The mechanisms which cause these phenomena are not clearly understood but it is believed that there is a post-mortem release of drugs from tissue sites of high concentrations into blood contained within those tissues or into connecting vessels, in other words, there is post-mortem redistribution of drugs. Drugs such as Tricyclic antidepressants, narcotic analgesics, local anesthetics, and antihistamines all accumulate in myocardial tissue and may be partially responsible for the observed rise and

subsequent high levels found in heart blood at post-mortem. Ethyl alcohol, which is evenly distributed throughout the body water, does not show this site dependence for concentration, which is approximately the same in both heart blood and femoral vein blood⁵.

In adverted decomposition, it may be difficult to obtain tissues or blood and insects can serve as reliable specimens for toxicological analyses and can provide more reliable qualitative results than can the decomposed tissues or/and blood. The arthropods are generally homogenized and then processed in the same manner as other tissues or fluids of toxicological interest. Apart from the toxicological value entomology can be used to some extent in the determination of time of death by estimation of the age of the maggots that found infesting the corpses^{5,6}.

Principles and practices used in the identification of a decomposed body recovered from a house.

Features used;

- Bones human
- Sex
- Height
- Race
- Dental impression
- Radiology
- Facial construction and documents.
- Clothing
- X-rays
- Dental impressions (can remove the jaw for later examination)
- Wounds, scars, tattoos,
- Color-race,
- DNA profiling
- Photographs.



Figure 48. Skeletonized remains

CONCLUSION

Cases involving skeletal remains are often technically and logistically difficult to monitor. They require a detailed systematic report, multidisciplinary approach to their management. The pathologist in the death investigation should place great importance on the early involvement and careful documentation of all steps in the handling process is essential to prevent lapses or errors during the prolonged investigation.

The possible practical applications of molecular biological techniques in tissue diagnosis and in identification

- Filter hybridization
- In-situ hybridization
- Interphase Cytogenetics

- Polymerize chain reaction
- Oncogenes and tumor suppressor genes.

DNA TECHNOLOGY IN FORENSIC MEDICINE

DNA Technology in forensic medicine involves the identification of persons in a mass disaster, victims, assailants, rape, Incest, baby miss ups, abduction, Inheritance, Immigration, and Criminal investigations among others. It is a highly powerful discriminatory, 1: several hundred million.

SPECIAL EXAMINATION IN FORENSIC MEDICINE AND PATHOLOGY

a) THE BODY FLUIDS USAGE IN FORENSIC MEDICINE FOR IDENTIFICATION PURPOSES

1. Bloodstains - Blood splatters, splashes
 - Kastel-Meyer test
 - Takayama test
 - DNA profiling
 - Blood grouping
 - ABO and Rhesus, M, N, Kelly, Duffy, and Lewis groups have forensic uses, bloodstains in the weapon clothing match with the victim or the suspect, matching the fragmented human remains paternity, and inheritance disputes, confusions in the maternity unit.
 - Electrophoresis
 - Fluorescent antibodies.
2. Spermatozoa
3. Sweat, saliva, semen, gastric and other body fluids
 - a. 80% of people secrete water-soluble group substances identical to their blood groups. These 'secretors may be identical from seminal stains and saliva.

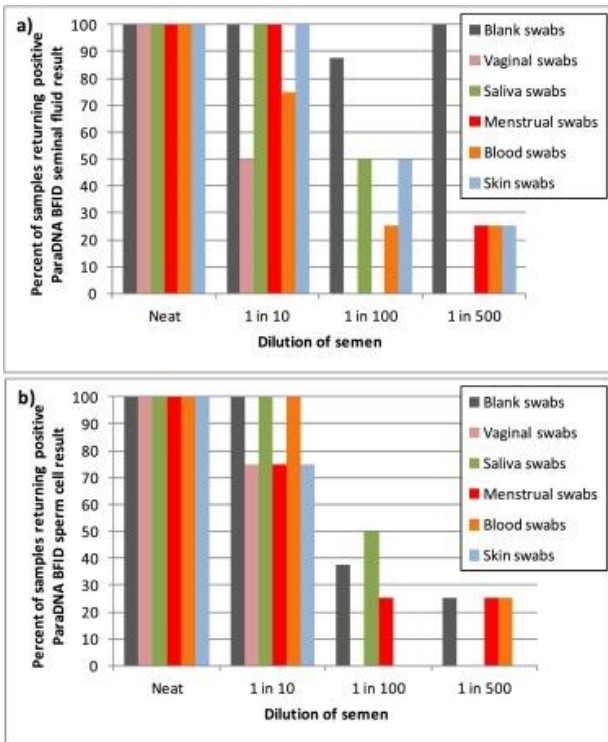


Figure 49. Developmental validation of the ParaDNA® Body Fluid ID System—A rapid multiplex mRNA-profiling system for the forensic identification of body fluids

b) THE FORENSIC EXAMINATION OF HAIR

- Identification
- The weapon used in committing a crime
- Remains at the scene of the crime
- Motor vehicle accident hair found in the vehicle hit and run
- Charges of bestiality or rape hair of underclothing of suspect.
- Toxicology Heavy metal arsenic, mercury, lead, morphine



c) MEDICO-LEGAL IMPORTANCE OF TATTOOS

- Identification in a mass disaster, or unknown person
- Related to ethical and racial differences
- Behavior related -Homosexuals prostitution or drugs use. E.g. tattoos inside the lips may and number 13 may indicate drug usage.
- Some boyfriends or girlfriend names may be tattooed in the skin.

d) FORENSIC IMPORTANCE OF EXAMINING THE EAR



Figure 50. Ear print analysis

Identification: Fingerprints comparison, dental, scars, tattoos have a high identification value.

1. Identification of a person on the basis of features ear features.
 - Photograph numerous measuring points at the ear.
 - Traces of ear prints at the scene of the crime for instance in burglaries imprints when dusted.
 - Use in paternity cases-deformities
 - Temperature middle ear.

- Otorrhae in head injury
- Piercing for the earrings for females and some men

Identification: Dust in cerumen e.g. coal, dust in the miner, coffee dust in farmers, small pieces of hair in barbers, asbestosis fiber in those who work in these industries.

d) Medical-Legal Examination of the Eye, at both Ante-mortem and Post-Mortem in both adults and children

Ante-mortem:

- Dilation of the pupil,
- Constriction of the pupil (illicit drugs),
- Petechial hemorrhage,
- Hyperemia,
- Corneal dislocation,
- Retinal hemorrhage,
- Orbital edema,
- Visual acuity,
- Range of eye movement in testing for alcohol intake.

Post-mortem:

- Color,
- Petechial hemorrhages,
- Conjunctival hemorrhage and congestion,
- Retinal hemorrhage,
- Detachment and optic nerve status.
- Gas in the retinal vessels in diving (scuba deaths)
- Segmentation of the blood in fetal vessels (train tracks) sign of death.



Figure 51. Forensic examination and autopsy

FORENSIC ENTOMOLOGY

Forensic Entomology is the application of insect biology to forensic pathology. This is commonly applied in determining the time of death.

The study on insects and other arthropods can be valuable tools with a death investigation of homicide, suicide, and other unattended deaths. For post mortem interval, an alternative specimen for toxicological analysis is used in the absence of tissue or fluids.

- Toxicology tests are always best carried out in living specimens rather than decomposed ones.

Lack of insects can also be informative of the truth. In the process of decomposition, insect development occurs in successive patterns.

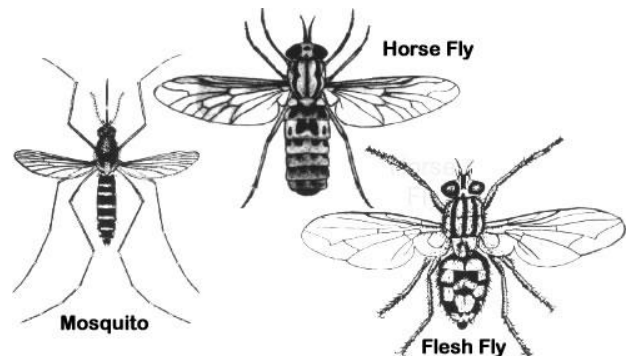


Figure 52. True flies (Diptera) Calliphoridae (blowfly), Sarcophagidae (Flesh fly), Muscadine (Housefly)

These are highly motile strong-flying insects typically the first to arrive at a body. The first regions for them to lay eggs are the eyes, ears, nose, mouth, anus, and genitals. This is followed by wounds and blood materials.

Purpurial cases remain intact for hundreds of years and can supply valuable forensic information long after the body has decomposed. i.e

- Buried vs Unburied body- The insects infesting a body exposed above ground are very different from those infesting a buried body that is decomposed.

- The age of maggots depends on climate, temperature, and humidity. The composition of the insects' fauna attracted to a body changes with time as the body decomposes.
- Insects can determine when and where the

death occurred, i.e

- Ecological place; Habitat woodland, sea, mountain.
- Geographical place; Actual location (scene of crime)

Chapter Three

Wounds and their characteristics

Come, thick night. that my keen knife see not the wound it makes'
Macbeth, Shakespeare.

INTRODUCTION

A wound is an injury to the body that penetrates the full thickness of the skin and extends into the underlying tissues or damage to the tissues of the body by mechanical force or violence. This includes; beating, knifing, kicking, biting, shooting, strangling, punching, explosives, falling, and injuries from Machinery and vehicles.

CLASSIFICATION OF WOUNDS

Wounds are classified based on;

- Mode of production - Rituals, Surgical, Accidental, Suicidal, Homicidal.
- Their appearance - Abrasion, Laceration, Incision, Stab, Gunshot, Electrical, Burns and Patterned wounds

ABRASION

The various forms of abrasion and their medico-legal significance;

Abrasions are the most superficial types of injuries confined to the epidermis and normally no bleeding is associated. They are the most informative of all injuries, injury force, discretion, and weapon used.

- a) **Scratches:** They are caused by sharp objects i.e. Fingernails, pins, or thorny bushes. Hand lens can show the direction of movement usually with a clean area at the commencement of scratch and tags at the end.

- b) **Imprint:** Impact with an object with such a degree of force that the pattern of the object is imprinted on the skin by virtue of compression of the epidermis. Car tyres, seat belt steering wheel, and the necklace beads during throttling.
- c) **Graze:** "Grave rash". Oblique contacts with the rough surface the direction shown by the skin tags common in motor vehicle accidents.
- d) **Friction:** Caused by robes or cords indent and rub the surface of the skin when applied by tying and pulling - ligature marks in hanging.



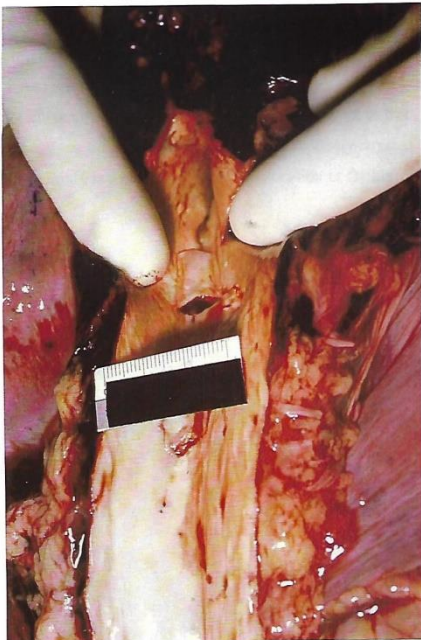
Figure 53. Skin abrasion on extremities

Importance of abrasions to forensic pathology

- They retain the pattern of the causative object better than other types of injuries.
- The direction of force causing the abrasion can be determined.

LACERATION

Splitting or tearing wounds caused by a blunt injury that passes through the full thickness of the skin and thus bleeds profusely. The edges are ragged.



The thoracic aorta laceration (clearly severed)

Figure 54. Thoracic aorta laceration (clearly severed)

BRUISES

They are caused by blunt injuries to the tissues that damage blood vessels beneath the surface, allowing blood to extravasate (leak) into the surrounding tissues. Certain bruises may suggest the causative implement e.g. tramline, or railway-line, color change with age blue-brown-green-yellow.



Figure 55. Bruise

Assessment of timing of bruises

A bruise is the subcutaneous escape of blood from small vessels, due to blunt impact that may not rupture the skin.

A fresh bruise is red or purple depending on the amount of blood visible through the semi-translucent epidermis. The progression e.g. color changes are usually from purple to brown to greenish-yellow the time taken for these changes depending on both on the amount of extravasated blood and upon the general physical state of the victim. In a healthy adult, the full range of color changes may be seen within the first week, and the bruise may well fade completely within a couple of weeks.

- The estimate of age is an extremely different and inaccurate exercise.

INCISED WOUNDS

These are sharply cut injuries from the knives, razors, and machete.



Figure 56. Blade damage

STAB WOUNDS

A stab wound is whereby the depth of the wound is greater than the length; it carries the connotation of having been inflicted by a knife. The popular idea is

that a knife is the weapon responsible for a stab wound but other (usually pointed) instruments may also produce stab types of injuries.



Figure 57. Chest and abdominal stab wounds.

FEATURES OF STAB WOUNDS

I. Depth of the wound

In stab wounds, the depth of the wound produced by the instrument is greater than the length that appears on the skin surface. This is in contrast to the incised wounds where the length of the surface wound is greater than its depth. In some cases there may be a combination of stab wounds and incisional wounds and careful examination is required to distinguish whether the incisional or the stabbing element is the major feature.

II. Internal Injury

A stab wound always causes extensive damage to the underlying structures. Deaths are often rapid as a result of hemorrhage produced or air embolism when major vessels such as in the neck are involved. Any stab wound has the potential to cause extensive internal injury, usually in the form of massive hemorrhage. The danger is compounded by the fact that most of the blood which is released from the damaged organ or vessel is contained within one of the major cavities of the body and there may be little in the way of escaping blood to

indicate the severity of the injury caused.

i. The length of the wound.

Most of the stabs gap as a result of the natural tensions and elasticity of the skin. In documenting the injuries it is advisable to take photographs of the wound/s with its sides approximated so that the wound may resemble a linear incision of the skin. When describing the length of the wound to the court, it must be made clear that one is referring to the length on the surface of the skin and no way does length indicate the depth of penetration into the underlying tissues. It must be recognized that it is the wound that is being measured and it is not necessarily synonymous with the width of the instrument.'

III. The shape of the wound

This is an important feature of a stab wound because it will help in distinguishing between a variety of weapons that may have been collected by the police and brought to the attention of the pathologist. A double-edged weapon usually causes a clean-cut wound with two sharp ends while single-edged weapon will cause a wound that has one clean-cut end while the other is more blunted, occasionally with small splits at the end of the wound, which is often referred to as a fishtail appearance. The shape of the wound can be distorted by the movement of the weapon on removal, a feature resulting from movement between the two parties.

IV. Force required to cause a stab wound

This is a common question asked to the pathologist in court. The answer depends on;

- The sharpness of the knife,
- Whether it is sufficiently pointed,
- The underlying tissues,
- Velocity
- Momentum,
- Age of the victim,
- stages of penetration and
- The clothing of the victim¹⁻²

Normally it impossible to translate the degree of force into mathematical terms and one should *restrict* his/her opinion to *using general terms like light, moderate, considerable, or severe force*.

Another frequently asked question in court is how quickly death would supervene once a stab wound has been inflicted. This depends very much on

- Structure penetrated,
- Penetrating injury to the heart,
- Injuries to the arteries and veins of a certain caliber that puts the victim at high risk¹⁻²

Pathologists should be cautious in offering any form of a time-scale since most of the findings have indicated that rather penetrating injuries to either the heart or other vital organs do not exclude the victim from having made physical movements to some extent²⁻⁴.

CUT THROAT WOUND

The cut-throat wounds are a special form of incised wounds that may be suicidal, homicidal, or accidental.



Cut throat wound.

Figure 58. Cutthroat wound

a) **Suicidal cut-throat wounds**

They are found more often in men than in women.

The classical site for the suicidal cut-throat wound is on the side of the neck, commencing just below the ear and moving downwards towards the front of the neck.

There are often small, parallel incisions (tentative or hesitation) marks because of the earlier uncertain attempts at making the final fatal wound.

b) **Homicidal wounds**

They are usually single and unaccompanied by tentative marks, although several unusual marks have been found increasingly in association with a single homicidal cut-throat wound.

c) **Accidental cut-throat wounds**

They are not so rare and can be caused when a person slips and the head goes through a glass window or shop door, when an explosion occurs in a bottle filled with gaseous fluid or when falling onto some glass or other fairly sharp object.

i. **Homicide wounds**

Homicide is the death of an individual that resulted from the culpable or nonpalpable actions of another individual.

Most of the homicides occur at home and the assailant is in most cases known by the victim. They are due to;

- Sharp force - stabbing or incisional wounds.
- Blunt force
- Firearm.
- Asphyxia - Manual strangulation.
- Alcohol and other drugs both licit and illicit are detected in more than half of the cases.

FEATURES OF HOMICIDE WOUNDS

- Lack of planning - scattered in the body.
- Unaccompanied by tentative incisions
- Mostly deep, penetrating "stab wounds".
- Differ in sizes and may be in shape depending on the inflicting weapon/s.
- Defense wounds may be present
- Affects the sensitive areas

REASON TO PERFORM AN AUTOPSY ON A BODY WHICH HAS SUFFERED MULTIPLE STAB WOUNDS

❖ Characteristics of stab wounds

- Fatal wounds,
- Weapon/s used,
- The direction in which organ/s were involved
- The force used
- Time of death
- Clothing
- Time of death after injury
- Surgical intervention
- Homicide, suicide, or accident.

THE ROLE OF A PATHOLOGIST AT THE SCENE OF HOMICIDAL STABBING

The pathologist has to

- Detect defense wounds
- Take photography of the scene, measurement of the wounds, and drawing.
- Detect any struggle at the scene.
- Take materials for laboratory examinations - Clothing, blood, Toll Marl analysis ballistics, gunshots, footwear, bite marks

Furthermore he/she has to determine, detect, document and analyze;

- The injury pattern including bruises and other injuries,
- Their location and measurement,
- The weapon used on the scene,
- Blood splatter direction and blood flow,
- Amount of blood on the floor or the ground,
- Shoe imprint on the scene
- Differentiate between accidental stabbing, suicide, and homicide.

The pathologist may examine area by area and fail to recognize the patterns

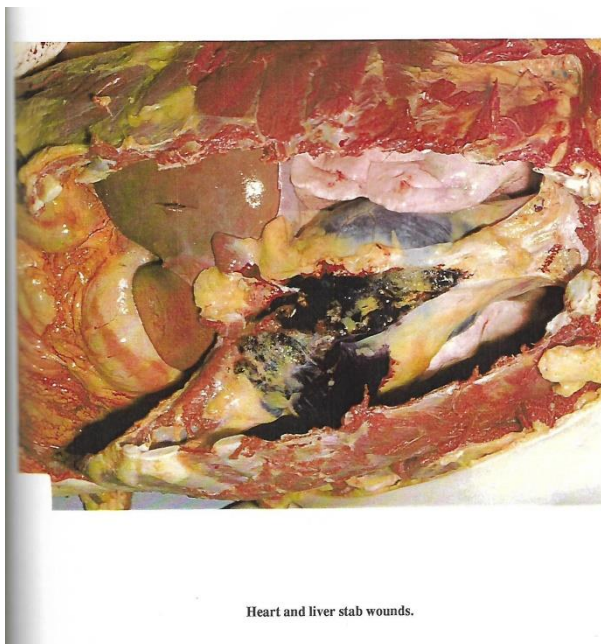


Figure 59. Heart and liver stab wounds

CAUSATIVE WEAPON

Wound patterns suggest a particular wounding object, or mechanism, or sequence of events.

SELF-INFLICTED INJURIES

Self-inflicted injuries are damages occurring through the intentional act of harming oneself. Suicides are self-inflicted injuries that result in death. Self-inflicted injuries can be due to

- Suicide.
- Attempted suicide - self-destruction.
- To attract attention - mental aberrations

a) Features of self-inflicted injuries

- Sites of selection" - The Throat, Wrist, Abdomen, and the front of the chest. Avoid sensitive areas and vital organs e.g eyes, lips, nose, and ears.
- Wounds typically multiple, superficial, and of the same characteristics, parallel and

characterized by tentative and Repetitive atrial incisions.

- A suicidal cutthroat has trial incisions. The incision starts high on the left side of the neck below the angle of the neck and at the lower level on the right.
- Deliberate cutting of the wrists is rarely effective as the sole method of suicide - flexor surface at the level of the skin flexion creases. Most of the injuries are on the left side.
- Suicide injuries of the chest - almost always stab wounds.
- Stab wounds of the neck are uncommon.
- In areas covered by garments, the cuts do not march with injuries and the damage to the clothing.
- This occurs in groups whereby it's oriented in the same direction. The most convenient for infliction by each alternative is the hand.
- The picture does not fit with strangling.
- The victim is prepared to explain and admit how she or he came by the wounds.
- Mostly on back or palm of the least dominant hand
- Common over forehead, neck, jaw, and cheek. (its more on the left side of the person is right-handed).

b) Causes of self-inflicted injuries other than suicide

- Abnormality of mind - usually bizarre in multiple sites
- The motive of gain. Fabrication of an injury to stimulate an assault or to direct attention from the person's theft or to arouse sympathy.
- Malingering - Armed forces.
- Fraudulent - Attempts to obtain compensation.

b) Management of self-inflicted injuries

The management depends on;

- The extent of the injury- Emergency bleeding, sutures, transfusion, dressing, analgesics, and antibiotics.

- Motive- Inform the police, relatives, sexually associated - sympathy, and feminists overtones.
- Mental status- Involve Psychiatrists, psychologists.

PETECHIAE

Petechiae are pinpoint non-blanching tiny spots seen under the skin caused by bleeding of the small capillary vessels, or areas of peri capillary bleeding. The spots measure less than 2 mm in size, which affects the skin and mucous membranes.

A non-blanching spot is one that does not disappear after applying brief pressure to the area. Purpura is a non-blanching spot that measures greater than 2 mm. Petechial rashes are a common presentation to the paediatric emergency department (PED). Non-blanching rashes can be a great cause for concern for parents and physicians alike. Therefore, careful assessment and evaluation are necessary to formulate a sensible management plan



Figure 60. Petechial rash on the back

❖ CAUSES OF PETECHIAE

Causes can classify into the following categories:

Infective

- Viral: Enterovirus, parvovirus B19, dengue
- Bacterial: Meningococcal, scarlet fever, infective endocarditis
- Rickettsial: Rocky Mountain Spotted fever
- Congenital: TORCH

Trauma

- Accidental injury
- Non-accidental injury
- Increased pressure following bouts of coughing, vomiting or straining
- Drowning

Haematological and Malignant

- Leukemia
- Idiopathic thrombocytopenic purpura (ITP)
- Thrombocytopenia with absent radius (TAR) syndrome
- Fanconi anemia
- Disseminated intravascular coagulation (DIC)
- Haemolytic uraemic syndrome (HUS)
- Splenomegaly
- Neonatal alloimmune thrombocytopenia (NAIT)
- Fat Embolism

Vasculitis and Inflammatory Conditions

- Henoch-Schonlein purpura (HSP)
- The systemic lupus erythematosus (SLE)

Connective Tissue Disorder

- Ehlers-Danlos syndrome

Congenital

- Wiscott-Aldrich syndrome
- Glanzmann thrombasthenia
- Bernard-Soulier syndrome

Other

- Drug reaction
- Vitamin K deficiency
- Chronic liver disease
- SIDS Mechanical disruption

CLOTHING

This is an important examination before considering the wound on the skin. The pathologist should be concerned in determining the precise number of the wounds on the clothing because it is possible that some cuts may be found on the clothing's which do not appear on the body or there may be some cuts on the clothing which do not correspond

to those on the body if the clothing has been racked up, folded or creased in some manner.

Another value of examining clothing is when the victim had undergone surgery. In some cases, the surgeon always enlarges the stab wound to convert it into a surgical incision or they may use one of the stab wounds a site for a drainage tube. Only in examining the clothing can the number and some indication of the site of the original injuries can be determined.

In examining the stab wound it is essential that a record of the position and number of the stab or stab wounds are made accurately before the body is opened. An easy method of recording a very large number of stab wounds is to number each wound with an indelible mark on the skin as it is recorded and photographs taken, this makes it easier for pathologists to refer to the photographs in the court at a later date.

DEFENSE INJURIES**CHARACTERISTICS AND SIGNIFICANCE OF DEFENSE INJURIES**

'**Defense injuries**' are characteristic injuries sustained by a victim of an assault which indicates that the victim attempted to defend him/herself. Defense wound is a term used to describe the injuries resulting when the victims extend his/her hand or arms to grasp the blade or the weapon in an attempt to ward off the blow or to turn the weapon aside from his/her body. The incisions on the palms of the hands are sometimes parallel, indicating that one is dealing with a double-edged knife. The implication is that, if a defense wound is present then the victim anticipated the blow; this can be used to rebut the defense of accidental or even suicidal causation.

Defense wounds to the hands are the commonest. Their presence or absence depends on several factors including the length of the time of the attack and whether the victim of the attack was able to move his/her hands in a useful manner⁴. They are common in the forearm, back of the hands and

knuckles of fingers. The presence of incised or stab wounds on the palm, especially involving the flexure creases of fingers on the radial aspect of the forearm is of crucial importance. They may also be a deep incision across the web of the palm between thumb and index finger. Kicking in the thigh outside as the victim crosses his legs to protect his genitals. Overall defense injuries are seen in 45% of the fatalities with no clear relationship between the number of stab wounds and the presence of defense injuries⁴. One problem is that it may be difficult to examine the hand when rigor mortis is established. The injuries are easier to examine even before the rigor mortis set in or after it had passed off. However, this is not usually practical and the hand can be fully opened by pressing firmly on the back of the wrist or knuckles, thus causing extension of the fingers. Alternatively incising the flexor tendons just proximal to the wrist achieves the same effect.

Typical defense wounds suffered in a knife attack

There are incisions across the flexor surfaces of the finger joints and between the thumb and palm, from grasping the blade.

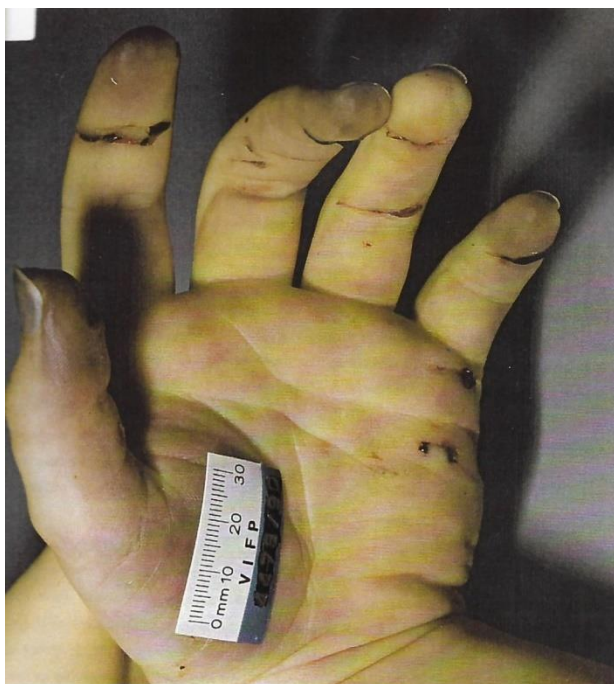


Figure 61. Injuries sustained from a knife attack

STABBING AND OTHER INCISIONAL WOUNDS

The force required to cause the injury depends on the sharpness of the knife and whether it is sufficiently pointed to the clothing of the victim.

Predisposing factors: Suicide/homicide
Depth, length, shape, and number



Figure 62. Knife stab

a) Domestic Violence

"Cockpit of conflict" nursed accumulate aggression. "**Battered spouse syndrome**" or **battered wife**. It involves women who have suffered demonstrable and repeated physical injuries at the hands of the man with whom she lives with or from the father or one of her children. It starts with slaps and light punches and gradually escalates to heavier punches, kicking, and use of weapons. Domestic violence is most cases result in child abuse, burns, fractures, and bite marks.

b) Injuries by burns

Burns in wars, and accidents.

c) Injuries in sports and other recreational activities

Boxing eye injuries, use of refrain system, Intracranial haemorrhage, traumatic encephalopathy, wrestling-cervical injuries, intracranial haemorrhage, rugby, football, Karate, Judo firearms, diving.

d) Injuries in construction industries

Falls, failing materials, excavation, electrical, explosion.

e) Injuries by in mining and quarrying

Falls, Spinal fractures, Fire and Explosions

d) Envenomation

Envenomation is the exposure to a poison or toxin resulting from a bite or sting from an animal such as a snake, scorpion, spider, or insect, from marine life, arachnids, reptiles, and dogs causing rabies and tetanus.



Figure 63. Exotic viper envenomation

Table 1
Grades of local envenomation

Grade 1	redness and mild swelling
Grade 2	redness and extensive swelling
Grade 3	Grade 2 + blistering
Grade 4	Grade 3 + severe pain
Grade 5	Grade 4 + necrosis
Grade 6	Grade 5 + regional lymphadenopathy

Case Study

Australian dingo dog case

When parents were charged with murder following the disappearance of their 2 months infant who they thought had been carried by a wild dog, Perth case, Big cat (lion, tiger).

Elephants Africa and Indian. Sharks in Australia

leads in the incidence of unprovoked shark attacks 72% attacks from 188601963 occurred in Austria.

d) Violence and civil disturbance

Civil disorder, also known as a civil disturbance or civil unrest, is an activity arising from a mass act of civil disobedience (such as a demonstration, riot, or strike) in which the participants become hostile toward authority, and authorities incur difficulties in maintaining public safety and order, over the disorderly crowd. It is, in any form, prejudicial to public law and order.

Spectators wind up encountering torture, sensory irritant agents (Tear gas), explosions, rubber, and plastic bullets, 1 -Chlorocetophenone, 2-chlorobenzylidene, malononitrile, Dibenzoxazapine. These cause irritation to the eyes, lacrimation, spasms of the eyelids, and ischaemic heart disease due to experiments. Different types can be used. A disorder breaks out in 1971 Glasgowcrush barrier collapsed under pressure 66 persons died and 100 seriously injured.

DIFFUSE EXTERNAL INJURIES

CAUSES OF DEATH IN DIFFUSE EXTERNAL INJURIES

1. Death directly related to the injury
 - 50% immediately
 - 30% within 4 hrs
 - 20% after 4 hrs
2. Death due to the complications of the injuries
3. Road Traffic Accidents/Aircraft.

Accidents affect more than 1 million people worldwide. Most of the injuries are in the heart 50% Thoracic, abdomen (liver), pelvic injuries, and fractures of the extremities.

The extent of the injuries will depend on:

- Sitting position
- The direction of the impact
- Design of the cabin
- Force of the impact

- The behavior of the vehicle after the impact
- Ejection from the vehicle

a) Hemorrhage

The volume varies with the organ in small quantities of bleeding into the brain stem. It is likely to be lethal compared to the same amount in the pleural cavity. An indication of delayed bleeding e.g subcapsular hematoma of the liver after rupture, the unrestrained bleeding can pour into the peritoneal cavity causing infection, erosion, and bleeding into the vicinity of the vessel wall i.e Aneurysm formation.

a) Infection

Purulent wound infection from Gram-positive cocci, Gram-negative bacilli, anaerobes such as *Clostridium perfringens*, Tetanus, and anthrax.

c) Embolism

An embolism is the lodging of an embolus, a blockage-causing piece of material, inside a blood vessel.[1] The embolus may be a blood clot (thrombus), a fat globule (fat embolism), a bubble of air or other gas (gas embolism), or foreign material. An embolism can cause a partial or total blockage of blood flow in the affected vessel.[2] Such a blockage (a vascular occlusion) may affect a part of the body distant from the origin of the embolus. An embolism in which the embolus is a piece of thrombus is called a thromboembolism.

An embolism is usually a pathological event, i.e., accompanying illness or injury. Sometimes it is created intentionally for a therapeutic reason, such as to stop bleeding or to kill a cancerous tumor by stopping its blood supply. Such therapy is called embolization.

Embolism is common in forensic pathology. After trauma, the victim is at risk from pulmonary embolism because of;

- Increased coagulability

- Injury to the tissues may cause local venous thrombosis. The contused muscles or fractured bones.
- The victim is confined to a bed because of trauma

i. Types of embolism

- Pulmonary embolism; Most under-diagnosed condition.
- Fat and bone marrow; Occurs after an injury to the bone or fatty tissue.

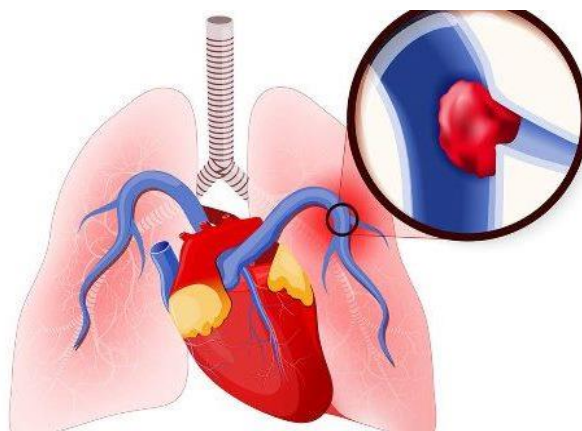
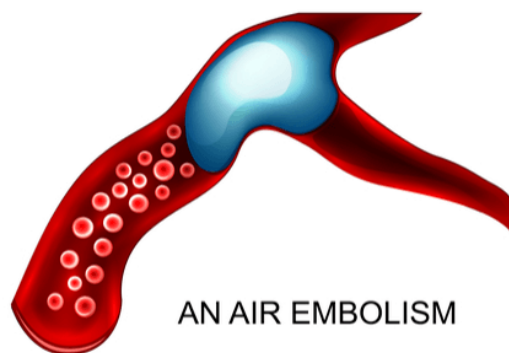


Figure 64. Pulmonary embolism

Embolism is common in lungs and can be demonstrated in histology by using oil

- Red - O frozen sections of the lung. Grades 0-5 systemic fat embolism.

The air into the circulation usually comes as a result of trauma or surgical operation. Death is usually immediate but can be delayed up to two hours.



AN AIR EMBOLISM

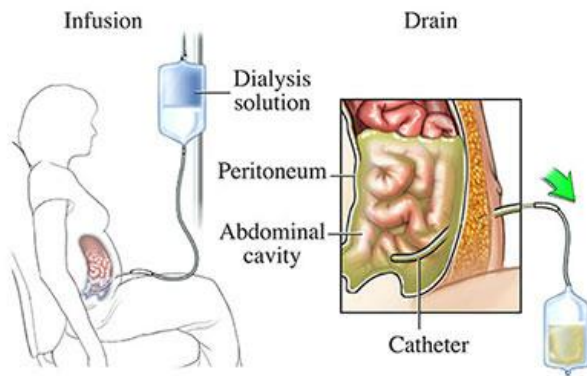
Figure 65. Air Embolism

b) Adult respiratory disease syndrome

Following severe lung injury lung epithelium one may suffer 'diffuse alveolar damage'.

c) Renal failure following trauma

Renal failure occurs due to extensive muscle damage or burns as well as Ipoisins. This is due to the destruction of the renal tubular epithelium. (Tubular necrosis and casts).

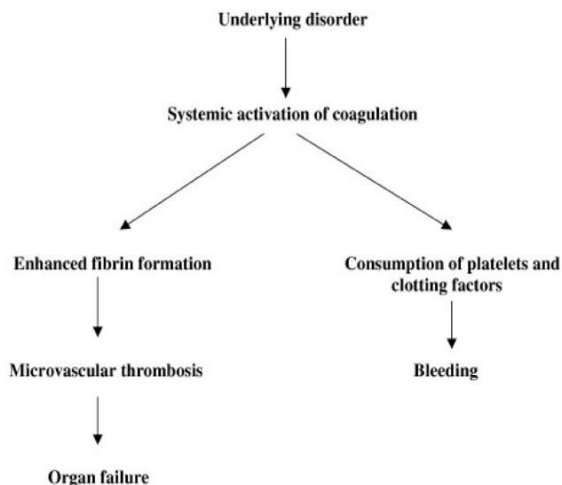


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Fig 66. Kidney failure

d) Disseminated intravascular coagulation



Damaged tissue from trauma can trigger thromboplastin-initiated coagulation: Vascular endothelial damage and stasis of blood flow can have the same effect.

a) Sumendocardial hemorrhage.

This presence of well-marked hemorrhage under the endocardium of the left ventricle 'Sheehaan's hemorrhage' the hemorrhage flame-shaped and confluent. The mechanism of production obscures but commonly seen in hypotension. After intracranial damage, obstetric catastrophes, and poisoning (heavy metal)

b) Sudden death from suprarenal haemorrhage.

This is uncommon. It is L8a well recognized as a terminal event after trauma as a general response to stress, 2-21 days after trauma.

TERRORISM

Terrorism refers to the use of violence for political ends with the sole purpose of putting the public in fear. The injuries are easy enough to recognize and describe. What matters is how they are caused and what light these shades on the incident. Weapons used include stones, bricks, bottles, homemade bombs, and petrol bombs.

Chapter Four

Heat, Electrification and Lightning

'Can a man take fire in his bosom, and his clothes not be burned?' Proverbs 6.27

ELECTROCUTION

Electrocution is not an uncommon cause of death in Forensic pathology. Death occurs mostly at a voltage between 100-380V which is the voltage range of home and industrial electricity. Low tension of 50V or under rarely causes death. 200 volts of electric current is unlikely to cause death. The lethal factor is when the current is flowing through the body at the existing voltage and this, in turn, depends upon skin resistance and earthing i.e

- ❖ Poor earthing - Fatal outcome is unlikely.
- ❖ Good earthing - Death is likely i.e in bathrooms, wet floor, damp conditions, wet skin, and metal studded shoes. It commonly occurs at home in warm months.

Most of the electrocutions are due to accidental exposure to live wires. It depends on the following factors:

- ❖ The electricity - voltage and resistance, site of contact, and the duration of contact.
- ❖ The human body - Humid, sweating, hot environment.
- ❖ Earthing - ground

General injuries include blister burns, spark burns with dry pitted lesions, thermal burns, crocodile skin, and thrombosis of the vessels.

The findings of electrocution include the following;

A) ELECTRIC INJURY

- ❖ Extensive and severe burning after prolonged conduct
- ❖ Minimal signs of the conduct faulty appliance.

- ❖ Blister in hand forming a raised rim with a concave contour
- ❖ Skin is pale, often white and areola of pallor, the skin may peel off leaving a red base.
- ❖ Blisters occur when the conductor is in firm contact with the skin but the type of the electrical mark is a "spark burn" where there is a gap between mental and the skin.
- ❖ For an electrical burn of the foot and shoe, there is a burnt middle region with rare brown decoration on a run of pale white area around the wound. The shoe has been damaged due to the current. High voltage burns show multiple sparks that may crackle onto the victim and cause large areas of damage sometimes called 'crocodile skin' from the appearance.



Figure 67. The skin manifestations on the body in a fatal electric injury

b) Extensive and severe burns, blisters or scorched with a raised rim with a concave center

The skin is pale often white with an areola of pallor due to local vasoconstriction. The skin may peel off leaving a red base. The "spark burn" where there is an air gap between metal and skin. -a central nodule of fused keratin, brown or yellow in color is surrounded by the typical areola of pale skin. In high voltage, multiple sparks may crackle onto the victim and cause large areas of damage called "crocodile skin"



Figure 68. Fern shaper on the skin lightning effect.

Most of the electrocutions occur at the house and around homes. The most affected group is teenagers and mostly boys. Electrocution can also be used as a form of suicide.

Figure 69. Shoe recovered at an electrocution site

B) MICROSCOPY

Plaques show partial loss of the epithelium and bubbles forming in the dermis and polarisation of the nuclei in the dermal cells.

C) CAUSES OF DEATH

- Myocardial/ventricular fibrillation: The action of the current on the pacemaker, conducting system, or the actual muscle of the heart.
- Paralysis of the intercostal muscles, diaphragm, and medullary respiratory centers.
- Delayed deaths local complications: Extensive burns, Neurogenic, Oligogenic such, psychiatric state.

D) MANNER OF DEATH

- Accidental, suicide.

E) MECHANISM OF DEATH

- Paralysis of the muscle with secondary asphyxia and ventricular fibrillation.

LIGHTNING

- The Kerauri Pathology - the study of pathology features of fatal lightning.

Thunderstorms account for the greatest number of weather-related fatalities in most countries. In Kenya, most of the thunderstorms occur in Western Kenya. Lightning causes injuries and deaths instantly.

The features of lightning include:-

- Keraunographic markings on the ground
- Clothing frequently burned, torn or shredded caused by blast effect of the lightning, with over-pressures of several atmospheres.
- Metallic objects such as keys may be charred and coins may fuse and become magnetized.
- Erythematous marks in a branching pattern

- are pathognomonic for lightning injury.

They are known by several names - arborization, feathering, ferning, arborescent keraunographic markings, and lightening figure.

BURNS

INTRODUCTION

1. The basic investigation at the scene of death i.e in a house fire and the subsequent autopsy
2. The investigation stays from the scene of death, post mortem room, and theological investigations.

a) SCENE OF DEATH.

Factors considered:

- Position of the body at the rest of the surrounding
- The color of the skin
- The extent of the burns
- How many bodies are there in the building
- Approximate age, height, sex.
- The position of the hands-free or tied together
- The direction of the skin splits
- Heat contractors.

NOTE:

The body at the scene of the fire and the arrangement of the body in relation to door exit and other households is useful.

b) SCENE APPROACH AND IDENTIFICATION

In general, deaths due to fires cause problems for pathologists and the fire investigating team. Normally the approach to a charred body found in a house should be systematic because the multiplicity of problems confronting the investigator is not always obvious. The underlying investigating dilemma is the separation, with certainty, of those instances that are tragic accidents from those that require detailed criminal

investigation.

In this respect, the investigator should

- Record the scene, including taking photographs where applicable,
- Identifying the victim to whatever degree possible
- Identifying whether the fire occurred during life or post mortem
- Examining and collecting whatever physical evidence may be present that would assist in the findings

Identification might be a problem in bodies found in fires because of the complete charring of the body. Weight and length of the body are unreliable as weight loss may amount to over 60%. Identifiable particularities of the body surface such as scars, tattoos, and moles are frequently destroyed and fire injuries like skin splitting may be confused with lacerations. Artefactual epidural haematoma may be confused with traumatic epidural haematoma and also heat fractures may be mistaken for traumatic fractures. In cases of self-immolation, the question of identification does not always arise and the most pressing issues for the pathologist is the mechanism and the cause of death.



Figure 70. Heat flexures of the limbs. The elbows, knees, and wrists, are strongly flexed because muscle contracture is strong in the flexor groups.

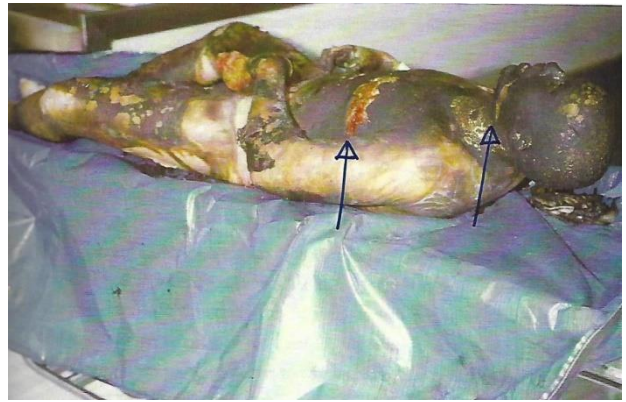


Figure 71. Skin splits which can be confused with antemortem lacerations or incised wounds

c) POST MORTEM ROOM

- ❖ Confirm the examination at the scene
- ❖ Conduct X-ray to look for bullets, lead shots, metallic foreign bodies, fractures, etc
- ❖ Check out for heat haematoma in the head due to blood boiling out of the skull, diploe veins or the venous sinuses to produce a spurious extradural haematoma lying between the burnt bone and the dura [epidural],
- ❖ Soot in the nostrils, trachea, and the bronchus- The particles of soot adherent to the laryngeal mucosa

Heat cracking of bones rules out fractures.

d) TOXICOLOGY

This will include the determination of the following.

1. Carboxyl haemoglobin levels
 2. Hydrogen cyanide
 3. Carbon dioxide.
- ❖ Accident?- The age of the person, location of the firehouse, factory or in a motor car
 - ❖ Suicide?-Self-immolation - Circumstances history of depression, Health problems loss of home, financial problems, pending criminal charges, Schizophrenia, religion – Oriental
 - ❖ Concealed murder?- Accelerant {gasoline, aerosols}

The phenomenon of the fire has always played a significant and many-sided part in the history of mankind. It has been put to many uses, for example as an agent of succor, warmth, and light, of healing and cleansing, but sadly also of destruction. The latter is only too evident in contemporary society with its daily reports of bombings, explosions, deaths, and maiming caused by fire¹.

