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Concise Forensic Medicine & Toxicology

4th Edition

KS NARAYAN REDDY

**CONCISE
FORENSIC MEDICINE
AND
TOXICOLOGY**

CONCISE

FORENSIC MEDICINE

AND

TOXICOLOGY

Fourth Edition

By

Dr. K.S.NARAYAN REDDY, M.D., D.C.P., Ph.D. F.A.M.S.,
F.A.F.M., F.I.M.S.A., F.A.F.Sc., F.I.A.M.S.

Honorary Professor of Forensic Medicine,
S.V.S. Medical College, Mahabubnagar.
(Retired Principal, Osmania Medical College, Hyderabad)



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Jaypee Brothers Medical Publishers (P) Ltd

Headquarters

Jaypee Brothers Medical Publishers (P) Ltd
4838/24, Ansari Road, Daryaganj
New Delhi 110 002, India
Phone: +91-11-43574357
Fax: +91-11-43574314
Email: jaypee@jaypeebrothers.com

Overseas Offices

J.P. Medical Ltd
83, Victoria Street, London
SW1H 0HW (UK)
Phone: +44 20 3170 8910
Fax: +44 (0)20 3008 6180
Email: info@jpmedpub.com

Jaypee-Highlights Medical Publishers Inc
City of Knowledge, Blvd. 237, Clayton
Panama City, Panama
Phone: +1 507-301-0496
Fax: +1 507-301-0499
Email: cservice@jphmedical.com

Jaypee Medical Inc
The Bourse
111 South Independence Mall East
Suite 835, Philadelphia, PA 19106, USA
Phone: +1 267-519-9789
Email: jpmcd.us@gmail.com

Jaypee Brothers Medical Publishers (P) Ltd
17/1-B Babar Road, Block-B, Shaymali
Mohammadpur, Dhaka-1207
Bangladesh
Mobile: +08801912003485
Email: jaypeedhaka@gmail.com

Jaypee Brothers Medical Publishers (P) Ltd
Bhotahiti, Kathmandu
Nepal
Phone: +977-9741283608
Email: kathmandu@jaypeebrothers.com

Website: www.jaypeebrothers.com

Website: www.jaypeedigital.com

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PREFACE

This is not a textbook. It is the concised version of the book published under the title “Essentials of Forensic Medicine & Toxicology” 33rd edition, 2014. The subject matter has been dealt with concisely, but includes the essentials of all topics which are dealt in a standard textbook. Students are advised to first master the material from any one accepted textbook. It is intended to meet the needs and enable to review the subject and refresh the memory of undergraduate students before appearing for theory, practicals and oral examinations in the subject of Forensic Medicine. It is hoped that this edition will be warmly welcomed just like the previous editions of this book.

KSN Reddy

OTHER BOOKS BY THE SAME AUTHOR

(1) THE ESSENTIALS OF FORENSIC MEDICINE AND TOXICOLOGY

Thirtythird Edition, 2014, 24cm. x 18cm. PP 6+628, Price ₹ 425/-

(2) THE SYNOPSIS OF FORENSIC MEDICINE AND TOXICOLOGY

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(3) MEDICOLEGAL MANUAL

Fifth Edition, 2010, 24cm. x 18cm. PP 4+300, Price ₹ 250/-
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Printed by Andhra Law Times, Hyderabad

(4) M.C.Qs IN FORENSIC MEDICINE

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(5) MEDICOLEGAL MANUAL FOR POLICE OFFICERS

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(6) MEDICAL JURISPRUDENCE AND TOXICOLOGY

Third Edition, 2010, 24 x 18cm. PP 1344, Price ₹ 1350/- Ph. 2452930

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FORENSIC MEDICINE

CHAPTER 1

LEGAL PROCEDURE

Forensic (legal) medicine deals with application of medical knowledge to aid in administration of justice, i.e. it deals with **medical aspects of law**, such as assault, murder, sexual offences, poisoning, etc.

Medical jurisprudence deals with legal responsibilities of doctor, i.e. with **legal aspects of practice of medicine**, such as medical negligence, consent, professional misconduct, duties of doctors, etc.

INQUEST : An inquest is an **enquiry or investigation into the cause of death** (S.174, Cr.P.C). It is conducted in cases of unnatural and suspicious deaths, such as suicide, murder, accident, etc.

(1) POLICE INQUEST : (1) **It is conducted throughout India.** (2) The officer - incharge of police station, informs the Executive Magistrate, and proceeds to the place where body of deceased person is. (3) He conducts investigation (*panchanama*), in the presence of two witnesses (*panchas*). (4) The report includes the description of wounds, the nature of weapon and apparent cause of death. (5) The report is signed by police officer and witnesses. (6) If foulplay is suspected, the body is sent for autopsy with a requisition to the authorised Government doctor. (7) If no foul play is suspected, the dead body is handed over to the relatives for disposal.

(2) MAGISTRATE'S INQUEST : **This is conducted by an Executive Magistrate** (who are revenue officials), such as District Collector, deputy Collector, Tahasildar, etc. It is done in cases of (1) death in

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prison, (2) death in police custody, (3) death due to police firing, (4) dowry death, (5) exhumation, (6) death in a psychiatric hospital (S. 176, I.P.C).

Coroner's inquest is not done in India, but is done in U.K., some states in U.S.A and some other countries.

Medical examiner's inquest is done in most States of USA.

Trial by **Jury** is not done in India.

COURTS OF LAW : (1) Civil. (2) Criminal. In India, criminal courts are of four types.

(1) Supreme Court is the highest court. It has the power of supervision over all courts in India. The law declared by it is binding on all courts. It is purely an appellate court in criminal cases.

(2) High Court is highest court in every state. It may try any offence and pass any sentence authorised by law.

(3) Sessions Court can only try cases which have been committed to it by Magistrate. It can pass any sentence authorised by law, but a sentence of death passed by it must be confirmed by High Court.

Assistant Sessions Court can pass any sentence except death sentence and imprisonment not exceeding ten years.

(4) Magistrates' are of three types.

Class of Magistrate	Imprisonment	Fine
Chief Judicial Magistrate	Up to 7 years	Unlimited
I Class Judicial Magistrate	Up to 3 years	10,000 rupees
II Class Judicial Magistrate	Up to 1 year	5,000 rupees

In Metropolitan cities (population more than one million), Chief Judicial Magistrate and First Class Judicial Magistrates are designated as Chief Metropolitan Magistrate and Metropolitan Magistrate respectively.

Cognisable offence is an offence in which a police officer can arrest a person without warrant from the Magistrate, e.g. rape, murder, robbery, dowry death, rash or negligent act, etc. In such offences, the person is sent by the police to the doctor for medical examination.

Punishments authorised by law are : (1) death, (2) imprisonment for life, (3) imprisonment; (a) rigorous (hard labour), (b) simple, (4) forfeiture of property; (5) fine.

CONDUCT MONEY : It is fee paid to a witness in civil cases only at the time of serving summons to meet the expenses towards attending a Court. If the amount is less, the witness can appeal to the Judge, who will decide the amount to be paid. In criminal cases no fee is paid.

SUBPOENA OR SUMMONS : (1) It is a written document issued and signed by the Court in duplicate, and served on the witness under penalty, for giving evidence on a particular day and time. (2) It is served on the witness by a police officer, or other public servant. (3) It may also be sent by registered post. (4) Apart from giving evidence, the witness should produce documents if asked for. (5) If the witness fails to attend the Court in a civil case, he will be liable to pay damages, and in criminal case, fine or imprisonment. (6) The witness will be excused from attending the court, if he has valid and urgent reason. (7) **Criminal Courts have priority over Civil Courts and higher Courts have priority over lower.** (8) If he is summoned from two courts of same status, he must attend the court from where he received the summons first, informing the other court about it.

MEDICAL EVIDENCE : Evidence means, all legal means which help to prove or disprove any matter in question.

Direct evidence is evidence of a fact which is actually in issue, e.g. a prescription or a consent form. **Indirect or circumstantial** evidence is evidence of a fact which is not actually in issue, but which is derived from the circumstances. **Hearsay** evidence is any statement made by any person other than the witness giving evidence in Court.

Documentary evidence is of three types.

(1) MEDICAL CERTIFICATES : (1) **They refer to ill-health, insanity, age, death, etc.** (2) They are accepted in a Court of law, only when they are issued by a qualified registered medical practitioner. (3) A doctor is legally bound to give death certificate, stating the cause of death without charging fee, if a patient being treated by him dies. (4) The doctor should not issue death certificate (a) without inspecting the body himself, and satisfying that the person is really dead, (b) if he is not sure of cause of death, (c) if there is least suspicion of foulplay. In such cases, the police should be informed. (5) Death certificate

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should not be delayed, even if the doctor's fee is not paid. (6) Issuing or signing a false certificate is punishable.

(2) MEDICOLEGAL REPORTS : (1) They are reports prepared by a doctor usually in criminal cases, e.g, assault, rape, murder, poisoning, etc. (2) The injured person or dead body is examined, when there is a requisition from a police officer or Magistrate. (3) They consist of (a) facts observed on examination, and (b) opinion drawn from the facts. (4) They are admitted as evidence in court only when the doctor gives oral evidence under oath. (5) Exaggerated terms, superlatives, etc. should not be used. (6) The opinion should be based on the facts observed by the doctor. (7) The report will be given to the defence lawyer, as such care should be taken in writing the report. (8) The doctor should sign or initial at the bottom of each page, if the report exceeds one page in length. (9) If immediate opinion is not possible, the patient should be kept under observation, and investigations done.

(3) DYING DECLARATION: It is a written or oral statement of a person, who is dying due to some unlawful act, relating to the cause of his death. (1) A Magistrate should be called to record the declaration. (2) The doctor should certify that the person is conscious and his mental faculties are normal. (3) If the patient's condition is serious, the doctor, police, village headman, or any other person can record the D.D. in presence of two witnesses, but its evidential value is less. (4) Oath is not administered, because it is believed that a dying person will only tell the truth. (5) It is recorded in the man's own words. (6) Leading questions should not be put. (7) No influence or outside prompting should be permitted. (8) Questions may be put to make points clear. (9) The statement made must be of fact and not opinion. (10) If it is made in the form of an opinion, questions should be put to bring out the facts. (11) If the dying person is unable to speak, but is able to make signs in answer to questions, this can be recorded, which is considered as "verbal statement". (12) The doctor and the witness should sign the declaration. (13) Even if the declarant was not under expectation of death, it is admissible in the court. (14) If the declarant survives, the declaration is not admitted but has corroborative value.

Dying deposition is statement of a dying person on oath. It is superior to dying declaration, as it is recorded by the Magistrate, and the accused or his lawyer can cross-examine the dying person. This is not practiced in India.

Chain of custody of evidence: It is a method to verify the actual possession of an object from the time it was first identified until it is offered into evidence in the Court room. Each specimen when obtained, should be labelled with the victim's name, the time and date, the nature of the specimen, identification number, and signed by the doctor. This information must be documented, each time the material is handled by another person, and that person must give receipt for the material and will be included in the chain of custody. The evidence must not be damaged, contaminated, or altered in any significant way. The shorter the chain the better.

Oral evidence : It is evidence which is given orally by witness under oath in a court of law. (1) It is more important than documentary evidence, as it admits cross-examination. (2) In all cases, it must be direct, i.e. evidence of a person who saw, heard or perceived it. (3) A deaf and mute witness may testify by signs, by writing or through interpreter. (4) If oral evidence refers to any material thing, e.g., weapon, blood stained clothing, etc, it must be produced in the court. **(5) Documentary evidence is accepted by court only on oral evidence by concerned person.**

Exceptions to oral evidence : (1) Dying declaration. (2) Expert opinion expressed in a treatise. (3) Evidence of doctor recorded in a lower Court. (4) Evidence given by a witness in a previous judicial proceeding. (5) Reports of Chemical Examiner. (6) Reports of Director of Central and State Forensic Science Laboratories. (7) Reports of Director Finger print Bureau. (8) Report of Serologist to Government.

WITNESSES: **(1) Common witness** is a person who gives evidence about the facts observed or perceived by him. He must show that he was capable of perceiving the fact by one his own senses and that he actually observed this fact. (3) This is known as “**First-hand knowledge rule**”, which may be used to establish the exact circumstances of the case for the court.

(2) Expert witness is a person who has been trained or is skilled in technical or scientific subject, and capable or drawing opinions and conclusions from the facts observed by himself, or noticed by others, e.g doctor, fingerprint expert, handwriting expert, firearms expert, etc. (2) An expert witness may give his opinion (a) upon facts which are either admitted, or proved by himself or other witnesses at the trial, (b) on matters of common knowledge, (c) on hypothetical questions based thereon. (3) The main obligation of an expert is to point out professional facts. (4) The opinion on a key question must be given in a guarded manner using terms such as, that the findings are consistent with an alleged form of trauma, such as a fall against a hard object, or with the striking of the head with a blunt instrument. (4) An expert witness may refer to books to refresh his memory or to correct or confirm his opinion. (5) A doctor can be both a common and expert witness.

Hostile witness is one who is supposed to have some interest or motive for concealing part of truth, or for giving completely false evidence. (2) The court will declare a witness as hostile on the suggestion of the lawyer of the party who has summoned the witness or prosecution lawyer. (3) A hostile witness can be cross- examined by the same side lawyer. (4) Common or expert witness can be hostile.

Perjury means wilful giving of false evidence by witness while under oath, or failure to tell what he knows or believes to be true (imprisonment up to 7 years).

RECORD OF EVIDENCE : (1) **Oath:** “I do swear in the name of God (solmenly affirm in case of atheist) that what I shall state, shall be the turth, the whole truth, and nothing but truth.” (2) **Oath is required by the law which is compulsory.** (3) A chid below 12 years is not required to take an oath.

(2) Examination - in chief : (1) In this questions are put to the witness by the lawyer for the side which has summoned him. (2) In criminal trial, Public Prosecutor first examines the witness. (3) The object is to elicit all relevant medical facts, and the conclusions drawn from these facts. (4) “**Leading questions are not allowed**”, except when witness is hostile. (5) The questions are short and demand

some specific fact and short answer. (6) The answer can be given in narrative form, if it would be more informative and convincing.

A leading question is one which suggests to the witness the answer desired, or which includes the answer implied in the question itself and admits of a conclusive answer by “Yes” or “No”.

(3) Cross-examination : (1) **The witness is questioned by the lawyer of the opposite party, i.e. defence lawyer.** (2) The main objects are: (a) to elicit facts favourable to his case, (b) to test the truthfulness of the statements made by witness, (c) to modify or explain what has been said, (d) to develop new or old facts, (e) to discredit the witness, (f) to remove any excessive emphasis, which may have been given to any facts. (2) It need not be confined to the facts to which witness testified in exam-in-chief. (3) The competence, credibility and character of the witness may be tested. (4) The judge can always disallow questions which are irrelevant, incriminating or scandalous, but if they are relevant to the matter, they cannot be disallowed. **(5) Leading questions are permissible.** (6) It has no time limit. (7) It may act as double-edged sword, i.e. it may damage both the prosecution and defence.

(4) Re-examination : (1) **This is conducted by the lawyer who has conducted examination-in-chief.** (2) The objects are: (a) to correct any mistake, (b) to clarify or to add details to statements the witness has made in cross-examination. (3) The witness should not introduce any new subject. If he does so, he will be liable for cross-examination again. (4) Leading questions are not allowed.

(5) Questions by Judge : At any stage of examination, the Judge may ask any questions to clear up doubts.

MEDICOLEGAL MASQUERADES: Many cases of homicide go undetected because of the lack of suspicion and improper or inadequate investigation. All cases of death should be regarded as unnatural, until proved otherwise. Violent deaths may show minimal or no external evidence of injury, and conversely natural deaths can occur under such circumstances as to suggest falsely that violence was used. Accidental deaths and suicides can occur under circumstances which suggest homicide. In a suicide case, alterations may be made

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at the scene because of stigma. In a homicide case, the scene may be altered or rigged to suggest that death resulted from suicide or accident. The doctor must look for any possible inconsistencies between the apparent death scene and his actual scientific findings. In a case of hanging, the manner in which a ligature is applied to the neck, or the mode of suspension of a body may be determining features in the circumstances. In such cases, the real cause of death can be established by complete autopsy and police investigation.

CONDUCT AND DUTIES OF THE DOCTOR IN WITNESS

BOX : (1) Be well prepared. (2) Take all records. (3) Be relaxed and calm. (4) Be pleasant, polite and courteous. (5) Never attempt to memorise. Memory can be refreshed from copies of reports already submitted. (6) Answer briefly and precisely, but may be qualified for accuracy and completeness. (7) Be confident. (8) Use simple language. (9) Avoid superlatives and exaggerations. (10) Do not evade a question. Say I do not know if it is so. (11) Be honest, impartial, unbiased. (12) Do not lose temper. (13) Give opinion from your own knowledge and experience. (14) **Do not volunteer information which will be liable to cross-examination.** Volunteer only, if you think that injustice will occur if the statement is not made.

Scene of death : (1) Verify that a crime has been committed, (2) look for signs of how it was committed, (3) recover and preserve evidence.

Disadvantages of doctor not visiting scene of crime are: (1) Fresh abrasions may be produced on body during transit, (2) clothing will be disarranged, and blood stains form on parts of clothes originally free from them, (3) fresh tears may be produced in clothing, (4) partial breaking of rigor mortis.

Warrant case means, offence punishable with death, imprisonment for life, or for a term exceeding two years. **Summons case** is one in which punishment is less than two years.

2

CHAPTER

MEDICAL LAW AND ETHICS

Medical ethics deals with moral principles which guide members of the medical profession in their dealings with each other, their patients and the State. **Medical etiquette** deals with the conventional laws of courtesy observed between members of the medical profession.

The modernised version of Hippocratic oath is the **Declaration of Geneva** (1948).