Self-immolation is a method of suicide used in oriental countries where the victims pour petrol or kerosene over themselves and then set themselves alight. This is uncommon in other countries, and when it occurs the victim is usually one of the oriental ethnic minorities. There are many instances of victims sitting in a car and setting it alight. Identification of the body might be extremely difficult^{1,2}.

e) POST MORTEM FINDING

In most cases of burns, the only positive internal finding is in the respiratory system. Thermal injury to the respiratory tract is in most cases limited to upper areas including the mouth, the nasal passages the glottis and the epiglottis, the pharynx, and the larynx primarily because air have a low heat capacity and efficient heat exchange occurs in the nasal passages. However, thermal injuries in deeper parts of the lungs are still possible, particularly if the humidity of the air is high thus increasing the heat capacity.

Most of the studies done have revealed that moist air is more likely to produce burns in the lungs than dry air. The former may cause coagulative necrosis and oedema in tracheal and bronchial tree sloughing of the mucosa, atelectasis, and haemorrhagic consolidation⁽⁴⁾.

Evidence of sooty deposition as a result of smoke inhalation has been noted. In 91% in one of the studies, the soot was found as a mucous-bound layer on the walls of the air passages and was readily visible to the naked eye as far as small bronchi of lungs. In subjects, breathing through their nose at normal rest rates, large particles greater than 10 μm tended to be deposited in the nasal region, while the optimum diameter for deposition in the tracheal bronchial tree and the alveolar scars are 5 to 7 μm and 1 to 3 μm respectively.

The filtration effect is usually dependent on the airflow, thus deep rapid breathing may increase the amount of material deposited but the fraction of the total inspired material which is retained and the size of the material which reached the alveolar are not grossly affected. Therefore in fire victims breathing rapidly in a stressful situation it is unlikely that a particle larger than 10 to 20 μm will reach the alveoli^(4,8,9).

In conclusion, fires are complex events that kill by producing heat and toxic fumes. Death may occur very quickly after exposure to a fire and there may be little pathology shreds of evidence upon which to base a cause of death especially if the body is incinerated⁽⁷⁾.

INHALATION OF FIRE FUMES AND BURNS

HEAT FLEXURES OF THE LIMBS

The elbows, knees, and wrists, are strongly flexed because muscle contracture is strong in the flexor groups. Skin splits can be confused with ante-mortem lacerations or incised wounds.

INCAPACITATION AND FIRES

A victim exposed to such fire may collapse from extreme heat, (aided by water vapor created by combustion of hydrocarbons) weakened by oxygen deprivation before carbon monoxide inhalation becomes a significant factor.

In the Literature review, the cause of death in such fires is a combination of factors including carboxyhemoglobin, hydrogen cyanide, lack of oxygen, high levels of carbon dioxide in the blood, high hydrogen chloride, nitrogen dioxide, and aldehydes. Despite all these amounts, numerous products of combustion establishing the cause of death are important though there is evidence in the literature to show that this is not an accurate process.

SCENE APPROACH AND IDENTIFICATION

In general, deaths due to fire cause problems for pathologists and the fire investigating team. Normally the approach to a charred body found in a house should be systematic because the multiplicity of problems confronting the investigator is not always obvious. The underlying investigating dilemma is the separation, with certainty, of those instances that are tragic accidents from those that require detailed criminal investigation.

In this respect the investigator should record the scene, including taking photographs where applicable, identifying the victim to whatever degree possible, identifying whether the fire occurred during life or post mortem, examining and collecting whatever physical evidence may be present that would assist in the findings.

Identification might be a problem in bodies found in fires because of the complete charring of the body. Weight and length of the body are unreliable as weight loss may amount to over 60%. Identifiable particularities of the body surface such as scars, tattoos, and moles are frequently destroyed and fire injuries like skin splitting may be confused with lacerations. Artefactual epidural haematoma may be confused with traumatic epidural haematoma and also heat fractures may be mistaken for traumatic fractures. In cases of Self-immolation, the question of identification does not always arise and the most pressing issues for the pathologist are the mechanism and the cause of death^(1,2,3).

CARBON MONOXIDE POISONING

It is well recognized that carboxyhemoglobin [COHb] level of 50% is usually associated with fatality and that severe burns of external skin or severe mucosa indicate that the victim died from exposure to extreme heat. There are cases in which the victim demonstrates a low carboxyhaemoglobin and marked absence of soot and damaged tissue and is dead presumably as the result of the fire.

In most of the studies, only half of the fire victims studied had carboxyhaemoglobin levels above the presumed 50% lethal threshold and some of the

victims were known to have been dead before the fire and yet had less than 10% carboxyhaemoglobin levels and no detectable soot. This suggests that heat (neurogenic shock), oxygen depletion, or excessive carbon dioxide, as well as chemical toxicity of combustion by-products, are such possible factors in such deaths, especially in flash fires of hydrocarbon fuels, since the level of carboxyhaemoglobin can be measured but the concentration of oxygen and carbon dioxide in the blood cannot be measured post mortem.

THE ROLE OF HYDROGEN CYANIDE

Hydrogen cyanide is a product of thermal degradation of materials that contain nitrogen in their chemical structure including both natural and traditional materials.

Hydrogen cyanide is one of the most toxic gases, and unlike carbon monoxide with which the occurrence of incapacitation depends on a dose accumulated over some time, the toxicity of hydrogen cyanide exposure appears to be critically dependent upon the concentration to which a victim is first exposed.

Cyanide is a cytotoxic poisoning that inhibits the metabolism of oxygen, producing cellular hypoxia. It reacts only with a ferric state of iron (Fe^{3+}) of the cytochrome oxidase in mitochondria but reacts readily to form a complex that inhibits cellular respiration. The body is capable of handling relatively large amounts of cyanide, but the reaction is limited by a low endogenous supply of thiosulphate substrate needed for enzymatic conversion of cyanide to thiocyanate. Cyanide also combines with methemoglobin to form cyanmethemoglobin. In the presence of a high concentration of methemoglobin, the formation of cytochrome oxidase-cyanide complex is inhibited or reversed.

The first symptom upon cyanide exposure is hyperventilation due to its powerful stimulator on respiration. Upon hyperventilation, more hydrogen cyanide is inhaled and as a result, there is a positive feedback situation in which cyanide intake increases

even more. Most of their studies conducted showed that early death caused by cyanide may be due in part to cardiovascular and respiratory center depression of CNS. The ensuring tissue anoxia may also lead to neuromuscular dysfunction causing the victim to collapse and may be unable to move. With the combined effect of cyanide on respiration, the circulation, CNS and muscles, it is highly possible that even to sub-lethal levels of cyanide the victim may be incapacitated to be incapable of escaping the fire scene before being burnt or otherwise killed, as by carbon monoxide poisoning⁽³⁾.

HYDROCARBON LIQUIDS

In this case, the victim used fuel (flammable and hydrocarbon liquids which catch fire very fast and pose difficulties for extinguishing the fire. Hydrocarbon fuels such as gasoline are good fuels because they have several physical properties that contribute to their ease of ignition⁽⁴⁾.

- ❖ First, they have very high vapor pressure (high volatility), that is they evaporate readily.
- ❖ The second important factor is the low flash point which is the lowest temperature in which a flame can occur above it. Gasoline has a flashpoint of approximately -40 degrees while kerosene has a flashpoint of equal or greater than 38 degrees or higher.
- ❖ The third desirable property of common hydrocarbon fluids is their low flammability range.
- ❖ The fourth reason hydrocarbon liquids are considered good fuels is that they have low ignition energies that are they need only a small amount of energy to trigger their combustion^(2,4).

THE ROLE OF A FORENSIC PATHOLOGIST

A forensic pathologist should not only certify the cause and mode of death in fire-related investigations but also address the needs of the fire safety community. The forensic pathologist can

work with fire officials, including safety and prevention group or arson investigators, to develop a team that can conduct in-depth studies, standardize investigative procedures, recommend laboratory methods, standardize forensic interpretation of findings, and develops preventative measures. If these findings are implemented, it is conceivable that many fire-related injuries and fatalities may be prevented in the future.

ARSON AND ARSONIST

ARSON

Arson is setting fire to a building or property



Figure 72. Arson

ARSONIST

An arsonist is the one who destroys the property by setting it on fire

Arson is a serious crime [felony] declared by law and the punishment is often severe. It falls in the same district as class murder, manslaughter, rape, theft, burglary, or bigamy.

A person who without lawful excuse destroys or damages any property belonging to another, intending to destroy or damage such property or being reckless as to whether any such property would be destroyed or damaged is guilty of an offense. If the destruction or damage is by fire the offense is arson and is punishable by 10 years of

imprisonment

Arson is common in urban areas and has a dramatic input upon the livelihood and wellbeing of millions of people. Every arsonist regardless of motive is a potential mass murderer. In every fire in the house or open place under investigation the pathologist should have to rule out arson especially in urban places

1. Characteristics of Arson

- Destructive, revenge, re-housing, envy jealousy
- Mental illness-Personality disorder is not guilty because of insanity.
- Intoxicated
- Cover theft and/or burglary,
- Excitement
- Vandalism hatred
- Cry for help attention seeking
- Attempted suicide
- Carelessness
- Financial gain,
- Insurance fraud
- Cover up heroism, proxy,
- Political.

2. Investigation of Arson

In the investigation of fires, the following phases may be helpful

- a) Fire intent - Was the fire intentional or accidental?
- b) Examination of the body -How many people died? Was the victim alive or dead?

Arson sometimes is employed in an attempt to disguise a crime scene or to destroy evidence of criminality. In concealing of homicide the post mortem should rule out life during a fire by the examination of the respiratory mucosa and the presence of carbon monoxide in the blood.

The crime scene examiner/pathologist;

- Takes the visual inspection and physical examination of the scene
- The condition of the body and its relation to the origin of the fire.
- Photographs of the body in situ.

- Identifies tattoos,
- Gets evidence of prior surgical procedures and prior fractures, unique or unusual deformities, sex, race, features, and approximate age.
- Documents personal papers, jewelry, clothing e.t.c
- Gets Forensic odontology, Radiography, and fingerprint comparison.

c) Who saw the fire first

d) Who saw the victim/s alive?

e) Cause and the origin of the fire-

- a. Was the fire planned or as an impulsive act?
- b. Was the torch was an amateur or a professional? ie Whats the possible age differentiation [Adult or child] by target chosen
- c. Was the source of ignition sophisticated or a common match - The first material is ignited

f) Investigation procedure. In the investigation of an arson/homicide, the key element is the identification of the motive of the fire. The fire may have been set to kill the victim. In most cases, the arsonist does not intend to kill. There may be no connection between the motive for the fire and the death that results. Death is an unintended consequence.

g) Follow up the investigation

h) Arrest and trial.

INJURIES PRODUCED BY DRY AND MOIST HEAT

INJURIES CAUSED BY DRY HEAT

This occurs when the body comes into contact with hot substances or fire itself.



Figure 72. Thermal burn injury

INJURIES CAUSED BY MOIST HEAT

Primary, secondary, and tertiary burns can occur through clothing. Such injuries are common in children and should be differentiated from child abuse. Among the elderly, they can occur via inhalation. In these cases, death usually is due to oedematous of respiratory membranes

SCALD

It is the injuries produced by application by moist heat (like as hot water, oil) to the body .



Figure 73. Scalds

HEAT STROKE

This is a less serious condition due to excessive loss of chloride depletion leading to fairness, muscle cramps, and collapse with circulatory failure.

HEAT EXHAUSTION

Heat exhaustion is caused where the breakdown of physiological heat controlling system and hyperthermia up to 42°C or system occurs. It's closely related to humidity as well as temperature. It's heralded by delirium, photophobia, and convulsions. Suppression of fat is a feature worsened by drugs like atropine, or phenothiazines. Malignant hyperthermia occurs in Anaesthesia due to drugs such as halothane and suxamethonium.

HYPOTHERMIA AND THE POST-MORTEM FINDING

Hypothermia is exposure to cold temperatures in a cold climate, winter, mountaineers, hill-walkers, swimmers, and in marine disasters.

It's common in extremes of age. Old children and occasionally drunken people-lie down to sleep after too much alcohol and thyroid deficiency, Clinical myxoedema; drugs such as phenothiazine, barbiturates, benzodiazepines drugs, and alcohol predispose the body to low temperatures towards hypothermia. Medical conditions include brain damage, hypopituitarism, hypothyroidism, and diabetes mellitus. Children have a high surface to weight ratio thus lose heat rapidly.



Figure 74. Hypothermia

a) Signs of Hypothermia

- ❖ Cessation of shivers at 32°C shivering ceases after hypothermia sets in at 35°C. At 28°C or less almost most of the cases die despite treatment.
- ❖ Pink areas slightly brown pink with indistinct, blurred margins over joints such

as knees, elbows, and hips due to unreduced Oxy-haemoglobin as the cold tissues have little uptake of oxygen and red blood cell hemolysis

- ❖ Blisters in the affected skin.
- ❖ Numerous brown-black acute ulcers within the stomach lining.
- ❖ Frostbite- Infarction of peripheral digits
- ❖ Slugging of blood in small vessels may lead to micro-infarcts in many organs- brain, patches or fat necrosis,
- ❖ Haemorrhagic pancreatitis- High levels of serum amylase
- ❖ Pulmonary oedema with lung haemorrhage,
- ❖ Pre-existing myxoedema.
- ❖ Confusion.
- ❖ Hide-and-die syndrome
- ❖ Chapter

Chapter Five

Death from Immersion

Lord, Lord! Methought what pin it was to drown, What dread full noise of water in my ears! What sights of ugly death within my eyes! **Shakespeare Richard III (I iv)**

INTRODUCTION

Examination of bodies recovered from water can generate difficult interpretation problems. This is probably the prime context where appropriate historical and circumstantial evidence is vital to arrive at the proper overall conclusions. It must be appreciated that, at the outset, not all persons whose bodies are recovered from the water will have died from its inhalation, although they may show features reflecting immersion in water.

Such bodies, therefore, should be particularly carefully examined, both externally and internally,

- To catalog all injuries present
- To determine whether death indeed followed immersion in the water, and
- To see whether any natural disease, such as ischaemic heart disease, cerebral vascular disease, and hypertension may have contributed, precipitated, or even caused death.
- It is also important to determine whether the deceased was under the influence of alcohol or other drugs at the time of death.

The determination of the cause of death normally requires careful investigative work on the part of both the police and the pathologist. Opinions as to the cause and manner of death should not be derived from the autopsy alone but must result from a logical correlation of data regarding victim identity, circumstances, autopsy, and laboratory findings.

The pathologist has a vital role in determining, from all pathological and circumstantial evidence available, whether the overall findings are consistent with or even point directly towards the accident, suicide, or even concealed homicide^{1,2}.



Figure 75. Decomposition of the body which had stayed in the water for 3 days

HUMAN FACTOR IN DROWNING

Human factors in drowning imply that human deficiencies were significant factors in the drowning episode. Such factors may play a role before or during the drowning process.

For the most part, pre-event and event factors tend to be the same. Lack of experience, inability to swim, immaturity, intoxication, and physical infirmity are all factors that may result in people getting into trouble in a water environment.

Toddlers, who lack judgment and swimming ability, fall into home pools with frequency during lapses of parental control. Some studies reveal older drowning victims often are drug or alcohol-impaired. Diseased impaired individuals such as epileptics, or those suffering from ischaemic heart disease may die from interaction with an otherwise perfectly safe water environment. In all these cases present a history of the disease, like syncopal attacks and overall debilitation should be considered before the autopsy findings are interpreted².

In cases of professional divers using Self-Containing under water Breathing Apparatus (SCUBA) death due to drowning falls into four groups:

- Panic in minor emergencies
- Improper use or maintenance of equipment
- Effect of ethanol or other drugs
- Pre-existing disease.

In general, SCUBA divers have been shown autonomous, aggressive, and willing to take risks. The risks sometimes can be very great and thus tragically the quotation "***There are many old divers and many bold divers, but there are no old, bold diver" is seen to be true***"².

MECHANISM OF DEATH IN DROWNING

Mechanisms for death from drowning are multiple, complex and in part, still incompletely understood. Although drowning is much more than simple asphyxia following mechanical airway obstruction by water, this process probably does at least contribute².

Major factors, however, seem to be osmotic and perhaps also hydrostatic effects of the inhaled fluid once it reaches alveolar spaces and gains access to semi-permeable alveolar membranes; here water and electrolyte exchanges take place, the nature of

which is influenced by the tonicity of the inhaled fluid -fresh or saltwater.

❖ FRESH WATER

This is hypotonic relative to plasma. Therefore, when present in the alveoli, it is rapidly absorbed into the pulmonary circulation; this causes pronounced haemodilution which, in turn soon produces local haemolysis which leads to hyponatremia, circulation overload, and ultimately, high output cardiac failure. Haemolysis is probably more important, as it causes hyperkalemia and consequent cardiac arrhythmias, particularly with concomitant generalized hypoxia.

❖ SALT WATER

This is hypertonic to plasma. Therefore, when present in alveoli, it attracts water into the airways from the pulmonary circulation, causing local haemoconcentration and severe pulmonary oedema. Haemoconcentration increases blood viscosity and produces acute hypernatraemia, while severe pulmonary oedema causes clinically important hypoxia/hypercapnia; all these factors adversely affect the heart, with bradycardia and ultimately, asystole.

VAGAL INHIBITION (REFLEX CARDIAC ARREST)

Vagus nerve branches may be stimulated in several ways, with a direct and perhaps almost instantaneously fatal cardiac inhibition. Following submersion, it may be initiated by the sudden unexpected entry of water into the larynx, nose, or nasopharynx and concurrent emotional states may act as a contributing sensitizing factor.

It is more common when the submersion is;

- Total and unanticipated
- When the victim is under the influence of alcohol and/or drugs.
- When the individual enters its feet first.

LARYNGEAL SPASM

This is a rare mode of death from submersion although a number of human beings are drowned with dry lungs owing to glottic spasm leading to hypoxic death from the closure of the airway.

POST IMMERSION SYNDROME (SECONDARY DROWNING)

Occasionally, individuals survive the immersion and are recovered alive from the water, only to die later from delayed effects or other complications. Such deaths are usually pulmonary, reflecting surfactant loss following fluid inhalation resulting in adult respiratory distress syndrome presenting as prolonged profound hypoxia.

EXTERNAL AND INTERNAL FINDINGS IN DROWNING

❖ External Findings

The most commonly seen signs include firm, tenacious foam at the mouth or nostrils. Typically it is white or blood-tinged and reappears after wiping away.



Profuse froth around mouth and nostril in drowning.

Figure 76. Profuse froth around mouth and nostrils in drowning. The Froth is tinged with blood from the rupture of small pulmonary vessels.

❖ Internal Findings

The foam may be found in the major airways or secondary bronchi and bronchioles. In freshwater the lungs are often twice their normal weight and represent an appearance designated "emphysema aquosum" they are bulky and overdistended such that they overlap the pericardial sac and meet at the midline. In saltwater, the lungs are slightly heavier than in freshwater, emphysema aquosum less pronounced, and pleural effusion may be found. The factors that determine the amount of pleural fluid include the time spent in water, and mostly more pleural fluid is produced in saltwater than in freshwater drownings³.

In death due to laryngeal spasm, the features are those of classical mechanical asphyxia, including cyanosis, congestion, and widespread petechial hemorrhage with little or no water in the airways. In post immersion syndrome (secondary drowning) the major findings are haemorrhagic lungs, bronchopneumonia, with intra-alveolar hyaline membranes; later, abscesses may develop, and granulomatous reactions due to inhaled foreign particles may be identified^{1,3}.

SPECIAL TESTS AND INVESTIGATIONS OF A BODY RECOVERED FROM WATER

There is no "drowning test" anymore as there is a specific test for diabetes mellitus, carcinoma of the colon, or any other clinical disease. Most medical "diagnostic tests" are taken in isolation, non-specific. Each serves only to add to other data in order to arrive at a correct diagnosis².

❖ DIATOMS TEST

Diatoms are unicellular algae with hard siliceous exoskeleton resistant to decomposition, heat, and acids strong enough to destroy soft tissues. In theory, drowning should allow diatoms to enter not only the lungs but also, via the circulation, other organs. Therefore, in the drowned victim's diatoms should be extractable, after tissue digestion in strong acids, from such remote sites as bone marrow, liver, brain, and kidneys. This is a good

test although it has two main drawbacks.

- First: There may be insufficient or even no diatoms in the drowning fluid-from seasonal variations or following pollution by effluent.
- Second; when identified, they may represent contamination such as during necropsy, from tap water, reagents, from food via the deceased's gastrointestinal tract, or even from the atmosphere. At best, the diatom test can only provide supportive evidence of drowning.

❖ ELECTROLYTES

Electrolytes -Sodium, Chloride, Magnesium, fluoride. Although these tests are unreliable and unhelpful in general the hemodilution of freshwater drowning may reflect different electrolyte concentrations and plasma osmolality or specific gravity between the different sides of the heart^{1,2}.

THE ROLE OF THE FORENSIC PATHOLOGIST IN DROWNING CASES

Four groups of questions must be addressed and answered by pathologists.

1. What injuries are present on and within the body? How can each be explained satisfactorily?
2. What natural diseases are present? Maybe they have produced collapse and thus either caused death or precipitated drowning?
3. What was the cause of death? The possibility of death from the action of an assailant followed by immersion "dumping" in water as a means of disposal must always be considered.
4. Could the deceased's actions before entering the water or once in it have been modified by the influence of alcohol or other drugs? The case for requesting routine toxicological analyses is strong if only to facilitate interpretation of circumstances surrounding the death¹.



Figure 77. The Keratinized layer is macerated and has peeled off "Glove effect" or "washer woman's fingers" After immersion in water for one week. This is a common finding in drowning cases.

CONCLUSION

The investigation of a body found in the water is much more than an exercise of autopsy dissection and laboratory analysis for the pathologist. 'Tunnel vision' directed toward the body and its component results in a very unsatisfactory core investigation. The body may offer clues as to whether or not the victim drowned, and if the person drowned, why?. The transformation of clues into recognizable patterns and the transformation of patterns into reasonable opinions are an artifice of logic. Deaths due to drowning require the employment of logical skills to a much greater degree than many other problems facing the forensic pathologist. The

questions to be answered are complex. The physical and chemical evidence to seek the answers is often imprecise. These types of death require a most intensive correlative investigation between the police and the pathologist if correct opinions are to prevail^{3,4,5}.

BAROTRAUMA

Barotrauma refers to injuries caused by increased air or water pressure, such as during airplane flights or scuba diving. Barotrauma of the ear is common. Generalized barotraumas, also called decompression sickness, affects the entire body, eg. ear blockage of the eustachian tubes, hemorrhage, rupture of the tympanic membrane, paranasal sinuses, and teeth.

On an airplane, barotrauma to the ear – also called aero-otitis or barotitis – can happen as the plane descends for landing. Barotrauma of the ear also can happen when scuba divers descend. The pressure change can create a vacuum in the middle ear that pulls the eardrum inward. This can cause pain and can muffle sounds. Your ear will feel stuffed and you may feel as if you need to "pop" it.

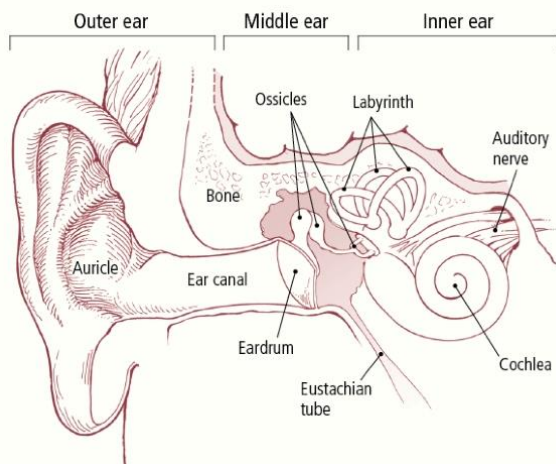


Figure 78. Barotrauma

In more severe cases of barotrauma, the middle ear can fill with clear fluid as the body tries to equalize the pressure on both sides of the eardrum. This fluid is drawn out of blood vessels in the lining of the inner ear, and can only drain if the Eustachian

tube is open. Fluid behind the eardrum is called serous otitis media. It can create pain and hearing difficulty similar to a middle ear infection.

The eardrum can rupture (break) in severe cases of ear barotrauma, causing bleeding or leaking of fluid from the ear. A ruptured eardrum can result in hearing loss. In severe cases, the pressure can create a leak between the deepest structures of the ear (the fluid-filled bony canals called the cochlea and semicircular canals) and the inner ear space. This deep leak is known as a fistula. If this occurs, the balance center can be affected, resulting in a sensation of spinning or falling called vertigo. This complication may require emergency surgery.

CAUSES OF DEATH, INVESTIGATIONS, AND USEFUL TECHNIQUES IN RECREATIONAL SCUBA DIVING

- SCUBA- Self Containing Under Water Breathing Apparatus

❖ Hazards

Drowning, Pressure changes associated with descent and ascent (barotrauma) Bends (Caisson disease) Pressure causes the formation of bubbles in blood and tissues, bubbles consist of nitrogen, acute pulmonary emphysema, Pneumothorax, Air embolism, CO intoxication, Nitrogen narcosis.

❖ Autopsy

The findings in autopsy may include one of the following findings; Pneumothorax, air embolism, tissue emphysema, middle hemorrhage, co poisoning.

DEMONSTRATION OF AIR EMBOLI

Air embolism may occur in the arterial or venous system. Venous air embolism may occur with open systems of intravenous infusion, during parturition or abortion, secondary to trauma, and during oral-genital sex in a pregnant woman.

(knight, 1983; Di Maio and Dimaio 1989)

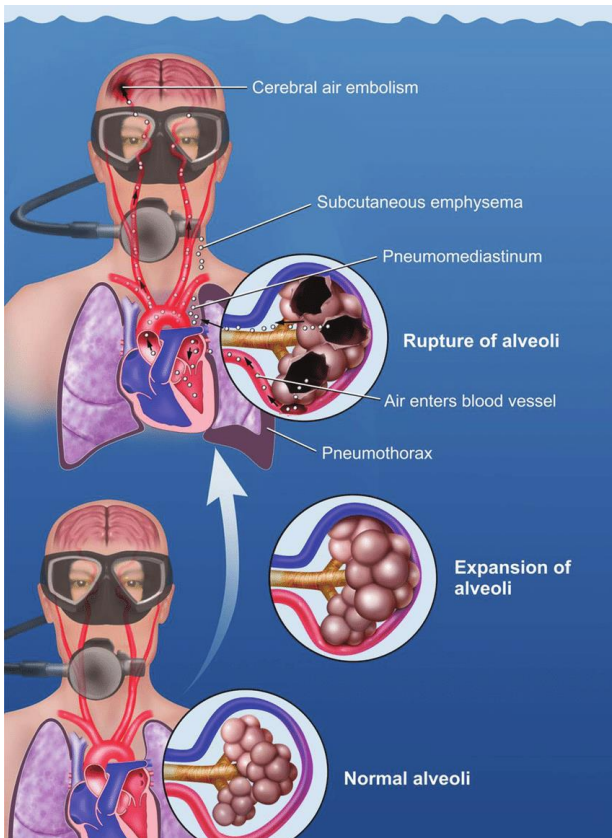


Figure 79 .Mechanism of pulmonary barotrauma in a diver breathing compressed gas and ascending while holding his breath

Arterial air embolism may occur during cardiopulmonary bypass or after chest injury with trauma to the pulmonary veins. It can be seen that most cases of air embolism are likely to fall within the jurisdiction of the police and careful consideration of the medico-legal position should be made before performing a hospital autopsy on a suspected case of air embolism.

The diagnosis of air embolism must be considered before starting an autopsy because air may be introduced into vessels during dissection. A massive venous air embolism will fill the right atrium and ventricle with air, so a radiograph of the chest may be a useful investigation before commencing the autopsy.

❖ Autopsy

The basic principle employed during the autopsy is to avoid opening vessels whilst examining for air bubbles, often demonstrated by immersion in

water.

- The retinal vessels may be examined for bubbles with an **ophthalmoscope**, the corners may be moistened with isotonic saline to remove post-mortem opacity.
- The pericardial sac must be exposed with as little trauma as to vessels as possible. This may be achieved by dissecting skin and soft tissue from the ribs and then making a window in the sternum over the heart.
- Alternatively, the ribs may be cut in the normal manner up to the second ribs but the sternum is divided distal to the sternoclavicular joint and the internal mammary vessels clamped. The pericardial sac is opened and the epicardial veins are examined for air bubbles. Bubbles will not be visible on the external examination of the coronary arteries, because of the thickness of the walls. The hospital autopsy will usually be performed on a body that has been stored at 4°C soon after death so there will be little decomposition.

Gas-forming bacteria can produce sufficient gas to simulate air embolism and in cases, with marked decomposition, the pyrogallol test should be performed to distinguish between the two (Ludwing 1972) as well as the microbiological culture of blood and pericardial sac contents.

- The pericardial sac should then be filled with water and a water-filled syringe, with the plunger removed, is connected to a needle that is inserted into the right ventricle. Air bubbles will appear if there has been a large venous air embolism.
- If an air embolism is present then the inferior and superior vena cava should be clamped before the heart is removed so the source of the embolism can be sought.
- In cases of large venous air embolism, the right side of the heart is filled with frothy blood.
- The rest of the thoracic cavity may be filled with water and the superior vena cava examined for the presence of air.
- The abdominal cavity may be opened and filled with water to examine the inferior

vena cava and pelvic veins.

A volume of 100- 250ml of air is estimated to be required to cause death from venous air embolism but much smaller amounts can cause death if introduced on the arterial side. The demonstration of systemic air embolism at autopsy is correspondingly difficult.

➤ The cranial vault should be removed

without puncturing the meninges and the meningeal vessels examined for bubbles with the brain in situ.

➤ To examine the inferior surface, the internal carotid and basilar arteries must be clamped before removal, the brain may then be immersed in water to enhance the chances of identifying bubbles.

Chapter Six

Motor Vehicle Accidents

'The causes of death appear, unto Our shame, perpetual' (Winter's Tale)

INTRODUCTION

Motor vehicle accidents are one of the most common causes of death in adults below the age of 50 years. The greatest toll lies in the 20-25-year-old group. Non-fatal road traffic accidents are a major social problem causing the hospitalization of and permanent disability to thousands of persons every year^{1,2}.

The forensic pathologist's investigation of a vehicle-related death serves several functions, both medical and legal. In addition to determining the cause and manner of death, the pathologist frequently needs to address other issues that have legal implications, such as identification of an occupant's role in a fatal vehicle collision. A determination of who was the driver and who was a passenger in a vehicle can be assisted in thorough examination and understanding of injury mechanisms, occupant's kinetics, vehicle dynamics, and trace evidence¹.

THE PATTERNS OF INJURIES IN MOTOR FATALITIES

In most cases of automobile accidents, the impact is in the anterior part of the body.

When a forward-moving automobile is brought to an abrupt halt, the unrestrained occupants will be thrown upwards and downwards until their progress is arrested by some part of the vehicle or, if they are ejected from the vehicle, by contact with the ground or some object.



Figure 80. Injuries sustained on the anterior part of the chest due to a motor vehicle accident

- As the driver is ejected forwards his chest will come into contact with the steering wheel and column which may cause fatal internal thoracic injuries unless it is of the collapsible type
- The head may come in contact with the windscreen or with its upper surround and the roof. The legs may be injured by contact with the fascia or dashboard.
- The injuries to the head and neck include glass injuries due to shattered windscreens,

relatively superficial injuries, spicules of glass being present in many of the wounds.

- Skull fractures are determined by the site of impact and maybe depressed, most frequently basal, involving the middle fossae of the skull; ring fractures of the base of the skull may be seen should the vehicle rollover.
- The nature of the brain injuries follows the distribution determined by the site and the direction of the skull fracture.
- Cervical spinal injuries are common such as dislocation of the atlanto-occipital joint causing irrecoverable damage to the brain stem³
- Atlanto-occipital disarticulation has its highest rates of occurrence in motorcyclists and pedestrians. They occur in high energy impacts and collisions and are commonly associated with an aortic laceration in 25% and basilar skull fracture in 21% of such cases.
- The biomechanics of disarticulation generally involve, most likely, a hyperflexion injury that results in rupture of the articular capsule and ligaments, often without bony fractures. Most of these injuries are rapidly fatal because of the brain stem and upper cervical spinal cord injury³.
- Separation, partial or complete, of the medulla from the pons, is seen occasionally but, commonly no obvious macroscopic injury to the medulla is visible. These injuries are commonly referred to as pontomedullary rent and occur in high-speed accidents. The mechanism of injury-causing pontomedullary rent has been described as traumatic craniocervical hyperextension. The types of basal skull fractures often associated with pontomedullary rent, such as hinge fractures and ring fractures around the foramen magnum, are also known to be caused by hyperextension. The pontomedullary junction is susceptible to tearing if sufficient force causes hyperextension with or without associated basal skull fractures. Though generally thought to be immediately fatal, partial rent

may be compatible with survival. Traumatic pontomedullary rent may have been underdiagnosed at autopsy because often tears in this region have been attributed to artificial damage inflicted during removal of the brain autopsy and a small tear in this region may be all too easily extended while removing the brain. In victims of high-speed accidents, the brain and brain stem should be examined carefully insitu, especially for brainstem subarachnoid haemorrhage⁴

- Thoracic injuries as a result of the impact with the steering wheel column or fascia are a common cause of immediate death. Death is due to traumatic rupture of the aorta or, more rarely, to rupture of other major vessels or of the heart itself. Visible injuries to the chest wall following a fatal impact with the steering column may be minimal or even absent. The external appearance is influenced not only by the force of the impact but also by the clothing and age of the deceased.

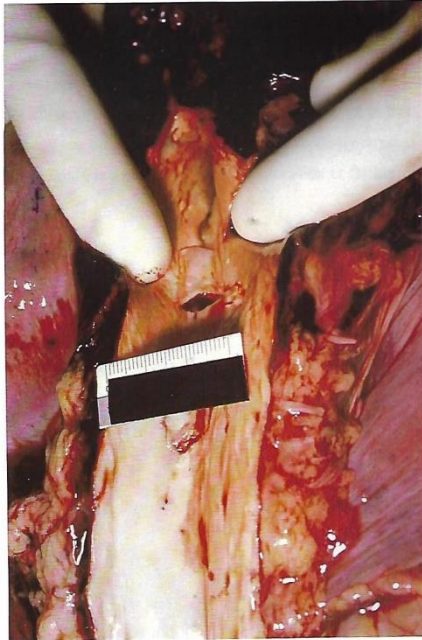


Minimal bruising over the anterior chest

Figure 81. *Minimal bruising over the anterior chest*

- Traumatic rupture of the aorta occurs most often in the distal arch but it may be found in any other part of the thoracic aorta. The rupture may be a complete transection, giving the appearance of having been cut across with a sharp knife; death is rapid in these cases, however, all degrees of rupture

may occur.

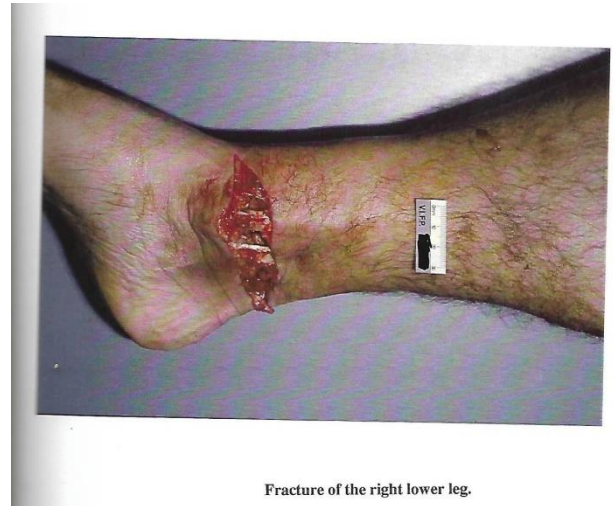


The thoracic aorta laceration (cleanly severed)

Figure 82. The thoracic aorta laceration (cleanly severed)

- The common fatal lesion in unrestrained car occupants following a deceleration impact results in severe fatal haemorrhage. A sudden violent compression of the chest wall may rupture the main bronchus although traumatic bullae occurring over the surface of the lung are the most common injuries seen after sudden compression of the chest wall. The contusion of the lung is common and may be fatal due to excessive haemorrhage. Laceration of the lung may occur with or without the penetration of its substance by fractured ribs.
- Visceral abdominal injuries in order of frequency involve the liver, spleen, and kidneys. The mesenteries and pancreas are rarely damaged.
- Pelvic injuries are uncommon and may result from a direct impact or from force transmitted through the femora when the forward projection of the knees is suddenly arrested by contact with the fascia board. The classic injury is a posterior fracture-

dislocation of the hip joint⁵.



Fracture of the right lower leg.

Figure 83. Fracture of the right lower leg.

TIME OF DEATH AFTER TRAUMA

The causes of death after a road traffic accident vary from haemorrhage, fat embolism, pneumonia, cardiovascular sequelae to carbon monoxide, and fire¹.

Normal death after trauma follows a trimodal distribution, with the first and largest peak, comprising 50% of the total, seen immediately, or within seconds of injury. The second peak, 30% of death occurs up to four hours later, while the third comprises those 20% of patients who die after four hours. The appropriate intervention for patients in the second group offers the greatest potential for preventing unnecessary deaths. In particular, ambulance services paramedic training and the concept of trauma centers should receive considerable attention.

Attempts to improve care for those who initially survive major trauma must continue but prevention offers the most effective and rational approach⁶.

THE ROLE OF A PATHOLOGIST IN THE ASSESSMENT OF FATAL AND NON-FATAL INJURIES IN MOTOR VEHICLE ACCIDENTS

- Establish the cause, manner, and mechanism of death.
- Determine the pattern of injuries
- Note the presence of natural disease
- Examine fluids to exclude the presence of drugs such as alcohol
- Exclude a novus actus interveniens
- To report the conclusion after and based on full examination.

THE ROLE OF A PATHOLOGIST IN THE INVESTIGATION OF DEATH OF A PEDESTRIAN KNOCKED DOWN BY A VEHICLE

- Identify
 - Primary injuries - Bruising due to the contact with the tyre and/ or impact of the vehicle
 - Secondary injuries – Bruising due to impact on the ground or the roadway
 - Tertiary injuries – Bruising due to further fall, run over by a vehicle or other things like electrical pole dragging, etc.
- Determine the age; common in the young and the elderly.
- Note the presence of any kind of predisposing disease e.g blindness, dementia
- Rule out alcohol/drug toxicity; This is achieved by the use of toxicology since most of the accidents are caused by poor judgment.
- Identify accessory car fragments in cases

of hit-and-run vehicles. The fragments left on the pedestrian may assist in filing the fragments into the vehicle. In cases of two vehicles;

- Each vehicle causes specific injuries, and each inflicts fatal injuries.
 - The mechanism and the extent of the injuries depend on the nature of the vehicle and the speed and site of contact. In such cases attending the scene of an accident will be of help.
- Note the pattern of injuries i.e surface injuries may be minor including abrasions, lacerations, bruises, grazed abrasions, imprint, tyre marks, head injuries, brain, neck, chest, abdominal, and pelvic injuries.

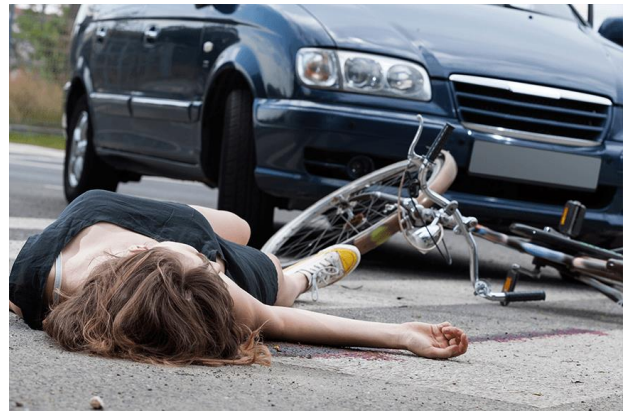


Figure 84. Pedestrian knocked down by a motor vehicle

The basis of an individual clinically unable to use a fixed breath analysis machine in connection with a drunk/driving offense.

MEDICAL CONDITIONS

- Asthma,
- Chronic airway obstruction disease,
- Pneumonia,
- Pleurisy,

- Peritonitis.
- Occasional Pulmonary tuberculosis.

❖ **CONDITIONS WHICH MAY PREVENT GOOD SAMPLING**

- Fracture of ribs
- Pneumothorax
- Perforation of the abdomen
- Facial injuries affecting the oral cavity
- Neck injuries and trauma to the airways.
- Tracheostomy.
- Injuries in the face and mouth with blood contamination.
- Severe depression of the respiratory centers (Unconsciousness).
- Impairment of ability to drive caused by drugs.
- Depression of brain functions, lengthening reaction time, lessening muscular control and coordination, vision blurred, awareness depressed.
- Ability to judge speed and distance impaired, even when the driver under the influence of alcohol believes that they can drive well.

FITNESS TO DRIVE

❖ **FACTORS CONSIDERED**

- Drugs (prescribed and illicit).

Examination to determine whether or not the driver of a motor vehicle may be impaired for the time being of having proper control of the motor vehicle is done which may include;

- Detection of a large number of prescribed over the counter drugs; which is time-consuming, expensive, and requires body fluids samples.
 - Drugs which impairs driving ability.
 - Use of alcohol, codeine, diazepam, Nitrazepam, Nitriptyline, pethidine, tetrahydrocannabinol by the driver
- The driver must be subjected to a breath test for alcohol where the police must initially have evidence of impaired behavior. If the breath test indicates that the driver is below the prescribed blood alcohol concentration then the urine and the blood are tested for drugs.
 - 10 MLS of blood and 100 MLS of urine divided into two once given to the driver and the other one given to the police.
2. Age, over 70 years
 3. Fatigue,
 4. Illness like diabetes mellitus, nervous system-epilepsy, and mental vision
 5. Cardiovascular accident or head injury.

Chapter Seven

Head Trauma

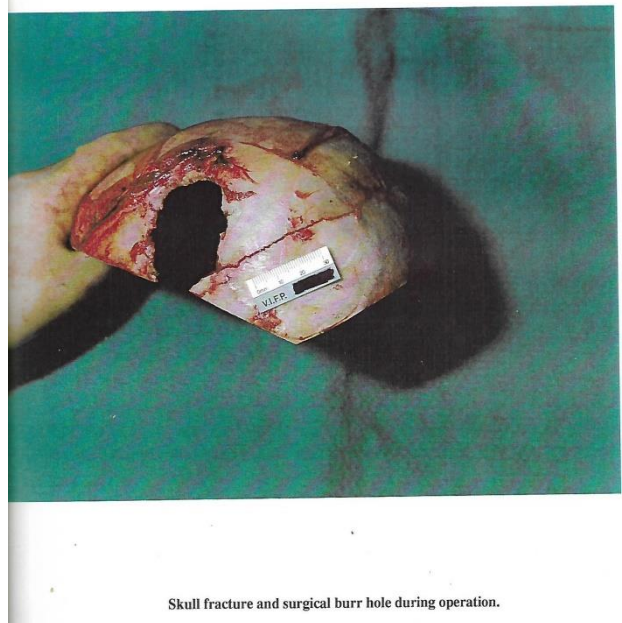
INTRODUCTION

Head injury can be defined as any alteration in mental or physical functioning related to a blow to the head. Head injuries are injuries to the scalp, skull, or brain caused by trauma

CLOSED HEAD INJURY

Trauma to the head is one of the most common causes of sudden unexpected violent deaths. It may involve the skull, extradural space, sub-dural space sub-arachnoid space, or the brain itself. Traumatic injuries remain the leading cause of death in children and adults aged 45 years or younger. Head injuries cause immediate death in 25% of acute traumatic injuries.

- Skull fracture, cranial vault, base.
- Extradural haematoma.
- Subdural haematoma which can be divided into -Acute, -sub-acute, and chronic.
- Sub arachnoid haematoma. Intra cerebral haematoma.
- Cerebral contusions
- Cerebral oedema.
- Consequences of closed head injury - Includes Herniations, acute hydrocephalus, infections, prolonged coma.



Skull fracture and surgical burr hole during operation.

Figure 85. Skull fracture and surgical burr hole during operation

RUPTURED BRAIN ANEURYSM AND HEAD TRAUMA

Ruptured berry aneurysm is common in both the young and middle-aged people. It develops as a person grows older as a weak spot in the vessel wall usually at a bifurcation. It's not congenital and occurs earlier than the "Coronary Age". In most cases, it's a common cause of subarachnoid haemorrhage, especially in women.

CAUSES OF RUPTURE

- ❖ **High blood pressure.** The most potent factor is the rise of blood pressure due to catecholamine released during the "Fight,

Flight, or Fisticuffs" situations catalyzed by alcohol either in sports, emotions, colors, etc.

- ❖ **Alcohol-** Though commonly disputed, alcohol increases the risk of rupture due to the dilatation of cerebral blood vessels and increased blood flow.
- ❖ **Trauma-** The vessels protected under the buffer provided by the mass of the brain. It is hard to deny - however, that a heavy blow to the head or neck cannot rupture, split, or weaken the fragile wall of a large, thin, walled aneurysm, but when the bleeding comes from a tiny vessel bulge, the evidence is not convincing. Trauma is commonly disputed, as it is virtually beyond absolute proof.
- ❖ **Spontaneous (Slow leak)-** Spontaneously leaking aneurysm may have a rapidly developing neurological or even behavioral abnormality that leads the victim into conflicts with another person or in a dangerous physical position like a fall, or MVA. The aneurysm rupture may be blamed on the trauma - instead of the reverse.

The various types and cause of intracranial bleeding encountered in forensic practice

- Extradural haemorrhage
- Subdural haemorrhage
- Intracerebral haemorrhage
- Intraventricular haemorrhage

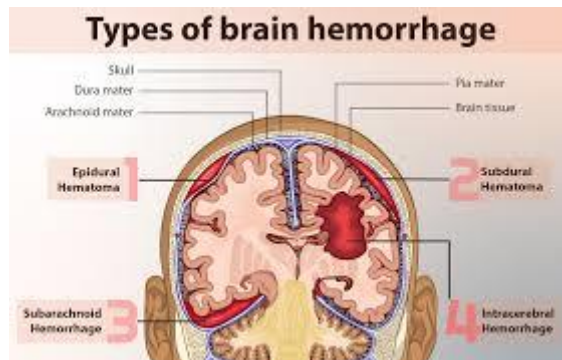


Figure 86. Brain haemorrhage

INTRACEREBRAL HAEMORRHAGE

Intracerebral hemorrhage (ICH) is caused by bleeding within the brain tissue itself — a life-threatening type of stroke. This form of haemorrhage occurs in around 15% of fatal head injuries. They may occur in relation to contusions in the frontal and temporal lobes or in a more deep-seated location - commonly in the basal ganglia or thalamus. These lesions may be multiple and associated with significant brain swelling and diffuse axonal injury. High blood pressure and trauma are two leading causes. Taking blood-thinning drugs may also increase a person's risk.

Symptoms can vary based on the location of the haemorrhage in the brain, but may include numbness or weakness in part of the face, difficulty speaking or difficulty walking.

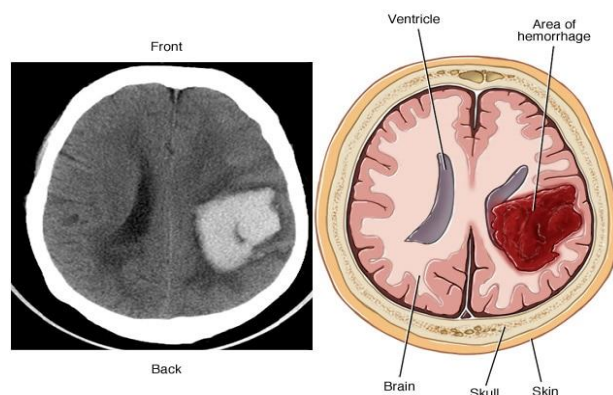


Figure 87. Intracerebral haemorrhage

EXTRADURAL HAEMATOMA

This form of intracranial haemorrhage occurs most frequently as a complication of fracture of the squamous temporal bone which results in rupture of a meningeal artery. It has been found in up to 15% of fatal head injuries. The characteristic clinical history is that of a lucid interval of several hours, following which the patient becomes drowsy and deteriorates as the accumulating haematoma reaches a critical size and acts as a space-occupying lesion.

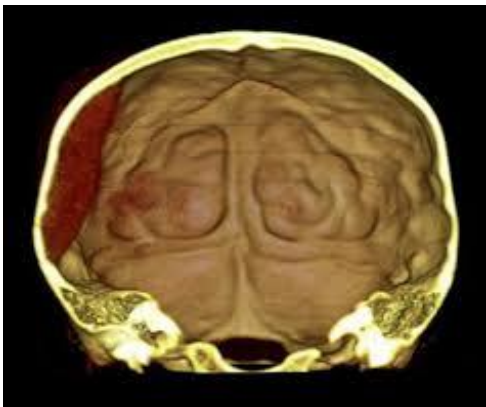


Figure 88. Extradural haematoma

Extradural Hemorrhage

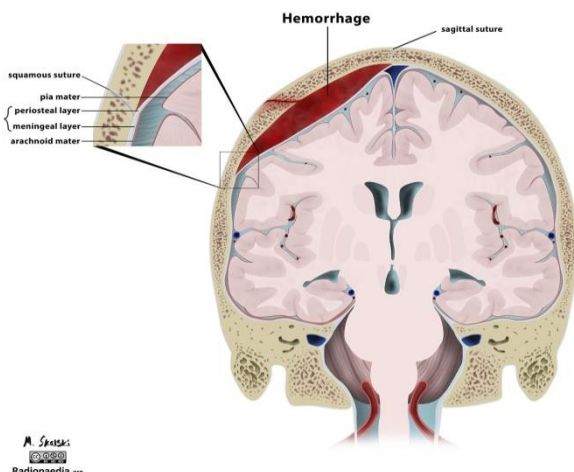


Figure 89. Extradural haemorrhage

SUB-ARACHNOID HAEMORRHAGE

This type of haemorrhage is common in blunt head injuries due to extravasations of blood from congested or disrupted small vessels in the subarachnoid space. It may also occur in areas overlying cerebral contusions. Basal subarachnoid haemorrhage can be associated with trauma and acute alcoholism.

The importance of recognizing a traumatic basal subarachnoid haemorrhage lies in the fact that the manner of death in these cases is homicidal or accidental rather than natural. Most traumatic haemorrhages follow fist or occasionally, foot blows to the head and the neck. Other less common causes of trauma include blows from thrown objects, falls, and motor vehicle accidents.

Death occurs within half an hour of the trauma in most cases although resuscitation and life-support measures may prolong life for a few days. The most consistent association with traumatic basal subarachnoid haemorrhage, apart from trauma, is that of alcohol intoxication. This is possible so because alcohol causes vasodilation and this makes cerebral arteries more susceptible to traumatic damage.

Alcohol also slows reflexes and diminishes co-ordination. These factors may serve to exaggerate the rotational and hyperextension motions of the head and neck when an intoxicated individual is struck, which in turn, generates greater shearing forces on the cerebral arteries. Finally, there is the fact that intoxicated persons are more prone to become involved in fistfights in the first place, and some believe that this is the major role of alcohol in this lesion.

SUB-DURAL HAEMORRHAGE

Subdural haemorrhage is bleeding into the wide space between the dura and the arachnoid membranes. It is more common than extradural haemorrhage.

Subdural hemorrhage

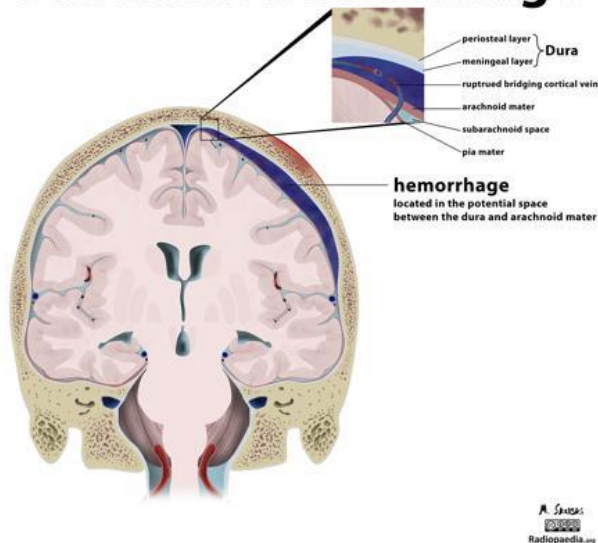


Figure 90. Subdural haemorrhage.

Subdural haemorrhage can occur at any age but is common in both extremes of life. It is one of the major causes of death of fatal child abuse. It may present as retinal haemorrhage, subdural or subarachnoid haemorrhage; the hallmarks of the shaken infant syndrome less than one year.

This type of intracranial haemorrhage results from the rupture of the bridging veins between the superior sagittal sinus and the cerebral hemispheres due to shearing forces that act in the head injury. Large haematomas which act as space-occupying lesions have been reported in 60% of fatal head injuries resulting from blunt trauma.

CAUSES OF SUB-DURAL HAEMORRHAGE

This condition is always due to trauma. Even in states of vascular fragilities, such as in senility and in bleeding diatheses, some minimal trauma must precipitate the bleeding even if it was too trivial to record in history.

TYPES OF SUB-DURAL HAEMORRHAGE

- Acute subdural haemorrhage

- Chronic subdural haemorrhage

❖ Acute Sub-Dural Haemorrhage

This is a common sequel to any substantial head injury and the presence of or absence of a fracture is immaterial except as an indicator of the trauma of the head. A fracture plays no part in the pathogenesis of haemorrhage, which arises from torn communicating veins that traverse the dural sinuses. This lesion is often pure, however, it is associated with a closed head injury where the only other signs may be scalp bruising or even nothing at all as when an infant is violently shaken.

- **Location**

Where a blunt impact strikes the subdural bleed need not be situated directly under the impact area or the same side. Subdural haemorrhage is quite mobile. The lesions that have originated high on parietal area commonly drain under gravity and cover the whole hemisphere with large accumulation in the middle and anterior fossas and even though the tentorial opening into the posterior fossae.

- **Volume**

Its basically around 35 -100mls with a lucid interval- There's no upper limit to this interval.

❖ Chronic Sub-Dural Haemorrhage

This is common in old people, frequently as an incidental finding at autopsy where death was caused by some un-related condition. The chronic haematoma arises from the acute lesion, which after an interval becomes sheathed in a capsule of connective tissue. It may absorb, remain dormant, or enlarge in more than three (3) weeks after the injury.

In alcoholics, and the elderly, central atrophy predispose to bilateral subdural haemorrhage in 15-20%. A sub-Dural haematoma occurs in 50% of cases where there is no evidence of chronic head

injury.

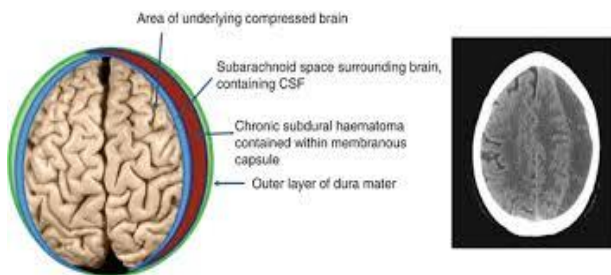


Figure 91. Chronic subdural haemorrhage

DATING OF SUB-DURAL HAEMATOMA

In accidents, there may be doubt about whether the subdural haematoma arose as a result of the injury, or whether a pre-existing lesion caused unsteadiness that may have precipitated the accident. Despite several claims to reliable methods of dating subdural haematoma, such estimates are of doubtful value, partly because repetitive bleeding results in varying ages within the same haematoma.

Histological Criteria (Monro and Merritts)

- 36 hours fibroblasts appear at the margin of the clot.
- 48 days the membranes become well established and fibroblasts migrate from it into the clot. There are progressive lysis and haemosiderin-laden phagocytes that are present, which may be stained by Perle's reaction.
- 8 days the membrane is 12 to 14 cells thick and is visible to the naked eye.
- From 11 days the clot is subdivided by strands of fibroblasts.
- By 15 days a membrane is also present on the under the surface of the clot and the outer neomembrane is half to one third the thickness of the dura itself.
- By 26 days it equals the thickness of the

dura, but the inner membrane is still only half as thick.

- Between one and three months the membrane has lost many fibroblast nuclei and is becoming hyaline.
- By six to 12 months the membranes become thick and fibrous resembling the dura itself.

CAUSES OF SUB-ARACHNOID HAEMORRHAGE

In the majority of the cases of subarachnoid haemorrhage there is an association with subdural haemorrhage.

❖ Traumatic Causes

Trauma (moderate) direct blunt localized to the lateral or poster lateral neck, causing direct trauma to the vessels of the skull).

- Fracture of the skull
- Brain injury, contusion, and laceration.
- Vertebral artery rupture and bleeding due to twist of the neck, and fracture of the transverse process of the atlas which may be caused by;
 - 1. Blow at the site of the neck.
 - 2. RTA, - Brain injury Contusion, laceration.
 - 3. Child abuse Battery - Shaking shaken baby syndrome).
 - 4. Congenital abnormality of the cranial cervical articulation.
 - Pre-eclampsia, ineffective endocarditis, tumors, - cerebral amyloid angiopathy.
 - Vascular malformations, Aneurysm, A/V malformation, Cappillary telangiectasia, cavernous angioma,
 - Secondary to various causes -

Brain stem secondary to herniation, Tumour hemorrhage, Haemorrhage infarcts

- Child abuse – Shaking of a child

❖ Non-traumatic (Spontaneous)

- Rupture of Berry aneurism, -Hypertension- (Stroke)- cerebral hemorrhage
- Leukemia, Bleeding disorder, and blood dyscrasia, Factors IX, VIII
- Thrombocytic purpura, Haemophilia Sickle cell anaemia, Polycythemia
- Increased intracranial pressure, - Bleeding diathesis - a disorder of Factors IX, VIII, Lupus anticoagulopathy.
- Cerebral amyloid angiopathy
- Primary tumor in the brain
- Metastatic malignancies
- Haematological malignancies.
- Anticoagulation and antithrombotic therapy,
- Dural and arachnoid arteriovenous fistulas
- Drugs such as Cocaine, Alcohol, Amphetamine.
- HIV

INVESTIGATION

Examination of vertebral artery trauma causing bleeding.

- In-situ (preferred method) Barium sulphate
- After removal of the cervical spine remove the brain leaving lower pons and basilar artery in-situ. Arise from the subclavian artery, Ascends through the transverse process of the axis through which it runs

upwards and laterally to the transverse process of the atlas.



Haemorrhage base of the skull

Figure 92. Haemorrhage at the base of the skull

It emerges from the transverse foramen of the atlas, it then curves behind its lateral mass then lies in the vertebral artery sulcus on the upper surface then enters the vertebral canal bypassing below the lower, arched border of the posterior atlantooccipital membrane.

- Fix the brain - "spontaneous intracranial haemorrhage of unknown aetiology" when there is no lesion identified.

CEREBRAL INJURIES AND THE PHENOMENON OF 'CONTRA COUP'

When a mobile head is struck with an object, the site of maximum cortical contusion is likely to be beneath at least on the same side as the blow. This is a coup lesion. There is often cortical change on the opposite side of the brain; The 'Countre coup'

lesion.

- There may be no coup damage at all - only contrecoup.
- There needed to be no fracture of the skull.
- The most common site for countre coup injury is the frontal lobes.
- In the temporal or parietal impacts, the countre coup lesions are likely to be diametrically opposite on the contralateral surface of the brain.
- Falls on the frontal region rarely produce occipital contrecoup.
- In a temporal impact the contrecoup damage may not be on the contralateral hemisphere, but on the opposite side of the ipsilateral hemisphere - falx cerebri.

COUP AND COUNTER-COUP INJURIES

- ❖ Diffuse axonal injuries, concussion (transient neuronal deficiencies, contusion bruises pugilistic encephalopathy).
- ❖ Death nearly always due to intracranial bleeding- Sub Dural haemorrhage into one of the middle cranial fossa is the most common cause of death.

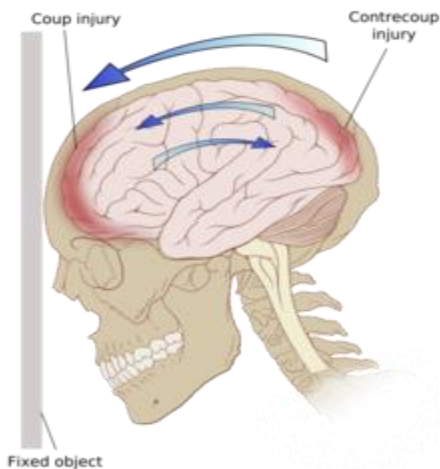


Figure 93. Coup and contrecoup injury

HISTOLOGY

- Cerebral cortical atrophy,
- Neuronal loss reactive gliosis
- Large numbers of neurofibrillary tangles.

DEMONSTRATION

- Fixation of the brain for two weeks
- Silver impregnation methods.
- Congo red and viewing in polarised light; to show the evidence of foreign material.

BOXING AND HEAD INJURY

These depend on survival after injury.

INJURIES INCLUDE;

- Skin cuts, a laceration above the eye, cauliflower ear due to necrosis of the annular cartilage following haematoma of the pinna.
- Fracture of the nasal septum.
- Maxillo-facial and mandibular injuries
- Eye injuries - Retinal haemorrhage and detachment, vitreous humor haemorrhage, choroidal tears.
- Meninges tense, swollen brain, and convolutions flattened.
- Sub-dural haemorrhage and Subarachnoid haemorrhage with a thin film of bleeding.
- Distension of the perivascular and pericellular spaces and capillaries show congestion with endothelial swelling.
- Cerebral oedema with increased intracranial pressure
- Punk drunk syndrome; (Traumatic encephalopathy,
- Dementia Pulgillistica - chronic sequelae) -

Progressive dementia, dysarthria, ataxia, and parkinsonism.

- Cerebral ventricle dilation,
- Labile mood,
- Abnormalities in septum pellucidum with fenestrations,
- Scopus collusum attenuated cerebellar, and other scaring with loss of Purkinje cells and demyelination,
- Neurofibrillary tangles similar to Alzheimer's disease,
- Degeneration and depigmentation of substantial nigra, locus coeruleus, and senile plaques.

DIFFUSE AXONAL INJURIES (DAI)

Diffuse axonal injury (DAI) is a form of traumatic brain injury. It happens when the brain rapidly shifts inside the skull as an injury is occurring. The long connecting fibres in the brain called axons are sheared as the brain rapidly accelerates and decelerates inside the hard bone of the skull. DAI typically causes injury to any parts of the brain, and people who suffer a DAI are usually left in a coma. The changes in the brain are often very tiny and can be difficult to detect using CT or MRI scans. It is one of the most common types of traumatic brain injury and also one of the most devastating.

The occurrence of diffuse axonal injury causes damage to the axons in the cerebral hemisphere, in the corpus callosum, in the brain stem, and sometimes also in the cerebellum resulting from a head injury.

DAI is one of the most important types of brain damage that can occur as a result of non-missile head injury. It's known to be the commonest cause of vegetative state and severe disability after injury and the second most common lethal head trauma after subdural haematoma.

❖ SYMPTOMS OF DAI

What are the symptoms?

The prevailing symptom of DAI is the loss of consciousness. This typically lasts six or more hours. If the DAI is mild, then people might remain conscious but display other signs of brain damage. These symptoms can be extremely varied, as they depend upon which area of the brain has been damaged. They can include:

- disorientation or confusion
- headache
- nausea or vomiting
- drowsiness or fatigue
- trouble sleeping
- sleeping longer than normal
- loss of balance or dizziness

❖ GRADES OF DAI

- i. There is histological evidence of axonal injury in the white matter of the cerebral hemispheres, the corpus callosum, the brain stem, and less commonly, the cerebellum. (... Produced by sagittal acceleration.)
- ii. There is also focal lesion in the corpus callosum
- iii. There is, also, a focal lesion in the dorsolateral quadrant or quadrants of the rostral brain stem (produced by an acceleration in the coronal plane)

❖ CAUSES OF DAI

DAI is caused by direct force to the head that stretches axons to the point of rupture at the Node of Ranvier. Axonal swellings appear within hours of the injury.

- i. Road Traffic Accidents are the largest cause of D.A.I in adults whereas in children

shaking, blows or contact with hard surfaces as a result of abuse. (low IQ observed in many battered infants may be due to cumulative effect of DAI produced by recurrent injuries).

- ii. Fall from heights- a considerable height simple fall-fall not more than the subject's height.
- iii. Assault.

Diffuse Axonal Injuries occur in primary events that occur at the moment of injury and are secondary to hypoxic brain damage, cerebral oedema to damage in the brain stem.

DIAGNOSIS

❖ Microscopically

Presence of focal part techie haemorrhage in the corpus callosum and the dorsolateral quadrants of the rostral brain - stem.

❖ Histologically

They are identified as round, eosinophilic masses of varying sizes often surrounded by a clear halo, retraction balls, and axonal swelling.

Stains to demonstrate DAI include;

- Nauomenko and Feigin's silver method.
- Glial fibrillary acidic protein (GFAP).
- Woelk's modification of Heidenhain's technique for myelin.
- Nissl's method of cresyl violence.

BLUNT HEAD INJURY

Discussion

Head injury has now become the commonest cause of death among adults in developed countries. The most common causes of head injuries are road traffic accidents, falls, and or

blows to the head.

The effect of blunt injury to the head is complex and depends not only on the mechanisms of the injury and the severity of the force applied but also on the site of its application to the skull and the presence or absence of injury to other parts of the body. Traumatic damage to the structure of the brain is irreversible; the cerebral damage sustained in head injury is a major factor in determining the clinical outcome. A blunt (non-missile) head injury may result in the damage to the scalp, skull, intracranial blood vessels and other vessels of the head and neck, the meninges and the brain either singly or in varying combinations^{1,2}.

However is often helpful to consider brain damage occurring as a consequence of blunt head injury as either primary or secondary, particularly when attempting to reconstruct the sequence of events before death. Nothing can be done about primary damage other than by encouraging preventive and other public health measures¹. Interventions by clinicians can minimize the effects of secondary brain damage such as hypoxia, ischemia, brain swelling, and the formation of intracranial haematoma, epilepsy, and infections.

Blunt injuries are liable to be associated with a variety of complex movements and deformations of the brain, blood vessels, meninges, and skulls.

When the head is accelerated or decelerated as a result of the impact with a blunt object, movement of the brain in relation to the skull may be linear or angular to the direction of the applied force¹.

When a person falls from a standing height, the gravitational torque acting on the body causes downwards acceleration of the head above the acceleration due to gravity. The brain lags towards the trailing cranial surface before impact, dissipating the protective cerebrospinal fluid layer. At impact, contre-coup compressive stress may occur. Also, a relative rotational gliding motion between the brain and the skull is produced when an impact suddenly arrests the skull's rotation. Dissipation of protective cerebrospinal fluid renders compressive stress at impact non-uniform, thereby generating contre-coup shearing stress.

The concentration of rotational shearing stress is also likely to occur beneath the frontal and temporal lobes because of the rough local surface of contact between the brain and skull⁴.

PRIMARY DAMAGE

This may involve any part of the head; scalp, skull, cerebral cortex, or vascular injury.

❖ Scalp

Scalp and facial injuries range from simple bruising through abrasions and extensive lacerations, which may provide a potential route of entry for organisms that may establish an intra-cranial infection if associated skull fracture is present.

❖ Skull Fractures

The commonest skull fractures encountered in severe head injury are linear fractures of the cranial vault which may extend into the base of the skull.

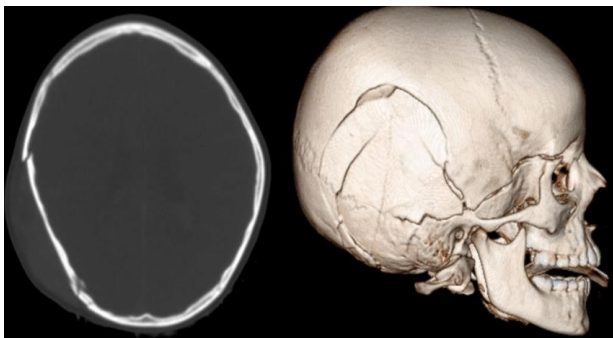


Figure 94. Axial CT head shows a depressed skull fracture of right temporoparietal bone with overlying scalp hematoma, well demonstrated on reconstructed VRT image.

- When the fracture is depressed, the displacement of the inner table of the skull may be associated with tearing of major dural venous sinuses, severe focal damage to the cerebral cortex, or both.

- Compound fractures occur when the overlying scalp is lacerated. Such lesions greatly increase the risk of sepsis and post-traumatic epilepsy.
- Fractures that involve paranasal air sinuses, cribriform plate, or middle ear are all compound fractures that may be associated with infection and in the case of the cribriform plate, cerebrospinal fluid rhinorrhea or intracranial aerocele.
- Fractures of the base of the skull around the foramen magnum, if displaced, may cause severe focal damages to the brain stem.

❖ Cerebral Contusions and Lacerations

Many investigators have shown that the change in the intracranial pressure after an impact to the head plays an important part in the causation of cerebral contusion.

When the head, being movable, is given an impact, a deformation force develops from an in-bending of the skull at the impact site and is transmitted to the opposite side of the impact. The deformation force causes positive intracranial pressure at both the impact site and the side opposite the impact. During the sudden acceleration motion of the head caused by the impact, the skull is set in instant motion while the brain movements lag due to inertia of the cerebral mass. Acceleration consequently develops in the intracranial space, causing positive pressure at the impact site and a negative response at the site of the impact. A coup contusion is caused by the sum of these two positive pressures in the region and a contre coup contusion does not occur because of the counteraction between the positive pressure and negative pressure in the region opposite the impact⁵

On the other hand, if the magnitude of the impact force is so strong such that it develops a significant in-bending and out-bending of the skull, a linear, a depressed or a comminuted fracture, the skull deformation can cause a cerebral

contusion⁵.

A coup contusion may be caused by great positive pressure induced by a marked in-bending of the skull or by a skull fracture. When a skull fracture develops, most of the kinetic energy of the impact force is spent in producing it, and the accelerated motion of the head will be reduced. Thus, the pressure change induced by accelerated motion of the head becomes small, and the negative pressure at the side opposite the impact becomes lower and no contrecoup contusion occurs. In such circumstances, it is the skull deformation and not the acceleration motion of the head that plays an important part in the causation of cerebral contusion⁵.

Cerebral contusions are bruises that characteristically affect the crests of gyri in the cerebral cortex. The presence of such lesions indicates the application of significant force in a head injury and distribution of contusions may be informative in determining the nature and direction of application of that force. Their location depends upon the position and motion of the head at the moment of impact. The commonest sites for contusion following a blunt injury to the head are the inferior surfaces of the frontal lobes and temporal poles. Contusions, although often bilateral, are rarely symmetrical and are found most often on the ipsilateral side to an intracranial haematoma or area of focal brain swelling. Contrecoup contusion may be more extensive than primary impact-related contusions; this must be recognized when the direction of the force applied to the brain is considered.

Cerebral lacerations are tears or rents in the substance of the brain which, like contusions, occur most frequently in the frontal and temporal lobes. Extreme forms of cerebral lacerations are usually incompatible with survival, for example, the pontomedullary rent which is often associated with ring fracture around the foramen magnum¹.

❖ Primary Vascular Injury

Several important vascular lesions may occur as a primary consequence of non-penetrating head injury. These include rupture of the carotid artery, traumatic aneurysms though rare, and intracranial haemorrhage.

Intracranial haemorrhage is frequent in complications of blunt head injury, particularly in cases sustaining a skull fracture. Intracranial haemorrhage is the commonest cause of death in patients who have experienced lucid interval following head injury. Intracranial haemorrhage may begin as a primary event at the time of injury although it does not become evident clinically until it acts as a space-occupying mass. Intracranial haemorrhages are considered most simply in the anatomical sequence in which they are encountered at necropsy¹.

❖ Haemorrhage of the Skull

Other forms of primary brain damages include multiple petechial haemorrhages throughout the cerebral hemispheres; mid-brain and pons represent another variety of diffuse brain damage which may be seen in patients who die at or shortly after a severe injury to the head. These lesions are thought to indicate an injury which is incompatible with survival being, perhaps, a manifestation of unusually severe diffuse axonal injury¹.

SECONDARY COMPLICATIONS

The brain may be frequently damaged by secondary complications of blunt injury including brain swelling, raised intracranial pressure, hypoxic brain damage, and infection. These processes may be fatal but, as they are secondary events, considerable scope exists for clinical intervention to secure a more favourable outcome

SYSTEMIC EFFECTS OF HEAD INJURY

Many patients who have sustained a non-penetrating head injury die as a consequence of either the primary or secondary forms of brain damage. However, significant proportions die not from direct consequences of trauma to the brain but, rather from the systemic complications of head injury. The commonest complications of head injury include neurogenic pulmonary oedema, ulceration of the gastrointestinal tract presenting as acute gastric erosions or peptic ulcers, acute pancreatitis, focal myocardial necrosis also occurs rarely and may be accompanied by abnormalities in the ECG.

Many of these complications are poorly understood but some have attributed to an imbalance in the activity of the autonomic nervous system, possibly as a consequence of hypothalamic or brain stem damage.

THE LATE EFFECTS OF BLUNT HEAD INJURY

Many patients who sustain a blunt head injury make a good clinical recovery, particularly if the injury is more minor.

However, a wide range of disabilities may be found in other survivors, ranging from relatively minor cognitive and behavioral problems to severe functional disability or extreme cases to a persistent vegetative state.

Many of these complications are a result of irreversible brain damage - in particular, hypoxic brain damage and diffuse axonal injury. The onset of epilepsy is a common complication and occurs at two peak incidence; within the first week after injury (early epilepsy) or two to three months later (late epilepsy).

EFFECTS OF THE SPREAD OF CARCINOMA ON THE BRAIN AND THE SPINAL CORD

5% of all cases of malignancy metastasis to the brain constitutes to 20-40% of all intracranial tumours.

The **M** rule: Metastasis, Malignant Lymphoma, Melanoma, Medulloblastoma.

TUMOR MAJORITIES

- Carcinoma of the bronchi - 35%
- Adenocarcinoma of the lungs - 35%
- Breast - 20%
- Skin - 10%
- Malignant melanoma(39-92 metastasis)
- Kidney - 10%
- GIT-Colon - 5%
- Choriocarcinoma - low
- Others <20%
- Lymphoma, leukemia, Prostate, Nasopharyngeal, and orbital (retinoblastoma).

EFFECTS OF TUMOR METASTASIS TO THE BRAIN

- Increased intracranial pressure
- Brain herniation, flattening of the gyri,
- Brain stem infarction and haemorrhage
- Lateralizing (localizing) signs with paralysis
- Loss of smell
- Blindness (papilloedema)
- Loss of speech,
- Paraplegia

- Loss of memory
- Behavioral changes
- Psychiatric illness,
- Wasting,
- Dehydration due to vomiting
- CSF rhinorrhea,
- Meningitis,
- Deafness,
- Amenorrhea,
- Nystagmus and headache.
- Neuropathies associated with malignancies.
- Deep infiltration or compression
- Cause mononeuropathy and polyradiculopathy
- Diffuse symmetric peripheral neuropathy
- Paraneuroplastic affects sensory and motor neuropathy.
- Systemic amyloidosis and plasma cell dyscrasia

Chapter Eight

Asphyxiation

I thought I could not breathe in that fine air. That pure severity of perfect light'. Tennyson

INTRODUCTION

Asphyxiation refers to the deprivation of oxygen that can result in unconsciousness and often death: an act of asphyxiating a person or animal or a state of asphyxia: SUFFOCATION

❖ Suffocation

Suffocation refers to insufficient oxygen in the local atmosphere or reduction in the oxygen content of the inspired air.

❖ Chocking

This is internal blockage of the upper air passages by foreign material

❖ Strangulation

This is due to constriction of the neck by a force applied other than by the weight of the body.

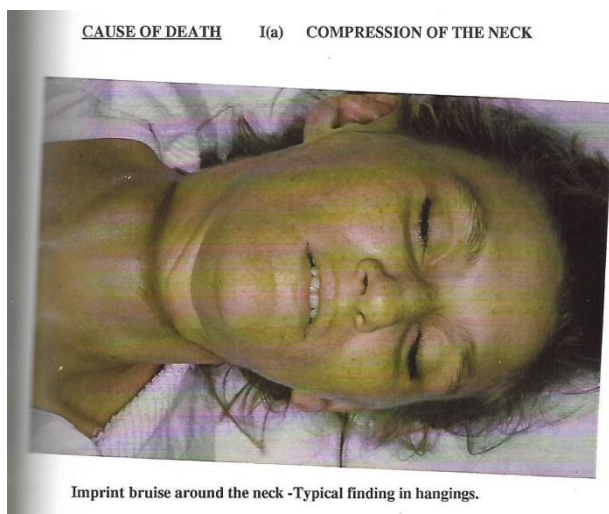


Figure 95. *Imprint bruise around the neck*

DEFINITION OF TERMS

Smothering

This is due to obstruction of the respiratory orifices e.g nose or mouth can be due to clothing's plastic bag.



Bruising around the neck muscles.

Figure 96. *Bruising around the neck muscles*

❖ Throttling

This is strangulation by hand (manual strangulation)

❖ Hanging

This is constriction of the neck by ligature, the force being applied indirectly to the ligature by the weight of the body.

VERDICTS WHICH MAY BE GIVEN BY COURT OF LAW ON A PERSON FOUND HANGING

- Concealed homicide
- Suicide
- Misadventure
- Pure homicide
- Accident
- Judicial hanging

HANGING

INTRODUCTION

Hanging occurs when a ligature is applied to the neck of a wholly or partly suspended individual compressing the neck when it is tightened by part or all of the body weight. A consequence of cerebral hypoxia may rapidly result in unconsciousness, with death being inevitable without outside intervention. Most of the statistics have shown that most hanging deaths are suicides with occasional accidental deaths and rare homicides^{1,2,3}.

The other common methods of suicide used include drowning, carbon dioxide poisoning, guns, either firearms or shotguns, poisoning which may be of a manufactured or naturally occurring substance, jumping from heights, jumping or lying in front of trains, motor vehicle, stabbing or incised

wounds, suffocation e.g. using plastic bags (often in combination with drugs) and self-immolation.

There is a rising suicide rate among males, particularly the young, and this is associated with increased use of hanging as a suicide method in most of the countries (e.g. Britain, Saudi Arabia, Western Australia, and elderly males in the U.S.)^{1,2,3}. In Kenya, this is the most common form of suicide followed by poisoning.



Figure 97. Death by hanging

FORMS OF HANGING AND THEIR DIFFERENTIATION

❖ Full-Suspension

This is where the ligature applied to the neck suspends the victim by compressing the neck when it tightens by all body weight.

❖ Typical Hanging

Suspension point is low and the body leans over away from the robe, a horizontal mark may be produced by the ligature used. This form of hanging may be done on the bed while the victim is sitting on the floor-common in police custody.

❖ Long-distance fall

This is common judicial execution hanging where the height of fall is more than 6 feet high. The ligature may produce laceration to the neck.

SCENE OF DEATH

As in many medico-legal autopsies, the scene investigation is an important part of the autopsy. In many cases, the cause of death cannot be determined without first-hand knowledge of the circumstances and the probability of the detection of suicide varies with the method employed.

Sir John Sibbed pointed out that "A death by hanging can seldom be concealed and when known it seldom be regarded as otherwise as suicide. This cannot be said of any of the other methods". The statistics in suicidal hanging are likely accurate. In one study 59% of hangings the material used is a rope. Other less preferred ligatures include an electrical cord, belt, dress cord, dressing gown cord, sheet or blanket, clothesline wire, shirt, dog lead, tie, curtain, or stocking¹.

As well as the availability, factors of acceptability and lethality of different suicide methods are also likely to influence the suicide rate.

Elderly men are more "efficient" in their suicide efforts, that is, if the old attempts at suicide they are usually successful. Among many of the possible explanations for the differences in suicide attempts and completion among the young and elderly the most often quoted is that the elderly tend to use more lethal (drastic, violent, serious, or active) methods than do the young³.

RISK FACTORS

The risk factors both in the young and elderly include lack of company, separation from spouse, and physical illness including depression. Divorced or widowed men have a three times greater risk of committing suicide compared to married men. Previous alcohol misuse and social isolation also increase the risk within these age groups^{3,5}.

In most of the hangings, the individual is found in an isolated lonely place where there are difficulties for any outside intervention. Hanging is also a common phenomenon in police custody. These suicides, typically occurring in a police lock-up often occur soon within three hours of arrest.

Often the cell is usually supervised by an inexperienced officer, the victim having been arrested for a relatively minor offense, often intoxicated and with no criminal record.

Countries with low suicide mortality by hanging either have low suicide rates for all causes, (for example, Ireland and Spain) or recently used hanging as a method of capital punishment. It seems likely that the use of hanging for capital hanging causes a social prejudice against hanging as a suicide method. The abolition of judicial hanging in most of the countries may have affected the erosion of this dishonorable association. If this is so, it might be expected that hanging as a suicidal method would become more acceptable. Certainly, the recent marked increase in male suicidal hangings, particularly young males cannot be related to methods of availability or awareness and may be explained by increased acceptability. If this interpretation is correct, then it might represent an unusual circumstance in which an explicable increase in the acceptability of a highly lethal suicide method, unrelated to availability, has resulted in a significant increase in the use of methods with a subsequent rise in the number of suicides and the suicidal rate. This explanation may hold for the increasing numbers of suicide hangings seen in other English speaking countries such as Canada and Australia⁷.

CAUSE OF DEATH

Death by hanging is due to one or a combination of the following mechanism.

- Occlusion of the larynx.
- Obstruction of the venous return from the brain and anoxia of the brain.
- Interruption of the arterial blood applied to the brain.
- Vagal inhibition of the heart.

It seems likely that unconsciousness ensues within several seconds of neck compression in most hangings, assuming that compressive force to the neck to be optimally applied. The progressive

cerebral hypoxia becomes irreversible within minutes. The precise period, to which this progression to death probably depends on several factors, including the nature of ligature and degree of suspension and height fall.

POST MORTEM FINDINGS

In cases of hanging the typical findings is an imprint abrasion, usually without bruising of the neck muscles. Fractures of the hyoid bone, thyroid or cricoid cartilages are "exceptions rather than the rule". A review of the literature has suggested that 8% of hyoid bones are fractured and 15% of the thyroid cartilage, while the cricoid cartilage was fractured in only 0.003% in hangings^{6,9}.

Fractures are common with increasing age because of increased calcification and some studies have revealed a fracture incidence of 26% in a population average of 39 years.

Most of the others agree that fractures of the thyroid are more common than the fractures of hyoid while some reports higher frequency of hyoid than thyroid fractures.

Features in the thyroid bone or thyroid cartilages are often seen without any reaction in the form of haemorrhage. There may be different explanations;

- The bones may have fractured after death; the circulation may be compromised during the poorly hanging thus no haemorrhage occurs.
- The fracture may have occurred during the autopsy procedure. This means the autopsy has been poorly conducted.

Careful handling of the specimen is of the utmost importance and the structures should be palpate and inspected in situ. It must be stressed that the diagnosis of antemortem fractures should not be made without evidence of recent haemorrhage. Radiography has been recommended prior to dissection, a method that is very useful⁸.

Fractures also occur in young people and the fractures will be found in the neck structures are examined properly. The type of hanging which

gives the highest number of fractures is where they fall is of a long-distance like in judicial hanging and also the time between the hanging, and where the body removed from the hanging place^{8,9}

TOXICOLOGY

In suicidal hanging like any other type of suicide, toxicological data is of importance because in most of the cases there is a higher use of alcohol (35%) and prescribed drugs like benzodiazepines, illicit drugs like cocaine or cannabis that may be detected in the blood¹

In some of the cases the level of alcohol or drug in the blood may be very high; the highest level recorded I have been able to find has been 0.52 grams %. Finding a higher alcohol level may raise the question of the ability of the deceased to undertake the possible manipulation needed to complete suicide by hanging. Naturally, each death needs to be assessed on its merits with particular attention being paid to the alcohol consumption history of the deceased and the likelihood of possible assistance by someone else. It is well known that significant intolerance to effects of alcohol may develop following regular use so that even complex tasks seem to be undertaken with apparently little impairment¹.

Role of the clinical forensic pathologist in the examination of a case (apparent) suicidal hanging in police custody

Suicidal hanging in police custody usually occurs in the first 3 hours after booking, in sentenced, unmarried, convicted of theft, and serving the first month of prison time with no criminal record.

- Confirm if the person is alive or dead.
- Preserve the remains to allow photography of the scene.
- History from police and the inmates may be necessary.

- Inform the relatives and inform the police. The autopsy should be done as soon as possible and report completed to allay the anxiety of the police, relatives, and the public at large.

NON-MECHANICAL ASPHYXIA

Asphyxia is the process of interference with the respiratory exchange. It is generally used to denote a mechanical interference with respiration leading to lack of oxygen and death, but can also be used in conditions which don't result from mechanical obstruction. All cases of asphyxia show three cardinal features of Congestion, Cyanosis, and Petechiae haemorrhage.

- Hydro cyanide poisoning - The cell enzymes' ability to utilize oxygen prevents tissue respiration. Cytochrome 450.
- Drowning.
- Carbon monoxide poisoning

The oxygen carrying capacity of the blood is impaired to the greater affinity of haemoglobin for carbon monoxide than oxygen.

Macroscopic appearances of the brain following carbon monoxide poisoning where death has occurred several weeks after exposure

Carbon monoxide is a tasteless, colorless, odorless gas. It combines with haemoglobin with an affinity of 210-270 times greater than that of oxygen shifts dissociation curve to the left. (Halidon effect)

CARBON DIOXIDE POISONING

- The inhaled air contains only carbon monoxide resulting in tissue hypoxia as dry ice and propane.

SOURCES

- The internal combustion engine, machinery, tobacco, industry.

EFFECTS OF CARBON MONOXIDE POISONING

- Post-mortem lividity
- Death at different concentrations depending on many factors
- Death due to hypoxia
- Confusion
- Severe headache
- Seizures
- Coma.

DELAYED DEATH

- CO encephalopathy
- Symmetrical necrosis of globus pallidus,
- Multiple punctate haemorrhage in the white matter
- Focal myocardial necrosis
- Fatty vacuolation
- Heart failure.

CAUSES OF MECHANICAL ASPHYXIA

- Employing plastic bag
- Suffocating gag or pad.
- Food jammed in the throat
- Strangulation by ligature
- Manual strangulation - throttling.
- The pressure at the chest cavity.



Figure 98. Suffocation with a plastic bag

- Obstruction of the airways.



Figure 99. Obstruction of the airways

MODES OF DEATH THAT CAN ARISE FROM PRESSURE ON THE NECK

STRANGULATION

❖ **Manual Strangulation**

This is one of the forms of the pressure to the neck apart from the ligature strangulation and hanging. Manual strangulation (throttling) is a common mode of homicide by a man against a woman or children and sometimes with sexual attacks. Throttling is performed by both hands from the front or back.

The external examination shows evidence of bruises, due to fingertips, abrasions mostly liners from the fingernails from the assailant or victim during struggle. The sings depend on the time taken for the struggle and may vary from cyanosis, petechiae, and cardiac arrest.

Death is due to;

- Obstruction of jugular veins, with the impaired venous return of blood from the head to the heart
- Obstruction of the carotid arteries causing cerebral ischemia
- Vagal inhibition -reflex.

In cases of death post mortem examination may review;

- Bruising and haemorrhage of the neck muscles
- Fracture of the hyoid bone thyroid cartilage and/or cricoid cartilage
- Bilateral conjunctival haemorrhages with petechial, intramuscular extravasated blood involving the sternohyoid muscle,
- Patterned abrasions on the neck and facial congestion.

THROTTLING

Throttling is a type of asphyxial death where the perpetrator uses his hand to encircle and compress the front and side of the neck.

It is a common method of **homicide**, most often encountered when the physical size and strength of the assailant exceeds that of the victim. It mostly involves a man against woman and usually, the smaller one is considered less powerful.

❖ **Indications**

- Abrasions,
- Bruises intradermal,

- Cyanosis,
- Petechial haemorrhages,
- Fracture of hyoid bone bleeding of the neck muscle,
- Hypoxic brain damage due to compression of the neck,
- Occlusion of the anterior supplying blood to the brain and added failure of oxygenation of the blood due to the occultation of the airways, (vertebrobasilar system), the cerebral blood flow ceases because the heart stops,
- Baroreceptors in the carotid sinuses carotid sheaths - legally induce cardiac arrest.



Figure 100. Throttling injuries

Asphyxia as a manner of death in manual strangulation is an unsatisfactory explanation. Post mortem detection of hyoid fracture is relevant to the diagnosis of strangulation.

Fracture of the neck cartilages depends on;

- Nature and magnitude of the force applied to the neck.
- Age of the victim - This as a bearing to the degree of ossification or fusion of the hyoid synchondrosis.
- Nature of the system used to strangle

(ligature or hand).

- Intrinsic anatomical features of the hyoid bone (rigidity of the bone and shape). Fractures are common in hyoid, which are longer in the anterior-posterior plane and steeply sloping.
- The precise position of the force applied to the neck.

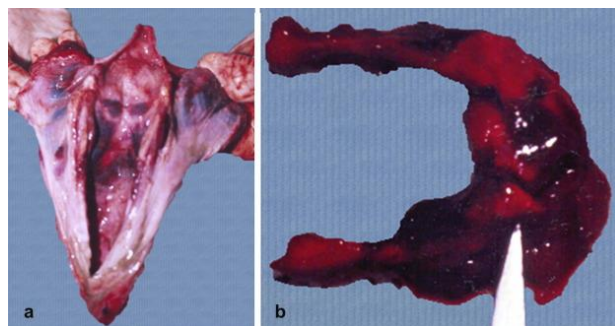


Figure 101. (a) Contusion of the inner wall of larynx and trachea. (b) Fracture of the body of the hyoid bone on the right side just medial to its junction with the greater cornua.