Homoeopathy Central Council Act, 1973: The act was passed to regulate the profession of Homoeopathy and to constitute central council. Its functions are almost similar to Indian Medical Council.

Indian Medicine Central Council Act, 1970: It was enacted to lay down minimum standards of education and practice of Indian system of medicine. It includes Ayurveda, Siddha, Unani and Ashtang.

INDIAN MEDICAL COUNCIL ACT, 1956: (1) Indian Medical Council consists of medical doctors elected from each State, each University and some nominated by Central Government. (2) The routine work is looked after by the Registrar. (3) The First schedule of the Act contains medical qualifications granted by universities in India, and the second schedule those granted outside India.

Functions of Indian Medical Council: (1) **Medical Register:** In this names of all doctors who are enrolled on any State Medical Register are entered.

(2) **Medical Education :** (1) It prescribes standards of undergraduate and postgraduate medical education for the

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guidance of the universities. (2) It prescribes the minimum standards of medical education required for granting recognised medical qualifications by universities or medical institutions in India. (3) It appoints Medical Inspectors to report to the council on the adequacy of the standards of medical education including staff, equipment, accommodation, training and other facilities prescribed for giving medical education and on the sufficiency of the every examination they attended. (4) If the council is not satisfied with the standards, it can represent to Central Government to withdraw recognition of any medical qualification of any university. (5) Prior approval of IMC is necessary before starting a medical college, and for starting a P.G. medical course in any discipline.

(3) Recognition of foreign medical qualifications on reciprocal basis.

(4) Appeal against Disciplinary action: If the name of any doctor is removed from State Medical Register, he can appeal to Central Government, which consults I.M.C. and gives decision, which is binding on State Medical Council.

(5) Warning notice : It prescribes standards of professional conduct, and a Code of Ethics for doctors. It can issue Warning Notice containing certain practices, which are regarded as “serious professional misconduct”.

State Medical Councils : They are autonomous bodies consisting of members elected by doctors of the State and some nominated by State Government.

Functions: **(1) Medical register:** The registrar of the SMC grants a provisional registration to any person having any of the recognised medical qualification on payment of prescribed fee. After undergoing a period of training, a permanent registration is given.

(2) Disciplinary Control: They have the power to remove the names of medical practitioners, permanently or for a specific period from their Register, when after due enquiry they are found guilty of serious professional misconduct. They can also restore any name so removed.

(3) Warning Notice: They can issue warning notices similar to MCI.

Erasure of name: The name of the doctor is removed from the medical register: (1) after death of practitioner, (2) entries made wrongly or due to fraud, (3) **Penal erasure (professional death sentence)** is done if the doctor is found guilty of serious professional misconduct. The doctor will lose the rights and privileges of a registered medical practitioner.

Serious professional misconduct (Infamous conduct in professional respect): It is any conduct of doctor which may be reasonably be regarded as disgraceful or dishonourable. The conduct of doctor is judged by professional men of good repute and competence. Duty of care and damage to patient need not be present.

Judicial Procedure of State Council: The proceedings are started when the doctor is convicted of a cognisable offence or a complaint made by some person or society against the doctor. The council has the same powers as civil court. The executive committee considers the complaint, causes further investigation and takes legal advice. If no case is made out the complainant is informed accordingly. Otherwise, a notice is issued to the practitioner, directing him to answer the charge in writing and to attend before the council on the appointed day. After conclusion of evidence, if the charge is proved, the council votes again to decide whether the name should be removed or the doctor should be warned.

WARNING NOTICE: The name of the medical practitioner can be removed from the Register for violation of Code of Medical Ethics. Some examples are: (1) Adultery (voluntary sexual intercourse between a married person and a person married or not, other than his or her spouse). (2) Advertisement. (3) Abortion (criminal). (4) Addiction (drug). (5) Issuing false certificate. (6) Conviction by court of law. (7) **Covering**, i.e. assisting some one who has no medical qualification to attend, treat or perform an operation on some person in respect of matters requiring professional discretion or skill. (8) **Dichotomy** or fee-splitting, i.e., receiving or giving commission to a professional colleague, or a manufacturer or trader in drugs or a chemist, dentist, etc. (9) Not giving information of notifiable diseases to health authorities. (10) Selling scheduled poisons to the public. (11) Refusal to treat on religious grounds. (12) Drunk and disorderly so as to interfere with skilled practice of medicine.

Rights and privileges of Registered Medical Practitioners:

Right to: (1) Choose a patient, (2) to practice medicine, (3) dispense medicine, (4) possess and supply dangerous drugs to patients, (5) recovery of fees, (6) add title, description, etc. to his name, (7) issue medical certificates.

DUTIES OF MEDICAL PRACTITIONERS: A doctor should

(1) Exercise reasonable degree of skill and knowledge in treating a patient. (2) Furnish proper and suitable medicines or give a legible prescription. (3) Give complete instructions to his patients or their attendants regarding use of medicines and diet. (4) Warn patients of the dangers involved in use of prescribed drug or device. (5) Attend a patient as long as he requires treatment. (6) Warn the patient and third parties, if the patient suffers from infectious disease. (7) Inform patient of risks. (8) Information should be given about communicable diseases, births, deaths, etc. to Public Health authorities. (9) Advise consultation with a specialist when required. (10) In case of poisoning, assist the police in determining whether the poisoning is accidental, suicidal or homicidal. (11) Maintain professional secrecy.

PROFESSIONAL SECRECY: (1) It is implied term of contract between doctor and his patient. (2) Doctor should keep secret all that he comes to know concerning the patient in the course of his professional work. (3) If he discloses, it would be a breach of trust and confidence, and the patient can sue the doctor for damages, if the disclosure is (a) voluntary, (b) has resulted in harm to the patient, and (c) is not in the interest of the public.

Some examples are: Without the consent of patient, the doctor should not disclose the nature of illness of his patient (1) to others, (2) answer any enquiry by third parties, (3) any facts about the illness to parents or relatives if he is a major, (4) about the illness even when requested by a public or statutory body, except in case of notifiable diseases, (5) even in the case of husband or wife to the other, (6) to master even when he is paying the fees, (7) to the employer, (8) Government, (9) undertrial prisoner.

A convicted person has no right to professional secrecy. Medical examination for taking life insurance policy is a voluntary act, and consent to the disclosure of findings is implied.

PRIVILEGED COMMUNICATION: (1) It is a bonafied statement made upon any subject matter, by a doctor to the concerned authority, due to his duty to protect the interest of the community or of State. (2) To be privileged, the communication must be made to a person having interest in it, or in reference of which he has a duty. (3) The privilege fails, if made to more than one person, or a person who has no direct interest in it. (4) The doctor should first persuade the patient to get his consent before notifying proper authority. **Examples of privileged communication, or exceptions to professional secrecy are:** (1) A cook or waiter in hotel, a teacher, children's nurse, etc. suffers from infectious disease. (2) If a bus-driver suffers from epilepsy, high blood pressure, alcoholism, drug addiction, or colour blindness. (3) Notify births, deaths, infectious diseases, etc. to **Public Health authorities.** (4) A person suffering from **venereal disease**, if he tries to use swimming pool. (5) If the doctor treats a patient involved in a **suspected crime.** (6) **Self-interest:** In civil and criminal actions by patient against doctor. (7) **Patient's interest:** If patient suffers form melancholia, suicidal tendencies, etc. (8) **Courts of Law:** Doctor has no privilege in a Court of Law, if it is relevant to inquiry.

Crimes: A doctor who is aware of commission of crime by his patient, such as murder, dacoity, waging war against Govt., etc. is legally bound to report them to the nearest Magistrate or police officer (S.39, Cr.P.C., S.176, I.P.C.).

Duties of Patient: (1) He should give complete history about his illness. (2) Follow instructions of the doctor as regards medicines, diet, mode of life, etc. (3) Pay a reasonable fee to doctor.

Rights of Patient: Every patient has right to: (1) choose his own doctor, (2) access to health care facilities, (3) to be treated with care, respect and dignity, (4) privacy during therapy, (5) confidentiality about his illness, (6) to receive full information about his disease, (7) to know day to day progress, (8) to consent or refuse any specific measure, (9) consultation, (10) access to his records, (11) to receive continuous care of his illness, (12) to complain for redressal of grievances, (13) obtain compensation for medical negligence.

PROFESSIONAL NEGLIGENCE (MALPRAXIS):

Professional negligence is the **absence of reasonable care and skill, or wilful negligence of medical practitioner, in the treatment of a patient which causes his bodily injury or death.**

(1) CIVIL NEGLIGENCE: It arises: (1) When a patient sues a doctor for compensation, if he has suffered injury. (2) When a doctor sues a patient for realisation of his fees.

Liability arises if the following conditions are satisfied: (1) **Duty:** Existence of duty of care by doctor. (2) **Dereliction:** Failure of the doctor to maintain care and skill. (3) **Direct causation:** Failure to exercise a duty of care must lead to damage (proximate cause). (4) **Damage:** Damage which results must be reasonably foreseen.

If no damage has occurred, the patient cannot sue a doctor for negligence. The patient must suffer some loss, e.g. (1) Loss of earning due to absence from work, or reduction of his ability to work. (2) Reduction in expectation in life. (3) Loss of limb or sense. (4) Pain and suffering. (5) Loss of potency. (6) Death.

Examples of Negligence: Failure to (1) obtain informed consent, (2) examine patient himself, (3) attend the patient, (4) immunise patient or to do sensitivity tests, (5) give proper post-operative care, (6) warn patient of side-effects, (7) give proper instructions, (8) obtain consultation when necessary, (9) keep abreast of advances in medical sciences, (10) making wrong diagnosis due to absence of care and skill, (11) giving overdose or giving poisonous medicines carelessly, (12) if his negligence causes others to catch a disease from his patient.

The doctor is not negligent for (1) An error of judgement or diagnosis, if he has secured all necessary data. (2) Failure to cure or bad results, that may follow, if he has exercised reasonable care and skill.

The doctors are expected to be well-informed of new developments and to follow general lines of treatment. The degree of competence varies according to the status of the doctor, i.e. house surgeon, general practitioner, specialist.

RES IPSA LOQUITUR: (1) It means “**the thing or fact speaks for itself.** (2) Conditions to be satisfied: (a) The injury would not have occurred in the absence of negligence. (b) The doctor had exclusive

control over injury-producing treatment. (c) The patient was not guilty of contributory negligence. (3) **In such cases medical evidence is not necessary to prove negligence of the doctor.** (4) This is applied both to civil and criminal negligence.

Examples: (1) Failure to give anti-tetanic serum in cases of injury causing tetanus. (2) Burns from use of hot water bottles or from X-ray therapy. (3) Prescribing overdose of medicine producing ill-effects. (4) Breaking of needles. (5) Blood transfusion misadventure. (6) Loss of use of hand due to prolonged splinting.

Medical maloccurrence: Inspite of good medical attention and care, patient fails to respond properly in some cases.

Novus Actus interveniens (unrelated action intervening):

(1) "A person is responsible for his actions, and also for its logical consequences". (2) This principle applies to cases of assault and accidental injury. (3) In these cases, if doctor is negligent in treatment of the patient, he becomes liable, e.g. leaving a swab or a surgical instrument in the abdomen after the repair of an internal injury, accidental substitution of poisonous drug for therapeutic drug, etc.

(2) CRIMINAL NEGLIGENCE: It arises: (1) When a doctor shows, gross absence of skill or care during treatment resulting in serious injury to or death of patient, (2) when doctor performs an illegal act, (3) when assaulted person dies, defence may attribute death due to negligence of doctor.

Conditions to be satisfied: (1) Indifference to an obvious risk of injury to health. (2) Actual foresight of the risk, but continuation of the same treatment. (3) Appreciation of the risk and intention to avoid it, but showing a high degree of negligence in the attempted avoidance. (4) Inattention or failure to avoid a serious risk.

(1) It is practically limited to cases in which the patient has died. (2) Most of such cases occur with drunkenness or with impaired efficiency due to the use of drugs by doctors. (3) Death resulting from injection of any drug producing anaphylaxis or by performing an operation by a quack is considered criminal negligence.

Examples: (1) Amputation of wrong finger or operation on wrong patient or limb. (2) Leaving swabs, instruments, etc. in abdomen. (3)

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Performing criminal abortion. (4) Administration of wrong substance into eye causing loss of vision.

The doctor is prosecuted by the police in a criminal Court under S.304, A.I.P.C. (causing death by rash or negligent act, punishable with imprisonment up to 2 years). The prosecution must prove all facts to establish civil negligence (except monetary loss) and gross negligence and disregard for life and safety of patient. Contributory negligence is not a defence in criminal negligence.

Difference between civil negligence and criminal negligence

Trait	Civil negligence	Criminal negligence
(1) Offence:	No specific and clear violation of law need be proved.	Must have specifically violated a particular criminal law in question.
(2) Negligence:	Simple absence of care and skill.	Gross negligence, inattention or lack of competency.
(3) Conduct of physician:	Compared to a generally accepted simple standard of professional conduct.	Not compared to a single test.
(4) Consent for act:	Good defence; cannot recover damages.	Not a defence; can be prosecuted.
(5) Trial by:	Civil Court.	Criminal Court.
(6) Evidence:	Strong evidence is sufficient.	Guilt should be proved beyond reasonable doubt.
(7) Punishment:	Liable to pay damages.	Imprisonment.

Difference between professional negligence and infamous conduct

Trait	Professional negligence	Infamous conduct
(1) Offence:	Absence of care and skill or wilful negligence.	Violation of Code of Medical Ethics.
(2) Duty of care:	Should be present.	Need not be present.
(3) Damage to person:	Should be present.	Need not be present.
(4) Trial by:	Court; civil or criminal.	State Medical Council.
(5) Punishment:	Fine or imprisonment.	Erasure of name or warning.
(6) Appeal:	To higher Court.	To State and Central Government.

If a doctor performs an unauthorised operation on a patient, he may be sued in a Civil Court for damages and prosecuted in Criminal Court for assault.

CONTRIBUTORY NEGLIGENCE: It is any unreasonable conduct or absence of ordinary care on the part of patient, which combined with doctor's negligence contributed to injury as a direct, proximate cause and without which the injury would not have occurred.

Examples: (1) Failure to give the doctor correct medical history. (2) Refusal to take suggested treatment. (3) Failure to follow instructions. (4) Leaving the hospital against advice. (5) Failure to seek further medical assistance if symptoms persist.

Defence: (1) It is good defence if both doctor and patient are negligent at the same time. (2) The doctor has to prove it. (3) Normally, it is only a partial defence, and the damages awarded vary, depending on the negligence of each party.

Negligence Prevention: (1) Establish good **rappor**t with the patient, his family, fellow physicians and paramedical staff. (2)

Rationale: Carry necessary investigations to make the correct diagnosis and formulate treatment. (3) Maintain complete, accurate, legible **medical records**. (4) Obtain **informed consent**. (5) Establish hospital **injury prevention programme**. (6) **Respect**. Treat the patient as the physician would wish himself or a member of his family to be treated. (7) **Risks:** Inform the patient of all side-effects and anticipated risks, and treat them promptly. (8) Participate in **medico-legal seminars**.

Defences against negligence: (1) No duty owed to patient. (2) Duty discharged according to prevailing standards. (3) Misadventure. (4) Error of judgement. (5) Contributory negligence. (6) **Res judicata**, i.e. if a question of negligence against a doctor has already been decided by a court, the patient cannot contest the same in another proceeding. (7) Limitation (case to be filed within two years).

THERAPEUTIC MISADVENTURE: (1) It is a case in which patient is injured or had died, due to some unintentional act by a doctor or hospital. (2) Almost every therapeutic drug and every therapeutic procedure can cause death. (3) Ignorance of the possibility of a reaction or continuation in the prescribing of drug with adverse reaction is negligence.

Examples: (1) Fatal hypersensitivity reaction caused by penicillin, aspirin, tetracycline, etc. (2) Prolonged use of stilboestrol may cause breast cancer. (3) Electric equipment may produce burns. (4) Blood transfusion reactions. (5) Excessive dose of an antidote to poisoned patient may cause death.

VICARIOUS LIABILITY (**liability for act of another**): An employer is responsible for his own negligence and also for the negligence of his employees, if such acts occur in the course of employment and within its scope. This is based on the principle of **respondent superior** (**let the master answer**).

Three conditions must be satisfied: (1) There must be an employer-employee relationship. (2) The employee's conduct must occur within the scope of his employment. (3) While on the job.

Examples: (1) In general practice, the principal doctor becomes responsible for his assistant's negligence. (2) The doctor will be responsible for negligence of his non-medical servants. (3) When two doctors practice as partners, each is liable for negligence of other. (4) If a sponge, instrument, etc. is left in the patient's body after operation, the surgeon becomes liable. (5) A hospital is responsible for the negligence of its employees. (6) A hospital is responsible for mistakes of resident physicians and interns. (7) **Borrowed servant doctrine:** The nurse employed by the hospital to assist in operations may be borrowed servant of the independent operating surgeon during operation, and the servant of the hospital for all other purposes. In this case, the surgeon will be liable for the negligence of the nurse.

PRODUCTS LIABILITY: (1) It refers to physical agent which caused injury or death of patient during treatment by the doctor. (2) The injury or death may be due to faulty, defective, negligent design, manufacture, assembly, packing of medical or surgical instruments, or inadequate operating instructions. (3) If the doctor can prove this, the manufacturer becomes responsible for injury or death. (4) The manufacturer of medicines is liable if a patient is injured due to a drug reaction, negligence or breach of warranty, or contamination of drug. (5) The doctor has to prove that a defect in the product existed before it left the manufacturer's hands and that the defect was the proximate cause of the patient's harm. (6) If the

physician or hospital misuses manufacturer's medical products, they become liable. (7) Products liability cases may be brought against manufacturers, sellers or anyone in the chain of sale.

Both the employer and the employee are sued by the patient. The employer may be ordered by the court to pay compensation. The employer can engage in "third party proceeding" against the negligent doctor or employee asking for repayment.