LIGATURE

The contracting band is tightened around the neck with gross congestion, cyanosis, and petechial haemorrhage in the face. The marks depend on the band used.

In most situations, the ligature material is not available during the forensic examination of hanging. Either, it was brought separately along with the body or sent later on for the examination if required by the investigating officer, or the relatives attempted to rescue the victim by removing the ligature from around the neck. However, although the ligature is not available, the type and position of the knot play an important role in the mechanism of death and autopsy findings in hanging. The police prepare the inquest and include the statements of eyewitnesses regarding the reasons and manner of death. In addition to this, at the time of autopsy, the police

also provide an additional 'spot inquest' that contains the detailed description of the scene of crime/ death concerning the dead body with pictorial representation and/or the photographs of the spot. This information may help in framing the manner of death in such circumstances or even when the body is highly decomposed. Hence, the ligature material is usually not examined; and its features are not submitted for systematic analysis. But, the type and position of the knot play an important role in the mechanism of death and autopsy findings in hanging. It is represented by an inverted 'V' shaped mark over the neck. The knot is the point of the ligature around the neck where the maximum force of traction occurs and the part of the ligature diagonally opposite to the knot bears the maximum bodyweight thus exerting maximum pressure on the underlying neck structures. Moreover, the position of the knot determines whether the effects of pressure/traction are unilateral or bilateral. If the direction of the flow of the saliva or other body fluids is not consistent with the position of the knot then it suggests a suspicious death/foul play. Hence, the features of the ligature material are important from the point of view of forensic examination.

Other additional findings may include stabbing, drowning, and multiple blunt force injuries.

VAGAL INHIBITION

REFLEX CARDIAC ARREST

❖ How it Occurs'

This is hypothetical, and no proof can be put forward.

Excessive sensory stimulation may cause reflex cardiac arrest. The stimulation of the carotid sinus and adjacent baroreceptors cause impulses to ascend in the afferent fibres of the glossopharyngeal nerves, which link to the nucleus of the tenth cranial nerve in the brain stem. Parasympathetic efferent impulses then descend in

the vagus nerve and its cardiac branches cause profound bradycardia which can amount to total cardiac arrest.

It arises from a variety of stimuli, including fear or intense emotion, pressure on the neck, impaction of food in the glottis, intubation of the glottis, penetration of the pleura or mediastinum, acute dilatation of the cervix as in criminal abortion sudden immersion in icy water, trauma to the testis and even sudden error.

Aspiration of gastric contents

- It causes "choking symptoms" of coughing, distress cyanosis, and petechial haemorrhage.
- "Cafe coronary" A person eating a meal suddenly dies due to food bolus in the larynx - cause vagal inhibition.
- Aspiration of vomit regurgitation of already swallowed gastric contents blocks the air passages.

Common causes include

- Acute alcohol poisoning
- Drugs, Anaesthesia
- Illness
- Increased intracranial pressure
- Convulsions with or without epilepsy.

Clinical or eye witness corroboration of retching or vomiting should always be obtained in all cases of aspiration of gastric content. Interpretation of gastric aspiration should be done with caution since food from the stomach may get onto the respiratory tree during movements after death. Post mortem histological examination of the lungs reviews food particles in the small bronchioles with inflammatory response mainly composed of acute inflammatory cells.

THE CHANGING PATTERNS IN THE INCIDENCE OF SUICIDE IN THE LAST 25 YEARS

SUICIDE

Suicide can be defined as the self-killing of a person of sound mind and years of discretions. In cases where suicide is not a crime, the person succeeded was beyond the reach of punishment.

SUICIDE PACT

This is a common agreement between two or more persons having has the object the death. The survivor is guilty of a complicity penalty of 14 years of imprisonment but this varies from one country to another. Suicide contributes to 1-3% of all deaths 18-37% of all sudden deaths. It is estimated that there are about 8 non-fatal attempts of suicide for every fatal suicide.

COMMON CAUSES OF SUICIDE

- Childhood experiences to deprivation
- Depressive illness
- History of previous suicide attempts.

SUICIDE RISK FACTORS

- Age,
- Severe mental illness,
- Physical illness,
- Previous alcoholic abuse,
- Social isolation,
- Stress and depression,
- rejection by a lover,
- Hopelessness
- Substance abuse.

COMMON SUICIDE METHODS

- Asphyxia, strangulation, hanging, and suffocation
- Drowning
- Cutting/stabbing,
- Gunshot
- Poisoning/drugs,
- Electrocutation.

Suicide is common in April to May in the northern hemisphere and from September to November in Australia. This type of phenomenon is not seen in tropics. Ligation and manual strangulation usually represent homicide. In most cases, a suicidal note is found in the vicinity in 15% of the cases of suicide.

Para suicide - This is the deliberate cause of self-injury without the intention of actually causing death. 20% repeat act common in 15-24 years. 10% of the cases of Para suicides eventually kill themselves.

INJURIES ASSOCIATED WITH A FALL FROM HEIGHT

Falls from a height may result from accidents like in high building sites or as suicide. The injuries vary according to the height, the objects on the falling path, and the body orientation at the body surface contact area.

Common injuries seen in fall from height include;

- Multiple fractures of the axial skeleton calcaneum, tibia, femur, separation of the symphysis pubis, fracture-dislocation of sacroluber joints, and fracture of the spinal column.
- Abrasions- friction, scratch, imprint and graze.
- Contusions

- Circular or spinal fractures of the skull at the foramen magnum.
- Lacerations including the complete transactions of the body.

Injuries depend on;

- Duration of deceleration
- Body orientation
- Landing surfaces
- Duration of impact
- Tissue elasticity
- Viscosity
- Impact velocity

In children, there may be multiple fractures of the skull, subdural and subarachnoid haemorrhage and otorrhea. One has to consider the possible mechanism of the fall, the age, condition of the child, the shape and consistency of the contact surfaces.

Injured body regions that are examined according to the frequency are the head, chest, abdomen, extremities, and the neck.



Figure 102. Lacerated organs in a person falling from a height

Chapter Nine

Firearm Injuries

'I Thought I could not breathe in that fine air, That pure severity of perfect light' Tennyson

FEATURES OF GUNSHOT ENTRY

Gunshot wounds are the most common cause of homicide globally. The medical, legal, and emotional costs of this violence impose a staggering burden on urban trauma hospitals, court systems, families, and society in general. The evaluation of these wounds requires specialized training and expertise, whether by an emergency physician in a living gunshot victim or a forensic pathologist in the deceased. Analysis and interpretation of fatal gunshot wounds is an important and common practice among forensic pathologists. Additionally, for pathology residents, it is an integral aspect of their training during their rotations at medical examiner or coroner offices.

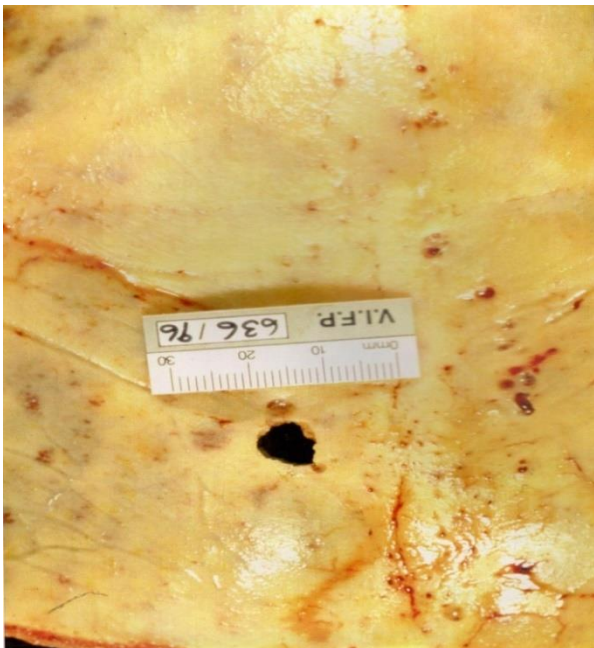


Figure 103. Gunshot wound

DETERMINING THE RANGE OF FIRE

Estimation of the range of fire is a major determinant of gunshot wounds. The range of fire is an estimate of how close the muzzle of the gun was to the surface of the victim's body or clothing at the time of discharge. This determination is usually made by an unaided visual inspection for the presence or absence of substances that exit the muzzle of the gun along with the bullet with consideration of the circumstances of the shooting.

Depending on the range of fire, these substances can be deposited on the skin or clothing;

❖ Contact

Bullet, soot, powder and hot gases, circular abrasion, smoking soiling, carbon dioxide residues, no pellets marks, wad, the plastic piston inside the wound, burned hair, cruciate, stellate with skin split, and tear ragged.

❖ New Contact

Bullets, soot, powder. few centimeters burning of the skin, clubbing of melted hairs, powder tattooing, and can't be wiped out. Pseudo powder tattooing, missile fragments, fragments from intermediate targets such as glass or wire, post mortem insect bites, haemorrhage into hair follicles, medical intervention such as suture marks, and bullet ricocheting.

❖ Intermediate

Bullet and powder. reduced smoke soiling, powder tattooing persists, irregular rim "rat hole", scalloped margins, scattered satellite pellets holes present. Wad may produce patterned abrasion around the wound maltase cross.

❖ Distance

Bullet. 2-3 meters cuff of satellite pellets holes around the central wound the spread of shot in cm 2-3 times the range in meters (wound 20 cm the distance 7-10 M not a suicide).

❖ At Long Range

Bullet. The bullet begins to wobble, yaw, and tumble end over end 20-30 meters peppering of shot rarely kills wads/plastic caps fall way from the scene.



Figure 104. Gunshot wound

EXIT WOUNDS

Exit wounds tend to have everted edges, no greasing, split flaps causing stellate appearance, no burning, smoke, or powder soiling irregular multiple, very large. They may be small and fail to show the typical eversion. Some unusual exit wounds will have abraded margins.

Shored wounds are made by leaning to the wall or lying on the floor, sitting back in a chair, or supportive tight clothing such as belts, brassieres, and girdles.

RE-ENTRY WOUNDS

Bullet passed through one part of the body and then re-entered another part. The wound has the following characteristics: wider, irregular abrasion ring, irregular entrance hole whose edges are ragged.



X-Ray of the head with pellets within the cranium.

Figure 105. X-Ray of the head with pellets within the cranium



Tangential shot gun wound of the neck "Site of election" Elliptical smoking soiling below the wound. There was no exit wound, all the missiles remaining within the head.

Figure 106. Elliptical smoking soiling below the wound. There was no exit wound, all the missiles remaining within the head.

CLASSIFICATION OF GUNSHOT WOUNDS

Gunshot wounds can be divided into four broad categories, depending on the range from the muzzle to target:

❖ Contact Wounds

The muzzle of the weapon is held against the surface of the body at the time of discharge.



Figure 107. Contact range- gunshot

❖ Near Contact Wounds

These types of wounds lie in a grey zone between contact and intermediate-range wounds. In these wounds, the muzzle of the weapon is not in contact with the skin, being held a short distance away.



Figure 108. Close range- gunshot wound

❖ Intermediate-Range Gunshot Wounds

In these wounds the muzzle of the weapon is held away from the body at the time of discharge yet is sufficiently close so that powder and other residues which are expelled from the muzzle along with the bullet produce "powder tattooing" of the skin.

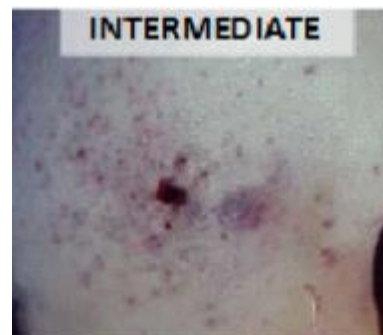


Figure 109. Intermediate range- gunshot wound

❖ Distant Gunshot Wounds

In these wounds, the only marks on the target are those produced by the mechanical action of the bullet in perforating the skin¹



Figure 110. Distant range- Gunshot wound

Most suicidal wounds are either contact or near contact and the typical sites are the center of the forehead, the temple (on the side of the dominant hand), the roof of the mouth, or the chest overlying where the heart is assumed to be. In head wounds, fragments of the scalp, skull, and brain may be dispersed over a wide area, but it is usual to find the lead pellets and wads retained within the fragmented skull.

In this case, the entry wound was not typically in the right side (the dominant hand), but the slanted nature of the entry wound and the course taken by the pellets was because the shotgun had a long barrel and it was very difficult to be placed in the right side of the head.

In most cases where such weapons are used, the weapon must be supported in some device or on the ground or against a wall, and the trigger activated either by hand or utilizing a remote control device such as a string tied to the trigger or the hand or foot.

In self-inflicted gunshot wounds, it is rare for more than one shot to be fired although few cases have reported suicide by multiple gunshots¹⁻².



Figure 111. The cause of death in this man was due to gunshot wounds. The features found around the wound and the type of destruction in the jaw and the base of the brain are in keeping with contact wound. The entrance wound was circular and about the size of the muzzle and the wound edge was regular with no marks. There was blackening of the skin around the entrance wound and the wound was elliptical, possibly because the rifle was slanted.

SUICIDE, ACCIDENT OR HOMICIDE..?

Suicide is not acceptable in any society and thus there is often objection to the ruling of death as a suicide. The objection can vary from the naive "he wouldn't do such a thing" to a sophisticated and complicated explanation for why a weapon "accidentally" discharged. These objections can be motivated by guilt, religious belief, social

pressures, or avarice. Most people contest the ruling of suicide by stating that the deceased, though previously depressed, had recently been happy. It is not common for individuals who have decided to commit suicide to show an elevation before suicide.

After all, they have solved the problem by killing themselves. Most people who commit suicide with a firearm, like suicide victims as a whole, do not leave a note. Notes are left in only 25% of all suicides¹.

In firearm deaths, it is not uncommon for the individual to attempt to make the suicide appear to be an accident.

- The first of these is the "gun cleaning accident" whereby the individual is found dead from a gunshot wound with gun cleaning equipment laid out beside him or her. The evidence that one is probably dealing with suicide and not an accident usually is the nature of the wound. By use of contact ie the nature of the wound, an individual does not place a gun against the head or chest and then pull the trigger in an attempt to clean the weapon.
- The second way an individual may attempt to make suicide appears as an accident is the "hunting accident". The individual goes out hunting and is subsequently found dead from a gunshot wound. Again the nature of the wound (contact) will indicate that one is probably dealing with suicide. In cases of homicide it can be generally said that if an individual is holding a weapon and this weapon discharges, killing another individual, this death is a homicide. This is true even if the individual who was holding the weapon did not intend to kill the other individual. The decision as to intent is not for the forensic pathologist but up to the courts.

Guns do not discharge by themselves while being held; neither do they magically go off. Someone has to pull the trigger. In all suspected suicidal

gunshot cases, swabs of the victims' hands should be taken from residues. The firearm discharged residues are usually found either on the palm or a strip of skin running along the radial surface of the index finger and palm, the ulnar and palmar surface of the thumb. Deposition of residues in this zone as well as the radial half of the palm is usually due to muzzle blast. Soot on the ulnar half of the palm is usually due to cylinder blast. The distribution of the soot also is influenced by barrel length and where the gun is held. Even if there is no visible powder or soot deposit on the hand, analysis for primer residues is often positive in addition to the swabs. Examination of the hand may reveal droplets on the hand used to fire a handgun in suicides.

Other methods used in the examination of the gun are the presence of blood or tissue and chemical tests for the identification of occult blood^{1,3}. In shotgun wounds, soot or primer residue or both are virtually never found on the hand that was used to fire the weapon. These are found on the hand holding the muzzle.

In differentiating between suicide and homicide, the questions to answer are

- i. Could the deceased have fired the weapon?
- ii. At what range was the shot fired?

Most of the suicidal wounds are either contact or near contact and have typical sites of the election. The center is the forehead, the forehead region on the dominant hand, the roof of the mouth, or the chest overlying where the heart is supposed to be.

The characteristics of the wound should be described;

- i. **Short-range** Circular or oval entrance, clean-cut, the wound margin, and the tissue within the base of the wound are usually blackened by powder and singeing of skin hairs by flame, pink discoloration of tissue along the track due to carbon dioxide. There may gross mutilation with bursting ruptures of the scalp and skull and evisceration or partial evisceration of

the brain.

- ii. **Long-range** - Subsidiary pellet holes, created or scalloped margins, satellite holes, small wounds around the main wound, peppering of the skin from individual pellets. "The maximum diameter of the skin wound in inches is equal to the range in yards minus one")

"For self-inflicted gunshot wounds more than one short are rare and a short woman is a homicide until proven otherwise".

GUN CONTROL

❖ Strong gun control registration

Doctors and psychiatrists are to inform the police about patients who are not mentally stable to have a gun. The most common method of suicide in the United States and most of the other developed countries is by firearm. Males form the great majority. For women, while drugs are still more popular as a method of suicide, they are gradually being supplanted by firearms.

Gunshot wounds are either penetrating when a bullet enters an object and does not exist, or perforating when the bullet passes through the object¹.

The availability of guns to most of the people makes suicide and also homicide by firearm common in the USA. The recent strict gun control in Australia following the mass shooting in Tasmania is a positive move towards a reduction of these cases. The first question to be asked is it necessary to have a gun in the house, especially in the city?

In general, guns are made to kill people and the fact that some people use them for hunting is being taken increasingly as an insufficient reason for obtaining a firearm. In those few cases where the use of a firearm for hunting or sporting purposes is required, the group should get the

guns on the material day, such as from a police station and return the gun after the sport.

The fact that somebody is regarded as being of sound mind to take care of the gun is a risky affair because in today's society there is such a lot of stress and it seems that on occasions, apparently rational people can be tipped over the edge into psychosis⁵⁻⁹.

FEATURES OF SUICIDAL DEATHS FROM A HANDGUN

❖ Features of contact and near-contact wounds

- Site of election; It could be the anterior part of the chest, the roof of the mouth, temporal region, neck, forehead, and abdomen.
- Weapon at the scene of death.
- One-shot fired - a few exemptions.
- Sex – i.e a shot woman is a murdered woman until proven otherwise.

NB - Nape of the neck execution site in terrorism and assassination.

❖ Laboratory Tests

- Swabs on the skin are taken for residues; (without formalin) for propellant residues, pellets, bullets, and wads preserved without damage.

Short gun injuries are homicidal unless proven otherwise and full investigation should be carried out in scene and photography.

BOMB BLASTS

The core objectives in the investigation of the bomb blast crime scene are:

- Identification of the number of bodies
- Reconstruction of the circumstances of death.
- Identification of organs (sex)
- Determination of the cause of death (X-ray)
- Circumstances of the death; ie. The position of the victims at the time of the blast, patterns, and severity of injuries, innocent bystanders, and terrorizer.



Figure 112. Bomb blast explosion

CHARACTERISTICS OF INJURIES FROM BOMB BLASTS

❖ Complete Disruption

- The wide dispersion of the body parts by the blasts.
- Jaws and fingers may be blown off
- Fragments and injuries may be confined to one area
- Extensive mutilating injuries of extremities.

❖ Explosive Injury

- Massive haemorrhage in the lungs due to shock waves following the blast.
- Fragments of the bomb may be trapped within the tissue or clothing.
- Cloths may be flown off by the blast and maybe recovered away from the victim.
- The articles belts, buttoned collar, laced boots are retained in the body.
- Burns with phosphorous and magnesium are frequently additives to the bombs and grenades and may be found as systematic poisoning in survivors.
- Injuries by falling masonry crush asphyxia.
- Burns, seinging of eyebrows, eyelashes, and scarring of protected regions such as the foot.
- Pulmonary haemorrhage, ear perforation of tympanic the membrane, and rupture of the eardrum - deafness.

Chapter Ten

Sudden Deaths

INTRODUCTION

The WHO defines "sudden death" as a death that takes place within 24 hrs from the outbreak of the symptoms of the disease. The word "sudden" (instantaneous) is descriptive of the rapidity of death, while "unexpected" is related to the surprising character of death in describing the discrepancy between the death and the non-existence or mildness of the illness. Violent deaths are not included in this category. Sudden deaths may occur without preceding symptoms or diseases. Sudden unexpected deaths typically take place outside the hospital and the ante-mortem symptoms and the circumstances of the death are known¹. Most of the causes of sudden deaths are due to the cardiovascular system although other systems may also contribute.

CAUSES OF SUDDEN DEATHS

❖ Common Cardiac Causes

Common cardiac causes of sudden deaths in children and young adults include the following ;

- Coronary artery atherosclerosis,
- Left ventricular hypertrophy (idiopathic and with hypertension,
- Myocarditis,
- Hypertrophic cardiomyopathy
- Dilated cardiomyopathy (including alcoholic)
- Aortic dissection especially Marfan's syndrome

- Coronary arterial anomaly
- Arrhythmogenic right ventricular dysplasia,
- Cardiac sarcoidosis,
- Conduction abnormalities, such as Woolf-Parkinson syndrome
- Cocaine abuse
- Coronary artery vasculitis²⁻⁵.



Figure 113. *Coronary atherosclerosis with calcification of the wall and cholesterol clefts*

Non-Cardiac Causes

Other causes of non-cardiac sudden unexpected deaths include the following;

- Asthma and other allergic condition
- Diabetes mellitus

- Cancer Haemorrhage
- Intestinal volvulus
- Atopic skin inflammation
- Metabolic and biochemical Hypo and hyperkalemia Thyrotoxicosis, pheochromocytoma
- Haematological - sickle cell crises, DIC.
- Acute renal failure
- Old age - Above 90 yrs
- Maternal Death - Delivery
- GIT -Acute pancreatitis, liver fatty change, esophageal variceal bleeding.

The first consideration on top is to exclude an undiagnosed congenital abnormality and it is always best to dissect the coronary arteries before any incisions have been made in the heart. Mediastinal radiation therapy may be a risk factor for premature atherosclerosis although blood should be taken for all patients with severe atherosclerosis before the age of 40 years for estimation of cholesterol levels and HDL: LDL ratio. Most cases of aortic dissection in young patients are associated with Marfan's syndrome, but a few cases of spontaneous coronary artery dissection have been recorded².

❖ Other Causes

- Alcoholism due to several mechanisms such as hypoglycemia, hypomagnesemia, fat embolism caused by fatty liver or disturbances in the function of the heart caused by alcohol
- Infections, in particular meningitis, pneumonia, cerebral malaria in tropical countries, acute asthmatic attack, and epilepsy have also been attributed to sudden unexpected deaths in young healthy individuals.
- Recently acute emotional stress has also been associated with sudden deaths

mainly due to lethal arrhythmia caused by autonomic nervous or biological abnormality⁷.

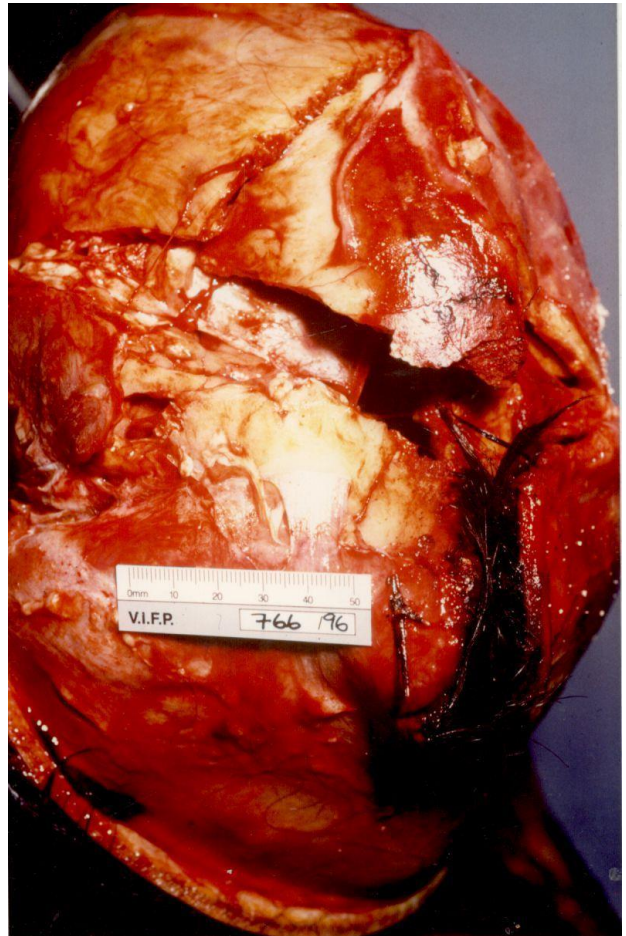


Figure 114. Coronary artery atherosclerosis with a thrombus

INVESTIGATION OF SUDDEN DEATHS

The investigation and explanation of the sudden death of a young healthy person can be an emotionally and technically demanding task for the pathologist. Even though these cases usually do not lead to legal proceedings, the need to answer the questions of public officials and grieving families gives these cases a high priority. Although some cases may be straight forward with obvious abnormality or pathology, some cases require detailed examination, both gross,

microscopically, and to some extent full toxicology to rule out any possible iatrogenic causes.

MYOCARDIAL PATHOLOGY

RUPTURED MYOCARDIUM

Myocardial rupture is variably reported to account for 3-13% of deaths with acute infarction. Rupture is common in women and occurs at above mean age for myocardial infarction and in general, is associated with hypertension¹

The majority of infarctions that cause extensive rupture area in the anterior wall of the left ventricle and the area of necrosis is not necessarily large. Spontaneous rupture of myocardial infarction is generally rapidly fatal². The mortality rate of myocardial rupture exceeds 90% and it is the second most common cause of death in-hospital deaths after myocardial infarction in patients with cardiac problems. The patients at most risks for rupture include elderly patients with no previous cardiovascular history, (women risk four times greater than men) patients with their first transmural infarction and patients with a history of hypertension that persists after infarction. Rupture usually occurs approximately five days after the acute infarction. Rupture of the free wall of the left ventricle usually leads to haemopericardium and immediate death from cardiac tamponade other than for a few minutes¹⁻³.

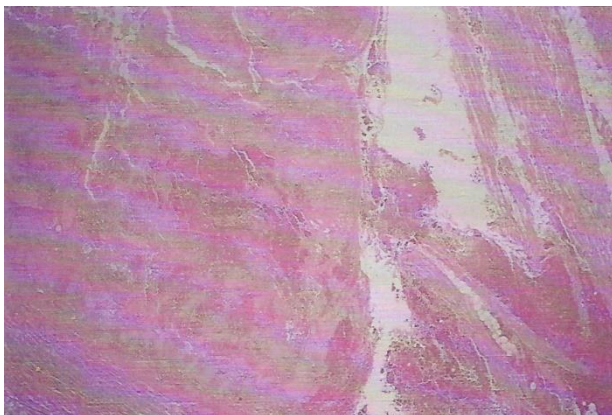


Figure 115. Ruptured myocardium with necrosis and haemorrhage

The myocardial rupture was therefore the terminal event. Rupture of the left ventricular free wall (ie including lateral, posterior, and inferior segments) is by far the most common and catastrophic type of myocardial rupture, although rupture can also occur through the interventricular septum, the papillary muscles and rarely the right ventricle.

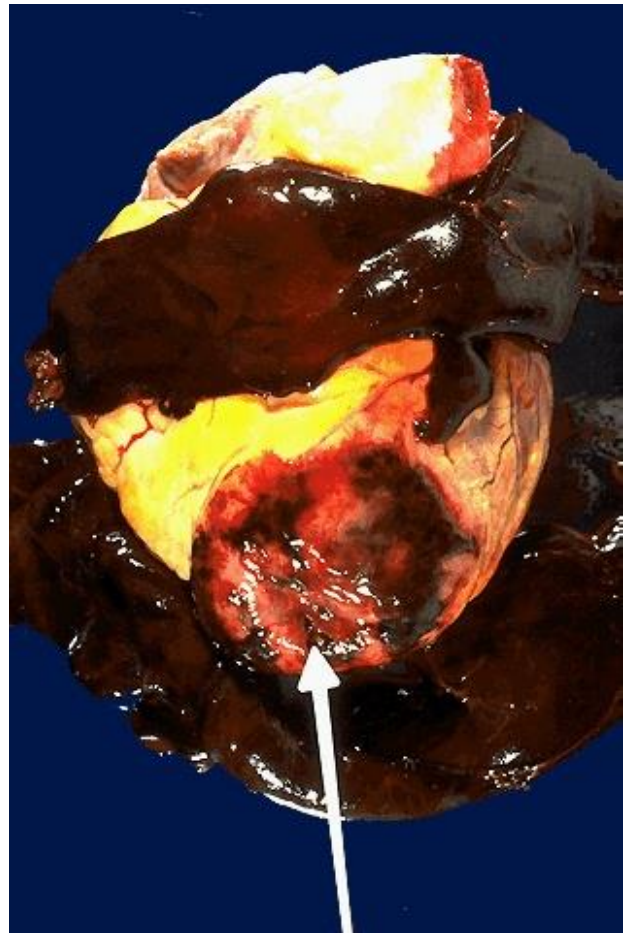


Figure 116. One complication of a transmural myocardial infarction is the rupture of the myocardium. This is most likely to occur in the first week between 3 to 5 days following the initial event when the myocardium is the softest. The white arrow marks the point of rupture in this anterior-inferior myocardial infarction of the left ventricular free wall and septum. Note the dark red blood clot forming the hemopericardium. The hemopericardium can lead to tamponade

Acute myocardial rupture often presents dramatically, with sudden chest pain followed rapidly by vascular collapse, electromechanical dissociation, and death. Survival is extremely rare; occurring only in patients who undergo rapid pericardiocentesis or thoracotomy, and prognosis depends on the site of myocardial infarction, operative repair, and clinical presentation¹⁻⁵.

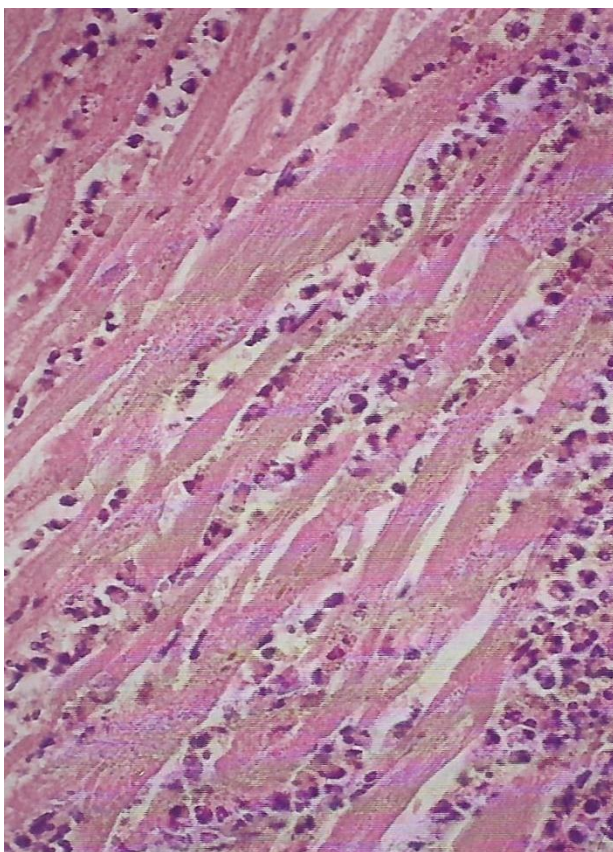


Figure 117. Acute inflammatory infiltrate to the ruptured myocardium

The deceased had had a previous myocardial infarction. A recent myocardial infarct had led to necrosis and rupture of the myocardium and cardiac tamponade leading to her death.



Figure 118. Ruptured myocardial infarction in an elderly lady. Death was instant.

DETECTION OF MYOCARDIAL INFARCTION

❖ The Aging of Myocardial Infarcts

Myocardial infarcts are aged depending on the macroscopical appearances. Macroscopically the most determining features are the color of the myocardium although less helpful. The earlier change after infarction is that involved areas of myocardium appear paler and dryer than normal. Sometimes, focal, blotchy, red-purple areas of haemorrhage are found. This occurs in the first 48-72 hours.

As soon as any degree of leucocytic infiltration has occurred, the infiltrated areas become yellow-brown in color. In about four days a fine yellow

line or border can be seen around its periphery. As the infiltration becomes more extensive, this yellow band becomes broader in external and sometimes even a yellow-green in color in six to eight days.

At three to four weeks, usually, only small islands of necrotic muscle are found, and these are surrounded by granulation tissue. As this granulation tissue becomes older its collagen content increases and the capillaries are compressed and less prominent. As a result of this, it becomes much paler and appears somewhat gelatinous. As the infarct becomes older it contracts more and more and eventually is transformed into a shrunken, firm, white, fibrous scar. It presents this appearance after about two to three months, and grossly no further change can be seen to take place⁶⁻⁷.

The age of an infarct can also be judged fairly accurately from the histologic pictures during the first three weeks. After this, the estimation is not very accurate.

The histologic changes are as follows:-

- In the earliest infarct, one about a half-hour old, ill-defined areas showing interstitial edema, congestion, and small haemorrhages may be found. The cross striations of the muscle fibres are decreased.
- By twelve hours there were also areas of hyaline necrosis of the muscle fibres, pyknosis or disappearance of muscle nuclei, polymorphonuclear leucocytic infiltration, and a few mononuclear cells.
- In the twenty-four-hour infarct, hyaline necrosis of the muscle is increased and the necrotic fibres become fragmented and invaded by polymorphonuclear leucocytes, and also the connective tissue around the blood vessels and beneath the endocardium may contain mitotic figures.
- These fibroblasts increase in number by forty-eight hours and after five days there is a well-defined zone of these cells at the periphery of the infarct.

- At six days definite plasma cells are found among the infiltrating cells.
- From eleven to eighteen days, the necrotic muscle gradually decreased in amount and is slowly replaced by connective tissue. Mitotic figures in the fibroblasts gradually decrease in number.
- At eighteen days the infarct becomes a well-defined scar, although necrotic muscle, monocytes, polymorphonuclear leukocytes, and lymphocytes may be still present.
- At sixty-seventy days very small areas of necrotic muscle are still present but the connective tissue becomes condensed and the cellular infiltrates disappears⁶⁻⁷.



Figure 119. Cardiovascular pathology

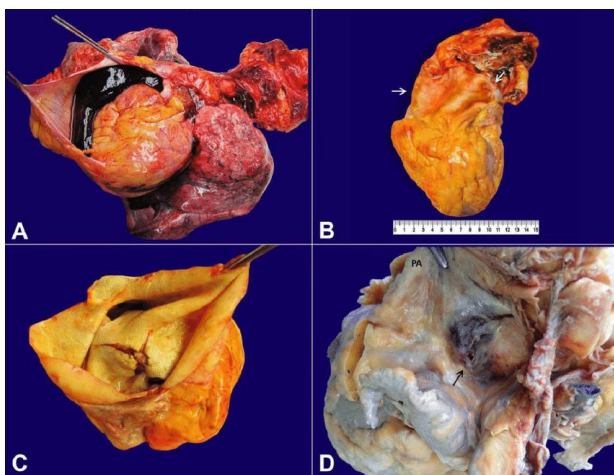


Figure 120. Gross view of the heart and ascending aorta. A-A clot within the pericardial sac, which was responsible for cardiac tamponade;

B-External view of the anterior aspect of the entire heart showing the aneurysm of the ascending aorta, which measured 8.5 cm in diameter (white arrows);

C-Internal view of the aorta, showing a fractured atheromatous plaque;

D-The heart after formalin fixation. The left lateral view of the heart base and intrapericardial segments of the pulmonary trunk (PA) and aorta, showing the orifice of rupture with a surrounding hematoma (arrow).

MICROSCOPY

Apart from the gross and histological aging and detection of myocardial infarcts biochemical parameters and staining techniques can be used.

Myocardial ischemia may remain macroscopically and microscopically undiagnosed when it is the result of acute and hyperacute processes in which tissue damage can only be reflected by the release of biochemical markers before structural lesions can occur. The myoglobin concentration, total creatine kinase, creatine kinase MB isoenzyme, lactate dehydrogenase, myosin and cathepsin D reach the pericardial fluid via passive diffusion and ultrafiltration due to pressure gradient and can be detected in this fluid earlier than serum in cases in

which reliable morphological findings are lacking⁸.

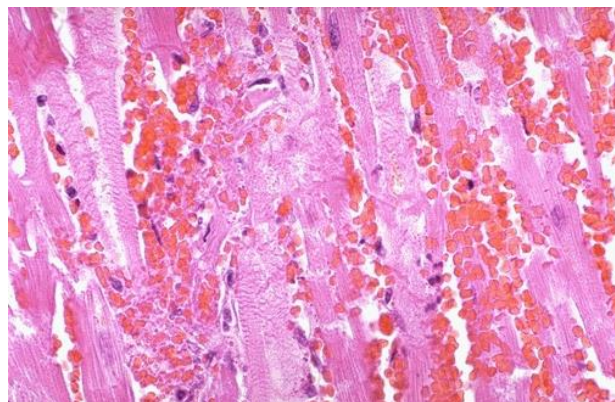


Figure 121. Acute myocardial infarction, 1-2 days

In this microscopic view of a recent myocardial infarction, there is extensive hemorrhage along with myocardial fiber necrosis with contraction bands and loss of nuclei.

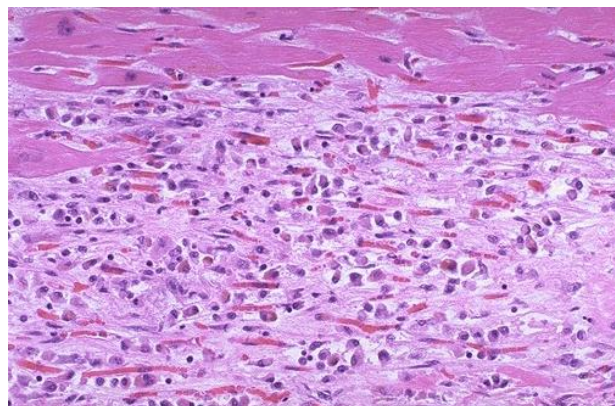


Figure 122. Intermediate myocardial infarction, 1-2 weeks

This is an intermediate myocardial infarction of 1 to 2 weeks in age. Note that there are remaining normal myocardial fibers at the top. Below these fibers are many macrophages along with numerous capillaries and little collagenization.

❖ Nitro – BT Test Technique

This technique depends on the absence of a myocardial enzyme in the infarcted myocardium when compared with the surrounding myocardium. When myocardium is stained using this technique normal myocardium produces a

purple-blue reaction but ischaemic myocardium, with its loss of enzyme activity should remain unstained⁸.

MYOCARDITIS

Myocarditis is the inflammatory involvement of the heart muscles. Most cases of well-documented myocarditis of **viral origin** are those of coxsackie virus group B, ECHO, Influenza virus, HIV, Cytomegalovirus, Mumps, Measles, Rubella, Infectious hepatitis, chicken pos, Infectious mononucleosis, and poliomyelitis.

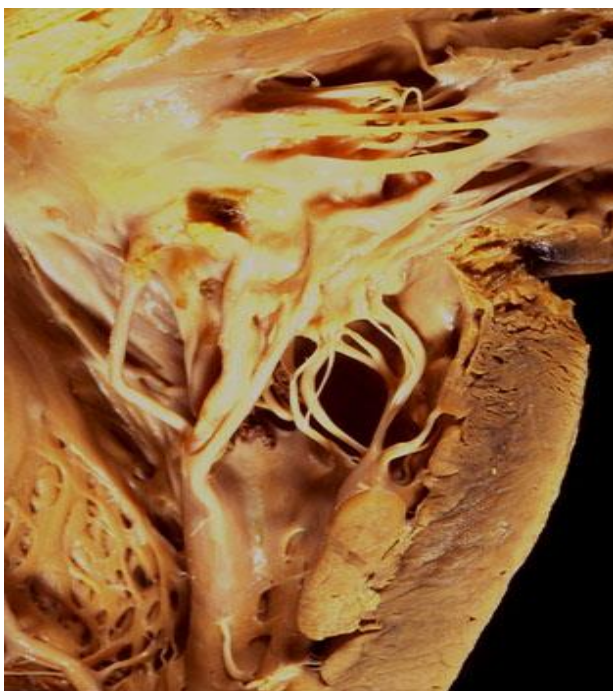


Fig 123. Chronic rheumatic valvulitis

In time, chronic rheumatic valvulitis may develop by the organization of the acute endocardial inflammation along with fibrosis, as shown here affecting the mitral valve. Note the shortened and thickened chordae tendineae.

Myocarditis occurs at any age but is more common in infants, immune-compromised people, and also pregnant women who are more vulnerable.

OTHER CAUSES OF MYOCARDITIS

- Bacterial -Staphylococcus, pneumococci, Meningococcal, Streptococcal, Diphtheria, and leptospira.
- Rickettsial -Scrub typhus, Epidemic typhus, rocky mountain spotted fever, and Lyme disease (Borrelia Burgdorfer).
- Protozoal -Toxoplasmosis, Chaga's disease, and sarcosporidiosis.
- Granulomatous myocarditis -Tuberculous, Fungal, sarcoidosis, Syphilitic, Wegener's granulomatosis, Fielder's, and chronic rheumatic valve disease.
- Noninfective- Metabolic and hypersensitivity myocarditis -Drugs eg sulphonamides, Adrenal tumours, Radiation, Collagen, and an expression of transplant rejection.

MACROSCOPIC, MICROSCOPIC FEATURES AND SPECIALIST TESTS

❖ Macroscopic

The myocardium may be normal, globular, flabby, enlarged or dilated. Ventricular myocardium is typically flabby with foci of minute haemorrhagic lesions. Mural thrombosis is common in any chamber.

❖ Microscopic

Mostly lymphatic Interstitial mononuclear infiltrate with focal necrosis. Cardiac damage due to direct viral cytotoxicity, Immune mediated of myocardial inflammatory lesions.

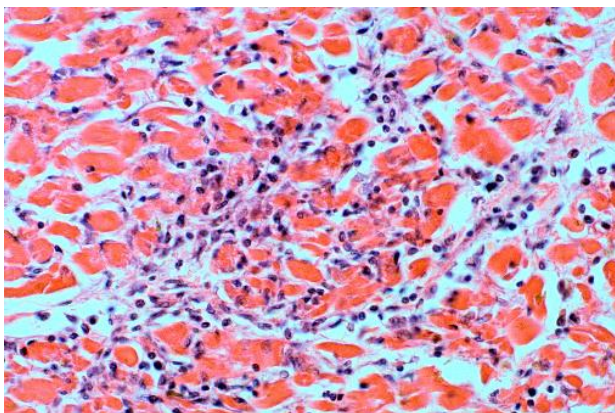


Figure 124. *Interstitial viral myocarditis-microscopic*

The interstitial lymphocytic infiltrate shown here within the myocardium are characteristic for viral myocarditis, which is probably the most common type of myocarditis. Many of these cases are probably subclinical. Viral myocarditis can be a cause for sudden death in young persons. There is often minimal myocardial fiber necrosis. The most common viral agent is the Coxsackie B virus.

❖ Dallas Criteria

- Inflammatory infiltrate -Lymphocytes (in hypersensitivity infiltrate rich in eosinophils)
- Myocyte necrosis or degeneration, frank necrosis, vacuolation, or disruption.

❖ Specialist Tests

- a) PCR
- b) In-situ hybridisation.
- c) Viral cultures.

CARDIOMYOPATHY

Cardiomyopathy: A disease of the heart muscle when hypertension, valve disease, congenital, or coronary artery disease has been excluded.

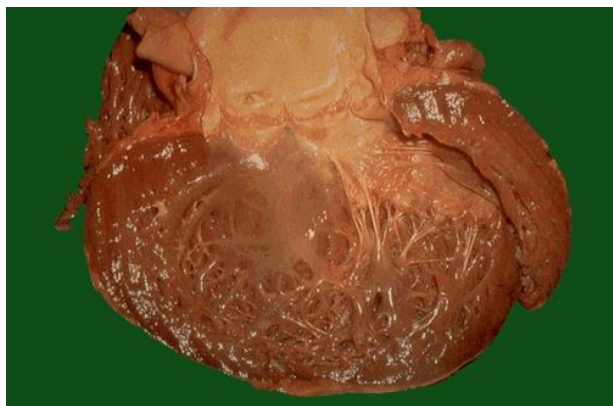


Figure 125. *Heart dilated cardiomyopathy*

Here is a large, dilated left ventricle typical of a dilated, or congestive, cardiomyopathy. Many of these have no known etiology (so-called "idiopathic dilated cardiomyopathy") while others may be associated with chronic alcoholism. The heart is very enlarged and flabby.

❖ Microscopy

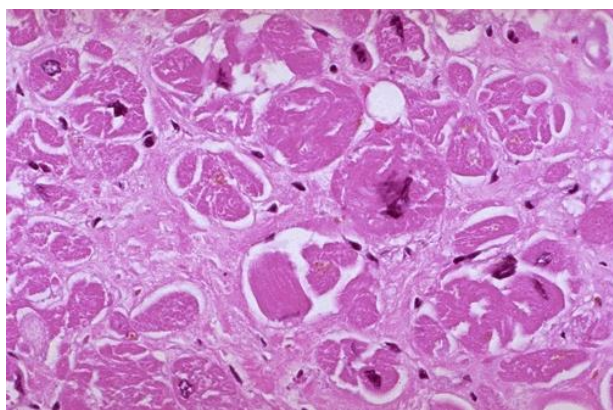


Figure 126. *Microscopically, the heart in cardiomyopathy demonstrates hypertrophy of myocardial fibers (which also have prominent dark nuclei) along with interstitial fibrosis.*

TYPES OF CARDIOMYOPATHY

- **Idiopathic dilated cardiomyopathy** - Failure of the ventricle to adequately empty in the systole (congestive cardiomyopathy) -Systolic failure -5% familial -Autosomal dominant variable penetrance.

- **Hypertrophic cardiomyopathy** - Obstruction to ventricular filling is diastole -Diastolic failure (Idiopathic hypertrophic subaortic stenosis) (Asymmetric septal hypertrophy)

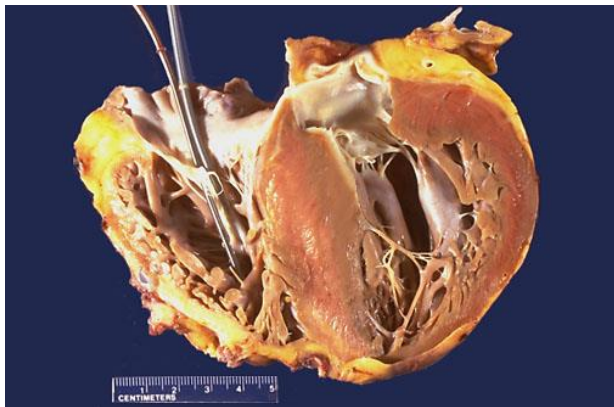


Figure 127. Hypertrophic cardiomyopathy, explanted heart

There is marked left ventricular hypertrophy, with asymmetric bulging of a very large interventricular septum into the left ventricular chamber. This is hypertrophic cardiomyopathy. About half of these cases are familial, though a variety of different genes may be responsible for this disease. Both children and adults can be affected, and sudden death can occur. Seen here is the explanted heart. Pacemaker wires enter the right ventricle. The atria with venous connections, along with great vessels, remained behind to connect to the transplanted heart (provided by someone who cared enough to make transplantation possible)

- **Restrictive cardiomyopathy** - Stiffening of the ventricular wall by a process.

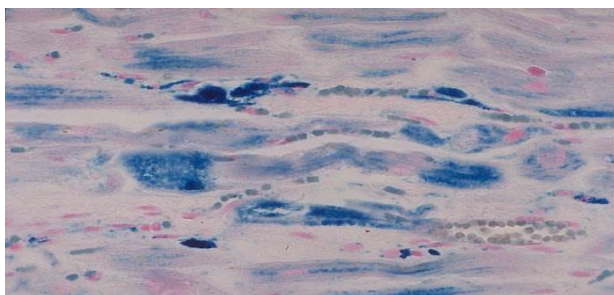


Figure 128. Restrictive cardiomyopathy from hemochromatosis- Microscopic

Hemochromatosis, with excessive iron deposition, can occur in the heart as shown here microscopically with Prussian blue iron stain. The excessive deposition of iron leads to heart enlargement and failure similar to cardiomyopathy, making hemochromatosis a form of "restrictive" cardiomyopathy.

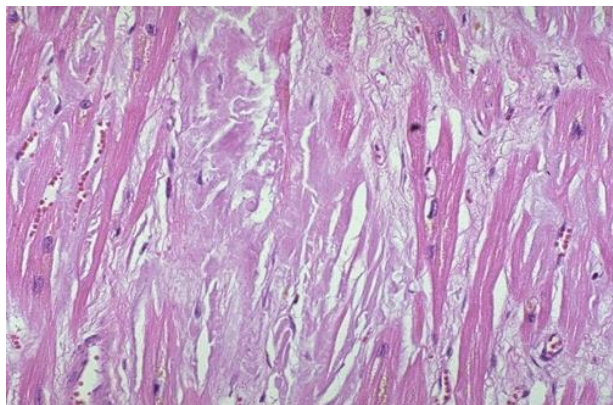


Figure 129. Restrictive cardiomyopathy from amyloidosis- Microscopic

This section of myocardium shows amorphous deposits of pale pink material between myocardial fibers. This is characteristic of amyloid. Amyloidosis is a cause for an "infiltrative" or "restrictive" form of cardiomyopathy. It is a nightmare for anesthesiologists when intractable arrhythmias occur during surgery on such patients

- **Obliterative cardiomyopathy** - Common in tropics gradual obliteration of the ventricular cavity. -Endomyocardial fibrosis
- **Familial cardiomyopathy** (10%)
- **Peripartum cardiomyopathy**
- **Alcoholic cardiomyopathy** -Dose-related toxic effects on striated muscle, skeletal, and cardiac muscles.
- **Adriamycin cardiomyopathy** 550 mg accumulated dose.

- **Infiltrative cardiomyopathy** - Amyloidosis, heamosiderin, hemochromatosis, and glycogenolysis.

HISTOLOGY

- Muscle fibre hypertrophy
- Short-run fibres interrupted by fibrosis,
- Focal fibre degeneration
- Bizarre muscle nuclei, and a disordered whorled cross over arrangement or eddy patterns.

CONDUCTING SYSTEM

❖ Post Mortem Examination

5% of myocardial infarcts patients develop some degree of heart block and they are a common cause of death.

❖ Congenital Conduction Defects

- Wolff Parkinson White Syndrome

It can cause death. The heart is fixed in a distended state after the removal of blood and packed with cotton wool. The right atrium is opened anteriorly allowing access to the anterior. The superior vena cava is left intact. The auricular appendage of the right atrium is identified and from the crest extends to about the superior vena cava -The Sino Atrial node is situated at this side, and the block is taken here.

❖ Landmarks of Anterior Right Atrium

Coronary Sinus - The AV node is just anterior to the coronary sinus and the bundle branches pass towards at this point before dipping down into the septal myocardium.

- Two blocks are taken for conducting the system by opening the superior vena cava

and continuing the cut into the right atrial muscle and five longitudinal sections are taken.

- The SA node is sampled by taking the area produced by the vertical cut anterior to the coronary sinus traversing the tricuspid valve ring and into the ventricular muscle.
- A parallel cut is then made through the supraventricular crest and again into the ventricular muscle.
- The two incisions are joined above and below by two horizontal incisions.
- This block is divided into two halves horizontally, leaving the conducting system in the lower block and horizontal blocks can be taken from this.
- The upper block is sectioned vertically from anterior to posterior and this contains AV node and bundle branches.

Pathology is seen in the conducting system

- Mesothelioma is the A-V node.
- Anomalous conduction path (Mahram type)
- Absent right branches
- Hypoplasia of main bundle/branches.
- Fibrosis bundle branches
- Medial hyperplasia of nodal arteries.
- Presence of mononuclear cells in close proximity to the conducting tissue (myocarditis)
- Fibro fatty changes in the conducting system.
- Presence of myxoid ground substance in the cardiac skeleton.
- Sarcoidosis
- Sub endocardial hamatomatic lesion.

Sudden death in a young man involved in a fight outside a public house, whilst being

restrained by police officers. post mortem investigation and possible findings as to the cause of death.

Death during police restraint is generally viewed with extreme suspicion by authorities, the media, and the public alike.

It is extremely important for the pathologist to obtain a detailed report of events surrounding the death, conduct, and a careful describing and photographing of all findings and submit toxicology specimens.

The most likely causes of death in such circumstances are;

- Head injury-Vertebral artery trauma with rupture due to the injury of the artery at C₁-C₂ as it enters the vertebral canal into the cranium
- Syndrome of sudden death occurring during agitation delirium due to drugs.
- Catecholamine release due to stress can also cause sudden death.

The likely causes of sudden death in young athletes during competitive exercises

A death that takes place within 24 hours from the outbreak of the symptoms of diseases.

"Sudden" (Instantaneous) is a description of the rapidity of death,

"Unexpected" Surprising character of death in describing the discrepancy between the death and the non-existence or mildness of the illness.

Violent deaths are not included in this category.

CAUSES OF SUDDEN DEATHS

❖ CVS- Cardiovascular System

- Cardiomyopathy -Dilated or hypertrophic. Alcoholic cardiomyopathy Congestive cardiomyopathy, Hypertrophic obstructive

cardiomyopathy

- Hypertensive heart disease-coronary artery atherosclerosis
- Coronary artery spasm or arterial anomaly
- Coronary artery bridging
- Diffuse myocardial disease (myocarditis, amyloidosis, sarcoidosis)
- Conducting system abnormalities (eg Wolff Parkinson White Syndrome).
- Coronary artery vasculitis (Kawasaki's disease)
- Coronary thrombosis
- Mitral (floppy) valve prolapse -Marfan's syndrome)
- Conducting system disorder (pre-excitation -Wolf Parkinson White syndrome, A-V block, Stroke Admass attacks syncope occurring in patients with A-V heart block the first attack.
- Mesothelioma (rhabdomyoma fibromas)
- Sudden emotional stress
- Aneurysm -Atherosclerotic, traumatic syphilitic, mycotic, berry.

❖ CNS – Central Nervous System

- Subarachnoid haemorrhage -ruptured aneurism
- Cerebral haemorrhage – Tumour
- Brain necrosis

❖ Drugs

- Alcoholism -Due to several mechanisms
- Hypoglycemia, hypomagnesemia, fat embolism, caused by fatty liver or disturbances in the functions of the heart caused by alcohol or cardiogenic death caused by the cardiotoxic effects of

alcohol.

- Drug abuse -Cocaine, Amphetamine
- Cocaine abuse/Solvent abuse (Arrhythmia's/cerebral haemorrhage)

❖ Infections

- Meningitis (adrenal haemorrhage), cerebral malaria, pneumonia.
- Plaque
- Ligonier's disease
- Food poisoning -salmonella, shigella, E Coli, staphylococcus aureus, clostridium.
- Haemolytic uraemic syndrome
- Bronchopneumonia, bronchitis, Aspiration, haemorrhage.

MEDICAL DISEASES

EPILEPSY

Epilepsies are a group of disorders characterized by chronic, recurrent, paroxysmal changes in neurologic function caused by abnormalities in the electrical activity of the brain.

Epilepsy affects 0.5-2% of the population and can occur at any age and 1-1.5% of all "natural" deaths.

❖ Types of Epilepsy

- Grand mal (Tonic-clonic)
- Petit mal (Absence seizures)
- Myoclonic seizures
- Infantile spasms or his arrhythmia
- Temporal lobe epilepsy.

❖ Causes of Epilepsy

There are many causes of epilepsy and they depend on the age of onset.

- **In Infants:** Hypoxia, ischemia. Infection, metabolic congenital, and genetic.
- **In Children:** Acute infections, febrile convulsions, trauma, idiopathic.
- **In Adolescents:** Idiopathic, Trauma, Drug, & alcohol withdrawal, A.V malformations
- **In young adults:** Trauma, Alcoholism, Brain tumor
- **In older adults:** A brain tumour, cerebral vascular disease, Metabolic disorders, (Uremia, Electrolite imbalance, hepatic failure, Hypoglycaemia,) and alcoholism.

❖ Causes of death in Epilepsy

The evaluation of sudden deaths in epilepsy poses many problems for the pathologists. Lack of compliance although therapeutic levels do not exclude sudden death, whereby death during sleep accounts to (25-50%) and lack of neuropathological lesions is up to (30-40%).

Full history with circumstances of the scene must be known and careful autopsy carried out to rule out mechanical asphyxia.

- **Status Epilepticus;** Tonic-clonic seizure accompanied by excess catecholamine release from the adrenal medulla predisposing to cardiac arrhythmias.
- **Asphyxia** during a fit in bed when the face is pressed into the pillow and saliva and mucus form an airtight seal against the fabric around the mouth and nose or respiratory obstruction with the aspiration of gastric contents.
- **Drowning** in bath-tub due to hypoxia resulting from either laryngeal spasm or inhalation of water, which occludes the airways. However, sudden reflux death due to autonomic discharges resulting in cardiac arrhythmia could also occur.
- Other massive cerebral electric discharge

or neural storm occurs leading to cardiac arrest.

- Other traumatic deaths e.g. MVA, Burns e.t.c
- **Myocardial fibrosis** (Pachy) due to episodic apnea during the fit. Epilepsy by itself may be the cause of ischaemic or hypoxic cardiomyopathy.
- Toxicity of antiepileptic drugs both carbamazepine and phenytoin can affect cardiac conduction and strokes, of which Adams attacks have been associated with their use.
- Antiepileptic withdrawal or a change in dose may precipitate a serious cardiac arrhythmia during and after a seizure.
- The vast majority die in bed at night.
- Failure to maintain an adequate level of prescribed anticonvulsant medication. Status epilepticus Tonic-clonic seizures excess catecholamine released from the adrenals cause cardiac arrhythmias.
- Fit Status epilepticus respiratory arrest hypoxia.
- Atherosclerotic cardiovascular disease.
- Alcoholism
- Sleep is a predisposing factor towards sudden death in epileptics i.e a catalyst for convulsions. Generalized convulsive activity -with massive cerebral electronic discharge or neural storm leads to cardiac arrest.
- Paroxysmal autonomic dysfunction, interfering with normal cardiac or respiratory activity.
- Falls, burns, and electricity
- Drug overdose -Anti epileptic drugs carbimazole and phenytoin effect - Antiepileptic withdrawal or change in dose may precipitate a series of cardiac arrhythmias during and after a seizure.

The cause of death should be given when all the

investigations have been done.

The possible post mortem findings in an adult patient known to be diabetic who died suddenly

Fatal diabetes metabolic derangement is difficult to diagnose post mortem because of the paucity of characteristic morphological findings. It is of paramount importance in forensic pathology especially in allegation of medical malpractice.

Live hyperglycemia is an indication of diabetic derangement. Fatal diabetic derangement is generally preceded by a longer period of hyperglycemia. Body fluids that may show diabetes after death include: vitreous humor and spinal fluid.

Glycosylation of haemoglobin and total serum protein or albumin 6-8 weeks and 2-3 weeks before death respectively are not reliable methods to show hyperglycaemia just before death. Short-lived serum proteins like Alpha Anti-trypsin and Haptoglobin 4 and 2-4 days respectively are more reliable and resistant to autolysis.

Over 50% of deaths in diabetics are due to coronary artery disease. The prevalence of clinical coronary artery disease is higher in the presence of hyperglycaemia than in its absence.

POSSIBLE OPERATING FACTORS IN DIABETICS

- An increase in the extent and degree of atherosclerosis -claudication, gangrene, impenitence silent myocardial fibrosis, cardiomyopathy, and stroke common.
- History of atherosclerotic plaques -plaque necrosis leading to thrombosis -The rate and mode of plaque growth with particular references to mural thrombus - Atheromatous aneurysm rupture
- Microangiopathy
- Platelet functions and fibrinolysis.

- Possible changes in the susceptibility of affected tissues to partial deprivation of their blood supply.
- The high plasma level together with hyperglycemia is the essential pathogenetic factor in producing the hyperglyceridemia
- Hypertension -cigarette smoking cardiac disease and Emphysema
- Retinopathy
- Nephropathy -Diffuse and nodular glomerulosclerosis and mesangial thickening (Kimmelsteel - Wilson lesion)
- Armani Ebstein cells - diagnostic for hyperglycaemic diabetic derangement.
- Diabetic neuropathy -Peripheral, mono, and autonomic neuropathy.
- Infections, eg candida, otitis externa due to pseudomonas aerognosa, hyperviscosity.
- Hypoglycemia and hyperglycemia
- Drugs overdose -Accidental or intentional.
- Alcohol intake

DIABETIC LABORATORY INVESTIGATIONS

- Glucose
- Acetone
- Lactic acid
- Gluconized Haemoglobin, alpha antitrypsin, haptoglobin.

EMBOLISM

Embolism as a cause of sudden death and the medico-legal implication of such deaths.

- An embolism is a foreign bolus that migrates through the vascular system causing damage when it lodges at a bifurcation. It can be solid, liquid, or

gases.

TYPES OF EMBOLISMS

- **Fat embolism** - Common in trauma involving fracture of bones rarely found in burns. Lungs are the common filter followed by the brain, kidney, skin, and myocardium. Death may be delayed for 72 hours before the onset of symptoms.
- **Air embolism**- can be iatrogenically caused in intravenous injections, in abortions, barotrauma, or release of pneumothorax. It can be caused by 100-250 MLS of air introduced in vein and far much less in arteries, commonly seen in the right atrium and ventricle.
- **Pulmonary thrombo-embolism** -can be caused by trauma, surgical operation immobility in bed, child delivery, or failure to administer anticoagulants.



A blood Clot in the Pulmonary Artery

Figure 130. A blood clot in the pulmonary artery

- **Amniotic fluid embolism** -This is commonly a complication or prolonged labor death due to allergic response DIC, or blocking of the capillaries in the lung.
- **Foreign body embolism**-injection of illicit drugs
- **Mycotic embolism** - bacteria or fungi

may embolus to distant organs.

➤ **Bullet embolism.**

FAT EMBOLISM SYNDROME

Traumatic fat embolism can be demonstrated anatomically in 90% of individual with severe skeletal injuries, osteomyelitis, diabetes, surgical operation, septicemia, steroid therapy, acute pancreatitis and fatty liver in alcoholism, thermal injuries to fatty areas of the body, sickle cell disease, and IV medications of fatty material.



Figure 131. Fat Embolism and Fat Embolism Syndrome

❖ Grades of Fat Embolism Syndrome

Grades 0-4

- 0 - No embolism seen
- 1 - Embolism seen after searching
- 2 - Embolism seen easily
- 3 - Embolism seen easily in large numbers.
- 4 - Embolism present in potentially fatal numbers.

1% manifest clinical signs and symptoms are known as fat embolism characterized by:

- Pulmonary insufficiency
- Neurological symptoms
- Anaemia

➤ Thrombocytopenia

These appear 24-72 hours after injury (lucid interval) and are fatal in 10% of the cases.

Indications include;

- Sudden onset of tachypnoea, dyspnoea, and tachycardia
- Neurological Irritability and restlessness with progress to delirium and coma.
- Patechieal skin rash common mostly in front of the chest, on the face, and eyelids are caused by the impaction of fat droplets in small venules.
- Micro aggregates of neutral fat cause occlusion of the pulmonary or cerebral microvasculature.
- Free fatty acids released from fat globules results in toxic injury to the vascular endothelium.
- Petechial haemorrhage related to thrombocytopenia
- Myriad fat globules become coated with platelets thus depleting circulating platelets.

❖ Demonstration of Fat Embolism

- Oil Red O
- Sudan black
- Image analysis system
- Osmium tetroxide

Fat Emboli: Fat particles or droplets that travel through the circulation

Fat Embolism: A process by which fat emboli passes into the bloodstream and lodges within a blood vessel.

Fat Embolism Syndrome (FES): serious manifestation of fat embolism occasionally causes multi system dysfunction, the lungs are always involved and next is brain

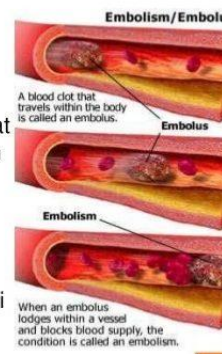


Figure 132. Fat embolism syndrome- bone and

spine

MISCELLANEOUS CAUSES OF SUDDEN DEATHS

1. PRION DISEASE

❖ Spongiform encephalopathies

These types of diseases can occur in epidemics/acquired, familial/inherited, and sporadic. These include; kuru, create Feldt -Jacob disease, Gerstman Strausser scheinker disease, fatal familial insomnia

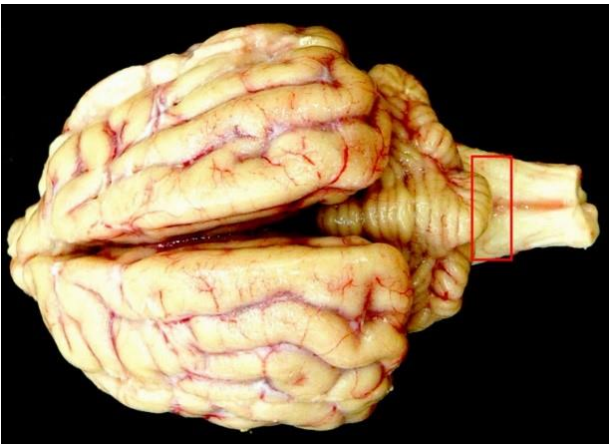


Figure 133. Bovine Spongiform encephalopathy

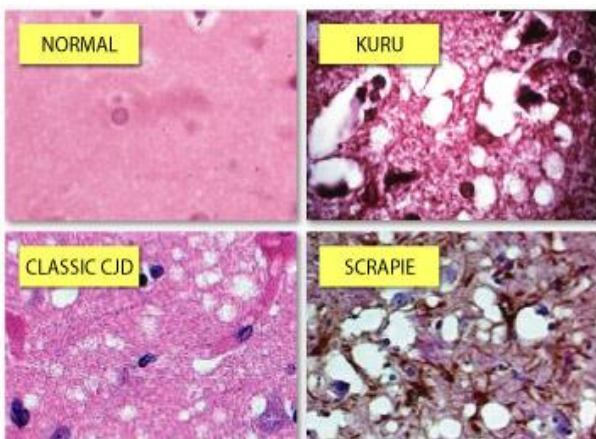


Figure 134. Microscopic representation

- No organism causing the infection is identified.
- There is Infectious abnormal protein
- The conversion of host normal prion protein to abnormal from the newly formed abnormal prion protein (PrP) - Protease resistance
- Protein goes on to convert more of the brain's normal prion protein over a while.

There has been a genetic susceptibility Homozygosity of codon 129 of the PRNP gene of chromosome 20 autosomal dominant fashion. This is a chain reaction and takes long incubation period 1-10 years and is associated with:-

- Dura matter implants
- Pituitary hormone replacement in infertility,
- Growth hormone in children with short stature, stereotactic probe, and intracerebral electrodes and corneal grafts.

❖ Clinical Presentation

- Rapidly progressive dementia
- Cerebellar ataxia
- Cortical blindness,
- Pyramidal and extrapyramidal signs,
- 70% die within six months.

❖ Histology

- Vacuolation of the neutrophil,
- Reactive gliosis, and neuronal loss in the neocortex, striatum, and cerebellum.

❖ Control

Central Nervous System

Tissue most infectious material.

Other organs like lungs, liver, kidney, spleen, lymph nodes, CSF fluid and other fluids may not be able to transmit disease.

Synthetic material,

- Discard the surgical instruments
- Avoid using organs, tissues, or blood, and other biological products.

thrombotic vessels at the skin site of the bite

- Coma
- Cardiac arrest; Cardiotoxic depolarising agent.
- Haemorrhaging lungs; alveolar septate, pulmonary congestion,
- Systemic congestion infarction,
- Fibrous strands in blood vessels in the kidney.
- Enzymatic -Proteases, hyaluronidase.

2. SNAKE BITE FATALITIES



Figure 135. Snake bite

The degree of effects depends on:

- Amount of active envenomation,
- The sensitivity of the victim
- The toxicity of the venom i.e from vipers, pit vipers, cobra, python, mambas, brown snake, tiger snake, inland taipan, and death adder. Snake venom functions as part of snake food gathering that immobilizes its victim and enables the digestive process before ingestion.
- Damage to skeletal muscles i.e Necrosis, neuropathy, subcutaneous tissue spread. neurotoxins, neuromuscles, nondepolarising blocking agents,



Figure 136. Swelling from a snake bite



Figure 137. Terrible consequences of poisonous snake bite

3. ANAPHYLAXES

- Plasma (serum) mast cell-derived Tryptase levels,
- Allergen-specific immunoglobulin E (IgE) visceral congestion,
- Pulmonary oedema,
- Angioedema of the larynx,
- Pulmonary emphysema due to obstruction.

Pathophysiology

Widespread release of histamine and other pro-inflammatory compounds from tissue mast cells.

Drugs food allergy plasma histamine.

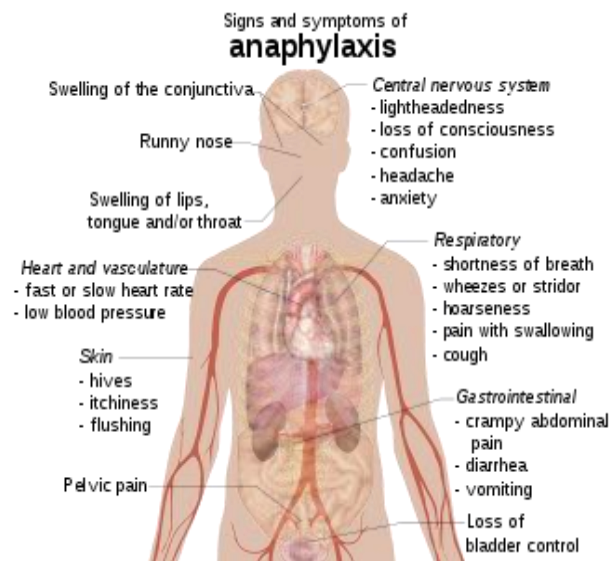


Figure 138. Signs and symptoms of anaphylaxies

COMA

A coma is a state of prolonged unconsciousness that can be caused by a variety of problems —

traumatic head injury, stroke, brain tumor, drug or alcohol intoxication, or even an underlying illness, such as diabetes or an infection.



Figure 139. Coma patient

Causes of Coma

- Alcohol
- Epilepsy
- Infection
- Opium(drugs)
- Uremia

DIVISIONS OF DISEASE

- Acquired
- Congenital
- Trauma
- Infection
- Neoplasm
- Others- Metabolic, Endocrine, and degenerative.

Chapter Eleven

Sudden Unexpected Infant Deaths Syndrome (SIDS)

DISCUSSION

Sudden infant death syndrome "SIDS". refers to the sudden death of an infant which is unexpected by history and which a postmortem examination fails to reveal an adequate cause of death¹⁻⁴.

Most of the deaths in SIDS occur in the fourth and fifth month and about 80% of deaths occur in first to six months and only about 5% in the final quarter of the first year of life. Death is indistinguishable from those of SIDS that occur in the second year, but these are uncommon and are often not included in the published data. Recent attempts to amend the definition of SIDS by excluding cases of one year and above appear therefore unjustified. The autopsy findings, toxicological screening for drugs, microbiology tests, and family history as described in most of the literature point to the classical findings seen in SIDS¹⁻⁶.



Figure 140. SIDS

The following makes the diagnosis of SIDS likely.

- Negative microbiology cultures
- Negative viral cultures
- A negative toxicology report of all the screened drugs
- Numerous petechial haemorrhages found in the skin, heart thymus, lungs
- Pulmonary congestion and oedema
- Grossly enlarged thymus gland for age weighing more than two times the normal weight for age.
- Poor social-economic environment (the mother had been having psychiatric problems as indicated in the review of the clinical history of the mother).
- Maternal drug use (the mother had been on antidepressants and anxiolytic drugs, carbamazepine, and diazepam because she had expressed some suicidal ideas in the past.
- Infection. The child had a viral infection three months before its death, although there is little evidence to support the idea that death is the result of overwhelming viral infection, the formation of immune complexes, or anaphylaxis. Infection probably acted as a trigger either by indirectly affecting the respiratory control or in the case of respiratory viral infection by narrowing the upper airways.
- Positive prolonged apneic attacks. Such episodes become known as "near-miss SIDS" or "aborted SIDS" episodes and more recently as apparent life-threatening

episodes (ALTE). This child had such attacks as seen in the history three months before her death⁵⁻⁶.

- Muscle hypotonia
- Metabolic defects, and
- Spine haemorrhage.

With these positive risk factors, postmortem findings, and negative laboratory tests, this case falls into the class of Sudden Infant Death Syndrome and due to the age it best fits the description "as non-classical SIDS".

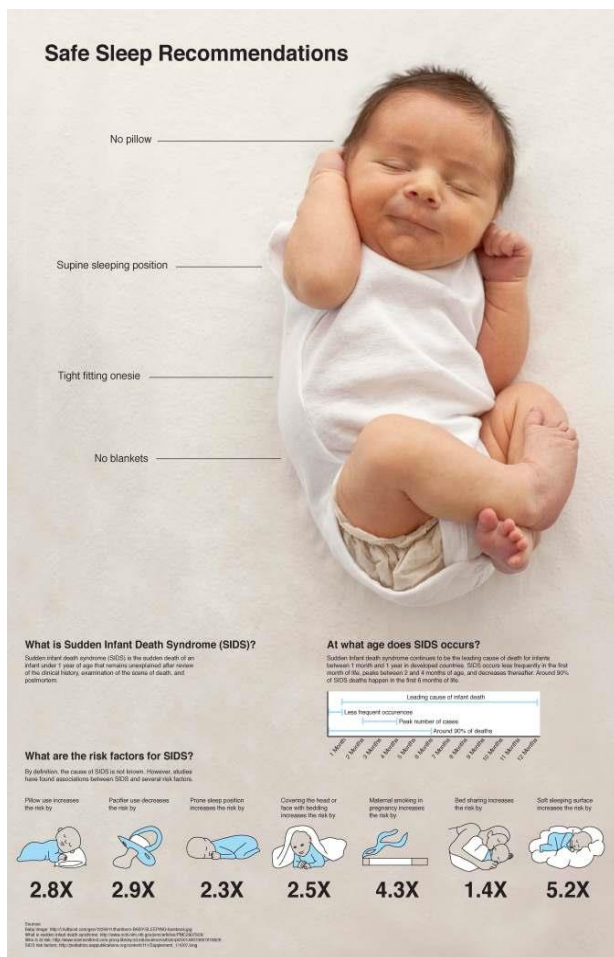


Figure 141. Safe sleep recommendations to prevent SIDS

POSSIBLE CAUSES OF DEATH IN SIDS

- Mechanical suffocation,
- Allergy to cow's milk
- Prolonged sleep apnea
- Hyperthermia
- Hypothermia,
- Viral bronchitis
- Carbon dioxide or monoxide poisoning.

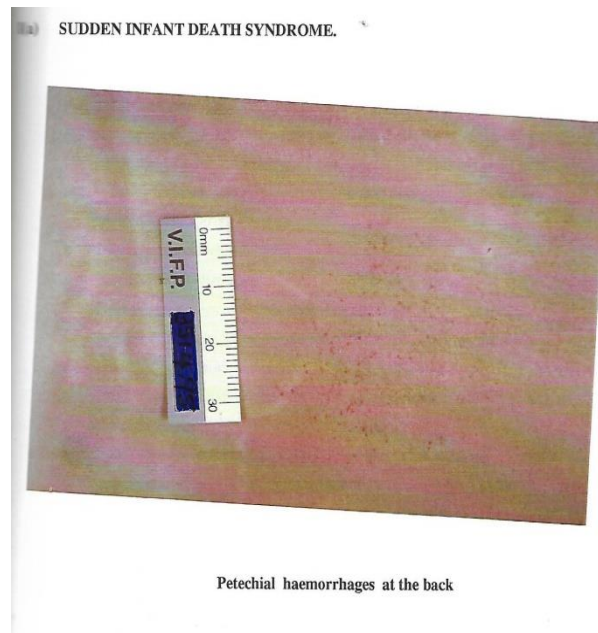


Figure 142. Petechial hemorrhages at the back (SIDS)

Many causes of sudden infant deaths have been postulated and those occurring in the neonatal period are quite different from those in the post-neonatal period. Sudden infant death syndrome has overshadowed the other causes of sudden infant deaths, owing in part to the fact that it constitutes the most common cause of postneonatal infant deaths in some western communities, accounting for one-third to one-half of all such deaths, in contrast to developing countries in the tropics where SIDS is known to be relatively uncommon⁶.

Fleming et al suggested that infants of two to three months of age may be more vulnerable to heat stress and this may be associated with some

sudden deaths in winter months and an inverse relationship between environmental temperature and the monthly incidence of SIDS in metropolitan Melbourne. The marked seasonal variation in SIDS incidence is thought to be possibly related to hyperthermia as many families tend to overwrap infants in winter months. In tropical climates, there is little variation in monthly temperatures all year-round and there is no significant association with mean monthly temperatures in the incidence of SIDS. The distinction from the true SIDS can only be made based on other information, notably the scene investigation. Furthermore, since asphyxia, whether accidental or intentional, can strongly mimic SIDS, it is even possible that on occasions murder and infanticides may masquerade as SIDS⁶.

In most cases, the pathologist has to differentiate SIDS from death due to smothering.

SMOTHERING

Smothering is death from mechanical occlusion of the mouth and nose by some sort of soft object. It might occur accidentally but not infrequently it is a mode of death in children who suffer non-accidental injury.

Smothering can be difficult to detect because pressure marks may not be found on the face if the object used is a soft, thick pillow. It is important to pay particular attention to the sides of the head and neck in such cases as the fingers of an assailant may slip over the edge of the object used for smothering and nail marks may be found on the lateral sides of the neck or any part of the face, these marks are important because, in such cases, other signs of asphyxia such as petechial hemorrhage and cyanosis are often absent.

In cases of smothering it is not uncommon that the child has suffered other forms of child abuse and the parent/s attempted to cover it by complaining of a false illness, a syndrome called Munchausen by Proxy⁶⁻⁷.



Figure 143. *Pillow smothering*

MUNCHAUSEN SYNDROME BY PROXY

This term is used in children presenting with a false illness ie with signs and symptoms fabricated by the caregiver. This is the hinterland of child abuse and one of the consequences of recognizing Munchausen syndrome by proxy abuse is that many more cases of non-accidental poisoning and smothering have come to light than detected previously. Many of these are happening in the context of repetitive illness events, but when it is only an isolated poisoning or an isolated act of smothering, it is unwise to invoke the term. Concerning children, this term can be used when.

- Illness in the child is invented by a parent or other caregiver
- The child is presented for medical assessment and care, usually persistently, often resulting in multiple medical procedures.
- The perpetrator, at least initially, denies inventing or causing the child's illness.
- The signs and symptoms diminish greatly or cease when the child is separated from the perpetrator.

Falsification Stages

There are different stages of falsification such as;

- False illness story alone
- False illness story with falsification of signs

and/or samples, and induced illness.

Although there may be escalation from the first to the third, each alone may be very harmful to the child⁷⁻⁸

Chapter Twelve

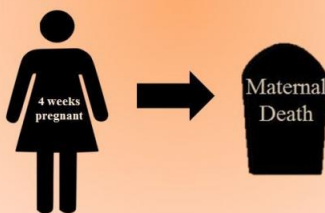
Maternal Death

INTRODUCTION

Maternal death is death during pregnancy or within 42 days of childbirth or an abortion.

Maternal death: the death of a woman while pregnant, (or within 42 days of termination of pregnancy).

- irrespective of the duration and the site of the pregnancy



Population Research Institute: ppi.org

Figure 144. Maternal death

Forensic Investigations of PeriPartum Maternal Deaths

- Death due to complications of pregnancy, labor, or peripartum.
- Death can be due to Direct, Indirect, or fortuitous causes.

❖ Direct Causes of PeriPartum Maternal Deaths

- Pulmonary embolism; risk factors being Immobilisation, obesity, and operation.
- Hypertensive diseases of pregnancy i.e

(pre-eclampsia or eclampsia), Intracranial and pulmonary complications, cerebral haemorrhage, necrosis, and cerebral oedema.

- Anaesthesia
- Amniotic fluid embolism; Foetal epithelial squames, lanugo hair, vernix, mucin, and meconium, demonstrated by special stains Lendrum's -Phloxine -Tartrazine alcian blue-green stain, or Attwood's stain. The buffy coat of pulmonary arterial blood may reveal evidence of fetal squames.
- Abortion; infections mainly coliforms, streptococci, staphylococci, or clostridium perfringens.
- Ruptured ectopic pregnancy-hemorrhage
- Sepsis
- Ruptured uterus
- Other causes; Acute fatty liver of pregnancy, Air embolism, Pseudomembranous colitis, trophoblast disease, cardiomyopathy of pregnancy, cardiac tamponade.

❖ Indirect Causes of PeriPartum Maternal Deaths

- Rheumatic heart disease
- Ischaemic heart disease, due to smoking, oral contraceptive pills, hypertension, diabetes, and hyperlipidemia.
- Intracranial haemorrhage.
- Berry or aortic aneurism rupture (Marfan's syndrome -Cystic necrosis)

- Choriocarcinoma, sepsis from puerperal breast abscess.

The role of the pathologist in the investigation of the death of a pregnant or recently delivered woman

- Hypertensive heart disease
- Haemorrhage APH or PPH
- Pulmonary embolism
- Ectopic pregnancy
- Amniotic fluid embolism
- Genital sepsis
- Ruptured uterus
- Cardiac diseases associated with pregnancy.
- Abortion
- Cesarean section
- Deaths associated with anesthesia
- DIC

THE SCOPE OF A CORONER'S INQUIRY

The role of the autopsy in the investigation of maternal deaths.

Maternal death is a death occurring during pregnancy or within six weeks after delivery. It may extend to a year in some cases.

In autopsy, one should involve relevant anesthetist since obstetrician or physician involved in a maternal death is normally only too anxious to be present.

❖ Causes of Death

➤ Amniotic fluid embolism

An amniotic fluid embolism (AFE) is a very uncommon childbirth (obstetric) emergency in

which amniotic fluid enters the bloodstream of the mother to trigger a serious reaction. This reaction then results in cardiorespiratory (heart and lung) collapse and massive bleeding (coagulopathy).



Figure 145. Amniotic fluid embolism

Examine the inferior vena cava, right atrium 'frothy' fill the right atrium with water. Observe for bubbles, small tears in uterus, vagina, and cervix.

Histological components of amniotic fluid are;

- Epithelial squames from fetal skin
- Lanugo hair
- Fatty material vernix caseosa
- Mucin from fetal intestines
- Bile pigment from meconium. Alcian blue Phloxine tartrazine technique
- DIC causes preeclampsia, amniotic fluid embolism, gram-negative septicemia
- Natural disease: ie trauma, gunshot, cardiomyopathy.

Chapter Thirteen

Aspects of Abuse in Forensic Medicine

CHILD ABUSE

The features of the "Shaken baby syndrome" or child abuse syndrome

Shaken baby syndrome is a common genuine accident and is frequently difficult to distinguish. It is vital that innocent parents are not unjustly accused of ill-treating their infants and it is equally important that true battering not be missed, given the constant threat of fatality or permanent disability.

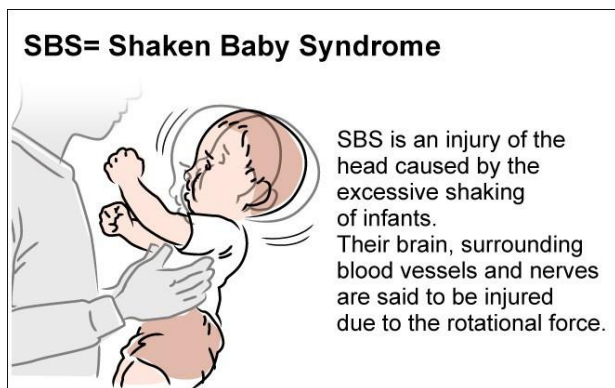


Figure 146. Shaken baby syndrome

The threshold between legitimate parental punishments varies with time, geographical distribution, and cultural variation. Shaken baby syndrome usually occurs in young children less than 3 years and is mostly inflicted by a father or a De-facto husband.

Deaths result from biting, beating, shaking, throwing, dropping, burning, or suffocation. The most common cause of death is head injury due to intracranial injury or haemorrhage and rupture of abdominal viscus.

COMMON FINDINGS

- Bruising at different ages in the limbs buttocks, face, mouth, chest, and abdomen.
- Skeletal fractures, skull, limbs, and ribs. Always rule out Oestrogenic imperfector, Infantile cortical hyperostosis (Caffey's disease), Congenital syphilis, Copper deficiency, and rickets. Most of the injuries are on the skin "Skin and bones tell a story that the child is either too young or too frightened to tell."
- Damage to the eyes, ears, mouth (fraenum) -These give good evidence of physical abuse 70% weapon rarely used.
- Head injury with intracranial haemorrhage and retinal bleeding.
- Visceral injury; ribs, intestines, mesenteries, liver rupture due to frontal blows and prodding fingers, cleanly transected gut peritonitis and shock, spleen rupture.
- Burns, bite marks and other injuries
- Eye vitreous haemorrhage, detachment of the retina, and subdural haemorrhage.
- 60% recurs and 10% will end in death.
- Detection of emotional abuse of children
- Growth retardation
- Difficulty interacting with family members
- Difficulty coping with frustration or required activity, poor adjustment to menarche or onset of puberty and delayed milestones
- Irregular sleep

- Difficulty in feeding
- Irritability
- Difficulty leaving home to go to school
- Withdrawn; depression, aggressive behavior,
- Clothing; poor and/or dirty. Poor hygiene, uncut hair, and unkempt, nails long dirty and uncut.

Problems may be encountered in dealing with a pregnant drug addict and her child resulting in poor maternal bonding and growth retardation.



Figure 147. Child psychological torture

Pathological investigations required when the body of a “neonate” is found

- Full autopsy
- Toxicology
- Born alive and killed or born dead
- Concealed birth.

By what statutes is therapeutic abortion controlled.

ABORTION ACT OF 1967

Pregnancy terminated by registered medical practitioner provided that two such practitioners are of the opinion that the continuation of the pregnancy would seriously endanger the life or health of the mother or that of her child to be aborted would if born be seriously handicapped termination shall not be unlawful.

- Write short notes on spiral fractures in the long bones of an infant.

BATTERED CHILD

A condition in which a young child <3 years who presents with injuries as a result of non-accidental violence inflicted by a parent or guardian.

❖ Pointers of child battery

- The obvious discrepancy between the nature of the injuries and the explanation offered by the parent.
- Delay to medical attention.
- The child is either the youngest, unwanted, or rejected.
- The child is seen by other doctors/hospitals for previous injuries "at-risk register". Male children are more susceptible to child battery than the girls.
- Parents' are young
- Father is not the "biological" father.
- The child is born in rapid succession.
- There is family isolation away from the proximity of relatives -grandparents, (rootless factory worker (caravan dweller) odontologist, ophthalmologist, and forensic pathologist.
- Father has a criminal record
- Father is unemployed

- The dominant partner is aggressive.
- Unhappy childhood experiences of both parents

Child battery is common in the lower level of the social spectrum. The ethnic variation is common in Anglo--American--Nordic phenomenon.

❖ Observations

- Bruises
- Healing fractures
- Failure to thrive
- Unkempt frenulum tore
- DXx Osteogenic imperfect
- Rickets
- Ehlers, Danlos syndrome
- Haematological disorder,
- Greenstick fractures,
- Check for other features of child abuse including bruises, abrasions, and tears of the frenulum.



Figure 149. Three years old battered by a girl

INFANTICIDE AND ITS DIFFERENCES WITH CHILD DESTRUCTION

INFANTICIDE

Infanticide is the killing of a child by a woman below one year of age either by willingly or by omission but at the time the balance of her mind was disturbed by the effects of childbirth or lactation.

The woman is considered not guilty of murder but of infanticide (manslaughter). It must be shown that the child had a separate existence and that death was caused by a willful act of commission or omission, and the child was born alive and had signs of life. The verdict of infanticides is given by the jury.

CHILD DESTRUCTION

- Death of a child which is unborn but viable ie 28 weeks gestation or more while in utero.
- The statutory crime of killing any child capable of being born alive (ie after 28 weeks gestation) before it has an existence independent of the mother provided that the act causing the death was not done in good faith for the purpose only of preserving the life of the mother.

STILL BIRTH

Any child, which has issued forth from the mother after the 28th week of pregnancy and which did not after complete separation from the mother breathe or show any signs of life.



Figure 150. A stillborn baby

SIGNS OF DELIVERY WHERE THE DELIVERY IS DENIED

This can be both clinical and biochemical.

❖ Clinical Signs

- Breast swelling and tenderness -changes in the nipple –Amenorrhea
- Frequency of micturition (inconstant) - Nausea -Softening of the cervix
- Balloting of the uterus on vaginal examination (Heger's sign)
- Suprapubic uterine enlargement

❖ Clinical Signs After Delivery

- Dilation palpable above the pubis.
- Perineal (tear) damage and evidence of an episiotomy.
- Vaginal discharge (lochia) blood-stained.
- Persistence breast changes -swelling and tension, milk expressible after 3/7.
- Abdominal stretch marks (striae gravidarum)
- Cervix remains soft and dilated for some time with a possible recent tear.

❖ Biochemical Investigations

- The pregnancy test positive.

What problems may occur during pregnancy and puerperium in the drug addict and her infant?

- Intrauterine growth retardation.
- Intrauterine death
- Abortion
- The intoxication of the infant by the drugs causing asphyxia
- Abnormal delivery eg when the mother does not know she is in labor in the toilet.
- Overlying the infant when the mother is drowsy.
- Choking the infant when breastfeeding.

A pre-autopsy X-ray of the body at a 3-month-old infant girl, who was apparently found dead in her cot, reveals possible healing fractures of the left femur and right clavicle, subsequent approach.