MEDICAL INDEMNITY INSURANCE: It is contract under which the insurance company, in exchange for the payment of premiums, pays compensation to the patient, for the professional negligence of the doctor. In addition: (1) It looks after and protects professional interest of doctor. (2) Arranges, conducts and pays for the doctor. (3) Arranges all other professional assistance.

EUTHANASIA (Mercy Killing): It means causing painless death to a person suffering from hopelessly incurable and painful disease. It advocates administration of lethal doses of opium or other narcotic drugs. It has no legal sanction.

Types: (1) **Active euthanasia** is an intentional act (**act of commission**), e.g. giving large doses of drugs to hasten death. (2) **Passive euthanasia** is discontinuing or not using extraordinary life-sustaining measures to prolong life (**acts of omission**). (3) **Voluntary euthanasia** means at the will of the person. (4) **Involuntary** means against the will of the person, i.e. compulsory. (5) **Non-voluntary** means person incapable of making their wishes known, e.g. persons in coma.

CONSENT IN MEDICAL PRACTICE: Consent means voluntary agreement, compliance or permission.

Kinds: (1) **Express:** specifically stated by the patient. It may be verbal, or written. (2) **Implied:** Consent is implied when: (1) patient attends hospital, (2) calls doctor to his house complaining of illness, (3) patient holds out his arm for injection. Express consent is required for collection of blood, giving an injection, blood transfusion, anaesthesia, operation, etc.

Informed consent: It implies an understanding by the patient of: (1) The nature of his condition, (2) the nature of proposed treatment, (3) the alternative procedure, (4) risks and benefits involved in

both proposed and alternative procedure, (5) the risks of not taking treatment, (6) the relative chances of success or failure of both procedures.

Full disclosure: In general, patient should be told everything, as in informed consent.

Therapeutic privilege: (1) This is an exception to rule of full disclosure. (2) In case where the patient is emotionally disturbed and fearful, he may refuse treatment if full disclosure is done. (3) In such case, the risk should be explained to the patient's spouse or next of kin.

Paternalism: The doctor does not disclose all the facts to the patient, so that the patient is unable to make a rational choice. It deprives the patient of his autonomy, or of his ability to make a rational choice.

Reasons for obtaining consent: (1) To examine, treat or operate upon a patient without consent is assault in law. (2) If there is no informed consent the doctor may be sued for negligence.

Rules of consent: (1) Written consent should refer to one specific procedure, and not blanket permission. It helps if the patient sues the doctor. (2) Oral consent should be obtained in the presence of a third party. (3) Any procedure beyond routine physical examination requires express consent. (4) The consent should be voluntary, free, direct and informed. (5) In criminal cases and sexual offences, the victim's consent is necessary for examination. (6) If a person is arrested for an offence, and sub-inspector of police gives requisition, the doctor can examine such person without consent, even by using reasonable force. In case of female, a lady doctor should examine (S.53, Cr.P.C.). (7) **A prisoner can be treated without consent.** (8) Consent given for committing an illegal act, such as abortion is not valid. (9) A person above 18 years can give valid consent to suffer any harm from an act done in good faith (S.87 & 88, I.P.C.). (10) A child under 12 years and an insane person cannot give valid consent (S.89, I.P.C.). (11) A consent given by a person under fear of injury, or under misconception of a fact or by intoxicated person is not valid (S.90, I.P.C.). (12) In an emergency, the patient can be treated or operated, if the person cannot give consent (as in coma, shock, etc) (S.92,

I.P.C.). (13) **Loco parentis:** In an emergency involving children, if parents are not available, consent is taken from person-in-charge of child, e.g. warden of a hostel, headmaster of a residential school, etc. (14) Professional secrets cannot be revealed without consent of the patient. (15) When an operation is made compulsory by law, e.g. vaccination, law provides consent. (16) Consent of one spouse is not necessary for an operation or treatment of other. (17) Consent is not a defence in cases of professional negligence. (18) Organs of dead persons cannot be removed for transplantation, without the consent of legal heirs, even though the person has consented before death. (19) Pathological autopsy should not be conducted without the consent of legal heirs. (20) For medicolegal autopsies (statutory authorisation) consent is not required.

MEDICAL RECORDS: Objects: (1) To serve as the basis for patient's care and for continuity of treatment. (2) To serve as documentation for reimbursement. (3) To provide data for use in medical education and clinical research. (4) To assist in protecting legal interests of patient and the doctor. (6) To follow up the patients and evaluation of drug therapy.

Patient has a right to know what is in his records, and is entitled to a copy of his hospital record on discharge on payment.

MALINGERING (shamming): (1) **It means conscious, planned feigning or pretending of a disease for the sake of gain.** (2) The diseases that might be feigned are many, e.g. ophthalmia, dyspepsia, intestinal colic, spitting of blood, ulcers, burns, rheumatism, lumbago, neurasthenia, aphasia, sciatica, vertigo, epilepsy, insanity, artificial bruises, etc. (3) Patients can distort or exaggerate their symptoms which do not conform to any known disease. (4) The history of the case should be taken from the person himself, and his relatives or friends. (5) It can be diagnosed by keeping the person under observation and watching him without his knowledge.

CONSUMER PROTECTION ACT (CPA) 1986: (1) It provides for the protection of the interests of the consumer, and simple redressal to consumers disputes. (2) District Forum, State Commission, and Central Commission are quasi-judicial bodies, and they are deemed to be Civil Courts which observe the principles of natural justice.

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District forum entertains claims up to 20 lakhs, State Commission between 20 lakhs to one crore and National Commission over rupees one crore. (3) The consumer can file a complaint within two years for any defect or deficiency of service in any product. (4) The dispute is settled on the basis of evidence provided by the parties. (5) Doctors and hospitals can be sued for medical negligence, provided the service has not been given free. (6) The patient is required to pay fixed court fee. (7) The cases are settled within three months. (8) The defect is that the doctor cannot produce medical expert as witness to defend himself. (9) Non-compliance of the order by the doctor, trader, etc., may be imprisonment ranging from one month to three years. (10) If a person is aggrieved by the decision of District Forum, he can appeal to State Commission within 30 days from the date of order. (11) Further appeal lies with National Commission and finally Supreme Court.

Transplantation of Human Organs Act, 1994: objects: (1) to prevent live unrelated transplants, (2) in live related transplant, the donor and recipient should be genetically related, except in cases of prior approval of Authorisation Committee, (3) it accepts brainstem death criterion, (4) death should be certified by a panel of experts.

CHAPTER 3

IDENTIFICATION

Identification is recognition of an individual based on certain physical characters, which are unique to the individual.

CORPUS DELICTI: (body of offence, essence of crime): It means the elements of any criminal offence, e.g. murder. The main part is the determination of identity of the dead body and causing of violence in a particular way, at a particular time and place, which are conclusive of death by foul play, by the persons charged with the crime. It also includes a bullet or a broken knife-blade found in the body, clothing and photographs of the deceased showing fatal injuries. The identification of a dead body and proof of corpus delicti is important before a sentence is passed in murder trials.

$$\text{RACE : Cephalic index} = \frac{\text{Maximum breadth of skull}}{\text{Maximum length of skull}} \times 100$$

Type of skull	Cephalic Index	Race
Dolico-cephalic (long-headed)	70 to 75	Aryans, aborigines Negroes.
Mesati-cephalic (medium-headed)	75 to 80	Europeans and Chinese.
Brachy-cephalic (short-headed)	80 to 85	Mongolian.

SEX: Sex chromatin is a small plano-convex mass (**Barr body**), which lies near nuclear membrane in the cell. Usually buccal smear is used for sex determination. It is found in 20 to 80% of cells in females and 0 to 4% in males.

INTERSEX: Characters of both sexes (in varying degree) are present in one individual including physical form, reproductive organs and sexual behaviour. It occurs due to some defect in embryonic development.

(1) Gonadal agenesis: Nuclear sex is negative. The testes or ovaries have never developed.

(2) Gonadal dysgenesis: External sexual structures are present, but at puberty testes and ovaries fail to develop. (A) **Klinefelter's syndrome:** Anatomical structure is male, but nuclear sexing is female (chromatin positive). The sex chromosome pattern is XXY (47 chromosomes). (B) **Turner's syndrome:** Anatomical structure is female, but nuclear sexing is male (chromatin negative). Sex chromosome pattern XO (45 chromosomes). Ovaries do not contain primordial follicles (**ovarian dysgenesis**).

(3) True hermaphroditism (bisexuality). : An ovary and testis or two ovotestis are present with external genitalia of both sexes.

Traits diagnostic of sex

Trait	Male	Female
SKULL		
(1) <u>General size:</u>	Larger, longer, rounded.	Smaller, lighter, rounded.
(2) <u>Capacity:</u>	1500 to 1550 ml.	1350 to 1400 ml.
(3) <u>Architecture:</u>	Rugged.	Smooth.
(4) <u>Forehead:</u>	Steeper, less rounded.	Vertical, round, full, infantile.
(5) <u>Orbits:</u>	Square, lower, relatively smaller, rounded margins.	Rounded, higher, relatively larger, sharper margins.
(6) <u>Cheek bones:</u>	Heavier, laterally arched.	Lighter, more compressed.
(7) <u>Zygomatic arch:</u>	More pronounced.	Less pronounced.
(8) <u>Occipital area:</u>	Protuberance marked.	Protuberance not marked.
(9) <u>Mastoid process;</u>	Medium to large, round, blunt.	Small, medium, smooth, pointed.
(10) <u>Palate:</u>	Large, broader, U-shape.	Small, parabola.

PELVIS

(1) <u>Bony frame work:</u>	Massive, rougher; stands higher and more erect.	Less massive, gracile, smoother.
(2) General:	Deep funnel.	Flat bowl.
(3) Ilium:	Less vertical; curve of iliac crest reaches higher level and is more prominent.	More vertical; distance between iliac crests is less; iliac fossae shallow; curve of crest well-marked.
(4) <u>Preauricular sulcus:</u>	Not frequent, narrow, shallow.	More frequent, broad, and deep.
(5) Acetabulum:	Large, directed laterally.	Small directed anterolaterally.
(6) <u>Obturator foramen:</u>	Large, often oval with base upwards.	Small, triangular with apex forwards.
(7) <u>Greater sciatic notch:</u>	Lower, deeper.	Larger, wider, shallower.
(8) <u>Ischial tuberosity:</u>	Inverted.	Everted.
(9) <u>Body of pubis:</u>	Narrow, triangular.	Broad, square.
(10) <u>Subpubic angle:</u>	V-shaped, sharp angle 70° to 75°.	U-shaped, rounded, broader angle 90° to 100°.
(11) <u>Pelvic brim or inlet:</u>	Heart-shaped.	Circular or elliptical; more spacious; diameters longer.
(12) Pelvic cavity:	Conical and funnel-shaped.	Broad and round.
(13) Sacroiliac articulation:	Larger extends to two- and- half to three vertebrae.	small, oblique, extends 2 to two-and-half vertebrae.
(14) Sacrum;	Longer, narrower, with more evenly distributed curvature; promontory well marked. Body of first sacral vertebra larger.	Shorter, wider; upper half almost straight, curve forward in lower half; promontory less marked. Body of first sacral vertebra small.

(4) Pseudohermaphroditism: Gonadal tissue of only one sex is seen, but external appearance is of opposite sex. **(A) Male pseudohermaphroditism:** Nuclear sex is XY, but sex organs and characteristics deviate to female form, because of **testicular feminisation.** **(B) Female pseudo-hermaphroditism:** Nuclear sex is XX, but sex organs and characters deviate towards male, due to **adrenal hyperplasia.**

SKELETON: Before puberty, bones do not show sex differences except pelvis, and accuracy from this bone is 75 to 80%. Sex is determined mainly from pelvis, skull, sternum and long bones. Male skeleton weighs 4.5 kg. and female 2.75 kg. **Accuracy;** Entire skeleton 100%, pelvis 95%, skull alone 90%, pelvis + skull 98%, long bones alone 80%. Ischiopubic index, sciatic notch index, and sternal index are more in female, but corporobasal index of sacrum is less. **Greater sciatic notch is the ideal feature to determine the sex of a female child.**

AGE: Age is determined from: (1) teeth, (2) ossification of bones, (3) secondary sex characters, (4) general development (children).

TEETH: (1) At birth, rudiments of all temporary teeth and of first permanent molars are found in the jaws. (2) Root formation begins after completion of crown and as root becomes longer, crown erupts and comes out of jaw. (3) During eruption of permanent tooth, overlying root of its deciduous predecessor gradually undergoes resorption, due to which unsupported crown is shed.

Temporary (deciduous) teeth are 20 : (1) 4 incisors, 2 canines and 4 molars in each jaw. (2) Dentition may be delayed in ill-nourished children, especially in rickets. (3) In syphilis eruption is early, or even present at birth. (4) Spacing between teeth is seen at 4 years. (5) First permanent molar teeth erupt behind second temporary molars between 6 to 7 years. (6) After this temporary teeth begin to shed. (7) Mixed dentition is present from 6 to 12 years.

Permanent teeth are 32. (1) 4 incisors, 2 canines, 4 premolars, 6 molars in each jaw. (2) Superadded permanent teeth erupt behind temporary teeth. All the permanent molars are superadded. (3) Successional permanent teeth erupt in place of deciduous teeth. (4)

Permanent premolars erupt in place of deciduous molars. (5) **In both deciduous and permanent teeth, dentition occurs earlier by about one year in lower jaw, except lateral incisors.** (6) Third molar first erupts on the left side of lower jaw. (7) **The dental and skeletal ages are almost same in the male, but in the female skeletal age is usually one year ahead of the dental age.** (8) Eruption occurs earlier in warmer climates and in urban areas. (9) **Eruption of temporary teeth is more regular than permanent.** (10) Eruption is not always bilaterally symmetrical. (11) Heredity, environment, endocrine reactions and nutrition affect eruption and calcification. (12) In ill-nourished children and rickets, dentition is delayed, but in syphilis dentition appears early or may be present at birth. (13) Stunted and notched upper central incisors are seen in syphilis.

Deciduous tooth	Eruption	Resorption of root begins	Calcification of root completed
Central incisor:			
Lower:	06 to 08 months	4th year	1.5 to 2 years
Upper:	07 to 09 months	5th year	1.5 to 2 years
Lateral incisor:			
Upper:	07 to 09 months	5th year	1.5 to 2 years
Lower:	10 to 12 months	5th year	1.5 to 2 years
First molar:	12 to 14 months	6th year	2 to 2.5 years
Canine:	17 to 18 months	8th year	2.5 to 3 years
Second molar:	20 to 30 months	7th year	3 years
Premant tooth	Eruption	Calcification completed	
First molar	06 to 07 years	09 to 10 years	
Central incisor	06 to 08 years	10 years	
Lateral incisor	07 to 09 years	11 years	
First bicuspid	09 to 11 years	12 to 13 years	
Second bicuspid	10 to 12 years	12 to 14 years	
Canine	11 to 12 years	12 to 13 years	
Second molar	12 to 14 years	14 to 16 years	
Third molar	17 to 25 years	18 to 25 years	

Difference between temporary and permanent teeth		
Trait	Temporary teeth	Permanent teeth
(1) Size:	Smaller, lighter, narrow, except temporary molars which are longer than permanent premolars replacing them.	Haevier, stronger, broader, except permanent premolars replacing temporary molars.
(2) Direction:	Anterior teeth are vertical.	Anterior teeth are usually inclined a little forward.
(3) Crown:	China-white colour.	Ivory-white colour.
(4) Neck:	More constricted.	Less constricted.
(5) Root:	Roots of molar smaller and more divergent.	Roots of molars are larger and less divergent.
(6) Ridge:	A ridge or thick edge at the junction of the crown with the fangs present.	No ridge.

Temporary teeth are smaller, lighter, narrower, china-white colour, neck is more constricted, and a ridge is seen at junction of crown with root.

Permanent teeth are (1) heavier, stronger, broader, ivory-white colour, neck is less constricted, no ridge at junction of crown with root. (2) Permanent incisors and canines have single root, premolars one or two, and upper molars 3, and lower molars two roots. (3) The crown of incised is chisel-shaped, canine large and conical, premolars circular and molars cubicle. (4) The chewing surface of premolars have two cusps and molars 3 to 5.

07 years : 24 teeth (20 deciduous and 4 permanent).

09 years : 24 teeth (12 deciduous (molars and canines): 12 permanent (8 incisors and 4 first molars)).

11 years : 24 teeth (4 diciduous (canines) and 20 permanent: (8 incisors, 8 premolars and 4 molars)).

14 years : 28 permanent teeth.

After eruption of second permanent molar teeth, the body of jaw grows posteriorly, and ramus is elongated. **If third molars are fully erupted, the age is above 17.**

Gustafson's method: After 21 years, age is estimated by teeth from physiologic age changes in each of dental tissues. (1) **Attrition.** (2) **Periodontosis:** Regression of the gums and periodontal tissues occurs in old age, gradually exposing necks and roots. (3) **Secondary dentin:** It develops from walls within the pulp cavity and diminishes its size. (4) **Cementum apposition,** especially near end of root occurs continuously throughout life, and forms incremental lines. (5) **Root resorption** starts at apex and extends upwards. (6) Transparency of root is seen after 30 years. The canals in dentin are filled by mineral and dentin becomes transparent. **It is the most reliable of all criteria.** Error is said to be \pm 4 to 7 years.