This is a typical presentation of child abuse, although other factors which can cause multiple fractures in childhood have to be ruled out such as osteogenic imperfector, syphillis, rickets, scurvy, osteomalacia, copper deficiency, infantile cortical hyperostosis, kinky hair disease (Merke's syndrome) and congenital indifference to pain.

Other diseases that can mimic child abuse are coagulation and hematological defects such as Christmas disease, Factor XIII and IX deficiency, Acute dehydration, Accidental poisoning.

Other injuries have to be looked at including bruises of different ages, lacerations, signs of neglect, social history, or the mother and father.

The sudden causes of unexpected death in a child aged 6 months, management, of such a case and the possible pathological findings

- Accidental injuries
- Non-Accidental injuries
- Myocardial disease; Histiocytoid cardiomyopathy, Eosinophilic myocarditis
- Cerebral disease
- Sudden Infant death syndrome.

CAUSES AND EVALUATION OF TRAUMA TO INFANTS UNDER THE AGE OF SIX MONTHS

❖ Causes

Child abuse

Teeth bites, fingertips, thrown against hard surface or floor, shaking, stabbing, squeezing, burns with a hot iron, scalding from hot water, cigarette burning, strangulation, blows, and shooting.

❖ Evaluation

- X-rays; skeletal surveys, skull long bones, ribs, look for old and healing fractures.
- Ultrasound including computerized tomography and brain angiography.
- Family history; marital status, paternity of the child in relation to the husband or boyfriend.
- Involvement of social worker and/or family doctor.
- Full medical examination 'Head to toe'
- Eyes and mouth petechiae haemorrhage, torn frenulum. 'Fundoscopy'

❖ Abdominal injuries in a battered child

- External bruising
- Internal mesenteric tears or laceration, crushing or transection of the gut,
- Ruptured of perforation of the stomach and diaphragm or gut, Intraperitoneal bleeding, peritonitis, liver, and spleen - rupture.
- Ruptured pancreas
- Haemo peritoneum
- Healing intra-abdominal injuries.

ELDERLY ABUSE

Abuse of the elderly, (granny battering, battered old person syndrome)

Definition;

Actions or the omissions of actions that result in harm or threatened harm to the health or welfare of an elderly person.

TYPES OF ELDERLY ABUSE

- **Physical;** hitting, beating, sexual molestation, physical restrain.
- **Psychological;** verbal threats, fear, isolation, name calling, humiliation, intimidation, and insults.
- **Financial/Material;** Theft misuse of money and property.
- **Violation of personal rights;** Forced placement into nursing homes, forced confinement.
- **Neglect;** Failure of the caretaker to provide the goods or services that are necessary for the elder to maintain life.

The main causes of elderly abuse are neglect and starvation.

- Neglect can be inflicted by other people when a person cannot care for himself.

- Starvation may be due to poor nutrition which may lead to infections pellagra or beriberi. Emaciation is an obvious feature. Starvation may be either "dry" or "Wet"

Observations

- Wet oedema of the body, ascites, pleural oedema due to hypoproteinaemia.
- Dry -hypotension incipient cardiac failure.
- Chronic sedation by sedative drugs to be in a vegetative state in nursing homes.

Findings

- Sunken eyeballs, cachectic face, with skin stretched over the cheekbones, prominent jaws and zygoma, or orbital margins.
- Abdomen scaphoid, the head appears larger, pressure soles.
- All organs except the brain are reduced in size.
- Stomach and intestine distended with gas, thin-walled, and translucent gall bladder due to lack of stimulus for emptying.

Rule out malignancy, Addison's disease,

malabsorption, or congenital metabolic defects.

Risk factors both for the victim and the abuser

- Alcohol abuse, drug abuse
- Dementia
- Caregiver inexperience
- Economic stress
- History of child abuse blaming or hypercritical, personality, and unrealistic expectation.

Intervention

- A multidisciplinary team of caretakers from the medical, social, mental health, legal, professionals.
- A group of professionals and paraprofessionals from a variety of disciplines, often representing different agencies, working together to achieve a specified set of goals which includes co-ordination, diagnosis, prevention, treatment, consultation, and education.

Chapter Fourteen

Sexual Offences

All happy families resemble each other, each unhappy family is unhappy in its own way',- Leo Tolstoy (Anna Kareina)

RAPE, INDECENT ASSAULT, SODOMY

Case Study

The body of a young female is found partially clothed in a field, Outline your investigations at the scene and at post mortem examination

- Rape-murder
- Assault to the victim gravel, Abrasions, scrapes, bite marks, dental impression on the suspects or the assailant/s
- Strangulation can occur in consensual sexual intercourse.

RAPE

Sexual intercourse without consent with an adult above the age of 16 years, or 18 years in some countries, with the man knowing that the woman does not consent or is reckless whether she consents or not.

Rape is also termed as unlawful carnal knowledge of a female by force or fraud, against her will. Carnal means penetration to any degree. A person who does not offer physical resistance to sexual intercourse shall not, by reason only that fact be regarded as consenting to the sexual intercourse.

- Mere submission is not consent.

Consent must be real freely given and not induced by fraud, threats, e.t.c. Interpersonating husband or unconscious.



Figure 151. Sexual assault

This is sexually occasioned by the penetration of the vagina of any person or anus of any person by

- Any part of the body of another person.
- An object manipulated by another person except when the penetration is carried by proper medical purposes.
- Sexual connection occasioned by the introduction of any part of the penis of a person into the mouth of another.

CUNNULINGUS

This act is substituted for forced sexual intercourse in its usual sense. The aspect of violence is distinct from the sexual aspect. Sexual assaults should be viewed as violence than merely as the result of excessive passion. The victim of an assault in which a bottle or other object is inserted into the vagina or anus may be much more serious injuries both physically and physiologically than a female into whose vagina a man's penis is inserted without consent.

The husband cannot be guilty of a rape committed by himself upon his lawfully married wife for by their mutual matrimonial consent and contract the wife has given herself in this kind unto her husband, which she can't retract. When the couple is divorced and/or separated, the husband is not immune from prosecution for rape.

Depression and guilt, sometimes but not always alternating with anger are common psychological after-effects of rape.

The victim will probably unless guided by careful counseling feel self-doubt and uncertainty concerning the experience.

ASSAULT

Unlawful attempt or offer by force or violence to do a bodily injury to another in such a way as to cause reasonable fear in the mind of that person.

BATTERY

Battery consists of the actual application of unlawful force to another.

The ideal sexual assault examination unit

- Good surroundings and location are well lit, clean, well furnished, and equipped with proper examination couch instruments speculums, swabs.
- Kit for collection of trace evidence for scientific examination, pubic hair, fine comb, pipette, small tube for collecting fluids bottles for collecting blood urine.
- Examination gown.
- Instruments for photography, colposcopy, additional heating, ophthalmoscopy, ultra-violet, refrigerator, with freezer, bathroom/shower, toilet and toiletries, hairdryer, plants, pictures, magazine toys, and books for children, autoclave.

Unlawful Sexual Intercourse

- Sexual intercourse without consent in an adult above 16 years or 18 years in some countries, the man knowing that she does not consent or is reckless whether she consents or not.
- The unlawful carnal knowledge of a female by force and induced by fraud, threats, etc Impersonating husband or unconscious.

BATTERED SPOUSE SYNDROME

The 'battered wife' or 'battered spouse' has been defined as the woman (on man in a homosexual relationship) who has suffered demonstrable and repeated physical injuries at the hands of his/her partner or from the father of one of her children.



Figure 152. *Battered spouse syndrome*

In cases of heterosexual partners, most of the victims are females mostly between the ages of 26-35 years. The abusers often have chronic alcohol-related problems, misuse drugs, but even so, often have no criminal record. They are law-abiding citizens and belong to the lower socio-economical groups although spouse abuse also occurs in well off families.

The type of injury starts with slaps and light punches to the face and body resulting in bruising

which may escalate gradually to heavier punches, kicking, and the use of weapons to cause further blunt force trauma and/or penetrating injuries (stab wounds). Most of the abuse (battering) occurs in the evening or during the early part of the night and a number of the assaults are not precipitated by an altercation or argument.

In homosexuals the injuries and the homicides are often more violent than heterosexual homicides, the number and extent of injuries being greater. The most violent homicides seen by pathologists are among male homosexuals 1,5.

The Role of the Forensic Pathologist

The role of the forensic pathologist is to

- Ascertain the nature of the injuries to throw light on how they were caused
- Ascertain the mechanisms of death to answer questions as to how long a person may live with different kinds of organ injury and whether he might be capable to act or walk afterward ⁴.

More generally the pathologist tries to contribute to the reconstruction of the events leading to death. The number of injuries, how they were inflicted and the amount of force required that will be crucial information for a court to come to its conclusion about the accused *men's rea*.

'PARAPHILIA'

These are disorders in which an unusual act or imagery is necessary to achieve sexual gratification or non-psychiatric mental disorder where unusual or bizarre imaginary or acts are necessary for sexual excitation.

CHARACTERISTICS OF PARAPHILIASM

- Pornographic material, nude or near-nude failed

- Self-rescue mechanism
- Neck pending, body position, and extra sexual props.

The initial assessment excludes homicide, accident, and suicide.

INVESTIGATION

Look for;

- Suicide note,
- History for depression and evidence of the performance of the act in secluded or private areas, evidence of repetitive acts in the form of worn overhead beams of ceiling hooks. Aspiration of the vomiting and slipping of a mouth gag during bondage activity.

SEXUAL DEPENDENCY SYNDROMES

- Sadism – Masochism
- Klismaphilia -Use of enemas for sexual purposes,
- Pictophilia -Pornographic or obscene film or pictures
- Kleptophilia –theft
- Rapism -Violent assault
- Transverstophilia -Crossdressing, victim dresses in garments of the opposite sex
- Telephone (Scatophilia) -Erotic telephone calls.
- Pedophilia
- Voyeurism
- Coprophilia -Preoccupation with feces
- Mysophilia -Preoccupation with filth
- Fetishism- Victim wears plastic rubber or leather attire
- Bondage being physically bound or restrained.
- Prop-personal paraphernalia assumed to

have been used actively or passively for sexual imagination and arousal and not for bondage, fetishism, or transvestism. Both oral and penis props.

- Accidental autoerotic death -If it is solitary, accidental, and caused by lethal paraphilia.

Significance of self-inflicted injuries in a case where sexual assault is alleged.

- A large number of lesions arranged in groups, parallel and/or long superficial cuts.
- The omission of especially sensitive body regions
- No damage to the underlying clothing
- Fear of pregnancy and or venereal diseases after consented sex
- To breakdown the relationship where revenge or mischief are present.
- The sympathy of a companion who wanted to divorce.
- The implicated person in the hope to get punished for unrelated misdeeds he did to the lady.
- Extra-marital affairs
- Maligering for feminist overtone.

Locard's principle and its application to the investigation of sexual offenses

❖ Locard's Principle

Every contact leaves a trace behind

i.e semen, hair, blood, cloths, fabrics, saliva, teeth bites, and nails scratch.

INDECENT ASSAULT

This includes unproven rape to merely touching the buttocks in a crowded bus, fondling of breasts,

thighs, perineum, putting a hand up a woman skirt, etc. Few have medical aspects unless more serious injuries occur like bruises, bite marks, and abrasion. Allegations of male doctors assaulting women patients vary from touching, kissing, fondling, or breast to actual intercourse.

Doctors can lose their registration after disciplinary action and criminal prosecution.

- ❖ Psychiatrists are vulnerable due to the dilution and mental abnormality of their patients. Most patients' fantasy their feelings not returned and revenge by accusing him/her of decency, blackmail emotional or financial.
- ❖ Dentists equally handle patients who are under anesthesia, hallucination, dreams of erotic or fearful nature, and believe that the doctor "dentist" has "taken advantage of them sexually."

INDECENT EXPOSURE

"Flashing" man displays his genitals in public to annoyance and embarrassment or ladies and girls.

ANO-RECTAL TRAUMA

DIFFERENTIAL DIAGNOSIS

- Child abuse
- Insertion of objects or penis in the anus
- Fissure and tear in the anal mucosa with or without bleeding
- Fistula ani communication between the anal mucosa with outside
- Pruritus ani
- Fisting and Anal sex

ANAL FISSURE

These are small skin folds or cracks found in anal skin and mucosa. Anal fissures are common in childhood and are usually posterior and single.

ANAL FISTULA

This is any communication between the anus and other hollow structures in the pelvic region eg bladder, vagina, peritoneum, and outside in the buttocks.

Chapter Fifteen

Anaesthetic Death

INTRODUCTION

An anaesthetic death is defined here as the death of a patient, or prior to complete recovery from, an anaesthetic, or arising out of any instant during the anaesthetic period.

Like all sudden unexpected deaths in most countries, anaesthetic deaths are reportable to the police. Skepticism has been expressed by various authors about the value of an inquest or Procurator - Fiscal's inquiry into such deaths because these inquiries are rarely in possession of the full facts^{1,2,3}.

One of the most difficult tasks for a pathologist is to determine the nature and extent of the investigation into deaths that occurred during or immediately after a surgical procedure, whether with a general or local anaesthetic. Still, the death investigator has certain prerogatives that permit him or her to investigate any anaesthetic death. Difficulties occur in deciding which merit a full investigation. The easiest to identify are those occurring during minor elective surgical or diagnostic procedures. Such deaths invoke the enormous question "what went wrong?". This response contrasts with the deaths occurring during complex surgical procedures, particularly open heart surgery where the extent of natural disease obfuscates the contribution that the surgery or anaesthesia make to the death.

In these deaths, the attendant risks of the anaesthesia and surgery are significantly offset by the usually severe natural disease processes. Many deaths however occur under circumstances that are not clearly defined, that may be obscured by sustaining life-saving techniques, and that can become a central issue of acrimonious debate between the attending physicians and the

surviving family members^{1,2,3}.



Figure 153. *Death associated with anaesthesia*

Somewhere in between, the death investigator (pathologist) is likely to become entangled in the main issues that are present at the time of death. Even though the pathologist recognizes the limitations of an autopsy examination in such deaths, there will remain an expectation that an answer exists, if only someone would search carefully³.

CLASSIFICATION OF DEATHS ASSOCIATED WITH ANAESTHESIA

Several classifications have been published of deaths associated with anaesthesia and a relatively simple one is as follows:

- Deaths due to the anaesthesia itself and/or the method of its administration.
- Deaths due to surgical mishaps during anaesthesia
- Deaths due to natural disease, either that for which the treatment was given or

concurrent disease¹.

Anaesthetic deaths are relatively uncommon. Death occurs during or immediately after surgery in 0.2 to 0.6% of operations. Deaths directly attributable to anaesthesia itself are of the order of only 0.03 to 0.1% of all anaesthesia given^{1,2,3}.

- Intestinal obstruction
- Long-standing cases of peritonitis
- Obstructed labor and ileus.

Indeed the surgeon often describes the patient's condition as "grave", "desperate", "serious", or similar terms. This is followed by the assertion that it was essential to operate once if the patient was to survive. Thus some patients who have been ill for some hours or usually days are subjected to surgery after only the briefest of delays and have perfunctory preparation. Frequently insufficient attempts are made to restore blood or extracellular fluid volume or to determine the degree of electrolytes deficits even when facilities to do so were available. It cannot be emphasized too strongly that surgery by itself does nothing to replace these deficits but rather than makes them worse for a time. Resuscitation must be begun in the pre-operative period as early as possible if patients are to survive emergency surgery. Their fluids, electrolytes, and blood film state must be brought as close to normality as the urgency of the situation allows⁴.

RESUSCITATION

Inadequate resuscitation during anaesthesia is often a continuation of inadequate resuscitation/preparation before anaesthesia. It stems from the same lack of appreciation of the magnitude of the pre-existing deficit and/or a failure to observe or appreciate the fact that losses are continuing. Apart from blood losses and electrolyte imbalances drug overdosages and hypersensitivity may play an important part in this instance. Abnormal or anaphylactoid reaction to drugs has been experienced with dextran, causing violent bronchospasm during induction resulting in fatal pulmonary rupture and tension pneumothorax. Heart failure has been associated with trichloroethylene while intravenous administration of urea has caused hypertension and halothane has been associated with instances of liver necrosis and more recently it has been deemed to cause malignant hyperpyrexia^{1,4}



Figure 154. Anaesthetic Death

PREPARATION

Inadequate preparation is one of the five commonest factors in anaesthetic deaths. It is more common in emergencies and the majority of deaths are due to inexperience and failure to adopt precautions when they are indicated. Non-specialists fail twice as often as specialist anaesthetists to prepare their patients adequately.

Most of the emergency cases include;

VENTILATION

Inadequate ventilation is one of the causes of the disaster. It may be due to many causes including prolonged anaesthesia with potent agents, or obstruction of the airway either by malignant tumour or lingual tonsillar hypertrophy. The inadequate diameter of an endotracheal tube, postural handicaps to ventilation, and failure to control or assist respiration in the patient who has been given a muscle relaxant also occurs. It is an elementary principle of anaesthesia that the unconscious patient may have an obstructed airway due to simple soft tissue obstruction by the toneless musculature of the tongue and pharynx or hypertrophy of the tonsils which has been reported to cause difficulties in an anaesthetic incubation in children. Malignant growth in the airway may also obstruct the endotracheal tube or misdirect the tube to the esophagus instead of the trachea. Inadequate ventilation should always be suspected when a patient's color is unsatisfactory despite the high use of oxygen concentration⁴.

TECHNICAL MISHAPS

Technical mishaps like obstruction of the tubes, mismatching of gas lines, incompatibility of blood, or accidental air embolization of patients undergoing infusion and other similar accidents will continue to occur, as long as anaesthesia remains in the hands of human agents. In these circumstances, the maximum safe practice of anaesthesia demands the attention of the anaesthetist at all times to the state of the patient's respiration (if breathing is spontaneous) or ventilation is achieved by artificial means if breathing is controlled. For this purpose, it is essential to be able to observe some portion of the patient or the parameters which will indicate the rate of respiration.

Sometimes a completely appropriate anesthetic, correctly administered, resulting in the death of a

patient in the postoperative period, because of a breakdown in supervision at this time. Episodes of vomiting or partial airway obstruction, irreversible hypertension, and/or cardiac arrhythmia occur while the patient is not under the supervision of persons able to deal with the crisis. Delays, while appropriate personnel arrives, are sufficient to render a patient's condition irreversible.

Anesthetists are to be aware that the immediate post-operative period is the most hazardous time. The more ill the patient the longer the period during which the risk is present. The responsibility for ensuring the wellbeing of the patient rests on the anaesthetist and remains with her/him until the patient can be said to have recovered from the anesthetic, and not merely until the patient has left the operating theatre table⁴.

Anesthesia-related deaths

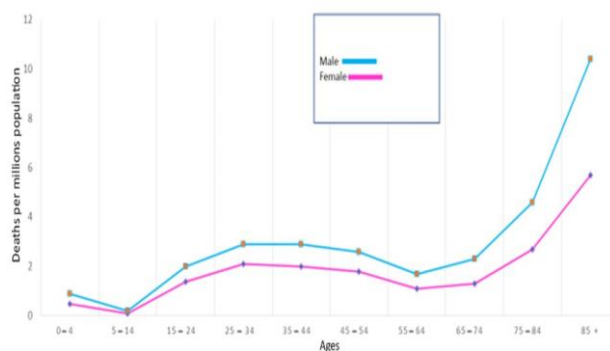


Figure 155. Life-threatening perioperative complications

DEATHS FROM DISEASES

Deaths occur from the condition necessitating surgery or other severe diseases such as ischaemic heart disease, severe liver disease, prolonged acute intestinal obstruction, or lung diseases. In such cases, surgery is a calculated risk but the collapse of a patient during anaesthesia, even when accompanied by electrocardiography signs of myocardial ischemia, cannot be assumed to be due to coronary artery disease alone. Furthermore, the discovery of long-standing

coronary artery disease at autopsy does not prove ischaemic heart disease to have been the cause of collapse^{1,2,3}.

The function of the pathologist in the investigation of anaesthetic deaths

Although most of the adverse incidents of anaesthesia are beyond detection by post mortem examination and are out of the pathologist's sphere, pathologists play an important part in these investigations.

He is an independent witness; he can detect or exclude evidence of

- Instrumental damage,
- Inhalation of foreign material,
- Surgical mishaps, and
- Natural disease.

Although he is not competent to perform (and may not even have facilities for) toxicological analysis, he has the responsibility for the collection of appropriate material for analysis. Therefore, when in doubt, he should consult a toxicologist so that a satisfactory analysis can be undertaken. Concerning other possible factors, he should consult the anesthetist or surgeon involved before the conduct of the autopsy.

The pathologist has to perform a thorough and competent autopsy and he should confine his evidence to his findings and their implications.

It may be proper for the pathologist to adopt the factual report of the toxicologist if the latter is not required to give evidence^{1,4}.



Figure 156. *Fungating an ulcerated mass in the larynx with the endotracheal tube in the oesophagus*

Given the multifactorial etiology that certain more subtle errors in clinical anesthetic management may play in the genesis of anesthetic morbidity and mortality, these errors are neither precisely assessable nor quantifiable nor are they ever likely to be. From a purely medico-legal viewpoint, experienced clinicians and clinical anaesthesiologists must participate as assessors in any Inquest Court proceedings.

It is only by adopting a comprehensive multifaceted approach in an attempt to assess the complex and difficult issues raised by cases of anesthetic associated mortality that insight can be gained into these tragic occurrences and the interests of the patient, court, and the anesthetist is served³.

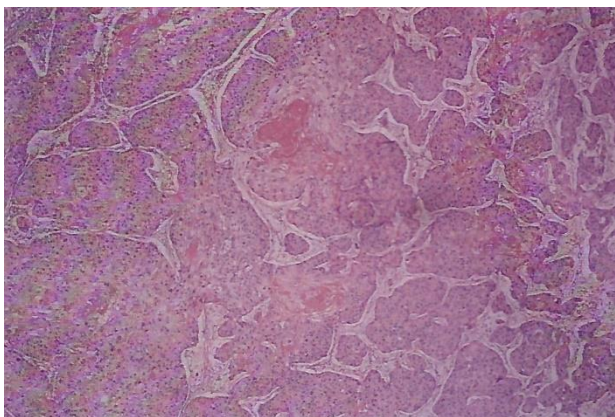


Figure 157. *Invasive well-differentiated keratinizing squamous cell carcinoma of the larynx*

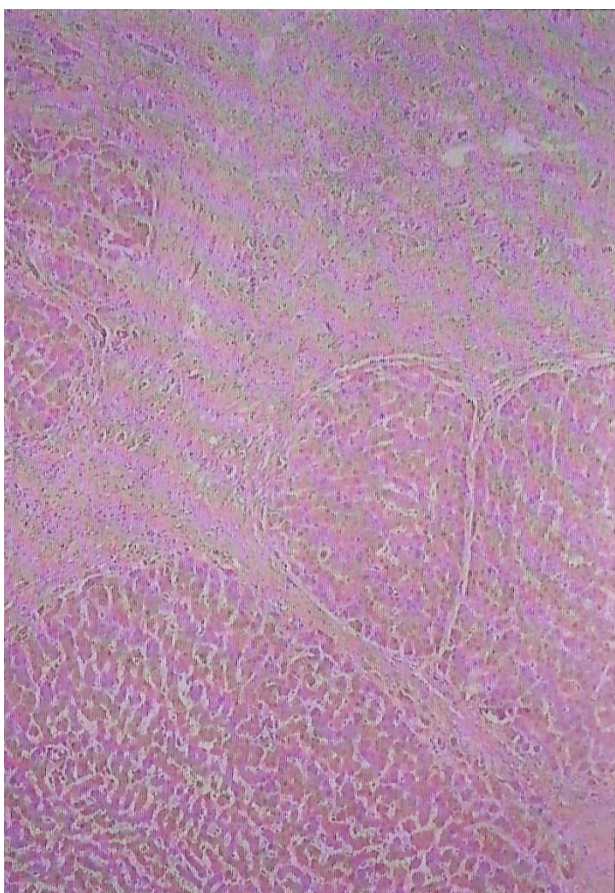


Figure 158. *Liver cirrhosis. Nodules of varying sizes are entrapped in fibrous tissue.*

THE POST MORTEM EXAMINATION AND FINDINGS IN A DEATH FOLLOWING CARDIAC SURGERY

❖ Peri-Operative Cardiac Deaths

- ❖ Notes are of paramount importance in all deaths after cardiac surgery.
- ❖ Intravenous fluid administration, urine output, prothrombin time should be obtained.
- ❖ Autopsy pathologist to eviscerate to organs him/herself to examine the anatomy *in situ*.
- ❖ The integrity of all surgical anatomizes should be inspected to rule out any linkage
- ❖ Exclude significant blood in the pericardial sac, embolism of more than 250 MLs of blood, and pulmonary embolism in the pulmonary arteries and hemorrhagic in the lungs.
- ❖ Take blood cultures of both heart and spleen to rule out predisposing causes of septicemia, malignant disease, malnutrition, chronic alcoholism, immunodeficient, pelvic abscess, emphysema, and parenteral nutrition.
- ❖ Lungs respiratory tract infections consolidation, pneumonia (20%) fatal pulmonary embolism, and infarcts.
- ❖ Careful examination of heart coronary artery stenosis, myocardial infarction, and cardiomegaly.

❖ Deaths After Cardiac Surgery

During the autopsy, the heart should be fixed and dissected later when all the structures are fixed.

The following should be thoroughly scrutinized

- Bypass grafting hemorrhage and thrombosis.

- Valve replacement, Infective endocarditis, perivalvular leaks
- Cardiac catheters bleeding in the groin and ventricular tachycardia and fibrillation.
- Angioplasty- Thrombus formation pericarditis, acute adventitial inflammation, and distal embolization of atheromatous debris.
- Directional coronary atherectomy -Wall rupture

Other general complications associated with cardiac surgery.

- Arrhythmia's ventricular and atrial 10% of patients die after the operation.
- Infections
- Neurological and neuropsychiatric abnormalities.
- Intra cerebral hemorrhages due to poor anticoagulant control.

Cardiac Disease in the elderly which commonly cause complications in cardiac surgery.

- Cardiac disease Heart failure
- Myocardial ischaemic disease hypertension, calcific aortic stenosis, RHD, Bacterial endocarditis.
- Mitral valve prolapse.
- Atrial fibrillation.
- Coronary artery atherosclerosis

ACUTE RESPIRATORY DISTRESS SYNDROME

Pathogenesis, Mechanisms, and Causes of Acute Respiratory Distress Syndrome

These are clinical symptoms characterized by the nonpathogenic pulmonary disease with severe

hypoxia, caused by R-L intrapulmonary shunting secondary to atelectasis and air space-filling from oedema fluid followed by dyspnoea, cough, cyanosis, finger clubbing, orthopnea, hypoxemia, and progressive respiratory insufficiency.



Figure 159. Acute Respiratory Distress Syndrome- Wet lung

❖ Pathogenic Mechanisms

- **Neutrophils;** Adherence, chemotactic, phagocytosis, and triggering of phagocytic intracellular events. Toxic reagents are realized indicating lung injury. Presence of platelets and coagulation abnormalities DIC, thrombocytopenia, and microthrombi.
- **Mononuclear cells;** -cytokines tumour necrosis factor.
- **Endothelial cells-** death
- **Epithelial cells** – injury evident
- **Complement** system - C3a, C5a, Prostaglandins/leukotrienes
- **Proteases** -Diastase, plasminogen, activator, plasmin, hyaluronidase, can degrade the extracellular matrix leading to an increase in vascular permeability through interruption of structural integrity.

There is diffuse alveoli damage with nonspecific morphological changes consisting oedema of septate, intra-alveolar hemorrhage, fibrin deposition. This is followed by hyaline membrane formation causing hypoxia with increasingly severe respiratory distress which requires mechanical ventilation, a sparse interstitial inflammatory infiltrate, fibrin thrombi and hyperplasia of alveolar lining cells type 2 Pneumocytes and progressive alveolar and interstitial fibrosis.

Death results due to multiple organ failure after renal, hepatic, CNS, GIT, hematological, acid-base balance, multiple transfusions, and severe acute pancreatitis.

❖ Causes of ARDS- Acute Respiratory Distress Syndrome

- Infections - Virus
- Inhalants - Oxygen -Respirator
- Drugs -chemotherapy overdose
- Ingestants- kerosene, paraquat, irritation gases
- Systemic shock -after major trauma, fat embolism
- Blast injuries to the chest.
- Heavy impacts to the chest.
- Sepsis is the most common
- Radiation
- Near drowning

- DXX Congestive heart failure, Pneumonia, Sarcoidosis

AUTOPSY FINDINGS OF "ARDS"

- Heavy lungs with a dark, firm and liver like consistency
- Serosanguinous fluid,
- Fibrin deposits
- Microabscesses,
- Diffuse alveolar damage with hyaline membranes, dull cut surfaces, poorly aerated and exude dark, blood-stained fluid.

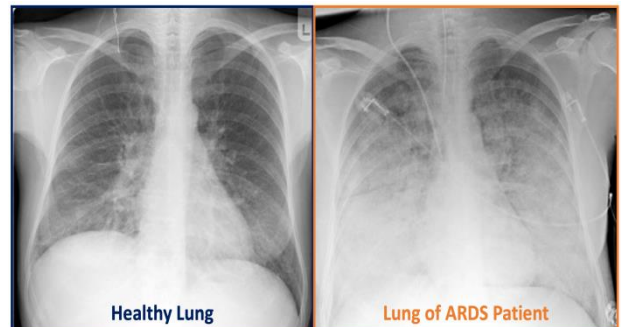


Figure 160. Chest x-ray radiograph of healthy lungs (left panel) and lungs from ARDS-affected patient (right panel) (images provided by courtesy of Prof. Dr. M. Witzenrath, Charite Berlin)

Chapter Sixteen

Drug Abuse

ILLICIT DRUG USE

The widespread availability of drugs during the past two decades has been attended by a conspicuous increase in deaths related to drug use. The heroin and methadone abuse has become leading causes of deaths between the ages of 15 years and 35 years in large cities^{1,2}

❖ Substance Abuse

"**Substance abuse**" refers to the socially prescribed non-medical taking into the body of any chemicals for the purposes of producing a change of mood usually some degree of euphoria. Surveys of deaths among addicts are useful indicators of drug abuse.

Several studies on drug addict deaths have been published but the data are different to compare due to the lack of definition of the terms "drug addict" and drug-related deaths.



Fig 161. Drug and substance abuse

❖ Drug Addict

In English law, a "**drug addict**" means a person who, by reason of habitual taking or using, other than upon medical advice, of any controlled drug within the meaning of the misused of Drug Act 1971 (a) is at times dangerous to himself or others or incapable of managing himself or his affairs; or (b) so conducts himself that it would not be reasonable to expect a spouse of ordinary sensibility to continue to cohabit with him. A person shall be recorded as being addicted to a drug if, and if only, he has as a result of repeated administration become so dependent upon the drug that he has an overpowering desire for the administration to be continued².

Most of the drug addicts use more than one drug in each episode to acquire the desired effect. The drugs used include alcohol, cocaine, heroin/morphine, benzodiazepines, methadone, cannabis, and others. The choice of drug to be it heroin, morphine, cannabis Sativa, khat (*Miraa*) or alcohol is a function of the culture, but abuse of that drug is a function man. Long term follow-up suggests that what is wrong with the addict is not that he is addicted to a drug-heroin or cannabis, rather, he is an intelligent person unable to sustain employment, he is a suicidal person unable to admit depression, he is lonely person, who inadvertently substitutes drugs for people, he is a person with a paucity of gratifying alternatives rather than a man whose instinctual needs are readily answered by heroin or cannabis Sativa¹⁻³

❖ Complications of drug abuse

Most major adult emergency hospital departments in developed countries see 500 or more drug overdose patients each year. Although this is rare in developing countries this is on the increase and if uncontrolled may reach an alarming state within a very short time. Although deaths are uncommon in those reaching hospital, death continues to be frequent outside the hospital ².

Many of the deaths of addicts occur statistically in a lavatory with a syringe in-situ in the vein.

❖ Causes of Acute Deaths

The most common causes of acute deaths in these circumstances include;

- Inhalation of vomit
- Acute overdose
- Pneumonia,
- Mixed drug toxicity
- Murder and hanging
- Burning

Other complications related to prolonged use include acute ulcerated colitis, acute hepatitis, renal failure, cerebral infarction, pulmonary septic embolism, endocarditis, vasculitis, bacterial infection, e.g. food botulism, tetanus or liver failure due to cirrhosis ¹⁻³.

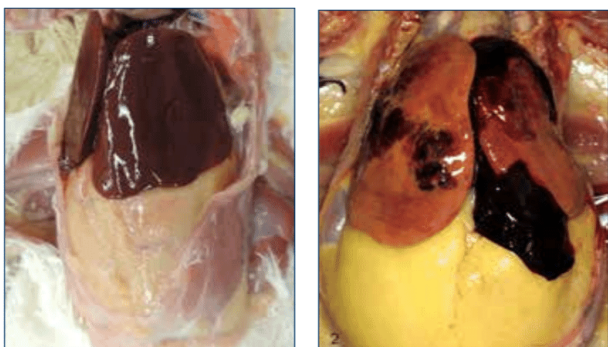


Figure 1a (left): Normal liver. Figure 1b (right): Fatty liver hemorrhagic syndrome. Large blood clots arising from the liver. Note the excessive abdominal fat.

Investigations of death from drug abuse are very important because addicts find the places where they are not likely to be disturbed or discovered, such as a friend's apartment, in a common bathroom, in a building or an unfrequented area such as rooftop or loof landing. If such death occurs, the body may be left where it was and the heroin works taken by others for later use. If however, the place of death is someone's apartment the body may be removed and dumped in a non-incriminating place. Initial examination or the death of an addict may suggest homicide.

If the scene of death has been tampered with, and the body has been removed after death, scarring abrasions and bruising may occur during the moving of the body. There may be marks on the body secondary to attempted resuscitation.

In a review of the literature, the most implicated drugs include heroin or morphine causing almost 35% of all cases and methadone in a further 5%. The next largest group is tricyclic antidepressants, which are responsible for 14% of these deaths. Benzodiazepines are thought to be a prime cause in 6.5% of the cases.

Heroin, morphine has been the preferred amongst drug addicts in most countries and the size of drug addicts population has probably been constant but the population has grown older. An older (prolonged use) and more worn out Population may be an explanation for apart of the increase in heroin-related deaths in these countries. The main explanation however probably is the cheaper heroin and increased availability leading to use that is more frequent and larger doses ²⁻⁴.

POST MORTEM FINDINGS

At autopsy, the major findings in drug addicts include typical linear needle track scars, which are most common overlying the veins of the antecubital fossa, forearms, and dorsal aspect of the hands. The scars sometimes are pigmented or hypertrophied as a result of multiple non-sterile injections and can be present in places where there are veins including the neck, lower

extremities, and even the penis. These scars are less frequent these days as insulin type syringes are freely provided and these cause less damage.

Heroin and cocaine can also be taken by inhalation or insufflation (snorting or sneezing) causing irritation, congestion, and atrophy of the nasal mucosa and can result in perforation of the nasal septum. Internal abnormalities due to drugs are not prominent at autopsy.

Examination of needle scars can reveal fibrosis in the intravenous addict or chronic abscesses or diffuse scarring. Small streaks of black carbon can be present in subcutaneous scar tissue. These are from deposits of needle tips heated by a match in an attempt to achieve sterility.

Microscopy examination often reveals foreign material in scar tissue such as fragments of clothing, cotton, alcohol, and identifiable matter inadvertently injected with heroin mixture.

These are most prominent in *skin poppers* with surrounding foreign body giant cell reactions. The most striking change following a fatal narcotic needle is severe congestion and oedema of the lungs with abundant froth filling the bronchi and trachea and protruding from the nose and the mouth in shaving cream fashion.

Bronchopneumonia also develops in addicts who lose consciousness but then survive an episode of aspiration of gastric contents or milk administered by a well-meaning friend/s. Viral hepatitis B, C, and HIV are the most common of the infectious disease associated with addicts and is a result of the sharing of needles. Other infections include fungal and bacterial endocarditis, such as *Candida* species. Unexplained fever in drug addicts should be investigated since they normally have infectious complications such as meningitis, brain, and pulmonary abscesses. A variety of neurological abnormalities have been reported in addicts including bilateral symmetrical necrosis of the globus pallidus and transverse myelitis which may be secondary to prior episodes of hypoxia in the course of drug-taking⁴.

Occasionally, an addict will become comatose following a heroin injection but is revived after

irreversible brain damage has occurred. He/She may then live in a coma for weeks or months until death occurs usually from secondary infection. Acute muscle necrosis with myoglobinuria and renal failure also occasionally occurs in addicts⁵.

Although drug-related deaths are commonly seen to be of suicidal intent, most are probably misadventure. Death by misadventure is a well-known risk of injecting narcotics. Injecting drug use has contributed to the prominence of the male deaths in the 15 to 24 years' age group, as 75% of deaths are common in non-known drug abusers.

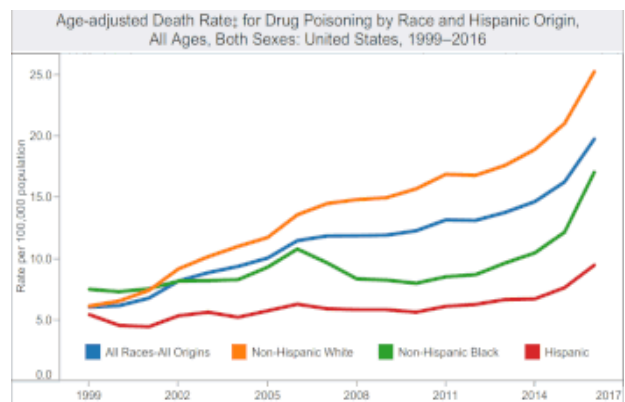


Figure 163. Death rates for drug poisoning by race

Figure 1. National Drug Overdose Deaths Number Among All Ages, by Gender, 1999–2018

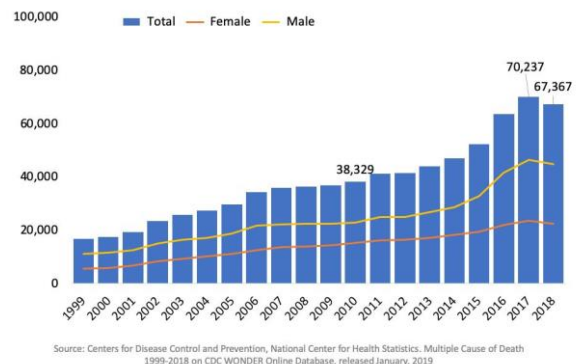


Figure 164. Drug overdose death rates

Some of the sudden deaths among the addicts recently from prison have been associated with the first "shot" after a long period of abstinence and the presence of vomited material in the air

passages is almost always found. However, studies done in Australia showed that 89% of these deaths occur outside the hospital suggests that any attempt to reduce drug-related deaths should be directed at preventing availability for potentially toxic substances ^{1,2}.

TOXICOLOGY

In toxicology analysis, it is not uncommon to find metabolites of drugs or to find very low levels of the original drugs depending on the tone taken for the individual to die after ingesting or injecting them.

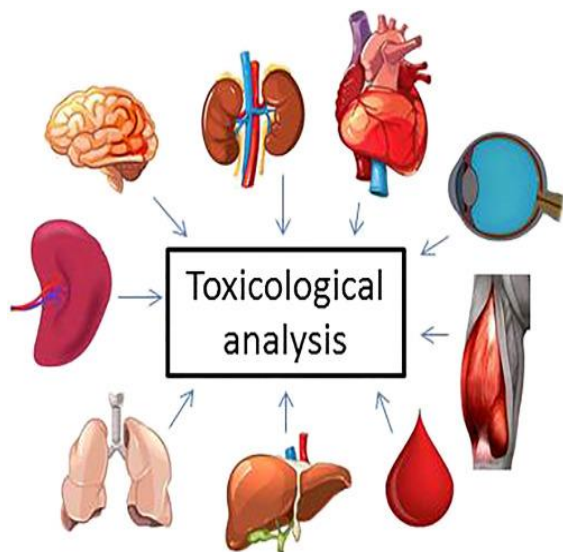


Figure 165. Drug concentrations in post mortem experiments

The heroine is metabolized in the body to morphine so that the taking of either heroin or morphine results in the finding of morphine toxicologically. Blood urine is a good specimen for morphine recovery. In the absence of urine and bile, kidney and liver should also be preserved for analysis. Any paraphernalia found also be preserved for analysis as heroin is often identified in needles or syringe, in a dry residue of the cooker, in the emptied envelope or in the cigarette filter used for filtering these drugs.

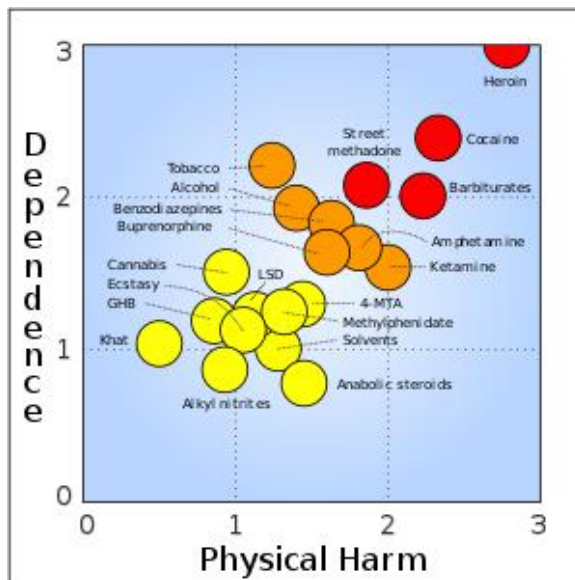


Figure 166. A 2007 assessment of harm from recreational drug use (mean physical harm and mean dependence liability)[1]

- Specialty Psychiatry
- Frequency 27 million[2][3]
- Deaths 307,400 (2015)[4]

INTERVENTION

Deaths from heroin "overdose" have increased substantially over the past decade in the absence of any public health measures specifically aimed at reducing them. Recently research suggests that many of these deaths may be preventable ⁶⁻⁸.

In most parts of the world, there is a widespread political and social pressure to increase the number of addicts receiving methadone as a form of treatment for their addictive behavior ³.

Methadone is an opiate, which is made to be taken orally, and which, when given to narcotic addicts in place of their usual drug abuse suppresses withdrawal symptoms. Advocates of methadone claim that it allows addicts to cease their abuse of illegal drugs, obtain employment, to maintain a stable relationship, reduce criminal behavior, and to lead a productive life.

Opiate Withdrawal - What to Expect

	Dose	Withdrawal Onset	Withdrawal Peak	Withdrawal Ends
Fentanyl	.01 mg	3-5 hr	8-12 hr	4-5 days
Meperidine	20 mg	4-6 hr	8-12 hr	4-5 days
Oxycodone	1.5 mg	8-12 hr	36-72 hr	7-10 days
Hydromorphone	.5 mg	4-5 hr	36-72 hr	7-10 days
Heroin	1-2 mg	8-12 hr	36-72 hr	7-10 days
Morphine	3-4 mg	8-12 hr	36-72 hr	7-10 days
Codeine	30 mg	8-12 hr	36-72 hr	7-10 days
Hydrocodone	.5 mg	8-12 hr	36-72 hr	7-10 days
Methadone	n/a	36-72 hr	96-144 hr	14-21 days

www.discoveryplace.info

Figure 167. Long term effects of methadone

Between 1991 and 1994 eighteen deaths from methadone poisoning occurred in Sheffield and it was the most common substance found in drug misuse deaths in the city during that period^{7,8}.

Methadone is a potent drug, which may well prove fatal if more than the prescribed dose is taken. The toxic effects are more likely to be manifested in naive users before any tolerance had developed.

A study from Melbourne, Australia, reported a similar increase in methadone deaths as reported in Sheffield and specifically highlighted the risk of deaths on maintenance programs and cautioned whether studying those were too high.

Methadone does not exert its full effects immediately after ingestion and thus it is possible to take a large amount without any immediate perception by the user of live craving intoxication.

There is often a time gap of several hours between taking the drugs and collapse. This fact is not always appreciated by those caring for persons who state that they have taken an overdose of methadone such as hospital medical, forensic examiners (police surgeons), or casual observers.

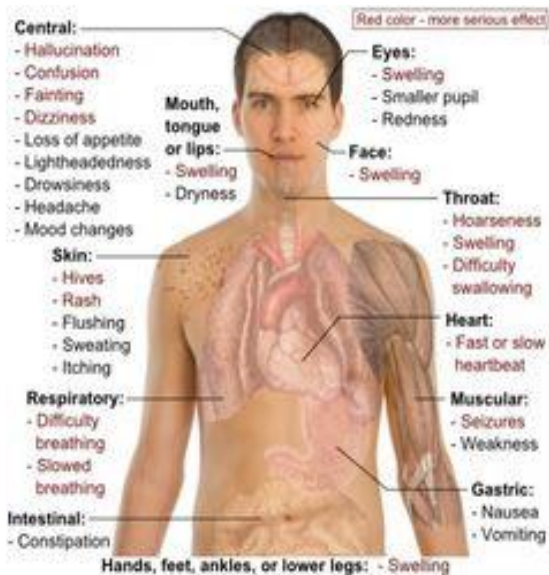


Figure 168. Effects of methadone

Methadone therapy can be a double-edged sword and caution must be exercised in its administration given the large volume frequently described at one time^{3,7,8}.

NARCOTICS

Investigation of the death when intravenous "Drug Abuser" is found dead

Drug abuse, today is truly an international epidemic. It affects all ages and ethnic groups.

INVESTIGATION

- Scene investigate - Drug paraphernalia spoons, and syringes, fillers, remnants of drugs,
- External examination - Fresh needle marks, skin-popping, ulceration, necrosis, perforation, phlebitis, and thrombosis of veins.
- Internal examination (Autopsy)

COMPLICATIONS

Pneumonia, endocarditis, pulmonary embolism, AIDS and intracranial hemorrhage, Delirium, Forceful struggle leading to head injury, agitation, psychosis, abruption placenta, and in children over-stimulation and distressed by unfamiliar sounds.

Gastro Intestinal Complications	Neurologic Complications
Chronic Diarrhea	Alcohol Dementia
Esophagitis	Alcoholic hallucinosis
Esophageal Cancer	Alcohol Withdrawal Delirium
Esophageal Varices	Korsakoff's Syndrome
Gastric Ulcers	Peripheral Neuropathy
Gastritis	Seizure Disorders
Gastro Intestinal Bleeding	Subdural Hematoma
Malabsorption	Wernicke's Encephalopathy
Pancreatitis	

Cardiopulmonary Complications	Psychiatric Complications
Arrhythmias	Amotivational Syndrome
Cardiomyopathy	Depression
Essential Hypertension	Impaired Social & Occupational Functioning
Chronic Obstructive Pulmonary Disease	Multiple Substance Abuse
Pneumonia	Suicide
Increased Risk of Tuberculosis	

Figure 169. Summary of drug abuse complications

Complications of Drug Abuse

- Abscess at injection site and infection from intense scratching of imaginary "bugs"
 
- "Meth mouth"
 - Enamel eroded away due to corrosive chemicals in product

Figure 170. The victim of Drowning Abused Drugs

COCAINE

Cocaine usage is a cause of sudden cardiac death and intracranial haemorrhage. Cocaine inhibits the uptake of catecholamine dopamine and noradrenaline.

COMPLICATIONS

Lungs Cocaine snorting "Crack Lungs"

Thermal airway injury, pulmonary oedema, hemorrhage, hypersensitivity reactions, interstitial disease, pneumothorax, pneumomediastinum, pneumopericardium, bronchitis, Bronchial obliterans organizing pneumonia (BOOP), Hypersensitivity eosinophilia, pruritis, Increased Ig E, Charcot Leyden crystals, Pulmonary granulomatosis, pneumoconiosis-like interstitial fibrosis,

TOXICOLOGICAL STUDIES

Most cases have several drugs on board.

The heroine of late has become a common cause of death than cocaine because:

- Availability of more pure heroin available.
- The market price of heroin has decreased significantly.
- Heroin is made more available and easier to obtain than cocaine.
- A transition from cocaine addiction to heroin addiction is quite common.
- Heroin can be snorted intranasally and this has increased its use because of fear of contracting AIDS with needle usage.

Death can be Homicide, Accident, Natural Suicide, or misadventure.

COCAINE TOXICITY

Cocaine is metabolized by plasma cholinesterase to ecgonine methyl ester and Benzoylcegonine in

the liver. Cocaine blocks the uptake of the neurotransmitter dopamine, noradrenaline, and serotonin at the postsynaptic region and brain.

Cocaine and Cardiovascular System-CVS

Concurrent cocaine and abuse significantly increase cocaine levels in the blood, leading to increased, prolonged cardiovascular risks. Previous studies have reported that use/abuse of cocaine is associated with increased risk of subsequent cardiovascular complications such as

- Rhabdomyolysis- Crossband necrosis, cardiac arrhythmia's -catecholamine stimulation and conducting system effects and cause spasm of small intramyocardial vessels, Dysrhythmias. Vasospasm. Myocardial infarction, stroke, pulmonary harmorrhage, rupture of aneurysm aortic dissection, focal myocardial necrosis. Vasoconstriction causes ischemia, tachycardia.
- Myocarditis endocarditis, myocitic necrosis with mononuclear infiltration of lymphocytes macrophages and eosinophils.
- Dilated cardiomyopathy
- Vasculitis Disseminated intravascular coagulation Release of tissue thromboplastin and other activators of the coagulation cascade.

Cocaine and the Central Nervous System

Although cocaine affects all systems in the body, the central nervous system (CNS) is the primary target. Cocaine blocks the reuptake of neurotransmitters in the neuronal synapses. Almost all the CNS effects of cocaine can be attributed to this mechanism. Euphoria, pharmacological pleasure, and intense cocaine craving share basis in this system. The effects of cocaine on other organ systems, in addition to its effects on the CNS, account for the majority of the complications associated with cocaine abuse. They

include;

- Depression and coma, vasoconstriction, hypertensive cerebral haemorrhage, convulsions, agitations, subarachnoid haemorrhage, cerebrospinal fluid rhinorrhoea. Fatal malignant hyperthermia direct action on the body's heat-regulating centers (skin cool, clammy, autosomal dominant trait with variable penetrance)

Cocaine and the Liver

Long-term cocaine abuse means a higher risk of overdose, and cocaine overdose can lead to liver injury, as the body is flooded with toxins that the liver cannot filter out. While most damage to the liver resolves if the person recovers from the overdose or if they get help ending their cocaine addiction, there have been instances of death due to acute liver damage. Chronic liver damage is less likely, unless the person mixed cocaine and alcohol, which can cause the liver to produce cocaethylene, which increases the depressive effects of alcohol, increases aggression, stresses the heart, and damages the liver; Severe liver dysfunction coupled up with fatty change and necrosis of the liver.

Cocaine and Pregnancy

Studies show that various drugs may result in miscarriage, premature birth, low birth weight, and a variety of behavioral and cognitive problems in the child. A baby can also be born dependent on the drug if the mother uses it regularly—a condition called neonatal abstinence syndrome.

- Abortion - 25%,
- Live births - 25%,
- 90% shows signs of drug withdrawal abruptio placenta, foetal prematurely.

Infants whose mothers misused cocaine during pregnancy tend to be easily overstimulated and distressed by unfamiliar sights and sounds.

Cocaine and the Renal System

Chronic cocaine abuse can damage the kidneys in two ways.

- First, permanently increased blood pressure leads to kidney damage due to loss of blood flow. While many organ systems are damaged through lack of oxygen and high blood pressure, the kidneys are especially susceptible.
- Second, long-term cocaine abuse causes rhabdomyolysis or the destruction of skeletal muscles; as these muscles die, toxins are released into the body, and they flood the liver and kidneys.

Kidney failure is a late-stage result of rhabdomyolysis i.e renal failure, due to tubular obstruction by precipitated myoglobin toxicity and impaired renal blood flow from vasoconstriction effects of kinins released by muscle and pharmacological effects of cocaine.

Cocaine and the Musculoskeletal System

Cocaine use is risky for many reasons, including that it can cause rhabdomyolysis.

Rhabdomyolysis is the breakdown of healthy muscle tissue and is one of the most dangerous side effects of cocaine use. When muscle tissue breaks down, the muscle cells break, spilling their contents into the bloodstream. The body then has to filter out the remains of the destroyed cells. If it cannot, the kidneys, heart, and liver can be damaged.

Cocaine can cause rhabdomyolysis in two different ways:

- Cocaine decreases the blood flow to different parts of the body: Cocaine causes blood vessels to constrict (tighten) and deliver less oxygen to some tissue. This tissue can be muscles, skin, or organs. If these tissues lose blood flow and oxygen for a long period, the cells start to die.
- Cocaine changes the levels of

neurotransmitters in the bloodstream:

Brain cells (neurons) use neurotransmitters to send messages to each other. Cocaine increases the levels of epinephrine, norepinephrine, and dopamine in the body. High levels of these neurotransmitters cause muscle cells to over-activate, which damages them.

Furthermore, cocaine causes increased muscle activity, convulsions, hyperthermia, and myoglobinuria.

HEROINE

Heroin and the Cardiovascular System

- Bradycardia
- Rhabdomyolysis

Heroin and the Central Nervous System

- Pinpoint pupils
- Sluggish reaction to light
- Depression of respiratory centres.

Heroin and the Respiratory System

- Pulmonary oedema,
- Pneumonia,
- Respiratory depression,
- Septicemia,
- Acute/subacute bacterial endocarditis
- Lung abscess,
- Pulmonary embolic phenomenon.

Heroin and the Renal System

- Nephrotic syndrome,
- Nephropathy
- Diffuse glomerulonephritis.

Other heroine related complications

- Hypothermia-chronic active hepatitis; Withdrawal symptoms set in after 8 hours and peak the gradually disappear with 48-72 hrs.
- Craving restlessness, yawning, lacrimation, rhinorrhoea, dilated pupils, piloerection, felling of cold and hot, tremors, insomnia, generalized aches and weakness, abdominal cramps, tachycardia, hypertension, vomiting, diarrhoea, dehydration (Antidote: Naloxone.)
- Congestion of the lungs and oedema are common findings in death associated with intravenous drug use especially morphine and heroin.
- The presence of polarisable material in the subcutaneous tissue is due to impurities injected together with the real drugs.
- Hepatitis C and/or B are common in drug users.

AMPHETAMINES

DRUG ECSTASY

❖ The pathological complications of drug ecstasy

'Ecstasy' is synonymous with -MDMA (methylenedioxy-methamphetamine) 'XTC', 'ADAM' . It's dangerous and common at young ages between 16-30 years. It causes euphoria and benevolence and heightens the sensation at raves and discos.

❖ Symptoms

Loss of appetite, trismus, nausea, muscle aches and stiffens, ataxia, sweating, tachycardia and hypertension, insomnia, fatigue, hyperthermia, convulsions, cardiac arrhythmias, rhabdomyolysis,

DIC, renal failure, hyponatremia, hepatotoxicity, aplastic anemia, cerebral infarction, cerebral haemorrhage, cerebral venous sinus thrombosis, restlessness, talkative, irritability, insomnia, tremor, hyperreflexia, dry mucus membranes, palpitation, hallucination, panic reaction, N/V/D pallor, tachypnoea, acute cardiomyopathy, renal ischemia, cardiac infarction, paranoid psychosis and coma followed by sudden death.

NOTE: MDMA acts on the noradrenergic system.

❖ Pathological Findings

- Liver necrosis-Focal necrosis in zone 3, fatty changes massive hepatic necrosis, sinusoidal dilation, and inflammation liver sinusoidal dilatation with foci of necrosis and inflammatory infiltrate. Individual hepatocyte necrosis zones 2 and zone 3 centrilobular necrosis with hepatitis.
- Myocardium - Myocytolysis, fibrosis contraction band necrosis, myocyte necrosis
- Kidney renal failure myoglobinuria- Acute tubular necrosis.
- Brain -Brain cerebral oedema due to water intoxication and perivascular necrosis there is increased secretion of antidiuretic hormone.
- Haemorrhage may occur due to hypertension and increased intracranial pressure.
- Hyperthermia Temperature -Hyperpyrexia 39° C -44° C Deaths is due to brain oedema water intoxication and acute death is similar to malignant hyperthermia on general anesthesia due to the central effect on thermoregulation.
- Focal perivascular haemorrhage, neural degeneration, gross oedema, pituitary necrosis.
- Hydro toxicity due to excessive thirst.
- Pulmonary oedema, pulmonary infarction, metabolic acidosis due to hyperventilation

DIC

- Rhabdomyolysis

Long Term Effects

The long term effects of amphetamines are not yet known since the drug has been in the market for a short time; relatively 5 years.

The effects of amphetamine are to produce delayed fatigue and suppress appetite, have a strong stimulant effect, can be injected, snorted, smoked, or ingested. Act by inhibiting catecholamine re-uptake lipid-soluble alpha and beta stimulation. Chronic use may lead to hyper excitement, hallucination, and psychosis.

Hyperpyrexia (40°) and hypertension can precipitate a cerebral or subarachnoid hemorrhage and a risk of cardiac arrhythmias.

MX: Symptomatic HT nitroprusside, cold blanket for hyperthermia.

Treatment

- Rapid cooling
- Control of seizures
- Paralysis with non-depolarising neuromuscular blocking agents,
- Ventilation and dantrolene.

PRESCRIBED DRUGS

The approach to the post mortem examination of an elderly individual with terminal carcinoma who is said to have been deliberately poisoned with an intravenous injection of potassium chloride

- Clinical notes
- External examination
- Internal examination
- Toxicology

PRESCRIBED DRUGS

The Approach investigation of the death of an involuntary patient held under the Mental Health Act who has died while receiving intravenous sedation

- The investigation of the death of an involuntary patient under the Mental Health Act who has died while receiving intravenous sedation.
- Death in the mental institute is the same as death in custody and raises a lot of public concern. The meticulous approach is required to avoid missing facts, which may be of importance at a later date. It falls within the cases reportable to the coroner.

INVESTIGATION FORMAT

The investigation should flow with the following format;

❖ Scene of Death

This involves the surroundings, any suspicious use of unnecessary force, bloodstains, vomiting, or urinating in the room where the patient was being given the drug for sedation.

Circumstances

This encompasses the reason for sedation; could be violence, normal treatment, the interval between treatments, the type of drugs he is on, and how frequent, who prescribed the drugs and who was giving, the last review by the doctor, and his comments.

❖ Past Medical History

History of head injury, drug allergy, if possible peruse the medical records to check for a history of natural disease. Conduct a meticulous post mortem external and internal examination.

❖ External Examination

Check for bruises, abrasions, or lacerations. The evidence of medical intervention needle punctures, dressings is also important.

❖ External Examination

Look out for the following complications;

- Head subdural haematoma, subarachnoid haemorrhage, dating of the haemorrhage,
- The musculoskeletal system,-fractures bruises the muscles
- Abdomen- Injury of the internal organs e.g. rupture of the liver, spleen, mesenteries, or small and large gut.

Rule out natural disease

❖ Toxicology Drug Screening

- Screen all the drugs including the drug being given during death.
- Evaluate the drug in the intravenous infusion just before death.
- Examine the drug in the syringe to confirm whether it is the actual drug being given, the expiry date and the recommended mode of administering by the manufacturer, the precautions are given, the dose recommended, the therapeutic range, the toxic levels, and the antidote if available.

❖ Conclusion

- Establish the cause of death i.e Cardiac arrhythmia's, hypersensitivity to drugs
- Establish a mechanism of death ie Drug toxicity (single or multiple) Manner of death which could either be homicidal or accidental.

MEDICINAL DRUGS

POISONING

❖ Hypoglycemic Agents

Insulin, alcohol, sulphonylureas chlorpropamide, tolbutamide, tolazamide, glyburide, and glipizide. biguanides, phenformin, metformin, and buformin.

An overdose of hyperglycemic agents causes hypoglycemia.

TREATMENT OF HYPOGLYCEMIA.

50% glucose, isotonic fluids, diazepam in cases of seizures, glucagon, gastric lavage, activated charcoal, alkalization of urine, dextrose 10%.

❖ Beta-blocking Agents

Beta-1 receptors increase head contractility, automaticity, and conduction velocity. Beta-blockers cause bradycardia, hypotension, and heart block first-degree block, changes in ECG, decreased contractility, may also cause delirium to coma, bronchospasm, and hypoglycemic reactions. Examples of beta-blocking agents are propranolol, labetalol, pindolol, and atenolol.

TREATMENT OF BETA-BLOCKING AGENTS OVERDOSE

Overdose treatment is achieved by gastric lavage, atropine, charcoal, cathartics, pacemakers, fluid replacement, phenytoin or barbiturates in seizures, and glucose infusion in hypoglycaemic situations, beta-2 aerosol in bronchospasm.

Beta-2 receptors relax the bronchial and other smooth muscles increase contractility of skeletal muscle, and glycogenolysis and gluconeogenesis.

Beta-2 blockers lead to bronchial constriction, increased motility, and tone of the GIT. Beta-blockers are prescribed is hypertension, angina,

ischaemic heart disease, cardiac arrhythmias, migraine headaches, eye drops in glycoma.

❖ SYMPTOMS AND SIGNS OF PARACETAMOL POISONING

10 grams or 20 tabs, the Blood level of 300 ug/ml.

- Nausea, vomiting, and abdominal pain.
- Liver necrosis cardiac arrhythmias and arrest
- Renal failure, tubular necrosis, renal papillary necrosis
- Bone marrow damage
- Thrombocytopenia
- Skin rashes.

❖ Treatment of paracetamol poisoning

N-acetyl cysteine, and methionine IV treatment of acidosis and other biomedical abnormalities, hemoperfusion

❖ ASPIRIN POISONING

5-12 grams of aspirin lethal dose of 15-20 grams.

❖ Signs and Symptoms

Vomiting, abdominal pain, tinnitus, hyperpyrexia, over-breathing -respiratory alkalosis -respiratory acidosis, hyperthermia, metabolic acidosis, dehydration, hypokalemia, sweating, componentry metabolic hyperthermia acidosis GIT bleeding, anaphylactic reaction asthmatics, tetany, coagulopathy rhabdomyolysis, and hyperglycemia, hypoglycemia in chronic intoxication.

Testing Ferric chloride gives a purple color with salicylates.

❖ Treatment

Aspirin overdose is treated by gastric lavage, bicarbonate increased excretion of urine forced alkaline diuresis, and hemodialysis.

FORENSIC PROBLEMS WHICH MAY OCCUR WITH MISUSE OF ANABOLIC STEROIDS

The effects of anabolic steroids are sociological, physical, and forensic.

FORENSIC EFFECTS

- ❖ Withdrawal symptoms depression, violent crimes, including murder.
- ❖ Drug addiction preoccupation with drug use.
- ❖ Craving has been reported with stealing to get money for the drug.
- ❖ Acute opioid withdrawal and respond to similar agents as in the case of opioids and alcohol.
- ❖ Abuser develops sex steroids hormone dependence disorder, personality changes such as depression, hostility, aggression, and paranoia.
- ❖ Active sexual precocity, associated with an increased rate of rape.

"In no way can a user of anabolic steroids be considered suitable for recruitment into police force". The potential for antisocial and violent behavior is just too great a risk.

PHYSIOLOGICAL EFFECTS

- ❖ Alteration and the pathological lesions that result from the use of the various steroids hormones.
- ❖ Tissue alteration and pathological lesions.

These depend on type, dose, and duration of use. There is increased use and most of the people do

not term their use of the drug as abuse.

EFFECTS OF ANABOLIC STEROIDS TO BODY SYSTEMS

- Liver abnormal liver function tests. Steroid associated adenoma and hepatocellular carcinoma, peliosis hepatitis, hepatocellular and intrahepatic cholestasis leading to severe jaundice hepatic failure, Creatinine kinase elevation.
- Increased muscle bulk
- Brain oedema with increased intracranial pressure.
- Breast tumours with hypertrophy
- Breast endometrial carcinoma
- Ovarian and cervical cancer
- Prostate cancer and hypertrophy.
- Promotes bone osteoporosis.
- Uterus endometrial carcinoma
- Abnormal spermatogenesis- Low fertility level of luteinizing hormone and follicle-stimulating hormone, can increase or decrease libido, Acne, Reduce testicular size, azoospermia, hirsutism, Amenorrhea, and frank virilization Gynecomastia.
- CVS:- Hypertension, Lipid metabolic disorder increase of LDL and decrease HDL, cholesterol concentration, and increase the risk of Myocardial infarction, Atheromatous changes, cerebrovascular accident secondary to carotid artery thrombosis, venous thromboembolism.
- Hematology:- Erythrocytosis, Thrombosis, Increase platelets counts, and platelets aggregation.
- Severe fluid retention with the result of hemoconcentration and increased risk of thromboembolic phenomenon

Other indications exhibited include;

- Nutritional problems.
- Psychiatric illness personality changes, hallucination depression, suicide, tendencies, sleep apnoea
- Violent crimes such as murder-rape.

Sociological Effects

75% of all the competitive bodybuilders use anabolic steroids in most countries.

SOLVENT ABUSE

GLUE SNIFFING

The solvent is placed in a plastic bag or soaked in handkerchief or rag the vapor is inhaled giving the desired intoxication and hallucination.

❖ Causes of Death

- Vagal stimulation by the freezing gas when sprayed
- Most of the solvents are sensitive to the myocardium also noradrenaline so any sudden fright releases catecholamine causing ventricular fibrillation and cardiac arrest.
- Vomiting into air passages
- Sheer hypoxia especially if the plastic bag is placed over the head
- Direct toxic effect of the substance on the tissues especially the brain and myocardium.

❖ Post Mortem Findings

Findings are minimal highlighting;

- Sores and excoriations on the lips.
- Liver damage occurs when there is the use of halogenated hydrocarbons.

Chapter Seventeen

Heavy Metals

THALLIUM

Thallium is used as a rat poison and is widely used in industries especially in the optic glass. It has been a major component of antihelminthic drugs substitute for potassium and causes membrane depolarization. Thallium binds to sulfhydryl groups interfering with mitochondrial respiratory chain, induces, riboflavin deficiency by binding with riboflavin.

Clinical Features of Thallium Poisoning

Gastritis, abdominal pain, and vomiting characterize acute poisoning, hair loss follows after 2-3 weeks. Muscle pains peripheral neuritis, confusion, sleep disturbances, and psychiatric symptoms appear.



Figure 171. Effects of thallium poisoning on the skin



Figure 1: Mee's line and erosion of nails in a case of thallium poisoning

Figure 172. Erosion of nails following thallium poisoning

Autopsy

Widespread non-specific degeneration in the heart, liver, kidneys, brain, and other organs is discovered.

MX: Activated charcoal, slow IV potassium chloride infusion, and oral Prussian blue (potassium ferric cyanoferrate).

LITHIUM

Lithium is used for the treatment of mood disorder, manic depression illness symptoms, and signs:

Signs and Symptoms of Lithium Poisoning

Neuropsychiatry, lethargy, tremor, alterations in consciousness, confusion, ataxia, fasciculations visual distortions, nystagmus seizures, paralysis,

coma, GIT/N/D/V, abdominal pain, and CVS Rythm disturbances, polydipsia, goiter, and hypothyroidism

- MX: As in another poisoning.

Effects of Lithium Poisoning

Lithium Toxicity Effects		
	ACUTE	CHRONIC
GI (nausea, vomiting & diarrhoea)	42%	20%
CNS (seizures)	delayed	Common > 2.mmol/L
Renal	Usually non significant	Universal
ECG	normal	QT prolongation usual
Thyroid	none	Hypothyroidism 20%
Recovery	Usual, rapid	Disability 10% delayed
Level corelation	poor	Good

Hypertox. 2007 14

Figure 173. Effects of lithium poisoning



Figure 174. Psoriasis as a result of lithium exposure

LEAD TOXICITY

SOURCES

- Oral-lead paint pica, newsprint.
- Inhalation welding, battery recycling plants, demolition, brass burning painted wood motor car exhaust fumes.
- Dermal absorption is minimal.
- Intravenous route-IV methamphetamine

users.

EFFECTS OF LEAD POISONING

- Lead reacts with sulfhydryl groups interfering with enzymes of heme synthesis for hemoglobin and cytochrome production (ALA).
- Sodium potassium ATPase pump
- Reduces RBC production in the bone marrow.
- Causes renal-fanconi Like syndrome, chronic nephritis
- Causes myocarditis and fibrosis, CNS peripheral neuropathy
- Results in GIT-N/V/C abdominal pain
- CNS-Ataxia, peripheral neuropathy, irritability, headache, convulsions, retinal pigmentation, encephalopathy.
- Radiology: Lead line opacities in abdomen films - multiple lines indicate repeated episodes of poisoning.

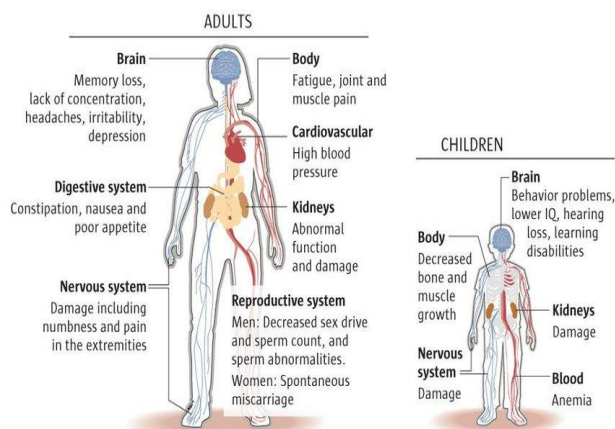


Figure 175. Effects of lead poisoning



Figure 176. Lead poisoning of teeth and gums

LEAD ANTIDOTE

Absorption after inhalation crosses the blood-brain barrier.

- Dimercaprol (BAL),
- Calcium
- Disodium versenate (ca Na-EDTA),
- D-penicillamine.

MERCURY POISONING

Mercury poisoning is common in glass thermometers, dental amalgams, electrical equipment, batteries, paint, scientific instruments, and disinfectants.



Figure 177. Lichenoid reactions on the mucosa of the tongue, associated with a contact allergy to mercury. The patient has amalgam filling in his teeth.

Mercury Exposure Levels and Clinical Features

- **Acute exposure:** corrosive bronchitis with fever, chills, dyspnoea, pulmonary oedema. Severe progressive intractable diffuse pulmonary infiltrates leading to diffuse alveolar damage, Abdominal pain, Neuropsychiatric disturbance intentional tremor, memory loss anxiety, depression.
- **Chronic exposure:** Corrosive bronchitis

with fever, chills, dyspnoea, pulmonary oedema, severe progressive intractable diffuse pulmonary infiltrates leading to diffuse alveolar damage, depression, gingivitis, salivation, tremor, nausea, diarrhea, esophagus erosions, stomatitis, acute renal failure due to renal tubular necrosis.

MX Chelation D penicillamine, Dimercaprol (British Anti-Lewisite) BAL ca-EDTA Removal from the exposure, gastric emptying, IV infusion with an isotonic solution.



Figure 178. Mercury poisoning from amalgam fillings causes acne, dermatitis

CYANIDE POISONING

Cyanide poisoning often occurs in victims of smoke inhalation. Tests that can confirm a diagnosis of cyanide poisoning are rarely available. However, treatment should not be delayed. The diagnosis is clinical and characterized by altered mental status, cardiovascular instability, and lactic acidosis. Hydroxocobalamin has been approved recently as a therapy for cyanide poisoning. It is relatively safe and is better tolerated than the ingredients of the traditional cyanide antidote kit (amyl nitrite, sodium nitrite, and sodium thiosulfate). The nitrites induce methemoglobinemia, which can worsen hypotension and reduce the oxygen content of the blood, an important consideration in patients with concomitant carbon monoxide poisoning.



Figure 179. Photographs showing a bright red discoloration of the patient's skin (A) and urine (B) after treatment with hydroxocobalamin for cyanide poisoning.

Cyanide poisoning is common in petrol chemical nitroprusside.

- Absorption; Oral, respiratory, fumes, dermal
- Elimination; Urine conversion to thiocyanate

Cyanide poisoning testing

Lee-Jones-Tests. ferrous sulfate sodium

- Hydroxide+HCL-->Green-Blue color.

Cyanide poisoning antidote

Nitrite thiosulfate and hydroxy cobalamin

Treatment of cyanide poisoning

Hydroxocobalamin should be administered as soon as cyanide poisoning is suspected — ideally in the prehospital setting.

- By combining with cyanide, hydroxocobalamin forms cyanocobalamin (vitamin B12), restoring mitochondrial function.
- Hydroxocobalamin imparts a harmless and transient reddish color to the skin and urine. It may also cause transient

hypertension, which can be beneficial in patients with cyanide poisoning.¹

PARAQUAT POISONING

This is an agricultural herbicide and the poisoning may either be suicidal, accidental, or homicidal.

The poison can be observed over the skin, inhaled, or ingested. The mechanism of toxicity poorly understood thought to reduce biological tissues to free radicals which react with oxygen to turn superoxide into hydrogen peroxide, which induces tissue damage either by lipid peroxidation of cell membranes or by alteration of cellular redox states with consequent depletion of NADPH. It accumulates in the lungs resulting in severe acute or delayed pulmonary effects.

Signs and Symptoms of Paraquat Poisoning

- Local skin irritation
- Reversible irregularity of the nails
- Neuropathy
- Keratoconjunctivitis
- Epistaxis



Figure 180. Paraquat poisoning by skin absorption

The poisoning dose depends;

- <20 mg/kg; vomiting, and diarrhoea,
- 20-25 mg/kg; vomiting, abdominal pain, diarrhoea, acute renal, and hepatic insufficiency due to acute tubular necrosis and centrilobular necrosis of the liver, pulmonary fibrosis.
- >50mg/kg; death within 72 hrs due to multiple organ failure, renal tubular necrosis, myocarditis, liver necrosis, pulmonary haemorrhage.

- Hemoperfusion
- Avoid oxygen therapy enhances pulmonary fibrosis.
- Clean contaminated skin, maintain respiration.
- There are no specific antidotes,

INSECTICIDES

PARAQUAT POISONING TEST

❖ Dithionite Urine Test

10mls of urine_2mls sodium hydroxide = Blue colour.

Treatment

- Gastric lavage
- IV fluids
- Mannitol (renal functions normal)

The Clinical Presentation

- DUMBELS- Muscarine receptors

Defecation, urination, myosis, bradycardia and bronchospasm, lacrimation, salivation.

- MATCH -Nicotinic receptors

Muscle weakness and fasciculations, adrenal medulla activity increase, Tachycardia, cramping of skeletal muscles, hypertension.

- MX Atropine and pralidoxine (PAM).

Chapter Eighteen

Alcohol Use & Abuse

INTRODUCTION

Ethyl alcohol is the most commonly used drug in the world to affect mood and to alleviate discomfort, with consequent influence on patterns of behavior.

Acute alcohol abuse exerts its effects mainly on the central nervous system, but it may also remarkably quickly; induce hepatic and gastric changes that are reversible.



Figure 181. Alcohol abuse

EFFECTS OF ALCOHOL USE

Chronic use has a variety of adverse effects as a form of liver disease namely;

- Hepatic steatosis, Alcoholic hepatitis and liver cirrhosis
- Oesophageal varices
- Acute pancreatitis
- Hepatic coma and
- Lobar pneumonia ¹⁻³.

Alcoholism is most common in men (30%) than women (19%) but women are over presented in medico-legal autopsies which may indicate that female alcoholics are more often than men die under circumstances qualifying them for a medico-legal autopsy, and that alcohol abuse among women has more severe consequences ².

Alcoholism causes many social problems such as loss of a job, divorce, early death due to accidents and/or disease, and may have suicidal tendencies ²⁻⁴.

THE ABSORPTION, DISTRIBUTION, METABOLISM AND EXERTION OF ALCOHOL

Ethanol is capable of being absorbed by any part of the gastrointestinal tract, but in practice, this is confined to the stomach and upper small intestine, and only a little alcohol remains to pass through the wall of the ileum and colon ⁵.

❖ ALCOHOL ABSORPTION

Absorption of alcohol can be affected by factors such as food, changes in motility, blood supply, or morphology of the gastrointestinal tract, concentration, and dose of alcohol.

Alcohol is very hydrophilic and therefore present in any body tissue or fluid is a function of the water content of that tissue or fluid. Women have higher alcohol concentration than men after taking equal amounts of alcohol largely to differences in adiposity. This is so because alcohol is to a great degree excluded from adipose tissue and normally women have higher adipose tissue than men do. Most of the body fluids have high amounts of

alcohol concentration including blood, bile, urine, vitreous humor, saliva, and sweat.

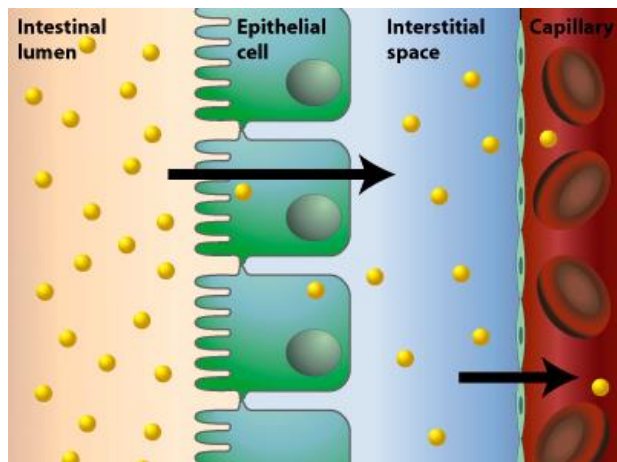


Figure 182. How alcohol is absorbed in the body

The speed with which different organs reach equilibrium depends on blood flow, permeability, and mass of the tissue ⁶.

❖ ALCOHOL METABOLISM

The main site of metabolism of ethanol in the liver, although some other tissues like kidney, muscle, the lung, the intestine, and possibly the brain may metabolize ethanol in smaller quantities. Oxidative metabolism of ethanol can be catalyzed by more than one enzyme and takes place in several steps;

- Oxidation of ethanol to acetaldehyde.
- Oxidation of acetaldehyde to acetate
- Oxidation of acetate to carbon dioxide and water.

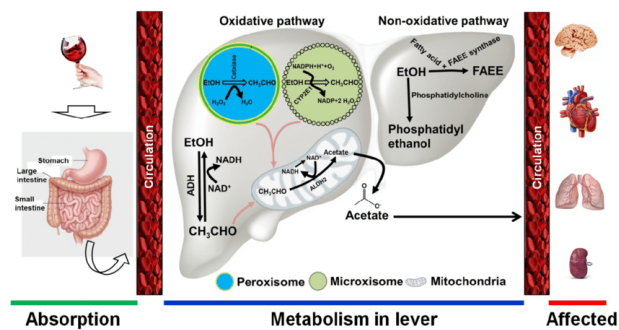


Figure 183. Alcohol metabolism

Elimination starts as soon as absorption and distribution commence and continues as long as alcohol is present in the body. Over 90% of absorbed ethanol is metabolized to carbon dioxide and water and the remainder 2-10% is excreted mainly via the kidney and the lungs ⁶⁻⁷.

The cause of fatty change in the liver results mainly from three mechanisms;

- The shunting of normal substrates away from catabolism and towards lipid biosynthesis owing to the generation of excess nicotinamide-adenine dinucleotide (NADH) by alcohol dehydrogenase.
- Impaired assembly and secretion of lipoproteins
- Increased peripheral catabolism of fat ¹.

Relationship between Blood, Vitreous and Urine Alcohol Levels

The most frequently performed test in a forensic toxicology laboratory is the post-mortem determination is ethanol ⁶.

Fifty percent of fatal automobile accidents involve drinking drivers and 60% of pedestrians killed have significant concentrations of ethanol. Ethanol is also found in 50% of murdered victims and 35% of suicide victims ⁷⁻⁸.

In ethanol analysis, three specimens are usually taken. Blood, vitreous humor, and urine (if urine is not present, bile is a suitable alternative). The assay may be simple but the interpretation of the results, especially for post-mortem specimens, is complex and compounded by considerable social and legal complications. Factors that must be taken into consideration include the ethanol distribution into the absorptive versus postabsorptive phases, the site of sample collection, possible trauma to the stomach and diaphragm, aspirated vomitus, and post-mortem distribution and/or synthesis of alcohol ⁶⁻⁸.

The mean distribution ratios (ethanol concentration in fluid/ethanol concentration in

blood) are vitreous humor 1.27 and urine 1.3. Although some studies have given different ratios, they did not attempt to distinguish between deaths occurring during the absorptive or postabsorptive (elimination) phase of ethanol distribution. Even if one determines there is an atypical ratio, one must also bear in mind that there are other factors besides post mortem production the result to atypical distribution, which includes the decomposition of the body extensive clotting, collapsed vessels, the position of the body, and rigor mortis may also affect ethanol distribution. Coe and Sherman found that the hematocrit could vary between 7 and 64% in post-mortem blood samples.

Besides, rigor mortis, coagulation, and abdominal pressure can cause blood to move post-mortem such that blood collected from one site in the body may also have originated in a different site⁷.

In cases with a positive or low blood alcohol (0.003%) and negative vitreous humor or urine, ethanol concentration and post-mortem ethanol synthesis should be seriously considered and the findings possibly considered negative⁷⁻⁸.

Significant ethanol concentration in urine with low or no ethanol concentration in blood can be used as proof of a prolonged time interval between the cessation of consumption of ethanol and the time of death. Similarly, if a high blood alcohol concentration is found with a low urine alcohol concentration, it may be suggested that a large amount of ethanol had been consumed and that soon after ingestion death occurred, possibly due to acute alcoholism⁹.

EFFECTS OF ALCOHOL CONSUMPTION

Complications of excessive alcohol intake include;

- GIT: Oesophageal varices, gastritis, gastric ulcers, hepatitis, and fatty liver/cirrhosis of the liver, pancreatitis.
- CVS: dementia, Wernicke-karsokoff's syndrome, epilepsy, cerebral degeneration, degeneration of corpus callosum, central pontine myelinolysis,

peripheral neuropathy, and myopathy.

- CVS: Hypertension, cardiomyopathy, and cardiac arrhythmias.
- Others: Anaemia Iron deficiency, vitamin B12, folate, Infection, and fetal alcohol syndrome.
- Psychological: Depressive disorders, dementia, pathological jealousy, alcohol hallucinosis, sexual disjunction, anxiety status, and high suicide rates.
- Social: Crime, RTA, work problems, unemployment, family problem, and violence

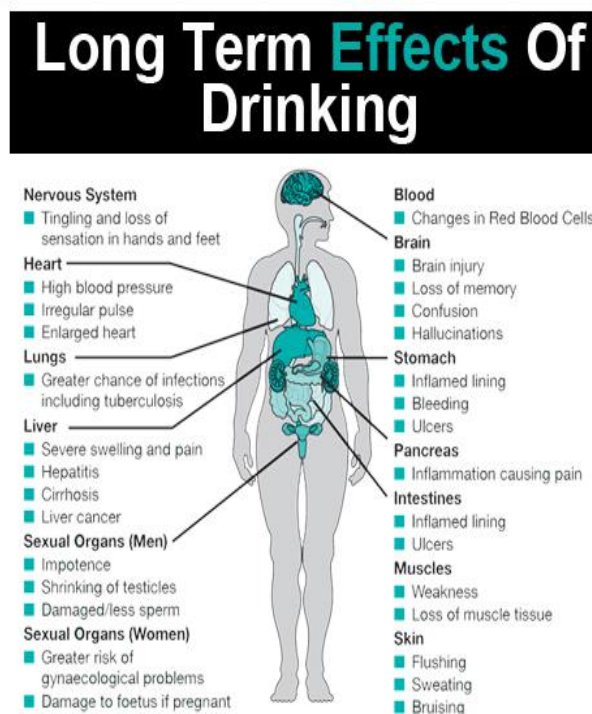


Figure 184. Long term effects of alcoholism

Drunken persons are often involved in activities leading to fatal trauma, including falls from a height, road traffic accidents, or burns both dry heat and moist heat and drowning¹⁻⁴.

A common mechanism of sudden death in acute alcoholism is the aspiration of vomit. The presence of gastric contents in the airways should be interpreted with caution. A firmer opinion may be

held when a drunken person is found dead with massive blockage of his or her air-passages by copious gastric contents and if there is other evidence externally of vomit on the clothing or immediate surroundings.

Not uncommonly, the inspiration of a food bolus in the larynx, the so-called "cafe coronary", causes death in association with acute alcoholic intoxication. The silence associated with such events is remarkable and characteristic.

ACUTE LIVER FAILURE IN FORENSIC PRACTISE

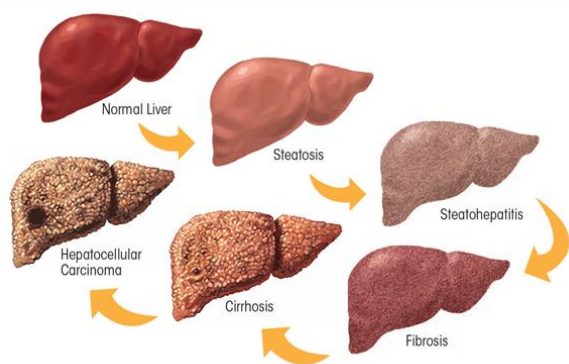


Figure 185. Liver cirrhosis resulting from alcohol abuse

❖ Death Mechanisms

Other mechanisms proposed for sudden death in acute alcoholic intoxication include;

- Hypoglycaemic
- Hypomagnesemia
- Fat embolism secondary fatty liver
- Disturbances in the functions of the heart caused by alcohol and cardiogenic death caused by cardiotoxic effects of alcohol¹⁰⁻¹²

Intoxication with alcohol is first suspected from the smell of alcohol on the breath during life and by the pungent smell of stomach contents in the

post-mortem. The circumstances of death will often indicate a likelihood of alcohol use or abuse.

The action of alcohol is depressant, and with increasing concentrations, there is a progressive depression of brain function. When these affect the center in the midbrain and medulla, there is the danger of fatal cardio-respiration failure. Alcohol also causes changes in the heart regularly mechanisms, both centrally and by a vasomotor effect. The latter causes vasodilatation, especially in the skin, and this may lead to marked heat loss and dangerous hypothermia. This may be aggravated by collapse out of doors in the cold.

There is an increase in heart rate with low alcohol concentrations, but when alcohol levels approach the dangerous ranges in excess of 300mg/100ml (0.3 gram/100ml bradycardia may develop. The blood level of alcohol (0.5 gram/100ml) is sufficient to cause death from respiratory depression.

Although other diseases such as focal myocardial fibrosis are associated with sudden unexpected death due to cardiac arrhythmias, acute alcoholic intoxication may increase the vulnerability of the victim to a fatal outcome from respiratory¹².

AUTOPSY SAMPLING FOR TOXICOLOGY

In testing for drugs, the use of leg blood is recommended. It gives a more accurate indication of the ante-mortem concentration because of the phenomenon of the post-mortem drug diffusion or redistribution. The former has been demonstrated concerning alcohol for example in major vessels around the gastrointestinal tract and the sites of injection in cases of intravenous drugs. The latter relates to drugs such as digoxin and tricyclic antidepressants bound to muscle, including myocardium, which falsely elevates levels after death in blood taken from heart chambers or the major vessels around the heart⁸⁻⁹.

The assessment and interpretation of post mortem blood alcohol level

- Diffusion of alcohol from stomach to pericardium and left pleural cavity,
- Contamination of the sample,
- Absorption of food from the stomach.

PHYSIOLOGICAL AND CLINICAL FACTORS THAT MAY AFFECT ALCOHOL ABSORPTION IN THE BODY.

- Rapid stomach emptying
- Gastro-Jejunostomy
- Alcohol in empty stomach
- Food in the stomach
- Diet, Fatty substances reduce absorption, the concentration of the alcohol - increased concentrations lead to increased elimination.
- Type of beverage; strong spirits irritate the stomach causing pyloric spasm and coat the lining with mucus thus delaying absorption, chronic alcohol intake lead to increased elimination rate, rate of consumption, presence of food, physical exercises, disease, and drugs.
- Age, sleep or unconsciousness, temperature, diurnal change has no change.

❖ ALCOHOL ELIMINATION

- 90% is completely oxidized to carbon dioxide and water
- 2-10% is excreted in the kidneys and the lungs.

Oxidation Ethanol -----> Acetaldehyde----->
Acetate ----->Water and carbon dioxide.

❖ Effects of Chronic Alcoholism

Chronic alcoholism may lead to;

- Alcoholic liver disease and hepatomegaly,
- Alcohol-related steatosis can be mimicked by diabetes, obesity, anemia, malnutrition (starvation) infections, drug therapy, rye's syndrome, phosphorus, carbon tetrachloride poisoning cerebral atrophy, nephromegaly.

Causes of death in alcoholics may be due to hypoglycemia during withdrawal, pulmonary fat embolism, fatty liver, and maladjustment derangement of neurotransmitters.

ALCOHOLISM AND SUDDEN DEATH

- IHD - arrhythmias,
- Cerebral disease - severe head injuries - subdural haematoma
- Epilepsy withdrawal seizures
- Status epileptic
- Aspiration asphyxia
- Cardiac arrhythmias,
- Liver cirrhosis,
- Infectious disease
- Malignancy
- Trauma.

Miscellaneous

- Magnesium depletion
- Hypotasaimia
- Cardiomyopathy
- Hypoglycemia
- Acidosis
- Increased adrenergic activity, and seizures.

Differential diagnosis of alcohol and diabetes mellitus

- Uraemia
- Drug poisoning (Opiates, Amphetamine, and cocaine).
- Head injury and Cerebrovascular accidents (CVA)
- Epilepsy.

Blood and Urine specimen collection and preservation for alcohol estimations.

Potential errors that may exist in relation to a correct result.

❖ Obtain

- Blood - Venipuncture 5MLS of blood do not use antiseptic that contains alcohol.
- Urine. Makes the person empty the

bladder and the collects a later specimen excreted after drinking begun 30-60 minutes later.

❖ Preserve

- Blood. Sodium chloride bottle with or without potassium oxalate as an anticoagulant.
- Urine. Universal bottles containing purric acid or a small amount of sodium azide if the delay is foreseen.