Growth in Individual Bones : (1) Bones develop from a number of separate centres of ossification, which is spread over a long period of time. (2) A large number appear in foetal life and few after birth. (3) 806 centres are present in foetus at eleventh week. (4) 450 centres are present at birth. (5) **Adult skeleton has 206 bones.** (6) Ossification begins centrally in an epiphysis which is amorphous, rounded and pin-head sized. (7) Most bones are ossified from several separate centres. (8) Carpal and tarsal bones ossify from a single centre. (9) Hyaline cartilage is present between the diaphysis and epiphysis (**epiphyseal plate or growth plate or growth cartilage**). (10) The bone increases in length at the epiphyseal plate, until its final dimensions are attained. (11) The process of union of epiphysis and diaphysis is called fusion. (12) **Union of epiphyses in cartilaginous bones occurs earlier by about one year in the females than in males, but the opposite is seen in suture closure of the skull.** (13) Ossification occurs earlier in tropical conditions than in temperate areas. (14) Metacarpals, metatarsals, phalanges, clavicles and ribs have epiphysis at one end only. (15) **Ageing of bones is more accurate with respect to the appearance of centres of ossification than the union of epiphyses.** (16) **Head of humerus is the last long bone epiphysis to unite.** (17) In upper limb, union occurs earlier at the elbow and later at the wrist and shoulder. (18) In lower limbs, union occurs later at

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the knee joint and earlier at the hip and ankle joints. (19) Variations occur in individuals depending on health, hereditary, nutritional, endocrine and environmental factors. (20) **Skeletal development in the female can be in advance of the male up to one year, while dental development may differ only from one to 4 months.** (21) The opinion of age based on X-rays must be expressed in plus or minus terms, e.g 10 ± 1 . (22) The union of epiphyses as seen in X-rays appear earlier by about 6 months as compared to anatomical evidence.

Symphysis pubis : It is the best single criterion for age determination from third to fifth decades.

Sternum : The four pieces of body of sternum fuse with one another from below upwards between 14 to 25 years. Xiphoid unites with body at 40 years and manubrium in old age.

Hyoid : Greater cornu unites with body between 40 to 60 years.

Age	Appearance of centre of ossification	Union of bone and epiphysis
5 th year :	Head of radius, trapezium, trapezoid, scaphoid.	Greater tubercle fuses with head of humerus.
6 th year:	Lower end of ulna.	Rami of pubis and ischium unite.
6 th to 7 th year:	Medial epicondyle of the humerus.	
9 th year :	Olecranon.	
9 th to 11 th year :	Trochlea of humerus.	
10 th to 11 th year :	Pisiform.	
11 th year :	Lateral epicondyle of humerus.	
13 th year :	Separate centres in triradiate cartilage of acetabulum.	
12 th to 14 th year :	Lesser trochanter of femur.	
14 th year :	Crest of ilium; head and tubercles of ribs.	Medial epicondyle of humerus; lateral epicondyle with trochlea; patella complete.

Contd...

Contd...

15 th year :	Acromion.	Coracoid with scapula; triradiate cartilage of acetabulum.
16 th year :	Ischial tuberosity.	Lower end of humerus; olecranon to ulna; upper end of radius; metacarpals; proximal phalanges.
18 th year :		Head of femur; lesser and greater trochanter of femur; acromion; lower end of ulna
18 th to 19 th year :	Inner end of clavicle.	Lower end of femur; upper end of tibia and fibula, head of humerus; lower end of radius.
21 st year :		Iliac crest; inner end of clavicle; ischial tuberosity.

Sacrum : Intervertebral discs ossify from below upwards after puberty and sacrum becomes single bone between 21 to 25 years.

Skull : (1) It consists of 22 bones. (2) Anterior fontanelle closes and two halves of mandible unite at second year. (3) Condylar portion of occipital bone fuses with squama at third year, and with basi-occipital at the fifth year. (4) Metopic suture closes about third year. (5) Basi-occiput fuses with basi-sphenoid between 18 to 21 years. **(6) Closure of the sutures begins on the inner side and proceeds externally.** (7) **Inner side union occurs 5 to 10 years earlier than on outer side.** (8) On the outer side fusion occurs : **30 to 40 years** : Posterior 1/3 of sagittal; **40 to 50 years** : Anterior 1/3 of sagittal and lower half of coronal. **45 years** : Lambdoid suture. **50 to 60 years** : Middle sagittal and upper half of coronal. **60 years**: Squamous temporal. (9) The order of reliability of suture closure : Sagittal, lambdoid and then coronal.

Secondary sex characters: **Male:** **14 years:** Fine hair on pubis; testes become large and penis begins to enlarge. **15 years:** Modest growth of hair on pubis, axillary hair. **16 years:** Well grown hair on pubis; genitals adult appearance. **16 to 18 years:** Hair on face and hoarse voice.

Female: **12 years:** Breasts begin to develop; 2 months later fine, downy hair on mons veneris. Labia develop and menstruation starts. **14 to 15 years:** Well grown pubic hair, hair in axilla.

Other changes: **35 to 50 years:** Ossification of laryngeal and costal cartilages and hyoid bone starts. Lipping and reduction of joint space; margins of bodies of lumbar vertebrae and inner border of ischial tuberosity, wrinkleless about eyes, eyebrows and in front of ears appear 35 to 40 years. **Arcus senilis** appears around 50 years, and is complete by 60 years. It is a grey opaque ring surrounding the margin of cornea, due to degenerative changes, but separated from the margin by an area of clear cornea. **Greying of hair** starts after 40 years, but is very variable. Pubic hair does not become grey before 50 to 55 years.

For determination of age between **6 to 12 years** take X-rays of (1) elbow joint, (2) wrist joint. **06 years :** lower end of ulna (A); **6 to 7 years :** medial epicondyle of humerus (A) ; **9 years :** olecranon (A); **9 to 11 years :** trochlea of humerus (A) ; **11th to 12th year :** pisiform (A) : **11th year :** lateral epicondyle of humerus (A).

12 to 14 years : X-rays of pelvis and elbow. **13th year :** Centre in triradiate cartilage of acetabulum (A); lesser trochanter of femur (A). **14th year :** Centre for iliac crest (A); fusion of lateral and medial epicondyles of humerus with trochlea. **15th year :** Fusion of triradiate cartilage of acetabulum. **16th year :** Centre for ischial tuberosity (A); fusion of lower end of humerus; olecranon to ulna; upper end of radius.

Fusion of Bones/Joints :

16 years : elbow joint.

16 to 17 years : ankle joint.

17 to 18 years : hip joint.

18 to 19 years : knee, shoulder and wrist joints.

20 to 21 years : fusion of ischial tuberosity, iliac cres and inner end of clavicle.

M.L. IMPORTANCE OF AGE :

7 months of intrauterine life : Not viable below 7 months.

5 years : Liable for punishment for unlawful act under Indian Railways Act.

7 years : No criminal responsibility below 7 years (S.82, IPC.).

7 to 12 years : Criminally responsible, if he had sufficient maturity of understanding and judgement (S.83, IPC).

12 years : Can give consent for medical examination.

15 years : (a) Can work in a factory as adult if found medically fit. (2) Age of consent for sexual intercourse by wife.

16 years : (1) Kidnapping from lawful guardianship in case of a boy under 16.

18 years : (1) A person becomes major. (2) A girl can contract marriage. (3) Juvenile in case of a boy or girl up to 18 years. (4) Can give consent to suffer any harm from an act not intended or not known to cause death or grievous hurt (S.87, IPC). (5) Kidnapping from lawful guardianship in case of girl under 18. (6) Procuring a girl below 18 years for prostitution. (7) Age of consent for sexual intercourse by a girl.

21 years : (1) Attainment of majority when a person is under guardianship of court of wards. (2) To import a girl from foreign country for prostitution is kidnapping. (3) A boy can contract marriage.

AGE OF FOETUS : (1) **End of seventh month :** Length 35 cm; weight, 0.9 to 1.2 kg; thick nails; eyelids open, pupillary membrane disappears. Meconium in whole of large intestine; testes at external inguinal ring; gall bladder contains bile; caecum in right iliac fossa.

(2) **End of eighth month:** Length 40 cm.; weight 1.5 to 2 kg. Nails reach tips of fingers, skin not wrinkled; left testis in scrotum.

(3) **End of ninth month :** Length 45 cm; weight 2.5 to 3 kg. Scalp hair 4 cm long. Meconium at end of large intestine. Both testes in scrotum.

(4) **Full term (10 months):** (1) Length 50 to 53 cm; weight 2.5 to 5 kg., average 3.4 kg. (2) Male infants weigh 100 g more than female.

(3) Head circumference 33 to 36 cm. (4) Anterior fontanelle is 4x2.5 cm. (5) Brain surface shows convolutions. (6) Scalp hair is dark, 3 to 5 cm. long. (7) Skin is pale and covered with vernix caseosa. (8) Face is not wrinkled. (9) Lanugo hair absent except on shoulders. (10) Nails project beyond end of fingers. (11) Nose and ear cartilages formed. (12) Vulva closed; labia majora fully developed and cover labia minora. (13) Meconium in rectum. (14) Placenta 22 cm. in diameter, 1.5 cm. thick, weight 500 g. Umbilical cord 50 to 55 cm. long and one cm. thick. (15) Umbilicus between xiphoid cartilage and pubis.

Ossification centres: (1) **Sternum:** Manubrium appears at fifth month; six centres in body appear between fifth month to tenth month. (2) **Lower end of femur** appears at 36 weeks; its diameter is 4 to 5 mm. at 38 weeks, and 8 mm. at full term. (3) **Upper end of tibia:** In 80% of full term infants, centre present. (4) **Calcaneum:** end of fifth month. (5) **Talus:** end of seventh month. (6) **Cuboid** may or may not be present at birth.

Rule of Haase: (1) It is a rough method of calculating the age of foetus. (2) During the first five months, the square root of length gives age of foetus in months. (3) During last five months, length in cm. divided by five gives age in months.

Length of child : At birth 50 cm; 6 months 60 cm; one year 68 cm; 4 years 100 cm. (doubles).

Birth weight doubles by 5 months and triples by one year.

Head circumference increases by 12 cm. at one year.

STATURE: (1) It varies by 1.5 to 2 cm. at different times of the day. (2) It is less in evening. (3) Malnutrition and advancing years reduce stature. (4) After 30 years it decreases by 0.6 mm. every year. (5) On lying it increases by 1 to 3 cm. (6) After death stature increases by 1.5 cm. in the male and 2 cm. in female. (7) The symphysis pubis lies about half way up the body at the age of 14 years. (8) **In a dismembered body approximate stature is obtained from:**

(1) length from sternal notch to symphysis pubis multiplied by 3.3. (2) length of forearm is equal to 5/19 of stature, (3) height of head from top to tip of chin is 1/7 of stature. (4) twice the length of one arm+ 34 cm. equals height. (5) length of entire skeleton + 2 to 4 cm.

Anthropometry (Bertillon system): It was used for personal identification. It includes : (1) description of eyes, nose, ears, etc, (2) body marks, such as moles, etc. (3) eleven body measurements, (4) photographs. **It is obsolete. As a sole means of identification, photographs are not always reliable.**

DACTYLOGRAPHY (Fingerprint system; Galton system; Dermatoglyphics): **They are impressions of patterns formed by papillary or epidermal ridges of the fingertips.** **Types :** (1) Loops (60 to 70%). (2) Whorls (25 to 35%). (3) Arches (6 to 7%). (4) Composite (1 to 2%).

(1) Identification is made by comparison of many details of characteristics occurring through the ridge and by their sequence. (2) 10 to 12 points of fine comparison are accepted as proof of identity. **(3) The patterns are not inherited, and are different even in identical twins. (4) The patterns are distinctive and permanent.** (5) A person can be identified 100%. (6) They can be teleprinted. (7) Sweat contains fats, which leaves a greasy impression on a smooth surface. (8) They can be latent (invisible), visible, and plastic (on soap, cheese, etc). **(9) Prints can be obtained from dermis.** (10) Sections up to a depth of 0.6 mm. give satisfactory finger prints. (11) Impressions may persist for years if not disturbed. (12) They can be mutilated by burns and application of corrosives. (13) Leprosy, electric injury, exposure to radiation impair finger prints. (14) Finger prints reader (FINDER) is a computerised automatic fingerprint reading system which records print in half second.

POROSCOPY: **(1) Ridges contain microscopic pores, formed by mouths of ducts of subepidermal sweat glands.** (2) 9 to 18 pores are present in each mm. of ridge. (3) They vary in size, shape, extent and number over a given length of ridge. (4) These pores are permanent and do not change during life. **(5) It is useful when fragments of fingerprints are available.**

M.L. Imp: (1) Establish identity of criminal by prints on weapons, furniture, clothes, etc. (2) Identification of suicides, deserters, dead or unconscious persons, and decomposed bodies. (3) Identification of accidental exchange of newborns. (4) Prevention of impersonation. (5) To maintain identity records.

SKULL-PHOTO SUPERIMPOSITION: It is the technique to determine whether the skull is that of the person in the photograph. (1) Photograph of head and face is enlarged to natural size, and negative is prepared. (2) A life size negative of the skull is prepared. (3) The negative of the photograph and the skull are superimposed by aligning characteristic points in the negative. (4) The superimposed negatives are photographed on bromide paper. (5) If contours and size of skull accurately correspond to the face of the photograph, the test is positive. (6) If they do not tally identification is excluded (negative value). (7) If they tally it is corroborative evidence.

VIDEO SUPERIMPOSITION: The skull is fixed on a rotatable universal stand. The photograph is also fixed with the same orientation parallel to the skull. One camera is directed at the skull and a second camera directed at the photograph of the face. Images of the skull and photographs are projected on a monitor placed near the skull. By performing a series of blending, fading and sweeping (vertical, horizontal and diagonal), the image of the skull and photograph are superimposed and analysed for conformity. All the anatomical landmarks are compared. This is an exclusionary method.

Computer pictures : Depending on the description of the person, hundreds of varieties of face can be drawn on the screen within a few minutes. Additions and alterations can be made.

Skull : If previous X-ray films are available, skull measurement and comparison of frontal, sphenoidal and maxillary sinuses, sella turcica and mastoid area are useful in identification.

SCARS : (1) A scar is fibrous tissue covered by epithelium without hair follicles, sweat glands or pigment. (2) Injury to dermis produces scar, but not injury to epidermis. (3) Faint scars become visible by application of heat, filtered ultraviolet light or surface friction. (4) Scars produced in childhood grow in size with development of the person. (5) Incised wounds produce linear scars; lacerated wounds produce firmer, irregular, prominent scars attached to deeper tissues. (6) Stab wounds produce oval, elliptical, triangular or irregular scars. (7) Bullet wounds produce circular scars. (8) Corrosive acids and burns cause irregular scars. (9) **Age :** (A) **5 to 6**

days: firm union producing a reddish or bluish scar. (B) **Two weeks to 2 months:** Pale soft and sensitive. (C) **2 to 6 months:** White, glistening, tough, wrinkled. No further change.

M.L. Importance : (1) Identification. (2) Shape may indicate nature of weapon or agent that caused injury. (3) If age of scar corresponds with date of attack, it may have circumstantial value. (4) Disfigurement of face or head is grievous hurt. (5) Linea albicans may indicate previous pregnancy.

TATTOO MARKS : (1) **They are the designs imprinted in the skin by multiple small puncture wounds with needles dipped in colouring matter**, such as Indian ink, carbon, cinnabar, indigo, cobalt, Prussian blue, etc. (2) Lymph nodes near tattoo mark show a deposit of pigment. (3) Permanent pictures are made when the dye penetrates dermis. (4) If the pigment is deposited below the epidermis, it may disappear after ten years. (5) Tattoos on hands disappear early due to constant friction. (6) A faded tattoo mark becomes visible by use of ultraviolet lamp, infrared photography or rubbing the part. (7) **In decomposed body, it is seen after removal of epidermis.**

M.L. Imp: (1) Identity. (2) Religion. (3) God of worship. (4) Indecent designs point to perversions. (5) Designs may indicate a particular country or region. (6) Drug addicts tattoo to cover needle puncture marks.

HAIR: (1) Cuticle is outer layer and consists of thin, nonpigmented cells. (2) Cortex is middle layer and consists of longitudinally arranged, elongated cells without nuclei. (3) Medulla is inner layer composed of keratinised remains of cells. (4) **Barr bodies** are found in hair follicles, $29 \pm 5\%$ in females and $6 \pm 2\%$ in males. (5) Hair of foetus and the new born is fine, soft, non-pigmented and non-medullated (lanugo). (6) Bleached hair is brittle, dry and straw-yellow. (7) Scalp hair grows 1 to 3 mm. a week (average 2.5 mm). (8) **ABO** group can be determined in a single hair from any part of body by modified absorption elution technique. (8) If the hair falls naturally, root will be shapeless and atrophied. (9) If hair is pulled out, hair bulb will be larger, irregular and swollen and sheath ruptured.

Difference between human and animal hair

Trait	Human hair	Animal hair
(1) General:	Fine and thin.	Coarse and thick.
(2) Cuticle:	Cuticular scales are short, broad, thin and irregularly annular.	Cuticular scales are very large and have step-like or wavy projections.
(3) Cortex:	Thick, well-striated, and 4 to 10 times as broad as medulla.	Thin, rarely more than twice as broad as medulla.
(4) Medulla:	Varies considerably, usually narrow; continuous, fragmented, or entirely absent.	Continuous and wider.
(5) Pigment:	Evenly distributed.	Mostly present near medulla.
(6) Precipitin test:	Specific for human.	Specific for animal.
(7) Medullary index:	Below 0.3	Above 0.5

M.L. Imp : (1) Helps in crime investigation, for it remains on clothes, body and weapon. (A) In rape, sodomy, bestiality and traffic accident. (B) Stains indicate the nature of assault, e.g. seminal stains in sexual offences, salivary stains in asphyxial deaths, blood stains in injury. (2) Nature of weapon can be made out from injuries of hair and hair blubs. (3) Singeing indicates burns. (4) Differentiates scalds from burns. (5) Sex may be determined. (6) Identification. (6) Heavy metals can be detected.

TEETH : (1) **In antemortem tooth loss**, bony rim of alveolus is sharp and feathered. (2) A blood clot forms and in one to two days there is early organisation. (3) In a week, socket is filled with organised clot. (4) In 2 to 3 weeks soft tissues are healed and socket partially filled with new bone. (5) In 6 months socket is filled with new bone, but the location of root outline is visible, and in one year whole socket is filled with new bone. (6) If entire tooth was knocked out, irregular edges of remaining bone, splintering of buccal plates, areas of compressed bone, or fracture of roots or crowns of adjacent teeth are seen.

The usual methods of charting of teeth are : (1) Universal system. (2) Palmer's notation. (3) Haderup system. (4) FDI two-digit system.

Bite marks: (1) Human bites rarely cause tearing of the skin, but usually produce semicircular or crescentic patterned abrasions with extensive haemorrhages under the skin. (2) The mark consists of a central area of bruising with a surrounding area, which may show separate bruises and abrasions. (3) Bites are always contaminated with saliva. (4) They may be found anywhere on the body. (5) They may be found in the materials left at the place of crime, e.g. cheese, bread, butter, fruit, etc. or in humans involved in assaults.

M.L. Importance of teeth : (1) Identification. (2) Dentures in identification. (3) Criminals identified by bite marks. (4) Age estimation. (5) Fracture or loss of tooth due to assault is grievous hurt. (6) Sex can be determined. (7) Heavy metal poisoning can be detected.

4

CHAPTER

MEDICOLEGAL AUTOPSY

Objects: To find out (1) Cause of death (natural or unnatural). (2) Manner of death (suicide, homicide, accident). (3) Time since death. (4) Establish identity. (5) To collect physical evidence to identify the weapon and criminal. (6) In new born to determine liverbirth and viability.

Rules: (1) Conducted in mortuary only, except spot P.M. (2) Requisition from police or Magistrate necessary. (3) Avoid delay. (4) Collect information from inquest, accident register, case sheet, etc. (5) Conducted in day-light as far as possible, because colour changes, such as jaundice, P.M. hypostasis and colour of contusions cannot be made out in artificial light. (6) Body should be identified by the police constable. (7) No unauthorised person should be present. (8) Assistant should note findings. (9) Autopsy must be complete and never partial.

Incision: I-shaped incision extending from chin down to symphysis pubis in midline.

To demonstrate **pneumothorax**, a pocket is dissected on the affected side between the chest wall and skin, and is filled with water, and the wall punctured with knife under the water. Air if present will bubble out of the opening through water.

Air embolism: (1) Open the head first, and examine surface vessels of brain for gas bubbles. (2) Cut the apex of heart with knife. The left ventricle will contain frothy blood. (3) The heart will float in water if the right ventricle contains air. (4) Pericardial sac is filled

with water and heart punctured with a scalpel and twisted a few times. Bubbles of air will escape if air is present.

Heart is opened in the direction of flow of blood.

Subendocardial haemorrhages: (1) They are seen in the left ventricle, on the opposing papillary muscles and adjacent columnae carnae. (2) The haemorrhages are flame-shaped, confluent and tend to occur in one continuous sheet rather than patches. (3) They are seen (a) after sudden severe hypotension due to severe loss of blood or from shock, (b) after intracranial damage, such as head injury, cerebral oedema, surgical craniotomy or tumours, (c) death from ectopic pregnancy, ante-partum or post-partum haemorrhage, (d) various types of poisoning, especially arsenic.

Stomach is removed by applying double ligature at both ends. It is opened along greater curvature. **Small intestine** is opened along the line of mesenteric attachment, and large intestine along anterior taenia. **Liver and spleen** are cut in long axis, **pancreas** at right angles to long axis, and **kidney** is sectioned longitudinally through convex border into hilum. **Testis** is removed by incising inguinal canal and pulling loop of vas through it. **Duodenum** is the widest and most fixed portion of small bowel.

A.M. blood clots are dark red, firm and on section show alternate layers of platelets and thrombi. **Postmortem clots** are moist, smooth, rubbery, homogeneous, loosely or not attached to wall, and there are no lines of Zahn.

Fluid blood in a dead body is seen in: (1) septicaemia, (2) CO poisoning, (3) rapid death from asphyxia, (4) amniotic fluid embolism, (5) puerperal sepsis, (6) retained abortion.

Head: A coronal incision is made in the scalp, which starts from the mastoid process just behind one ear, and carried over the vertex of the scalp to the back of the opposite ear. The skull is cut by sawing horizontally. **Undertakers fracture** is tearing of intervertebral disc around C-6 or C-7.

For fixation of brain, lateral fissures are opened with the fingers and a long sagittal cut is made in the corpus callosum and kept in 10% formalin for one week.

Spinal cord is not examined routinely. An incision is made on the back in midline extending from the occipital protuberance to the lower end of the sacrum. The laminae are sawed through the entire length of spine on each side and separated with chisel.

Preservation of viscera: In all cases of poisoning preserve: (1) **Stomach** and its contents. (2) Upper part of **small intestine** (about 30 cm) and its contents. (3) **Liver** half kg. (4) **Kidney** half of each. (5) **blood** 30 ml. (6) Urine 30 ml.

Preservatives: (1) **Saturated sodium chloride soultion** except in cases of poisoning by corrosive acids and alkalis, corrosive sublimate and aconite. (2) **Rectified spirit**, except in cases of poisoning by (a) alcohol, (b) acetic acid, (c) phenol, (d) paraldehyde, (e) phosphorus. **Never preserve viscera in formalin.**

Minimum of 10 ml. of blood should be preserved, to which 10mg/ml. of sodium or potassium fluoride is added. Blood should be collected from femoral, jugular, subclavian or iliac veins, but never from pleural or abdominal cavities.

Instructions : (1) Stomach and intestine are put in one bottle and liver and kidney in another bottle. Separate bottles are used for blood and urine. (2) Stomach and intestine are opened, liver and kidney are cut into small pieces. (3) Quantity of preservative should be equal to viscera in bulk. (4) Two-thirds of bottle only should be filled. (5) Seal the bottles. (6) Label the bottles with all particulars of the case. (7) Sample of preservative should also be sent for analysis. (8) Samples are kept in a box, locked and sealed. (9) A copy of inquest and P.M report are also sent. (10) The box is handed over to police constable after obtaining a receipt, who hands it over in the laboratory.

In decomposed bodies, bullet wounds, large incised wounds, valvular lesions of heart and fractures can be made out.

EFFACEMENT OF IDENTITY : (1) Purposive removal of identifying features. (2) Attack by animals. (3) Burning or incineration. (4) Advanced putrefaction. (5) Dismemberment and burying different parts in different places. (6) Chemical destruction by corrosives. (7) Bomb explosion.

VIRTUAL AUTOPSY (VIRTOPSY): It is a non-invasive technique of examining dead bodies to find out the cause of

death. It is a combination of CT and MR imaging. CT images give information about morbid anatomical findings and MR imaging focuses on soft tissue, e.g. muscles, bone, blood vessels, tissues and organs. MR spectroscopy measures metabolites formed due to decomposition, which help to estimate time since death. Two dimensional and three dimensional imaging is done with multislice CT. Emphysema, air embolism, pneumothorax, hyperbaric trauma and decompression effects can be better appreciated. When an injury is caused by a weapon, using a computer software, virtual model of an injury with the 3D image of a simulation can be created by using a similar weapon. The track of the projectile inside the brain or other internal organs with haemorrhage and damage to tissues can be viewed with CT scanning.

PSYCHOLOGICAL AUTOPSY: Psychological autopsy is a set of postmortem investigative procedures (gathering all the relevant information from the past life of the victim of suicide), that help ascertain and evaluate the role that physical and psychological factors play in the death of an individual, thus to determine the manner of death to as high a degree of certainty as possible. Description of scene of death, position of body, evidence at the scene, such as weapons, poison and notes, etc. are necessary. It involves systematic collection of psychological data (mental state) through structured interviews of the deceased's family members, friends, co-workers, employers and fellow students, who had dealt with the deceased are helpful, to reconstruct the habits of the victim as regard to his background, habits, character, personality traits, general life style and method of death. It is most commonly introduced in those involving custodial care-taking (police custody and prisons), and those of contested life insurance claims. They have also been introduced in criminal cases (suicide or homicide), workers compensation (unsafe job conditions), and professional negligence (proximate cause of suicide). The psychological autopsy cannot validly inform an expert that a suicide definitely occurred, but it significantly improves manner of death determination.

EXAMINATION OF BONES

General Description : (1) Keep the bones in anatomic arrangement and draw a skeletal chart, indicating which bones

are present. (2) Photographs of all bones are taken. (3) Note the attachment of the soft tissues to bones if any, and their stage of putrefaction. (4) Note whether the bones are moist and humid, or dry and their smell. (5) The bones are then washed by brushing with lukewarm water, and are placed under shelter to dry slowly.

(1) Human or animal : (1) If the bone is fairly fresh, and some of the blood constituents are still present, the precipitin test is useful. **(2) Bones of the hand and wrist of the bears may be confused with human bones.** (3) Human and animal bones can also be distinguished by chemical analysis of bone-ash. (4) Microscopic structure is also useful.

(2) One or more individuals : (1) This can be determined by reconstructing the skeleton. (2) If there is no disproportion in the size of various bones, or reduplication, articulation is correct, and if the age, sex and race of all the bones is same, they belong to one individual. (3) If mixing of bones from more than one skeleton is suspected, they can be separated by the use of short wave ultraviolet lamp.

(3) Sex : (1) **Recognisable sex differences are not present before puberty.** (2) After puberty, the sex can be determined by examination of the pelvis, skull, diameter of head of femur and humerus and measurements of femur, tibia, humerus and radius.

(4) Age at death : (1) It can be determined from examination of teeth, ossific centres, amount of wear and tear in teeth, length of long bones, epiphyseal union, pubic symphysis, closure of skull sutures, cortical resorption, bony lipping, osteoporosis, calcification, osteoarthritic changes, etc. (2) After the completion of bony union, age cannot be determined accurately.

(5) Race: There are certain racial differences in the skeleton, chiefly in the skull and face measurements, teeth and lower extremities.

(6) Stature: (1) When the skeleton is incomplete, or severely disintegrated, the stature may be calculated by applying mathematical formulae to the length of the long bones. (2) Long bones must be measured by means of osteometric board, measurement by use of the

tapes or calipers are not accurate. (3) Pearson's formulae or Trotter and Gleser formulae are used. **(3) The principle of these formulae is to measure the length of long bone and multiply it with a given factor, and then adding a fixed factor.** (4) The formulae are different for dry bones and wet bones, for white persons and Negroes, and for males and females.

Osteometric Board: (1) This has a rectangular base with a ruler fixed along one of its long sides. An upright is fixed at one end of the board, and a second one slides along the board. (2) The bone is placed with one of its ends against the fixed upright and the movable upright is brought up to the other end of the bone. (3) The distance between the uprights is then shown on the ruler. (4) Weight bearing long bones are used for applying these formulae. (5) Femur and tibia give more accurate results than humerus or radius. **(6) Useful rule of thumb is that humerus is 20%, tibia 22%, femur 27% and spine 35% of the individual's height in life.**

(7) Identification: (1) Identity may be established from teeth, disease and deformities of the bone, old healed or healing fractures, orthopaedic surgical procedures, regional atrophy, spinal deformities, flat feet, supernumerary ribs, congenital defects, etc. and by superimposition technique using the skull. (2) Dental charts and dental radiographs are also useful.

(8) Nature of injury: (1) The ends of the long bones should be examined carefully to find out if they have been cut by sharp instruments or hacked or sawn or bitten by animals. (2) If the body disintegrates naturally, articular surfaces are smooth.

(9) Time since death : (1) After the soft tissues disappear, pieces of cartilage and ligaments remain attached to bone for three to four months. (2) Traces of marrow and periosteum may remain in, or attached to the bones for several months. (3) A fairly recent bone is slightly greasy to the touch and heavy. (4) Odour is a good indication of relatively recent death. (5) After the bones have lost the covering tissue, and the odour of decomposition is lost, the bones still appear fresh. (6) Repeated freezing and thawing of the bones when buried superficially may cause a bone to expand and crack within few months.

(10) Cause of death : (1) The cause of death cannot be made out unless there is evidence of fracture or injuries which usually cause death, e.g. fractures of skull bones, upper cervical vertebrae, hyoid bone, several ribs, or marks of deep cuts in long bones or marks of burning. (2) The bones should be examined for firearm injuries or any disease, e.g caries or necrosis. (3) The type of the weapon can be known from the type and depth of the cut in the bone. (4) Metallic poisons, e.g., arsenic, antimony, lead or mercury can be detected in burnt bones.

EXHUMATION : (1) **It is digging out of an already buried body legally from grave.** (2) There is no time limit in India. It is done in cases of homicide, suspected homicide disguised as suicide, suspicious poisoning, criminal abortion, criminal malpractice, survivorship and inheritance claims, workmen's compensation claims, insurance claims, disputed identity, etc. (3) The body is exhumed only when there is a written order from Executive Magistrate. (4) **It is exhumed under supervision of medical officer in the presence of police and Magistrate.** (5) In cases of suspected mineral poisoning, half kg sample of earth in contact with body and from above, below, and from each side is collected. (6) Any fluid or debris in coffin, a portion of coffin and burial clothes are collected for chemical analysis. (7) Viscera should be preserved for chemical examination. Arsenic is most likely to be detected in exhumed bodies. (8) Disinfectants should not be sprinkled on the body. (9) Autopsy is done in usual manner. (10) If the body is reduced to skeleton, the bones should be examined.

5

CHAPTER

DEATH AND ITS CAUSE

Thanatology deals with death in all its aspects.

Somatic death is the complete and irreversible stoppage of circulation, respiration and brain functions (tripod of life). There is no legal definition of death. The question of death is important in resuscitation and organ transplantation. **Molecular death** is death of cells and tissues individually, which occurs 1 to 2 hours after stoppage of vital functions.

Brain death consists of (1) deep unconsciousness, (2) no movements, no spontaneous breathing, (3) stoppage of spontaneous cardiac rhythm, (4) no reflexes, (5) bilateral dilatation and fixation of pupils, (6) flat EEG, provided all of above are present (a) for 24 hours, (b) body temperature is not below 32°C. (c) no metabolic and endocrine disturbances.

For transplantation, cornea can be removed from dead body within 6 hours, skin in 24 hours, bone in 48 hours and blood vessels in 72 hours. Kidneys, heart, lungs and liver must be removed soon after stoppage of circulation

MODES OF DEATH : (1) Coma. (2) Syncope. (3) Asphyxia.

Coma is insensibility which involves central portion of brain stem. **Syncope** is sudden stoppage of action of heart, which may be fatal.

ASPHYXIA : (1) It is a condition caused by interference with respiration, or due to lack of oxygen in respired air (and failure to eliminate CO₂), due to which organs and tissues are deprived of

oxygen, which may cause unconsciousness and death. (2) Neurons of cerebral cortex will die in 3 to 7 minutes of complete oxygen deprivation. (3) Breathing stops within 20 seconds of cardiac arrest, and heart stops within 20 minutes of stopping of breathing.

Anoxia means lack of oxygen. (1) **Anoxic anoxia** : It occurs due to (a) breathing in contaminated atmosphere, e.g exposure to gases in wells and tanks, sewer gas, (b) mechanical obstruction to breathing. This type is usually known as asphyxia or mechanical asphyxia. (2) **Anaemic anoxia**: It occurs due to reduction in oxygen carrying capacity of blood, e.g. acute massive haemorrhage, acute poisoning by CO, nitrates, chlorates, coal tar derivatives. (3) **Stagnant anoxia**: Impaired circulation causes reduction of oxygen delivery to tissues, e.g. heart failure, embolism, shock. (4) **Histotoxic anoxia**: Enzymatic processes by which oxygen in the blood is used by tissues are blocked, e.g. cyanide poisoning.

Types of Asphyxia: (1) **Mechanical** : Due to mechanical blocking of air- passages, such as smothering, hanging, strangulation, drowning, traumatic asphyxia. (2) **Pathological** : due to disease of upper respiratory tract, e.g. acute oedema of glottis, laryngeal spasm and abscesses. (3) **Toxic** : (A) Use of oxygen is prevented, e.g. CO. (B) Enzymatic processes are blocked, e.g cyanides. (C) Paralysis of respiratory centre, e.g poisoning by opium, barbiturates, strychnine. (D) Paralysis of respiratory muscles by gelsemium. (4) **Environmental**: (A) Insufficient oxygen in air, e.g. enclosed places, trapping in disused refrigerator or trunk. (B) Exposure to irrespirable gases, e.g. CO, CO₂, sewer gases. (5) **Traumatic** : (a) pulmonary embolism, (b) pulmonary fat embolism, (c) pulmonary air embolism, (d) bilateral pneumothorax. (6) **Postural asphyxia** : It occurs when an unconscious person lies with upper half of body lower than the remainder, and also from forcible flexion of the neck on the chest. (7) **Iatrogenic** is associated with anaesthesia,

Pathology: Asphyxiareduction in oxygen tension...capillary dilation ...capillary stasis... capillary engorgement..... stasis of blood in organs..... diminished venous return to heart reduced pulmonary flow.... deficient oxygenation in lungs.... asphyxia (vicious cycle).

Asphyxial stigmata: The triad of (1) cyanosis, (2) facial palpebral, subpleural and subepicardial petechiae, (3) visceral congestion, are consistent with, but not diagnostic of asphyxia. Reliable local indications of fatal obstructing trauma must be present, to conclude that death occurred from asphyxia.

Cyanosis occurs due to diminished oxygen tension in blood and an increase of reduced haemoglobin. **The cyanotic colour of blood will be seen if there is at least 5 g/100 ml. of reduced haemoglobin in capillary blood.** **Petechial haemorrhages (Tardieu spots)** are caused due to raised venous pressure from impaired venous return, and not due to hypoxia of the vessel walls. **A minimum of 15 to 30 seconds is required to produce congestion and petechiae.**

P.M. appearances in asphyxia : External : (1) P.M lividity is well developed. (2) Face is pale in slow asphyxia. (3) Face is distorted, congested, often cyanosed and sometimes swollen and oedematous. (4) Fingernails are bluish. (5) Tongue protruded. (6) Frothy and bloody mucus escapes from mouth and nose. (7) Eyes are prominent, conjunctivae congested and pupils are dilated. (8) Tardieu spots (petechial haemorrhages) are seen in conjunctivae, and in the zone above the level of compression of neck.