❖ Transport

- Blood. Normal temperature does not freeze if the specimen reaches the laboratory within 24 hours. Two samples to the laboratory, one sample given to the driver to do his/her testing if need be.
- Urine. Do not freeze.

Chapter Nineteen

Investigation after death

INTRODUCTION

Laboratory investigation and their interpretation are well known to all practicing doctors and pathologists

For forensic pathologists, the investigation after death is the mainstay of forensic practice. The investigation starts from the time the pathologist gets the information to the time the verdict is given in a court of law.

FORENSIC RADIOLOGY

❖ The Role of Radiology in Forensic Medicine

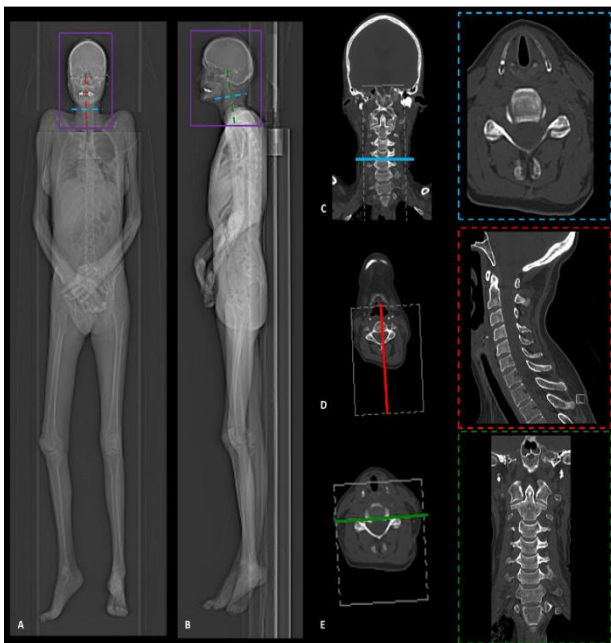


Figure 186. Imaging in forensic radiology

Radiology has several values into the investigation after death including;

- Child abuse- Callus of old fractures of the posterior ribs, visibility of hidden fractures.
- Gunshot wound
- Identification of burnt-out body (charred body)
- Dentistry
- Structure of bones a factor of biochemical load capacity
- Suspected air embolism, pneumothorax, barotrauma.
- Explosive death
- Traumatic subarachnoid hemorrhage - vertebral artery angiography.
- Mutilated remains in mass disasters
- Search for foreign bodies (spoons, coins) and identification of poisons especially heavy metals.
- Gastrointestinal organs in newborn
- Diagnosis of TB in a corpse
- Identification and determination of age.
- Experimental research with a corpse
- Where radiocontrast cerebral angiography is used to confirm brain death.

FORENSIC PHOTOGRAPHY

❖ Ultraviolet Examination and Photography

This is used in the detection of assault when the initial signs of injury have faded or completely disappeared which enable injuries to be photographed successfully many months after the initial sign has disappeared.

Good photographic records have been made two or three months after injury.

- **REASON:** It Takes time for melanocytes to migrate to the edge of the wounds in sufficient numbers to build up a recordable density of melanin.

In a severe injury, it is possible to take good photographs up to eighteen months after visual signs have disappeared.

The migrating melanocytes leave a depigmented area surrounded by heavily pigmented area, which deeply delineates the shape of the object, which produced the trauma. Depigmented area reflects ultraviolet (UV) and pigmented areas observe it strongly.

Photography in forensic practice is of paramount importance. Photographs taken after death can be used in various ways including.

- **Pathologists:** when writing the final report. This is used to relate the findings both macroscopically and microscopically to injuries seen during the autopsy.
- **The police:** This is mainly useful in cases such as when footprints are retrieved.

Alternatively, the weapon used is compared with the actual item presented from the scene of the crime or at the court of law.

- **Court of law:** This is the most important aspect of photography at the scene of crime.

The cases may come to court for several months. If not years after the case was done. It will be very

difficult for the pathologist to remember the way the injury looks at the site of injury (He /She has seen many injuries in many cases and it is always easy to confuse)

EMBOLISM

AIR EMBOLISM

A volume of 100 - 250 ml of air is required to cause death from a venous air embolism. A much small amount can cause death on the arterial side.

AIR EMBOLISM

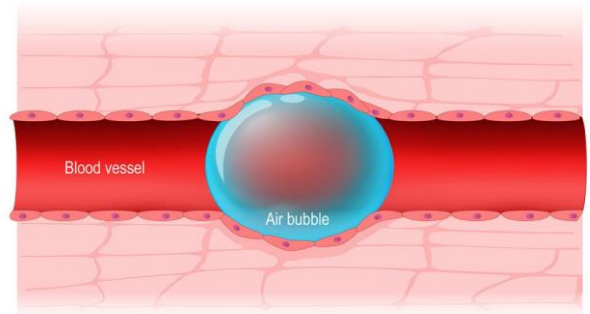


Figure 187. Air embolism

❖ Causes of Air Embolism

Venous

- The open system of intravenous infusion
- During parturition
- Abortion
- Secondary to trauma
- During oral-genital sex in a pregnant woman

Arterial

- Cardiopulmonary by-pass
- After chest injury or trauma to the pulmonary veins.

SUSPICION AND CONSIDERATION BEFORE THE AUTOPSY

- Plain X-ray.
- Retinal vessels examined with ophthalmoscope for bubbles.
- Pericardial sac must be exposed with as little trauma to the vessels as possible.
- A small window in the sternum
- Sternum divided distal to the sternoclavicular joint and internal mammary gland vessels clamped
- Pericardial sac opened and epicardial veins examined for air bubbles.
- A pericardial sac filled with water and filled syringe with the plunger removed needle inserted into the right ventricle, air bubbles will appear.
- The right side of the heart filled with frothy blood.
- Thoracic cavity filled with water to examine inferior vena cava and pelvic veins.
- Brain meningeal vessels examined for bubbles with the brain in-situ.

AMNIOTIC EMBOLISM

This is common in maternal deaths. This is mainly caused by the escape of amniotic fluid to the blood system. Amniotic fluid contains lanugo, fatty material, fetal squames, and mucus.

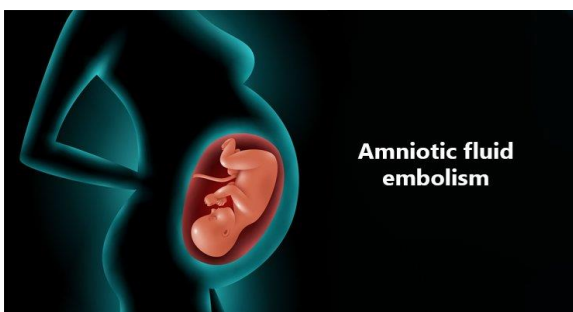


Figure 188. Amniotic fluid embolism

❖ Confirmatory Tests

- Oil red O or Sudan black IV
- Attwood's stain Alcian blue or green phloxine tartrazine technique.
- Immuno peroxidase methods for epithelial markers keratin
- Elastin stain.

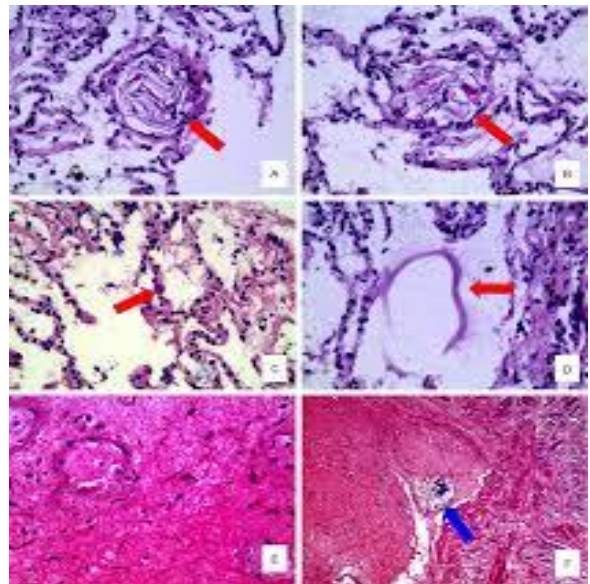
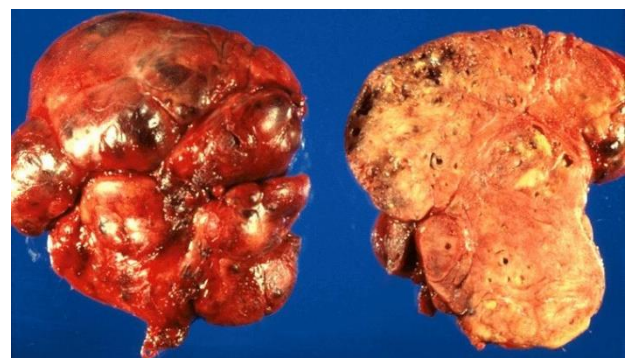


Figure 189. Amniotic embolism, a common cause of maternal deaths

AMYLOID



Enlarged and bosselated with salmon cut surface (AFIP)

Figure 190. Amyloid goiter

❖ Histological Sirius Red Staining

- Amyloid stains red and produces apple-green birefringence when viewed in polarized light.
- Lugo's iodine when applied to organs the amyloid material stains dark brown colors.

PNEUMOTHORAX



Figure 191. Catamenial Pneumothorax Due to Bilateral Pulmonary Endometriosis

❖ Causes of Pneumothorax

- Bullous lung disease
- Asthmatics
- Mechanical ventilation
- Drowning

❖ Method One

Anterior chest skin reflected laterally the intervening space filled with water one of the intercostal spaces then punctured with a scalpel and careful observation of bubbles is made.

❖ Method Two

Needle pushed just into subcutaneous tissue above an intercostal space over the anterior chest without entering the pleural cavity. The syringe is

then filled with water and plunger removed and the needle is advanced into the pleural space observing bubbles.

- Tension pneumothorax produces vigorous bubbling through water
- Normal -No movement of water
- Chronic pneumothorax (without tension) permits water to flow into the pleural cavity.

FORENSIC TOXICOLOGY

❖ TOXICOLOGY

Toxicology is the science of the study of poisons.

❖ FORENSIC TOXICOLOGY

Forensic toxicology is the application of toxicology to the needs of the law.

❖ FORENSIC TOXICOLOGIST

A forensic toxicologist is primarily concerned with the identification of chemical substances whether they are therapeutic drugs; illicit substances or other types either of chemicals including poisons in tissues or from exhibits brought to a laboratory pertaining to a case.



Figure 192. Forensic toxicology

WHY CONDUCT FORENSIC TOXICOLOGY?

In the case of a death, toxicology is conducted for any one or more of the following reasons: -

i) Assist in determining the cause of death by;

- Providing the cause of death in the absence of significant pathology.
- Eliminating drugs/poisons as a cause of death.
- Establishing if drugs/poisons played any contributing factor to the cause of death.

ii) Assist in reconstructing the sequence of events leading to death by: -

- Establishing the presence or absence of drugs in tissues
- Establishing the concentration of detected substances with the view to also ascertain the likely pharmacological and psychological effects.

iii) Establish the effects of drugs on mood and behavior, e.g. accidents and homicides.

iv) Determine compliance of therapeutic medication, e.g. epileptics, asthmatics.

v) Medico-legal reasons, e.g. insurance.

vi) Research: to increase our understanding of postmortem processes.

Toxicology is conducted on all homicides and suspicious deaths, all suicides, intravenous and prescription drug deaths, or deaths in which drugs of any type are suspected of playing a role in the death, industrial accidents, and motor vehicle fatalities and deaths for which there is no clear anatomical cause of death.

Toxicologists need to consider a variety of substances.

- Prescription drugs include analgesics (non-opiate and opiate).
- Antidepressants, hypnotics including barbiturates and benzodiazepines,

tranquilizers, and other antipsychotic medications, diuretics, and non-steroidal anti-inflammatory drugs.

- Illicit drugs include amphetamines, cannabis, cocaine, and narcotics.
- Other chemical substances with widely differing chemical properties may need to be examined for, e.g. butane (lighter fluid), methane (natural gas), propane (LPG), petrol and aviation fuel hydrocarbons, anesthetic gases, herbicides and pesticides, cyanide, metals, anions, and cations (detergents). E.t.c.

FORENSIC TECHNOLOGY TECHNIQUES

Techniques used include a combination of;

- Immunoassay (EMIT)
- Atomic absorption spectroscopy
- Capillary gas chromatography
- HPLC
- Mass spectrometry.

Detectors for gas chromatography include FID, NPD, ECD, and mass spectrometry, whilst detectors in HPLC include UV, photodiode array, fluorescence, electrochemical, and ion conductivity detectors.

When a case is presented to the laboratory a series of screening tests are run on the specimens using Immunoassay techniques for illicit drugs, including amphetamines, cocaine and opiates, column gas chromatography for alcohol, capillary gas chromatography and nitrogen phosphorus detection and mass spectrometry for nitrogenous and neutral substances, including amphetamines/stimulants, antidepressants, barbiturates, benzodiazepines, many narcotics, neuroleptic drugs and many drugs used in cardiovascular Medicine, and Gradient elution HPLC using photodiode array detection with computer matching facilities for acidic and neutral substances including anticonvulsants, diuretics,

non-steroidal anti-inflammatory drugs, analgesics and many other substances including some herbicides.

Depending on these results further tests for other substances may be conducted. These might include tests for heavy or light metals using Atomic Absorption Spectroscopy or tests for pesticides and herbicides and other agricultural or industrial poisons. Any identified substance is then confirmed using either mass spectrometry and/or alternative procedures.

The laboratory has a variety of class methods e.g.

- Benzodiazepines by HPLC and UV detection.
- Opiate narcotics by HPLC and dual UV/ECD detection
- Antidepressants by HPLC and dual wavelengths UV detection
- Phenothiazines by HPLC and dual UV/fluorescence detection

These allow quantification to be conducted on specimens including blood, liver, and stomach contents once the drug has been determined from one of the many screening methods.

All methods have been validated with respect to precision, accuracy, specificity, linearity, etc in post-mortem specimens and are all subject to rigorous quality assurance testing procedures.

As many tissues as possible or feasible must be taken at autopsy since it will be too late to take further specimens later. Toxicology on blood and urine is often the starting point of the toxicological screen, however, other tissues such as the liver are often useful to assist in establishing the presence of poison or helping to establish the significance of a blood concentration.

The usual tissues taken for toxicology are blood, urine, vitreous humor, liver, bile, and stomach contents although other tissues such as lungs and brain may sometimes be useful.

The stomach is very useful to help establish the timing and extent of drug/poison ingestion, whilst bile is useful in cases involving the use of opiates

such as morphine since morphine is secreted into bile.

Principal agents causing death in drug/poison-related deaths are carbon monoxide, narcotics, anti-depressants, alcohol, and the tranquilizers including the benzodiazepines.

EFFECTS OF POST MORTEM CHANGES ON DRUG CONCENTRATIONS

Postmortem drug concentrations must be treated with caution since concentrations may be affected by postmortem changes.

POST MORTEM CHANGES

❖ Decomposition/ Putrefaction

Chemical instability or putrefaction induced changes can lead to a lowering of tissue concentrations, e.g. morphine and benzodiazepines. Other processes may indeed generate substances, which may lead to erroneous conclusions, e.g. formation of alcohol and cyanide after death.

➤ POSTMORTEM CONTAMINATION

Contamination of specimens with the contents of the stomach or other parts of the bowel may lead to too much higher concentrations of substances.

❖ Post Mortem Redistribution

Many substances particularly those which have a high tissue/blood distribution may develop concentrations in blood higher than before death due to leaching of substances from tissues surrounding the blood. Blood taken from the heart is particularly prone to this phenomenon, whilst femoral blood is least. Drugs, which have this property, include digoxin, propoxyphene, and the tricyclic anti-depressants.

A toxicologist with experience in such interpretations is essential to allow proper conclusions to be drawn.

Drug concentrations must be interpreted properly with due regard to the known pharmacological and toxicological properties of the poisons, as well as pathological findings and circumstances of the case.

The cause of death is determined by reference to the following factors: -

- Is there an anatomical cause of death?
- Are drugs/poisons present which is capable of causing death?
- Consider possible drug interactions
- Are concentrations consistent with a fatal poisoning?
- Published literature?
- If drugs were not present would death have occurred?
- Are circumstances consistent with the proposed cause of death?
- Police report
- History of a deceased person
- Residues in the stomach.

The interpretation of toxicological data is based initially on the known pharmacology and clinical pharmacology of the substances being considered.

These include: -

- Route of administration of substance(s)
- Absorption and bio-availability characteristics of the substances(s)
- Rate of elimination and metabolism of the substance(s)
- Pharmacological effect(s) of the substance(s)
- Possible adverse effects of the substance(s), for example, "therapeutic" and "toxic" concentrations overlap for many drugs. An example of this is deaths

associated with the intravenous use of heroin. In these cases, the amount of morphine present in tissues may be no higher than the morphine present in a regular "live" user of heroin. The morphine in these fatal cases is generally much lower in concentration than in a person taking morphine regularly for pain e.g. a terminally ill person. The interpretation of blood or tissue morphine concentration is only useful if the tolerance to opiates is known. This is rarely the case since regular" users of heroin may not necessarily be tolerant to opiates.

Toxicology may provide evidence for the use of heroin by the presence of 6- monoacetylmorphine in the urine. This substance is a metabolite of heroin and is not formed from the use of morphine or codeine.

Drug interactions always need to be considered in this type of work. Pharmacological assessment of the type and likely severity of possible drug interactions are a frequent occurrence. Three-quarters of all drug-related deaths fall into this category. The most common interactions are between alcohol and other CNS depressant drugs such as narcotics, antidepressants, and benzodiazepines. In these cases, the individual concentration of each substance may not be necessarily excessive, but the combined effect may be toxic.

From a forensic point of view, it is important to differentiate between accidental and deliberate (suicide or homicide) exposure to a substance(s). Unless there are clear, unambiguous circumstances pointing to deliberate exposure than either accidental or unknown, reasons are given for the death. The involvement of a second person in the death needs careful investigation by the police since assisted suicide or homicide may be possible considerations. Accidental exposure to toxic substances, where suicide or homicide can reasonably be ruled out, may account for several hundred deaths in Australia each year.

Such accidental deaths due to the toxic effect of chemical substances may occur from: -

- Volatile substance use, e.g. inhalation of petrol or butane gas.
- Accidental overdose of a toxic substance, e.g. heroin death
- Use of two or more CNS depressants drugs, e.g. alcohol use in combination with tranquilizers
- Other drug interactions, e.g. NSAIDs plus diuretics, amitriptyline plus benzodazepines.

STORAGE OF FORENSIC SPECIMEN



Figure 193. Ventilated specimen stores

THE IDEAL WAY TO STORE THE FOLLOWING SPECIMEN TAKEN FOR FORENSIC ANALYSIS

- Blood for DNA profiling - In plain bottles
- Saliva. - In plain bottles
- Shoes. Open paper bags
- Damp stained knickers- Use open polyphone bags.
- High vaginal swabs - In a sterile container, they should not be placed in the transport medium.
- Endocervical swab for chlamydia. -In a transport media for chlamydia.
- Plucked pubic hair. -In paper bag

❖ INTIMATE SAMPLES

These are samples taken for forensic studies following allegation or rape after the suspect's consent. This includes

- A sample of blood, semen, or any other tissue fluid urine or public hair
- A dental impression
- A swab is taken from a person's body orifice other than the mouth that is a swab from the Ear, Nose, Rectum, and Vagina.

An intimate search is a search, which consists of the physical examination of a person's body orifices other than the mouth.

- ✚ Consent is necessary before these samples can be taken.



Figure 194. Blood collection tubes

❖ NON INTIMATE SAMPLES

- A sample of hair other than public hair
- A sample is taken from an anal or from under the nail.
- A swab is taken from any part of a person's body including the mouth but not on her body orifice.
- Saliva
- Footprints or any similar impression of a person's bodies other than a part of the hand. This includes a sample taken from the axillary region, penis however the

swab would become an intimate sample if the specific purpose were to obtain a sample of the suspect's semen by swabbing the penis.

Non-Intimate samples can be taken without the consent of the suspects and with the use of considerable force.

The difference between the Non-intimate and intimate samples is not related to how the sample is taken from the body above or below the skin but to the area of the body from which it is taken.

Chapter Twenty

Forensic Microscopy

INTRODUCTION

This is an important aspect in the practice of Forensic Pathology all forensic pathologists have had this first training in anatomical pathologists.



Figure 195. *Microscope*

Failure to perform a satisfactory microscopic examination may lead to important diagnostic failures and inadequate corroboration and substantiation of crucial forensic findings. This is true even when there is abundant gross pathology. For example, a blunt-force motor vehicle fatality may be triggered by myocarditis or fatal myocardial infarction diagnosed only on microscopic examination.

The major contribution of forensic microscopy is particularly evident in the following instances.

- Investigation of a sudden unexpected

death, SIDS.

- Determination of perimortem nature of injuries
- Aging of trauma and natural process
- Interpretation of gross findings of natural and unnatural disease and injuries.
- Diagnosis of poisoning
- Occupational diseases
- Identification of trace evidence.

SLIDES

❖ HEART

- Coronary atheroma
- Infarction.
- Myocardial glycogenesis (Pompe disease)
- Heart enlarged or globular with a lacelike work appearance of the muscle cells.

Early detection of myocardial infarct stains

- Myocardial muscle enzymes
- Nitro B T dye test
- Normal myocardium stain purple-blue reaction
- Ischaemic myocardium unstainable.
- Luxal forst blue.
- Mallory's phosphotungstic acid hematoxylin
- Heidenham's iron hematoxylin.
- Contraction bands degeneration
- Necrosis
- Coagulation changes indicate a recent myocardial injury.

- Triphenyl tratezelin chloride
 - Normal - red-brown,
 - Infarct - unstained.
- Hematoxylin basic Fuschia purric (HBPA)
 - Normal - Yellow,
 - Ischaemic - Red.
- Masson's and Gomer trichrome

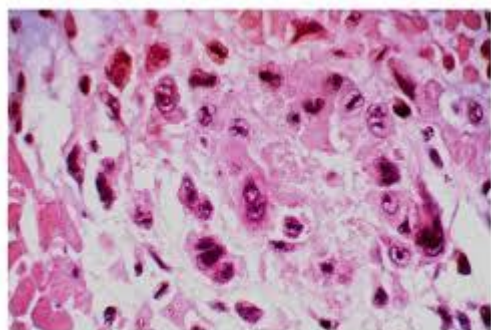
Rheumatic Heart Disease

❖ Aschoff Body

Aschoff body refers to a collection of pleomorphic histiocytes with large basophilic nuclei Nucleolus "Owl eye" Binucleated Necrotic collagenous tissue.

The microscopic structures seen in patient with rheumatic fever.

- Differential diagnosis. rheumatic fever.



Aschoff body

Figure 196. Rheumatism Infective Endocarditis

Myocarditis

- Necrosis Degeneration
- Infiltration of inflammatory cells, lymphocytes, and polymorphs.

Cardiomyopathy

Long strands of attenuated hypertrophic enlarged hyperchromatic nuclei, increased interstitial fibrosis

and scattered inflammatory cells.

Hypertrophic: Disarrayed facially hypertrophic or a typical interlacing myocardial fibres with or occasional swirled or whorled pattern separated by thick strands of interstitial fibrosis and asymmetrical thickening of the intervention septum.

Other diseases which may show

- Ventricular hypertrophy.
- Amyloid deposition.
- Lentitignosis
- Noorman's syndrome
- Friedreich's ataxia
- Skeletal myopathies- Abnormal desmin formation
- Glycogen storage disease.

FORENSIC APPLICATION

Forensic application is useful in sudden deaths. Not all sudden deaths are directly related to cardiac pathology. The fact that a person has myocardial infarction with coronary atherosclerosis or cardiomyopathy does not automatically imply that it is the cause of death. Poisoning and other factors may have contributed to his death.

❖ LIVER

Toxic Injury

- Paracetamol centrilobular necrosis.
- Alcohol; Pericentral and mid-zone
- Centrilobular around the central vein.
- Dimethyl glycol marked peripheral fatty change and necrosis.
- Phosphoric poisoning
- Peripheral fatty change and necrosis.
- Patterns of fatty change due to impaired

fat metabolism.

Hydrogen replaces two carbon fragments cleaved from fatty acids as the main energy source of liver cells, mitochondria and also depress the citric acid cycle.

There are decreased fatty acid oxidations and an increase in alpha glycerophosphate, a consequent increase in the trapping of fatty acids, and an accompanying increased synthesis of triglycerides.

In long-standing alcohol, protein synthesis depressed together with impaired liver cell secretory function, cause retention of lipoprotein, and contributes to the accumulation of fat in hepatocytes. Ballooned hepatocytes have a central nucleus while fatty change nucleus periphery.

❖ Microvesicular

- Nuclei remain central.

These changes are common in cerebral oedema, Reye's syndrome, aspirin poisoning, pregnancy, tetracycline, and metabolic disorders.

❖ Macrovesicular

Alcohol Abuse

- Nuclei displace the nucleolus eccentrically spreading the periportal areas
- Mallory bodies, fibrosis
- Haemosiderin in hepatocytes.

These changes may also be seen in Diabetes mellitus, obesity, malabsorption, jejunioileal bypass, drugs/toxins.

Mallory bodies are present in alcohol hepatitis, primary biliary cirrhosis, hepatoreticular degeneration, jejunioileal bypass, and toxic injuries to the liver.

CAUSE OF DEATH

- Fat embolism

- Fulminant sepsis
- Acute alcoholic intoxication and electrolyte imbalance
- Hypoglycemia,
- Hypokalemia
- Fatty acid hyperlipidemia

❖ Peliosis Hepatitis

Peliosis hepatitis refers to the large blood collection in the liver. The most common causes include; wasting disease, tuberculosis, malignancy, anabolic and contraceptive steroids.



Figure 197. Clinical and pathological features of peliosis hepatitis



Figure 198. Acute hepatitis

❖ LUNGS

- Fat embolism seen in skeletal trauma

- Amniotic fluid embolism seen in abortions, difficult labor, traumatic deliveries, protein, or other uterine stimulants.

Aspiration -lipid, food material.

❖ Micro

- Lung capillaries show epithelial squames, lanugo, hair, mucin, and meconium.
- DIC complication fatal thrombi composed of platelets and fibrin in viscera, brain lungs, kidney, heart, and liver with evidence of microinfarcts of these organs.

COAL WORKERS PNEUMONITIS

Silica and coal progressive massive fibroids seen as macules and nodules associated with chronic emphysematous and intestinal fibrosis.

❖ Macro

The nodules typically show as acellular hyaline layered core or whorled hyaline center surrounded by fibrous tissue and infiltrated by macrophages containing anthracotic pigment.

Polarised light shows small birefringent acellular crystals indicative of silica.

Progressive massive fibrosis occurs when fibrous scars or nodules measure more than 2 cm.

- Hilar lymph nodes
- Pneumoconiosis nodules
- Peripheral (eggshell) calcification.

Carcinoma of the lungs has been described in pneumoconiosis.

ASBESTOSIS

- Serpentine fibrous silicates
- Chrysotile, Crocidolite, and Amosite.

Inhalation result into;

- Severe pulmonary fibrosis
- Pleural adhesions
- Fibrocalcific plaques of the parietal pleura, pleural and peritoneal mesothelioma and bronchogenic carcinoma.

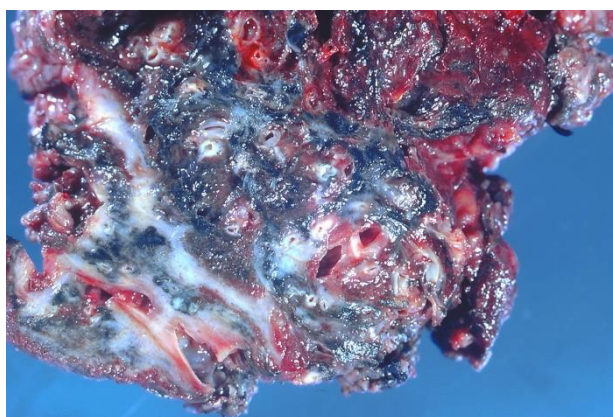


Figure 199. *Asbestosis*

❖ Micro

Presence of asbestos bodies in the lungs. These bodies are beaded drum sticks of dumbbell-like structures having an asbestos core and a coat of haemosiderin.

- Oedematous like eosinophilic intra-alveolar pulmonary exudate methenamine silver stain pneumocystis carinni.

Asthmatic cases

- Bronchiolar plugs of viscid secretion
- Patchy collapses of lungs.
- The epithelial lining consists of large mucus, secreting cells.

The epithelial basement membrane is thickened and the smooth muscle of the wall hypertrophied. The wall contains Eosinophils and lymphocytes

❖ BRAIN

- Trauma Respiratory brain
- Diffuse axonal injury, seen in head injury in road traffic accidents falls, and boxing.
- Retraction ball is seen in the corpus callosum, the rostral brain stem.

Confirmation- Silver stain.

❖ SKIN

Electrical burns

- Sharp borders with an abrupt transition from normal to injured tissue
- Honeycomb vacuolation of the stratum corneum (electrically cauterized biopsy) - Intra-dermal bulla.
- Denaturation of dermal collagen
- Metallization deposition of vaporized metal on the surface of the skin. The absence of electrical burn does not exclude electrocution.

DIABETES MELLITUS

- Diabetes neuropathy vacuolization of epithelial cells of renal tubules.
- Armani-Ebstain glycogen nephrosis.
- The distorted architecture of type pancreatic islets of Langerhans reduced
- Beta cells degenerated
- Hydropic degeneration from the accumulation of glycogen, and amyloidosis accumulation.
- Severe hyperkalemia
- Mimic Armani Ebtain nephropathy
- Clear cell due to hydropic changes.
- Kimmelstiel,
- Wilson Nephropathy

- Intercapillary glomerulosclerosis
- Focal glomerulosclerosis.
- Intranuclear vacuolization of hepatic cells with nuclear chromatin compressed and displaced to the periphery.

❖ BONE

Callus consists of vascular connective tissue and thick trabeculae of woven bone. The surface of bone trabeculae is covered by osteoblasts that lay down dense lamellar bone. These may be caused by a healing fracture, child battering, RTA, Burns, and bone disease.

Callus= Cartilage + trabeculae bone

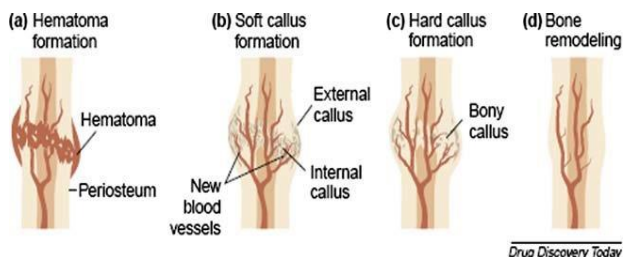


Figure 200.

a) Hematoma formation: following injury, fracture disrupts bony blood supply leading to hematoma formation in and around the bony defect

b) Soft callus formation: fracture hematoma is rich in VEGF, which promotes blood vessel ingrowth from surrounding vessels (angiogenesis) along with the formation of a cartilage intermediate by endochondral ossification (internal callus) and the external callus (intramembranous ossification)

c) Hard callus formation: the callus is mineralized as hypertrophic chondrocytes undergo apoptosis (partially regulated by VEGF) and woven bone is formed and eventually replaced by lamellar bone

d) Bone remodeling: the fracture callus composed of primary lamellar bone is remodeled to the secondary lamellar bone, and the vascular supply returns to normal.

Chondrocytes in the cartilage disorderly vary in size and shape.

- **Woven bone** - coarse fibred bone, prominent osteocytes in the matrix, and osteoblasts on the surface.
- **Remodeling**- Callus--cartilage removed trabecular of dense lamellar bone laid down in orderly fashion to reform the cortex of the bone. The normal structure of the bone can be restored completely.

This gives an idea to the time when the fracture occurred and the time of death.

❖ Calcium Stain

This is always helpful in differentiating calcified bone from uncalcified bone.

Alizarin Red S method is used.

AGING OF THE INFLAMMATORY RESPONSE

Progression is as follows;

- 4 hrs-polymorphs, peaks at 12 hours.
- 8 hrs macrophages peaks at 16-24 hrs.
- 72 hrs haemosiderin deposition.
- 2-3 days fibroblasts
- 10-14 days granulation tissue.
- Wound healing
- Cellular collagen fibres
- Normal dermis -Dark staining elastic fibres
- Scar elastic fibres lacking when stained with the elastic stain
- Keloid scar bulges on the surface of the skin contains collagen.
- Broad hyaline bands of collagen larger and thicker -fibroblast large and actively looking.

FORENSIC APPLICATIONS

Forensic applications are of importance in the examination of injuries and/or wounds.

- Wounds caused by injuries will react to inflammation depending on the duration between death and injury.
- Wounds caused after death have no inflammatory response most commonly seen in innocent animal predation after death.

ENZYMES

Non-specific esterases include;

- Acid phosphatase - 2hrs
- ATPase - appx.4hrs
- Aminopeptides - appx.4hrs
- Alkaline phosphatase - appx.4hrs

COLD

Cold is known to cause

- Intrapulmonary hemorrhage
- Acute hemorrhagic pancreatitis
- Focal pancreatitis with fat necrosis.

ETHYLENE GLYCOL POISONING

Ethylene glycol poisoning is poisoning caused by drinking ethylene glycol.[1]

❖ Symptoms

Early symptoms include intoxication, vomiting, and abdominal pain.[1] Later symptoms may include a decreased level of consciousness, headache, and

seizures.[1] Long term outcomes may include kidney failure and brain damage.[1] Toxicity and death may occur after drinking even a small amount.[1]

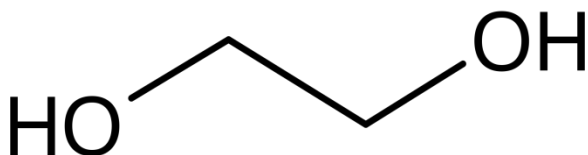


Fig. The structural formula of ethylene glycol

Ethylene glycol causes focal necrosis of renal tubules, many containing birefringent oxalates with the typical fan-like or sheaf configuration. In the brain, it can cause chemical meningitis.

❖ Treatment

Early treatment increases the chance of a good outcome. Treatment consists of stabilizing the person, followed by the use of an antidote. The preferred antidote is fomepizole with ethanol used if this is not available. Hemodialysis may also be used in those where there is organ damage or a high degree of acidosis. Other treatments may include sodium bicarbonate, thiamine, and magnesium.

SCAR

A scar is a dense fibro scar tissue

Gunshot residues -Heat-induced denaturation of the collagen at the beginning of the wound track, Heavy deposits of soot and powder.

HEAT STROKE

❖ Indications

- Rhabdomyolysis -focal necrosis in the muscle of locomotion.
- Heart - necrosis swelling, and calcification.
- Drug-induced hyperthermia malignant hyperthermia.
- Liver focal degeneration and focal central lobular necrosis in cases of shock.
- Brain-Focal neuronal shrinkage and necrosis

DRUG ABUSE

Phlebitis, peri phlebitis, periportal hepatic triaditis, multinucleated giant cells, and asteroid bodies in the dermis, embolization of foreign material contaminants eg fibres like cotton. The polarisable material eg tale, starch, glucose, flour, milk, mannitose, sugar, calcium, filters of drugs, other associated factors sepsis, bacterial endocarditis, hepatitis, AIDS.

TEXT BOOKS IN FORENSIC PATHOLOGY

1. Medico-legal investigation of death.
2. Legal aspects of Medical practice.
3. Ethics, Legal Medicine, and Forensic Pathology.
4. Simpson's Forensic Medicine.
5. Forensic Medicine
6. Lecture notes on Forensic medicine.
7. Forensic Medicine and the Law.
8. Forensic Pathology.
9. Gunshot wounds.

Chapter Twenty One

Post Mortem Examination

INTRODUCTION

POST MORTEM

A post-mortem examination, also known as an autopsy, is the examination of a human body after death. It's also called a necropsy. An autopsy can include a physical examination, examination of internal organs, and specialized laboratory studies. Autopsies may be used to help determine the cause and manner of death.

A post-mortem aims to determine the cause of death.

Post-mortems are carried out by pathologists (doctors who specialize in understanding the nature and causes of disease).

Post-mortems provide useful information about how, when, and why someone died. They enable pathologists to obtain a better understanding of how diseases spread.

Learning more about illnesses and medical conditions benefit patients too because it means they'll receive more effective treatment in the future.

If your child, partner, or relative has died and a post-mortem is to be carried out, hospital bereavement officers can offer you support and advice.

They also act as the main point of contact between you and the staff carrying out the post-mortem.

WHEN ARE POST-MORTEMS CARRIED OUT?

A post-mortem examination will be carried out if it's been requested by:

- A coroner – because the cause of death is unknown, or following a sudden, violent or unexpected death
- A hospital doctor – to find out more about an illness or the cause of death, or to further medical research and understanding

TYPES OF POST MORTEM EXAMINATION

i) Coroner's post-mortem examination

A coroner is a judicial officer responsible for investigating deaths in certain situations.

Coroners are usually lawyers or doctors with a minimum of 5 years' experience.

In most cases, a doctor or the police refer a death to the coroner.

Death will be referred to the coroner if:

- it's unexpected, such as the sudden death of a baby (cot death)
- it's violent, unnatural or suspicious, such as a suicide or drug overdose
- it's the result of an accident or injury
- it occurred during or soon after a hospital procedure, such as surgery
- the cause of death is unknown

The main aim of a post-mortem requested by a coroner is to find out how someone died and decide whether an inquest is needed.

An inquest is a legal investigation into the circumstances surrounding a person's death.

If someone related to you has died and their death has been referred to a coroner, you won't be asked to give consent (permission) for a post-mortem to take place.

This is because the coroner is required by law to carry out a post-mortem when a death is suspicious, sudden, or unnatural.

A coroner may decide to hold an inquest after a post-mortem has been completed. Samples of organs and tissues may need to be retained until after the inquest has finished.

If the death occurred in suspicious circumstances, samples may also need to be kept by the police as evidence for a longer period.

In some cases, samples may need to be kept for several months, or even years.

The coroner's office will discuss the situation with you if, following an inquest, tissue samples need to be retained for a certain length of time.

ii) Hospital post-mortem examination

Post-mortems are sometimes requested by hospital doctors to provide more information about an illness or the cause of death or to further medical research.

Sometimes the partner or relative of the deceased person will request a hospital post-mortem to find out more about the cause of death.

Hospital post-mortems can only be carried out with consent. Sometimes a person may have given their consent before they died. If this isn't the case, a person close to the deceased can give their consent for a post-mortem to take place.

Hospital post-mortems may be limited to particular areas of the body, such as the head, chest, or abdomen.

When you're asked to give your consent, this will

be discussed with you.

During the post-mortem, only the organs or tissue you have agreed to can be removed for examination.

The HTA recommends you should be given at least 24 hours to consider your decision about the post-mortem examination.

You should also be given the details of someone to contact in case you change your mind.

WHAT HAPPENS DURING A POST MORTEM

A post-mortem will be carried out as soon as possible, usually within 2 to 3 working days of a person's death. In some cases, it may be possible for it to take place within 24 hours.

Depending upon when the examination is due to take place, you may be able to see the body before the post-mortem is carried out.

The post-mortem takes place in an examination room that looks similar to an operating theatre. The examination room will be licensed and inspected by the HTA.

During the procedure,

- The deceased person's body is opened and the organs removed for examination. A diagnosis can sometimes be made by looking at the organs.
- Some organs need to be examined in close detail during a post-mortem. These investigations can take several weeks to complete.
- The pathologist will return the organs to the body after the post-mortem has been completed. If you wish, you'll usually be able to view the body after the examination.

Once release papers have been issued, the appointed undertakers will be able to collect the body from the mortuary in preparation for the funeral.

WHAT HAPPENS AFTER A POST-MORTEM

After a post-mortem, the pathologist writes a report of the findings.

If the post-mortem was requested by the coroner, the coroner or coroner's officer will let you know the cause of death determined by the pathologist.

If you want a full copy of the pathologist's report, you can request this from the coroner's office, but there may be a fee.

In some cases, the report may be sent to a hospital doctor or GP so they can discuss it with you.

If the post-mortem was requested by a hospital doctor, you'll have to request the results from the hospital where the post-mortem took place. You may be charged a small fee for this.

You can arrange to discuss the results with the doctor in charge of the deceased person's care while they were in the hospital (if applicable), or with your GP.

The HTA leaflet [Post-mortem examination: Your choices about organs and tissue \(PDF, 68kb\)](#) gives further information about what happens before, during, and after the examination.

THE HUMAN TISSUE AUTHORITY

The [Human Tissue Authority \(HTA\)](#) ensures that human tissue is used safely, ethically, and with proper consent.

It regulates organizations that remove, store, and use tissue for research, medical treatment, post-mortem examination, teaching, and public display.

All premises where post-mortems are carried out must be licensed by the HTA.

BEREAVEMENT SUPPORT

For many people, understanding the reason for a loved one's death helps them come to terms with their loss.

Talking and sharing your feelings with someone can also help.

Some people find that relying on the support of family and friends is the best way to cope.

Your GP will be able to put you in touch with bereavement services in your area.

FORMAT TOXICOLOGY REQUEST FORM.

_____ Affix label or fill in detail

Ante-mortem specimens: YES/NO _____ Case No _____

Hospital(s): _____ Name _____

Admission Date / / Time hr Sex M/F Age _____ Path _____

UR No _____

_____ Date of Death / / _____ Time _____

_____ Date of Autopsy / / _____

CASE TYPE: This may be Suicide, M.V.A, Homicide, Rape.

SPECIMENS COLLECTED (Circle) A B F G H I J L M N O Other _____

Source of blood

Tube	collection details	Site (circle/record)	signature
A	_____/Date/_____/Time	LEG/Heart/other_____	_____
B	_____/_____/_____	LEG/Heart/other_____	_____
F	_____/_____/_____	LEG/Heart/other_____	_____
G	_____/_____/_____	LEG/Heart/other_____	_____

Stomach contents description _____

FORENSIC TECHNICIANS SIGNATURE _____

RECORD ONE OR MORE TYPE (S) OF TOXICOLOGY ANALYSES REQUIRED

- ALCOHOL ONLY (MVA-Other, other accidents, natural)
- FULL TOXICOLOGY (Homicide, Suicide, and Drug-related, unknown, MVA-Driver, other)
- SPECIAL TEST (S) (Fire, volatile, Insulin/Glucose, Digoxin, etc)

specify _____

STORAGE ONLY

COMMENTS _____

Toxicology Use Only _____

HOMICIDE CASES

All security seals intact YES/NO _____ Signature _____ Date _____

Case details:

Case No. / UR No. _____ Place of Examination _____
 Subjects Name _____
 Address _____ Address _____
 Age _____ D.O.B. ____ / ____ / ____ M / F _____ Tel _____ Fax _____

Consent: Obtained from _____

Time called _____ hrs Time of arrival _____ hrs Time of departing _____ hrs
 (original callout) ____ / ____ at scene ____ / ____ from scene ____ / ____

Time of commencement _____ hrs Time of completion _____ hrs Time of completion _____ hrs
 of examination ____ / ____ of examination ____ / ____ of notes ____ / ____

Observers:

Name	Status	Name	Status
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____

Circumstances / History:

(a) From patient _____

(b) From others (police, ambulance, family, friends, others)
 Name of Informant _____

Clothing:

Jewellery:

Specimens:

Specimens handed to:

Recipient name _____
 Status _____
 Recipient signature _____
 Time _____ hrs Date ____ / ____ / ____

Past medical history:

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.....

.....

Drugs/Medication

.....

.....

Medical examination:

Pulse rate:

B P : /

temp: °C

Ht: cm

Wt: Kg

Morphometry

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General medical examination:

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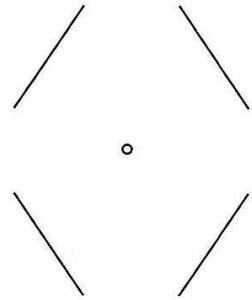
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Records of Findings: X rays Photography Video

Other

Examiner:

Name

Signature

Professional Address

Time hrs Date / /

Tel Fax

Notes on wound description:

1. In describing a wound *consider* the following features:

Site	Colour	Age
Size	Contours	Borders
Shape	Course	Classification
Surrounds	Contents	Depth

2. Ensure descriptions are consistent with the following definitions:

- Abrasion** – A superficial scraping injury of the body surface with or without bleeding
- Bruise** – Leakage of blood from blood vessels discolouring the tissues of the body
- Incision** – A cutting type injury that severs tissues in a clean and generally regular fashion
- Laceration** – A tear or split in tissues

3. All descriptions of wounds and injuries should be made by reference to the subject in the standard anatomical positions.
4. The use of terms such as Superior, Inferior, Anterior and Posterior should refer to the subject in standard anatomical position.
5. The measured position of wounds on the body should be located by reference to fixed bony landmarks.
6. The accurate classification of a wound type has major significance for determining injury causation.
7. An accurate Forensic Medical examination should assist in the reconstruction of the events in which the injury occurred.

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