Internal : (1) Blood is fluid and dark. (2) Larynx and trachea congested and contain frothy mucus. (3) Lungs are dark-purple and congested and oedematous. (4) Internal organs are congested. (5) Tardieu spots are usually present in subconjunctival tissues, under pleural and pericardial membranes, but they can be seen in internal organs. The spots are dark, round and well-defined; size varies from pinhead to 2 mm. (6) Asphyxia causes medullary suboxia causing vomiting, due to which air-passages may be filled by inhaled vomit. (7) **If heart failure occurs before respiratory failure, asphyxial signs will be less marked.**

NEGATIVE AUTOPSY : No cause of death is found after autopsy and laboratory investigations. 2 to 5% of autopsies are negative.

Causes : (1) **Inadequate history :** Deaths from vagal inhibition, status epilepticus, hypersensitivity reactions, dry drowning show

no anatomical findings. (2) **Inadequate external exam** : Burns in electrocution, injection marks, snake bite marks may be missed. (3) **Inadequate internal exam** : Air embolism and pneumothorax may be missed. (4) **Lack of toxicological analysis.** (5) **Insufficient laboratory exam.** (6) Lack of training of doctor.

OBSCURE AUTOPSY: Deaths due to following causes may be missed : (1) **Natural** : (a) Death precipitated by emotion, work stress, (b) functional failure, such as epilepsy, paroxysmal fibrillation. (2) **Biochemical**: (a) Uraemia, diabetes, potassium deficiency. (3) **Endocrine dysfunction**: Adrenal insufficiency, (b) thyrotoxicosis, myxoedema. (4) **Concealed trauma**: (a) Concussion, (b) self-reduced neck injury, (c) blunt injury to heart, (d) reflex vagal inhibition. (5) **Poisoning**: (a) Narcotic poisoning, (b) neurotoxic or cytotoxic poisons, (c) plant poisoning, (d) anaesthetic overdose. (6) Allergy and drug idiosyncrasy.

Inhibition of heart (vagal inhibition or instantaneous physiological death) : (1) **Death occurs suddenly, within seconds or in 1 to 2 minutes due to minor trauma or relatively simple or harmless peripheral stimulation.** (2) **Some persons have marked hypersensitivity to stimulation of carotid sinuses, which causes bradycardia and cardiac arrhythmias and arrest.** (3) Death occurs due to pressure on neck, particularly on carotid sinuses as in hanging or strangulation, a blow on the abdomen or testicles, unexpected blows to the larynx, chest, abdomen and genital organs, impaction of food in larynx, unexpected inhalation of fluid into the upper respiratory tract as in drowning, sudden immersion of body in cold water, insertion of an instrument into bronchus, uterus, bladder or rectum, sudden distension of hollow muscular organs, e.g during attempts at criminal abortion, sudden evacuation of pathological fluids, e.g. ascitic or pleural. (4) **Death is accidental and initiated by microtrauma.** (5) The stimulus should be sudden and abnormal for the reflex to occur. (6) The reflex is exaggerated by high emotional tension, mild alcoholic intoxication and hypoxia. (7) **Autopsy is negative.** (8) The cause of death is inferred from the circumstances of death.

SUDDEN DEATH : (1) Death is sudden when a person not known to have been suffering from dangerous disease, injury or poisoning is

found dead or dies within 24 hours after onset of terminal illness. (2) About 50% deaths occur due to diseases of cardiovascular system. (3) The major cause of deaths is myocardial infarction due to coronary thrombosis, embolism and obliteration of lumen of coronaries by the atherosclerosis. (4) Most common cause of death due to CNS lesion is intracerebral hemorrhage in the region of internal capsule due to rupture of lenticulostriate artery.

CHAPTER 6

POSTMORTEM CHANGES

Complete loss of circulation and respiration for more than 4 to 5 minutes is accepted as death. **P.M changes help in rough estimation of death.**

Suspended animation : (1) Signs of life are not found as functions are impaired for some time or reduced to minimum. (2) However, life continues and resuscitation is successful in such cases. (3) The metabolic state is so reduced that the requirement of individual cell for oxygen is satisfied through the use of oxygen dissolved in body fluids. (4) In freezing of the body or in severe drug poisoning of the brain, the activity of the brain can completely stop, and in some cases start again. (5) It can be produced voluntarily as in yoga. (6) Involuntary suspension of animation for few seconds to half-an-hour or more may be found in newborn infants, drowning, electrocution, cholera, shock, sunstroke, cerebral concussion, after anaesthesia, insanity, etc.

Skin becomes pale, ashy-white and loses elasticity within few minutes.

Eyes : (1) Loss of corneal reflex. (2) Opacity of cornea occurs due to drying. If eyelids are closed, cornea will be clear for 2 hours. (3) If eyelids are open for a few hours after death, a film of cell debris and mucus forms two yellow triangles on sclera each at side of iris, which becomes brown and then black, called "**tache noir**", upon which dust settles and surface becomes wrinkled. (4) The eyes look sunken and become flaccid. (5) Pupils are slightly dilated soon after

death due to relaxation of muscles of iris. Later, they are constricted due to rigor mortis of constrictor muscles. (6) **Retinal vessels** show fragmentation or segmentation of blood columns within minutes after death, which persists for an hour. (7) A steady rise in the potassium value occurs in vitreous humour.

COOLING OF BODY (Algor mortis) : (1) For half to one hour after death, rectal temperature falls little or not at all. (2) The curve of cooling is sigmoid in pattern. (3) Body heat is lost by conduction, convection and radiation and small fraction by evaporation of fluid from skin. (4) In serious illness, circulation begins to fail before death and hands and feet become cooler, which gradually extends towards trunk. (5) A laboratory thermometer is inserted 8 to 10 cm into rectum for two minutes, or under the liver through small midline opening, or into nose up to cribriform plate or in the ear through tympanic membrane to record temperature. (6) **A marked rise in temperature** occurs in case of fat or air embolism, infections, heat stroke, pontine haemorrhage, and exercise or struggle before death. (7) **Low temperature** occurs in cases of collapse, congestive heart failure, massive haemorrhage, secondary shock. During sleep rectal temperature is half to 1°C lower. (8) **In tropical climates the heat loss is roughly 0.4°C to 0.6°C per hour.** (9) Rectal temperature of naked body reaches that of environment in about 20 hours. (10) Time in hours of death can be obtained by the formula

Normal body temperature minus rectal temperature

Rate of temperature fall per hour.

Rate of cooling is affected by : (1) Difference in temperature between body and medium. (2) **The build of cadaver :** Children and old people cool rapidly. (3) **Physique of cadaver :** Fat bodies cool slowly. (4) **Environment of body :** Cooling is rapid in a well ventilated room, humid atmosphere, body immersed in cold water, and buried in earth. Cooling is slow when the body is clothed.

M.L Importance: It helps in estimation of time of death in cold and temperate climates only, but not in tropical countries.

Postmortem Caloricity: (1) The temperature of body remains raised for two hours or so after death. (2) This occurs when the

regulation of heat production has been severely disturbed before death, as in (a) sunstroke and some nervous disorders, (b) great increase in heat production in muscles due to convulsions, e.g. tetanus and strychnine poisoning, (c) excessive bacterial activity, e.g. septicaemic condition, cholera and other fevers.

POST MORTEM HYPOSTASIS (Postmortem staining): (1)

It is bluish-purple or purplish-red discolouration which appears under skin in the most superficial layers of dermis of dependent parts of body after death, due to capillo-venous distension. (2) The intensity of the colour depends upon the amount of reduced haemoglobin in blood. (3) The upper portions of the body are pale. (4) It begins soon after death, but is visible half to 1 hour after death in normal persons, and 1 to 4 hours in anaemic persons. (5) **In early stages mottled patches are seen**, which later enlarge and unite to produce extensive discolouration. (6) **It is well-developed in 4 hours and reaches maximum between 6 to 12 hours.** (7) When it first develops, it disappears when pressed by finger, and reappears after pressure is released. (8) It is well marked in asphyxia, but is less marked in death from wasting diseases, haemorrhage, anaemia and lobar pneumonia. (9) Any pressure prevents capillaries from filling, such as collar band, belt, wrinkles in clothes, etc. and such areas are seen as pale strips, resembling marks of beating. (10) As the vessel walls become permeable due to decomposition, blood leaks through them. At this stage, hypostasis does not disappear if finger is firmly pressed against the skin.

Distribution: It depends on position of body : (1) **In a body lying on its back, it first appears in neck and then spreads over entire back, except on the parts directly pressed on**, i.e. occipital scalp, shoulder-blades, buttocks, posterior aspects of thighs, calves and heels. (2) It is absent under collar bands, belts, wrinkles in clothes, etc. which are seen as strips and bands called vibices. (3) If the body is in prone position, lividity appears in front, colour is intense and Tardieu spots are common. (4) If the body is inverted as in drunken persons, hypostasis appears in head and neck. (5) If the body is lying on one side, blood will settle on that side. (6) If the body is suspended as in hanging, hypostasis will be marked in legs, external

genitalia, lower parts of forearms and hands. (7) In drowning, it is found on the face, upper parts of chest, hands, lower arms, feet and calves. If the body is constantly moving its position, as in moving water, it may not develop. (8) If the body is moved before blood clots in capillaries, hypostatic patches will disappear and new ones will form on dependent parts. (9) **Fixation of postmortem staining occurs in about 6 hours, due to blood coagulation in capillaries.** (10) Hypostatic congestion resembling P.M hypostasis may be seen a few hours before death in persons dying slowly with circulatory failure, e.g. cholera, typhus, tuberculosis, uraemia, congestive cardiac failure, morphine poisoning and asphyxia, which becomes marked shortly after death.

Distinct colouration of hypostasis is seen in : (1) CO poisoning: cherry -red. (2) HCN poisoning : bright-red. (3) Poisoning by nitrites, potassium chlorate, potassium bicarbonate, nitrobenzene, aniline (causing methaemoglobinæmia): dark brown or red. (4) Phosphorus poisoning: dark brown. (5) Asphyxia: deeply bluish-violet or purple. (6) Hypothermia: bright pink. (7) Clostridium perfringens septicaemia: bronze.

Internal : (1) All internal organs show hypostasis in the dependent parts. (2) In heart it can simulate myocardial infarction, in lungs pneumonia and dependent coils of intestine appear strangulated. (3) In early stages of **decomposition**, haemolysis of blood occurs with diffusion of pigment into surrounding tissues. (4) Blood stained fluid collects in chest and abdomen. (5) With progress of decomposition, the lividity becomes dusky, brown and green and disappears with destruction of blood. (6) In mummification, colour is brown to black.

M.L. Imp : (1) Sign of death. (2) Its extent helps in estimating time of death. (3) Indicates posture of the body at time of death. (4) In some cases, colour may indicate cause of death.

MUSCULAR CHANGES: I. Primary flaccidity: (1) Death is somatic. (2) It lasts for one to two hours. (3) All muscles of the body begin to relax soon after death. (4) Body flattens over areas which are in contact with the surface on which it rests (**contact flattening**). (5) Lower jaw falls, eyelids loose tension. (6) Muscular irritability and response to mechanical or electrical stimuli persist. (7) Anaerobic

chemical process may continue. (8) Pupils react to atropine or physostigmine. (9) Peristalsis may occur in bowel.

II. Rigor Mortis : It is a state of stiffening of muscles, with slight shortening of fibres.

Mechanism : (1) A voluntary muscle consists of bundles of long fibres. (2) Each fibre is formed of densely packed myofibrils, which are protein filaments of two types, actin and myosin. (3) In relaxed condition, actin filaments interdigitate with myosin filaments to a small extent. (4) If there is a nerve impulse, arrays of actin filaments are drawn into arrays of myosin filaments, rather like pistons into cylinders which causes muscles to contract. (5) After death, ATP is progressively and irreversibly destroyed leading to increased accumulation of lactates and phosphates in muscles. (6) Membrane disruption and lack of ATP after death results in increased calcium level in the sarcomeres and muscle contraction occurs. (7) When ATP is reduced to 85% of normal, overlapping portions of myosin and actin filaments combine as rigid links of actomyosin, which is sticky and inextensible, and causes rigor. (8) Simultaneously, a rise in lactic acid and fall in hydrogen ion concentration occurs. (9) When lactic acid concentration reaches a level of about 0.3%, muscles go into irreversible state of contraction. (10) Rigor mortis persists until decomposition of proteins of muscles occur.

Order of appearance: (1) It first appears in involuntary muscles (myocardium in one hour). (2) **It begins in eyelids, lower jaw and neck, and passes upwards to muscles of face and downwards to muscles of chest, upper limbs, abdomen, lower limbs and lastly in fingers and toes (proximo-distal progression).** (3) In the limbs it extends from above downwards. (4) It disappears in the same order in which it appeared. (5) It always sets in, increases and decreases gradually.

Development : (1) When rigor is developing limbs can be moved, which later develops in the new position, although rigidity is less. (2) If force is applied when rigor is fully developed, stiffness is broken up permanently. (3) When rigor is fully developed, the entire body is stiff, muscles shortened, hard and opaque, knees, hips, shoulders and

elbows are slightly flexed and fingers and toes often show a marked degree of flexion. (4) Pupils are partially contracted. (5) It develops independent of integrity of nervous system. (6) Rigor is tested by trying to lift eyelids, depressing jaw and gently bending neck and various joints of body.

Cutis anserina or goose skin is caused by rigor of erector pilae muscles.

Time of onset : In India, it begins one to two hours after death and takes further one to two hours to complete, i.e 2 to 4 hours. In temperate countries, it begins in 3 to 6 hours and takes further 2 to 3 hours for complete development.

Duration : In India it lasts for 24 to 48 hours in winter, and 18 to 36 hours in summer.

Conditions altering onset and duration: (1) **Age :** It does not occur in a foetus of less than 7 months. In healthy adults it develops slowly, and is well-marked; in children and old people it is feeble and rapid. (2) **Nature of death:** In deaths from diseases causing great exhaustion and wasting, e.g. cholera, typhoid, tuberculosis, cancer, etc. and in violent deaths, e.g. cut-throat, firearms, electrocution onset is early and duration short. Onset is delayed in deaths from asphyxia, severe haemorrhage, apoplexy, pneumonia, and paralysis of muscles. (3) **Muscular state:** Onset and duration long if muscles are healthy and at rest. Onset rapid, if there is fatigue or exhaustion before death. (4) **Atmosphere:** In cold weather onset is slow and duration long. In hot weather onset is rapid and duration is short.

M.L.Imp: (1) Sign of death. (2) Time since death can be made out. (3) Indicates position of body at time of death.

Conditions simulating rigor mortis: (1) **Heat stiffening:** When body is exposed to temperatures above 65°C, stiffness occurs which is more marked than RM, e.g. deaths from burning, high voltage electric shock, fall into hot liquid (pugilistic attitude). It remains until muscles soften from decomposition, and normal RM does not occur.

(2) **Cold stiffening :** When exposed to freezing temperatures, all the body tissues become frozen and stiff. If the body is shifted to hot atmosphere, stiffness disappears, and later normal R.M occurs.

Difference between rigor mortis and cadaveric spasm

Trait	Rigor mortis	Cadaveric spasm
(1) Production :	<u>Freezing and exposure to temperature.</u>	<u>Cannot be produced by any method after death.</u>
(2) Mechanism :	<u>Known.</u>	<u>Not clearly known.</u>
(3) Predisposing factors :	<u>Nil.</u>	<u>Sudden death, excitement, fear, exhaustion, nervous tension, etc.</u>
(4) Time of onset :	<u>One to two hours after death.</u>	<u>Instantaneous.</u>
(5) Muscles involved:	<u>All the muscles of the body, both voluntary and involuntary.</u>	<u>Usually restricted to a single group of voluntary muscles.</u>
(6) Muscle stiffening:	<u>Not marked; moderate force can overcome it.</u>	<u>Marked; very great force is required to overcome it.</u>
(7) Molecular death :	<u>Occurs.</u>	<u>Does not occur.</u>
(8) Body heat :	<u>Cold.</u>	<u>Warm.</u>
(9) Electrical stimuli :	<u>Muscles do not respond.</u>	<u>Muscles respond.</u>
(10) Medicolegal importance :	<u>Indicates time of death.</u>	<u>Indicates mode of death, i.e., suicide, homicide or accident.</u>

(3) CADAVERIC SPASM OR INSTANTANEOUS RIGOR :

It is very rare (1) In this, muscles that were contracted during life, become stiff and rigid immediately after death, without passing into stage of primary relaxation. (2) The change preserves the exact attitude of person at the time of death. (3) It occurs in cases of sudden death, excitement, fear, severe pain, exhaustion, severe haemorrhage, injury to nervous system, firearm wound of head, convulsant poisons, etc. (4) It is usually limited to a single group of muscles, and usually involves hands, but very rarely whole body is affected. (5) It cannot be produced artificially. (6) Stiffness is more than as seen in R.M. (7) It passes without interruption into normal R.M and passes off when rigor disappears. (8) Its mechanism is obscure. (9) At the time of its development molecular death does not occur, and the body is warm.

M.L. Imp : (1) Rarely, in case of suicide, weapon is seen firmly grasped in the hand. (2) In drowning, firm grasping of weeds, grass, gravel, etc. in the hand, indicates that victim was alive on entering the water. (3) In cases of assault, some part of clothing, hair, etc. from the assailant will be found firmly grasped in the hands.

PUTREFACTION : (1) Putrefaction or decomposition is final stage following death, produced mainly by bacterial enzymes, mostly anaerobic organisms derived from the intestines. Other enzymes are derived from fungi and insects. (2) "**C₁ welchii is the chief destructive agent**", which causes marked haemolysis, liquefaction of P.M clots and fresh thrombi and emboli, disintegration of tissue and gas formation in blood vessels and tissues. (3) **Lecithinase produced by C₁ welchii is important**, which hydrolyses lecithin in all cell membranes and causes haemolysis of blood.

(I) Colour changes : (1) **The first external sign of putrefaction in a body lying in air is greenish discolouration of the skin over the region of caecum**, where contents of bowel are more fluid and full of bacteria. (2) Internally it is seen on undersurface of liver which is in contact with transverse colon. (3) Green colour is due to conversion of haemoglobin into sulphmethaemoglobin, by hydrogen sulphide formed in large intestine. (4) **Green colour appears in 12 to 18 hours in summer and one to two days in winter.** (5) Colour spreads over abdomen, external genitalia and then patches appear on chest, neck, face, arms and legs. (6) Patches become dark-green and later purple and dark-blue. (7) **Marbled appearance** is due to greenish-brown or reddish-brown staining of superficial veins over roots of limbs, chest and neck. This is prominent in 36 to 48 hours. (8) Clotted blood becomes fluid due to which position of P.M staining is altered and fluid blood collects in serous cavities. The effusion in pleural cavities does not exceed 60 to 70 ml. (9) **Reddish-brown discolouration of inner surface of vessels, especially of aorta is the earliest internal change.** (10) The colour of viscera varies from dark-red to black, rather than green, and viscera become softer and greasy.

(II) Foul-smelling Gases : (1) Gases are non-inflammable in early stages, but when enough hydrogen sulphide is formed they can burn with a blue flame. (2) **Gases collect in intestines in 6 to 12**

hours in summer and the abdomen distends. (3) Eyeballs become soft, cornea becomes white and flattened. Later the eyes collapse. (4) Discoloured natural fluids and liquefied tissues are made forthy by gas. (5) Gas in abdomen pushes the diaphragm upwards compressing heart and lungs and blood-stained froth exudes from mouth and nostrils (P.M. purge). (6) Food from the stomach may be forced due to pressure of gases, and this food may fall into the larynx. (7) Gas bubbles accumulate in the tissues. **(8) From 18 to 48 hours, gases collect in tissues, cavities and hollow viscera under pressure, and features become bloated and distorted.** (9) Subcutaneous tissues become emphysematous, due to which the body appears obese. (10) Eyes bulge, tongue protrudes. (11) Sphincters relax. (12) Blisters are formed due to gas in blood vessels forcing fluid, air or liquid fat between epidermis and dermis. Blisters are formed first on lower surfaces of trunk and thighs, where tissues contain more fluid due to hypostatic oedema. Blisters, enlarge, unite and rupture. (13) After 2 to 3 days anus and uterus may porlapse. (14) A.M or P.M wounds cannot be made out. **(15) After 3 days face is so much discoloured and bloated that identification is not possible.** (16) The hairs become loose and can be easily pulled out. (17) In 3 to 5 days sutures of skull (especially in children) are separated and liquid brain comes out. (18) Teeth become loose and may fall off. (19) Skin of hands and feet may come off in a “glove and stocking” fashion.

(III) Liquefaction of tissues : (1) After 5 to 10 days colliquative liquefaction begins. (2) The abdomen bursts. (3) The tissues become soft, loose and are converted into a thick, semi-fluid, black mass and fall off.

Gas rigidity : Body becomes rigid due to inflation of tissues when changes of decomposition are well marked. (2) The lower limbs are abducted, flexed and rigid, arms are flexed and rigid, hands are open, and fingers are wide apart. (3) This is usually seen in bodies recovered from water. (4) The rigidity persists till the escape of gases.

Skeletonisation: (1) In India, an uncoffined buried body is reduced to a skeleton within about a year. (2) In deeply buried body, lower temperature, exclusion of air, absence of animal life, etc. delay decomposition markedly. (3) In hot climates bones on the ground surface may decay in 5 to 10 years.

Internal Changes: As blood decomposes, haemoglobin transudes into the tissues, which gradually change to greenish-yellow, greensih-blue and finally black. The viscera become greasy and softened.

Conditions affecting rate of putrefaction : (A) External : (1)

Temperature: (a) Putrefaction begins above 10°C and is optimum between 21 to 38°C. It is arrested below 0°C and above 48°C. (b) Rate of decomposition is about twice as rapid in summer as in winter.

(2) **Moisture:** Decomposition is rapid in generalised oedema and in bodies recovered from water if left in the air. (3) **Manner of burial:** (a) It is rapid in bodies buried in a damp, marshy or shallow graves. (b) It is delayed if buried in dry, sandy soil or in grave deeper than 2 metres, when body is covered and placed in a coffin, and when buried in lime.

(B) **Internal :** (1) **Age :** Bodies of children putrefy rapidly and of old people slowly. (2) **Sex** has no effect. (3) **Condition of body :** Fat bodies putrefy quickly. (4) **Cause of death :** Bodies of persons dying from septicaemia, peritonitis, inflammatory and septic conditions, general anasarca, asphyxia decompose rapidly. In wasting disease, anaemia and debility it is delayed. (5) **Mutilation :** Bodies having wounds, or suffered from violence putrefy rapidly. In dismemberment, limbs putrefy slowly and trunk rapidly.

Casper dictum states that a body decomposes in air twice as rapidly as in water, and 8 times as rapidly as in earth. It is more rapid in warm, fresh, stagnant water, than in cold, salty, running water.

ADIPOCERE (Saponification) : (1) Gradual hydrolysis and hydrogenation of pre-existing fats, such as olein, into higher fatty acids, which being acidic, inhibit putrefactive bacteria. (2) Ultimately, whole of fat is converted into palmitic, oleic, stearic and hydroxystearic acids, and a mixture of these substances forms adipocere. (3) Intrinsic lipases start the process, which is continued by bacterial enzymes, especially clostridia group. (4) Water required for hydrolysis is obtained mainly from body tissues. If body is in water, this fluid contributes to hydrolysis of subcutaneous fat. (5) It is delayed by cold and formed rapidly from heat.

Properties : (1) It has offensive or sweetish smell, but in early stages it has penetrating ammoniacal odour. (2) Fresh adipocere

is soft, moist, whitish, translucent, and old is dry, hard, cracked, yellowish, brittle. (3) It is inflammable.

Distribution : (1) It first forms in subcutaneous tissues. (2) **Face, buttocks, breasts and abdomen are usual sites.** (3) Rarely entire body is converted into adipocere. (4) Fatty tissues in viscera and muscles are also affected. (5) Epidermis disappears as adipocere forms. (6) **Liver is prominent and retains shape.** (7) Sometimes, gross features of organs may be made out from histology.

Time required : (1) In India, it may be seen within 3 to 4 days. (2) In temperate countries, it starts in 3 weeks. (3) Complete conversion in an adult limb occurs in 3 to 6 months. (4) **Foetuses of less than 6 months do not show adipocere.**

M.L Imp : If face is affected identification can be established.
(2) Cause of death and time of death can be determined.

MUMMIFICATION : (1) **Dehydration or drying and shrinking of cadaver occurs from evaporation of water, but natural appearance and features are preserved.** (2) It begins in exposed parts of body like face, hands and feet and then extends to entire body including internal organs. (3) Skin is contracted, shrunken, dry, brittle, leathery, rusty-brown in colour and adheres to bone. (4) Liquid oil is forced into dermis, which becomes translucent. (5) **Tissues are dry, leathery and brown.** (6) Face is distorted. (7) Whole body loses weight, becomes thin, stiff and brittle. (8) If protected it is preserved for years. (9) Body is odourless. (10) **It takes 3 months to 1 to 2 years for mummification of whole body.** (11) Absence of moisture in air and continued action of dry or warm air is necessary for its production. (12) Marked dehydration before death favours its development. (13) It is seen in bodies buried in shallow graves in dry sandy soils, where evaporation of body fluids is rapid. (14) Rarely body may show mummification in some parts and adipocere in others. (15) M.L Importance is same as for adipocere.

EMBALMING : (1) It is a method to preserve body. (2) Contents of G.I tract, bladder and blood vessels are removed through a wound of abdomen. (3) Venous drainage is done through internal jugular or axillary vein. (4) Embalming fluid consists of formalin (6% to 10%) sodium borate, sodium citrate, sodium chloride and eosin. (5) **8 to**

10 litres of this fluid is injected through the axillary, carotid or femoral artery by : (a) gravity feed injector, (b) bulb syringe, (c) hand pump, or (d) motorised pump injector. (6) By this proteins are coagulated, tissues are fixed, organs are bleached and hardened and blood is converted into a brownish mass. (7) **It produces chemical stiffening similar to rigor mortis, and normal R.M does not develop.** (8) Blood groups cannot be made out. (9) Thrombi and emboli will be dislodged and washed away. (10) **If done within 6 hours of death body will be well preserved.**

The following conditions **preserve the body** after death : (1) Embalming. (2) Mummification. (3) Adipocere. (4) Freezing. (5) Bodies buried in soil containing antiseptic substances.

If body is **refrigerated**, onset of rigor is delayed, reddish patches appear especially in hypostatic region, blood is bright red, tissues become hard, and abrasions and contusions become prominent.

P.M. interval is important (1) to know when crime was committed, (2) gives police starting point for their inquiries, (3) to exclude some suspects, and, (4) to check on a suspect's statement.

Entomology : (1) Flies deposit eggs between lips or eyelids, nostrils or wounds soon after death. (2) Larvae or maggots are produced from eggs in 8 to 12 hours in summer, which crawl into interior of body, and produce proteolytic enzymes and destroy soft tissues. (3) Maggots become pupae in 4 to 5 days and adult flies in 3 to 5 days.

G.I. Tract : (1) There is considerable variation in emptying of the stomach in the same and different persons even if the same meal is ingested. (2) Bulk of meal leaves stomach in 2 hours. (3) A light meal leaves stomach within 2 hours, medium-sized meal 3 to 4 hours. heavy meal 4 to 6 hours. (4) In head injury causing coma, it may not empty in 24 hours. (5) Any illness or emotional stress prolongs emptying time for many hours. (6) Carbohydrate meal empties earlier than protein meal, which empties earlier than fatty meal. (7) Head of meal reaches hepatic flexure in 6 hours, splenic flexure in 9 to 12 hours, and pelvic colon in 12 to 18 hours.

In **vitreous humour**, there is gradual linear increase in potassium concentration up to 120 hours after death. **Hair** does not grow after death. Beard hair grows at the rate of 0.4 mm per day.

7

CHAPTER

MECHANICAL INJURIES

An injury is any harm, illegally caused to any person in body, mind, reputation or property (S.44, I.P.C).

(I) Classification: Medical: (I) **Mechanical Injuries:** (A) Due to blunt force: (1) Abrasions. (2) Contusions. (3) Lacerations. (4) Fractures and Dislocations. (B) Due to sharp force: (1) Incised wounds. (2) Chop wounds. (3) Stab wounds. (C) Firearms: (1) Firearm wounds.

(II) Thermal Injuries: (1) Due to cold. (a) Frostbite. (b) Trench foot. (c) Immersion foot. (2) Due to heat. (a) Burns. (b) Scalds.

(III) Chemical Injuries: (1) Corrosive acids. (b) Corrosive alkalis.

(IV) Miscellaneous: Electricity, lightning X-rays, radioactive substances, etc.

(V) Explosions

Legal : (1) Simple. (2) Grievous.

Medicolegal : (1) Suicide. (2) Homicide. (3) Accident. (4) Fabricated. (5) Defence. (6) Undetermined.

ABRASIONS : (1) **Abrasion is destruction of skin, usually involving superficial layers of epidermis only.** (2) They are caused by lateral rubbing action by a blow, a fall on rough surface, being dragged in vehicular accident, fingernails, throns or teeth-bite. (3) Some pressure and movement by agent on the surface of skin is essential. (4) Abrasion has only length and breadth.

(I) Scratches : (1) They are caused by sharp object passing across the skin, such as fingernails, pin or thorn. (2) It shows clean area at the start and tags at the end, which tails off. (3) Fingernails produce curved scratch.

(II) Grawes : (sliding, scraping or grinding abrasions) : (1) They are most common type. (2) They are caused when there is horizontal movement between skin and rough surface. (3) They show longitudinal parallel lines (grooves or furrows) with tags at the end. (4) The furrow may be broad at one end and narrow in opposite direction. (5) Glancing kick produces a graze. (6) **Brush burn** is caused by violent rubbing against a broad rough surface, as in dragging over ground. (7) **Friction burn** is an extensive superficial, reddened, excoriated area with little or no linear mark, which occurs when skin is covered with clothing.

(III) Pressure abrasion (crushing or friction abrasion) : (1) They are caused by crushing of superficial layers of epidermis, and show bruising of surrounding area. (2) It occurs when the movement of instrument is around 90° to skin. (3) Movement is slight and largely directed inwards, such as ligature mark of hanging and strangulation, and teeth bite marks.

(IV) Impact abrasions (contact or imprint) : (1) They are caused by impact with rough object, when force is applied at or near right angle to skin, such as when a person is knocked down by a motor car, the pattern of which is left on the skin. (2) The abrasion is slightly depressed. (3) If impact is forcible, dermis is damaged with an underlying bruise, e.g. in traffic accident, radiator grille, tyre tread impressions, etc. are seen.

Patterned abrasions are (a) impact, (b) pressure.

Age : **Fresh:** Bright red. **12 to 24 hours :** Bright scab due to drying of blood and lymph. **2 to 3 days :** Reddish-brown scab. **4 to 7 days:** Epithelium covers defect. **7 days:** Scab dries, shrinks and falls off.

Antemortem abrasions occur (a) anywhere on body, (b) bright reddish-brown, (3) scab slightly raised, (4) vital reaction present.

P.M. abrasions occur over bony prominences, (b) yellowish, translucent, (c) scab often depressed, (d) no vital reaction.

M.L.Imp : (1) Site of impact and direction of force is indicated. (2) They may be only external sign of serious internal injury. (3) Patterned abrasions indicate the object causing them. (4) Age of injury can be made out. (5) Scene of crime may be known from presence of dust, dirt, sand, etc. in the open wounds. (6) Character and manner of injury may be known from distribution, e.g., in throttling, smothering, sexual assault, struggle, etc.

Differential diagnosis : (1) Erosion of skin by ants. (2) Excoriation of skin by excreta. (3) Pressure sores.

CONTUSIONS (Bruises) : (1) **Contusion is an effusion of blood into tissues due to rupture of venules and arterioles due to blunt violence.** (2) There is a painful swelling and crushing and tearing of subcutaneous tissues. (3) They are caused by blunt force, such as fist, stone, stick, boot, etc. (4) Skin is not usually damaged. (5) It also occurs in deeper structures and viscera. (6) They may be associated with abrasions (abraded contusions) or lacerations. (7) Haematoma (tumour-like mass) is produced when large blood vessel is injured. (8) Fresh bruise is tender and slightly raised. (9) The colour is lighter in the centre. (10) Size varies from pinhead to large collections, and slightly larger than the surface of agent which caused it. (11) The size and shape are modified by: **(1) Condition and type of tissue :** (a) If part is vascular and loose, such as face, vulva, scrotum, slight violence may cause a large bruise. (b) If tissues are strongly supported, contain firm fibrous tissues and covered with thick dermis, such as abdomen, back, scalp, palms and soles, a blow of moderate violence may produce a smaller bruise. **(c) Bruising does not occur** if injured part is thickly covered, or if weapon is yielding one, such as sand bag, or if pressure is continued until death occurs. (d) Chronic alcoholics bruise easily (e) Bruising is more marked on tissues overlying bone. **(2) Age :** Children and old persons bruise more easily. **(3) Sex :** Women bruise easily. **(4) Natural Disease:** Bruising is more in arteriosclerosis, scurvy, leukaemia, purpura, and haemophilia. **(5) Gravity shifting of blood :** Sometimes, bruise may not appear at the site of impact, but may appear at a relatively distant place, where the fascial plane arrangement permits it to reach the surface (**ectopic bruising**), e.g. in fracture of femur bruise is seen

on the outer side of lower part of thigh; kick on calf of leg it is seen around the ankle.

Black eye: Haemorrhages in the soft tissues around the eyes and in the eyelids (**spectacle haematoma, black eye**) may be caused by : (1) punch in the eye, (2) blunt impact to forehead, (3) fracture of anterior cranial fossa.

Patterned bruising : (1) A bruise is usually round, but it may indicate the nature of weapon. (2) If person is living, it may become obscure as area of bruising tends to extend and merge with adjacent structures. (3) A blow from hammer or fist produces a round bruise. (4) A blow with a rod, stick or whip produces two parallel linear haemorrhages. The intervening skin is unchanged. The edges may be irregular and width may be greater due to infiltration of blood in the surrounding tissues along the edges of the bruise. (5) A blow with a broad flat weapon, such as plank, produces two parallel bruises separated by a normal tissue. (6) Bruises by blows from whips are elongated, curved over prominences, and may partially encircle a limb or body. (7) Bruises from straps, belts or chains have a definite imprint. (8) Motor car accidents may produce patterned bruises.

Internal: (1) All organs can be contused. (2) Contusions of internal organs may cause rupture of organ and death. (3) Bruises not visible to naked eye, can be detected by ultraviolet light.

Delayed bruising : (1) Superficial bruise may appear immediately as a dark red swelling. (2) Deep bruise may take several hours, or one to two days to appear, and deeper extravasation of blood may never appear. (3) Rarely, when injury is produced before death, bruise may appear some time after death due to further escape of blood from the ruptured vessels due to gravitation and rapid haemolysis of stagnant blood, the pigment diffusing locally.

Age : It is determined by colour change, which starts at the periphery and extends to centre. **At first :** Red. **Few hours to 3 days:** Blue. **4th day :** Bluish-black to brown (haemosiderin). **5 to 6 days :** Greenish (hamatoidin). **7 to 12 days:** Yellow (bilirubin). **2 weeks:** Normal

M.L. Imp : (1) Size may indicate degree of violence. (2) Patterned bruises may connect victim and object or weapon. (3) Age of injury.

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- (4) In case of fall, sand, dust, gravel, etc. may be found on the body.
(5) Character and manner of injury may be known from its distribution as in case of abrasions.

Bruises are of less value than abrasions because : (1) Their size may not correspond to size of weapon. (2) They may become visible several hours or one to two days after injury. (3) Direction of force cannot be made out.

Difference between hypostasis and bruise

Trait	Hypostasis	Bruise
(1) Cause :	Due to distension of vessels with blood in the dermis.	Due to ruptured vessels which may be superficial or deep.
(2) Site:	Occurs over extensive area of the most dependent parts.	Occurs at the site of and surrounding the injury; may appear anywhere on the body.
(3) Appearance:	No elevation of the involved area.	Often swollen because of extravasated blood and oedema.
(4) Epidermis :	Not abraded.	May be abraded.
(5) Margins :	Clearly defined.	Merge with surrounding area.
(6) Colour:	Uniform bluish-purple.	Old bruises are of different colour. Fresh bruises may appear more intense than the adjacent hypostatic area.
(7) Incision :	On incision blood is seen in blood vessels, which can be easily washed away. Subcutaneous tissues are pale.	Shows extravasation of blood into the surrounding tissues which is firmly clotted and cannot be washed by gentle stream of water. Subcutaneous tissues are deep reddish-black.
(8) Effect of pressure:	Absent in areas of the body which are even under slight pressure.	Little lighter over the area of pressure or support.

Complications : (1) Contusion can contain 20 to 30 ml blood. (2) Multiple contusions can cause death from shock and haemorrhage. (3) Gangrene and death of tissue. (4) Pulmonary embolism is rare.

Artificial bruise : (1) It is caused by juice of marking nut, calotropis, or plumbago rosea. (2) Seen on exposed accessible parts. (3) Colour is dark-brown. (4) Shape irregular. (5) Margins well-defined and regular, covered with small vesicles. (6) Redness and inflammation is seen in the surrounding skin. (7) Contain acrid serum. (8) Itching is present. (9) Vesicles may be found on fingertips and on other parts of the body due to scratching.

LACERATIONS (tears or ruptures) : (1) Lacerations are tears or splits of skin, mucous membrane, muscle or internal organs caused by application of blunt force to broad area of body, which crushed or stretched tissues beyond the limits of their elasticity. (2) If there is bleeding into adjacent tissues, it is called contused-laceration or bruised -tear. (3) If the margins are abraded, it is called abraded laceration. (4) If there is extensive bruising and laceration of deeper tissues, it is called crush injury.

Types : (I) Split laceration : (1) Splitting occurs by crushing of skin between two hard objects, such as scalp being crushed between skull and some hard object. (2) **Incised-like or incised-looking wounds** are lacerated wounds. (3) They are caused by blunt force which does not cause excessive skin crushing. (4) Margins appear sharp. (5) This is seen in areas where skin is close to bone, and subcutaneous tissues are scanty, e.g. scalp, eyebrows, cheek bones, lower jaw, iliac crest, perineum, shin. (6) A wound produced by a fall on knee or elbow with limb flexed, and by a broken glass, or sharp stone also looks like incised wound.

(II) Stretch laceration : (1) Overstretching of skin causes laceration. (2) There is localised pressure with pull which increases until tearing occurs and produces the 'flap'. (3) They are seen in run over by a motor vehicle, kicking and in compound fractures.

(III) Avulsion : (1) It is caused when sufficient force is applied at an acute angle to detach (tear off) a portion of skin or organ from its attachment. (2) The shearing or grinding force by weight, such as lorry wheel passing over a limb, may produce separation of skin from underlying tissues (avulsion) over a large area. This is called '**flaying**'. (3) Underlying muscles are crushed and bones may be fractured. (4) The separated skin may show extensive abrasions.

(IV) Tears : Skin and tissues are torn from impact by or against irregular objects, such as door handle of car. This is another form of overstrectching.

Lacerations of **internal organs** may be caused by : (1) injury of viscera from fragments of fractured bone, (2) traction shears in viscera, (3) stretching of visceral attachments, (4) hydrostatic forces.

Characters : (1) Margins are ragged, irregular and uneven. Over bony areas, e.g skull, edges are undermined due to crushing and tearing force of the impact. **Swallow tails** are tears at ends of lacerations, at angles diverging from the laceration. (2) Margins are contused and sometimes abraded. (3) Deeper tissues are unevenly divided with tags of tissue (nerves, blood vessels, connective tissue fibres) at the bottom of wound **bridging** across the margins (**tissue bridges**). (4) Hair bulbs are crushed. (5) Hair and epidermal tags may be driven deeply in the wound. (6) Haemorrhage is less. (7) Foreign matter may be found in the wound. (8) Depth varies according to the thickness of soft parts. (9) Skin of wound opposite to direction of motion is torn free or undermined.

Complications : (1) Multiple lacerations may cause death due to shock. (2) Pulmonary or systemic air embolism. (3) Infection.

Sometimes, a single blow with a blunt weapon may cause abrasion, contusion and laceration.

INCISED WOUNDS (cut, slice) : It is a clean cut through tissues, which is longer than it is deep. It is produced by pressure and friction over a very narrow area of tissue by any object having a sharp- cutting edge.

Characters : (1) Margins are clean-cut, well-defined and everted. (b) Margins may be inverted if a thin layer of muscle fibres is adherent to skin as in scortum. (c) Edges are free from abrasions and contusions. (d) Wounds by glass are lacerated, but resemble incised and stab wounds. Margins show tiny side-cuts. (2) Width is greater than edge of weapon causing it. (3) Length is greater than its width and depth. (4) When skin becomes folded under cutting edge of weapon, a single movement of weapon may produce a series of incised wounds separated from one another by normal skin. (5) Shape is usually spindle-shaped. Gaping is more if underlying tissues are cut transversely or obliquely. Wound may be zig-zag, if skin is loosely attached as in axillary fold. (6) Haemorrhage is more. Spurting of blood occurs if an artery is cut. (7) Direction : They are deeper at beginning because more pressure is exerted on knife at this point. This is known as **head of wound**. At the end of the cut the wound is shallow, known as **tailing of wound**. (8) Bevelling cut : If blade

enters obliquely, tissues will be visible at one margin, and the other margin will be undermined, and if blade is nearly horizontal, a flap of wound is caused. Bevelling can be produced by sharp weapon only. It is usually homicidal and may indicate relative position of victim and accused.

Difference between incised and lacerated wounds

Trait	Incised wound	Lacerated wound
(1) Manner of production :	By sharp objects or weapons.	By blunt objects or weapons.
(2) Site:	Anywhere.	Usually over bony prominences.
(3) Margins :	Smooth, even, clean-cut and everted.	Irregular and often undermined.
(4) Abrasion on edges :	Absent.	Usually present.
(5) Bruising :	No adjacent bruising of soft tissues.	Brusing of surrounding and underlying tissues.
(6) Shape :	Linear or spindle-shaped.	Varies, usually irregular.
(7) Dimensions:	Usually longer than deep; often gaping.	Usually longer than deep.
(8) Depth:	Structures cleanly cut to the depth of wound.	Small strands of tissue at the bottom bridge across margins.
(9) Haemorrhage :	Usually profuse and external. Spurting of blood may be seen.	Slight except scalp and external.
(10) Hair bulbs:	Cleanly cut.	Crushed or torn.
(11) Bones :	May be cut.	May be fractured.
(12) Foreign bodies:	Absent.	Usually present.

Difference between	suicidal and homicidal	cut-throat wounds
Trait	Suicidal wounds	Homicidal wounds
(1) Situation:	Left side of the neck and passing across the front of the throat; rarely on both sides.	Usually on the sides.
(2) Level:	High; above the thyroid cartilage.	Low; on or below the thyroid cartilage.

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(3) Direction:	Above downwards and from left to right in right-handed person. Sometimes, horizontal cuts are seen which do not show variation in depth at either end.	Transverse or from below upwards. If attacked from the right side of victim, the wound runs from left to right; if from behind, it may resemble suicidal wound.
(4) Number of wounds:	Multiple, may be 20 to 30, superficial, parallel and merged with the main wound; rarely single.	Multiple, cross each other at a deep level; not repeated in depths of the main wound.
(5) Edges:	Usually ragged due to overlapping of multiple superficial incisions.	Sharp and clean-cut; bevelling may be seen.
(6) Hesitation cuts:	Present.	Absent.
(7) Tailing:	Present.	Absent.
(8) Severity:	Usually less severe. One wound severe but sometimes 2 to 3.	More severe; all the tissues including the vertebrae may be cut.
(9) Wounds in other parts of body:	Often present across wrists, groin, thighs, ankles, or knees; and rarely on the back of neck.	No wounds on wrists, etc. but severe injuries usually on the head and neck.
(10) Defence wounds:	Absent; unintentional cuts may be found on the fingers if a blade has been used.	Present.
(11) Hands:	Weapon may be firmly grasped due to cadaveric spasm.	Fragments of clothing, hair, etc., may be grasped.
(12) Weapon:	Usually present.	Usually absent.
(13) Vessels:	As head is thrown back, carotid artery is drawn beneath sternomastoid and against the spine and usually escapes injury.	Jugular vein and carotid artery are likely to be cut.

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(14) Blood Stains:	If standing, stains on the mirror and on front of body and clothes running from above downwards and splashes on feet.	If asleep, blood runs down on both sides of the neck and collects behind the neck and shoulder; stains found on both palms, for the victim attempts to cover the wound.
(15) Clothes:	Not cut or damaged.	May be cut corresponding in position to those in the body; disarrangement, tears and loss of buttons.
(16) Circumstantial evidence:	Quiet place, such as bedroom or locked bathroom; usually stands in front of a mirror in order to direct the hand better; suicidal note or farewell letter may be found.	Disturbance at the scene, such as disarrangement of furniture in a room; trampling and crushing of vegetable matter and shrubs, or confused foot-prints outside.

Age : Fresh : Haematoma. **12 hours :** Edges red, swollen and adherent with blood and lymph. **24 hours :** Crust or scab of dried clot is seen. Epithelium begins to grow at edges. **72 hours :** Vascularised granulation tissue is formed. **4 to 5 days :** New fibrils are formed. **One week :** Scar formation in small wounds.

Suicidal incised wounds are : (1) Multiple, and parallel in any area. (2) Uniform in depth and direction. (3) Relatively trivial. (4) Fatal wounds are present on several limited, easily reached areas of the body, such as neck, wrist, groin, etc. **(5) Hesitation marks or tentative cuts or trivial wounds** are present, which are multiple, small and superficial, and are seen at the beginning of incised wounds.

When a safety razor blade is used **unintentional** cuts are found on the fingers, where the blade has been gripped.

M.L Importance : Indicates: (1) Nature of weapon. (2) Direction of force. (3) Age of injury. (4) Mode of production, i.e. suicide, homicide, accident.

Cut-throat wounds cause immediate death from haemorrhage, air embolism, or inhalation of effused blood.

CHOP WOUNDS: (1) They are deep gaping wounds caused by blows with sharp-cutting edge of a fairly heavy weapon like axe, butcher's knife, etc. (2) Margins are sharp with slight abrasion and contusion. (3) If the edge is blunt, the margins are ragged and bruised. (4) Usually lower end (heel) strikes the body first, which produces a deeper wound than the upper (toe) end wound. (5) The deeper end indicates position of assailant. (6) There may be complete amputation of fingers or other bones, and the joints may be separated or disarticulated. (7) Wounds on the head and trunk are usually associated with injuries to important structures and are fatal. Cranium may be depressed or piece of skull may be removed. (8) These injuries are usually homicidal.

STAB OR PUNCTURE WOUNDS: (1) They are produced from penetration by long narrow instruments with blunt or pointed end into depths of body, such as knife, dagger, nail, needle, arrow, etc. (2) It is deeper than its length and width on skin. (3) They are called penetrating wounds, when they enter cavity of body. (4) When weapon enters body on one side, and comes out on other side, they are called perforating wounds or through-and-through puncture wounds. (5) Wound of entry is larger with inverted edges and wound of exit smaller with everted edges.

Characters: (1) **Margins** are clear-cut, without abrasion or bruising, but in full penetration of blade, bruising may be produced by hilt or hilt-guard. The wound will gape, if a muscle is cut across. (2) **Length** is slightly less than width of weapon, because of stretching of skin. If the weapon is withdrawn with cutting edge dragging against one end, wound would be extended superficially producing a tail. (3) **Depth:** (1) It is greater than width and length of external wound. (2) Depth is usually equal to, or less than length of blade, but on yielding surfaces like anterior abdominal wall, it may be greater. (3) A thin, slender, double-edged knife will penetrate more deeply than an equally sharp, wide, single-edged blade inserted with same force. (4) Skin is most resistant to knife penetration. (5) Stretched skin is easier to penetrate than lax skin. (6) When instrument strikes skin at

right angle, it goes deeper than when it strikes from acute angle. (4) **Shape:** It usually corresponds to weapon used. The wound will gape if **cleavage lines (Langer's lines)** are cut transversely or obliquely. (1) If a single-edged weapon is used skin wound will be triangular or wedge-shaped, and one end will be sharp and other blunt or torn. Blunt end may have small splits in skin (**fish-tailing**). Sometimes both ends may be sharp. (2) If double-edged weapon is used, wound will be elliptical or slit-like and both angles will be sharp. (3) A round object (spear) may produce circular wound. (4) A round blunt-pointed object (pointed stick) may produce a circular wound with inverted, irregular and bruised edges. (5) A pointed square weapon may produce cross-shaped injury, each of four edges tearing the tissues. (6) A screw dirver will produce a slit-wound with square ends and abraded margins. (7) If knife is twisted as it is withdrawn, wound may be cruciate. (8) Irregularly-shaped wounds are produced by stabbing and cutting (rocking). (5) **Direction:** If knife penetrates at an angle, one margin will be bevelled and other undermined.

M.L. Imp: (1) Type of weapon known from shape of wound. (2) Depth indicates amount of force. (3) Age of injury. (4) Broken fragment of weapon if found will identify weapon. (5) Manner of production. (6) Direction of wounds indicate relative positions of victim and assailant.

Complications: (1) Internal haemorrhage. (2) Infection. (3) Air embolism if jugular veins are damaged. (4) Pneumothorax. (5) Asphyxia due to inhalation of blood.

Concealed puncture wounds: (1) They are seen in concealed parts of the body, such as nostrils, fontanelle, fornix of upper eyelid, axilla, vagina, rectum, nape of neck. (2) A careful search is necessary to detect them. (3) Fatal injuries may be caused without leaving any external marks, e.g. thrusting a needle or pin into the brain through the fontanelles, through the inner canthus of the eye, or into the medulla through the nape of the neck.

Defence wounds: (1) They are caused due to immediate and instinctive reaction of victim to save himself, either by raising arm to prevent the attack or by grasping the weapon. (2) If weapon is blunt, bruises and abrasions are produced on extensor or ulnar

surfaces of forearm or back of hands and fingers. (3) If the weapon is sharp, cuts will be seen on hands, wrists, fingers and forearms. (4) If a single-edged weapon is grasped, a cut is produced on the palm or fingers. (5) If the weapon is double-edged cuts are seen on fingers and palm. (6) The cuts are irregular and ragged and irregular in depth and distribution. (7) Rarely, they may be found on the shins and feet if the victim was lying on the ground usually face up, as he kicks at the assailant, or tries to cover vital areas with his legs. (8) Defence wounds indicate homicide. (9) They are absent if the victim is unconscious or is taken by surprise, or attacked from the back or under the influence of alcohol or drugs.

Selfinflicted and fabricated wounds: (1) Self-inflicted wounds are those inflicted by a person on his own body. (2) **Fabricated (fictitious, forged or invented) wounds are those which may be produced by a person on his own body or by another with his consent.** (3) Fabricated wounds are mostly incised, and sometimes contusions, stab wounds and burns. (4) Lacerated wounds are rarely fabricated. (5) Incised wounds are usually superficial, multiple and parallel. (6) Stab wounds are multiple and superficial. (7) Burns are superficial. (8) Clothes are not cut. (9) The history of assault is incompatible with the injuries.

FIREARMS

Classification: (I) Smooth-bored (shotguns). (II) Rifled. (1) Air and gas-operated. (2) 0.22 rifles. (3) Military rifles. (4) Revolvers. (5) Pistols. (6) Automatic weapons.

Rifling: (1) **The bore is cut internally with a number of shallow, spiral grooves (2 to 20), most common being 6, which run parallel to each other, but twisted spirally, from breach to muzzle.** (2) These grooves are called rifling, and projecting ridges between grooves are called lands. (3) Rifling vary in number, direction, depth and width. (4) Rifling gives the bullet a spin, greater power of penetration, a straight course, and prevents it from unsteady movement as it travels in the air.

Bore, calibre or gauge: (1) The dimension of rifled weapon is measured between a pair of diametrically opposed lands in decimals of an inch or in millimetres. (2) In smooth bored weapon, the internal

dimension is measured up to 1.27 cm (half inch). (3) For larger bores, the size is determined by the size of lead ball which will exactly fit the barrel, and number of such balls of equal size and weight as can be made from 545 gm. (one pound) of pure lead. (4) 12 bore gun is one in which one of the 12 balls made from one pound of lead will fill exactly.

Choking of the shotgun: (1) The distal 7 to 10 cm. of barrel is narrowed. (2) Different degrees are known as full-choke, half-choke, quarter-choke or imporved cylinder. (3) **Choking lessens rate of spread of shot after it leaves muzzle, increases explosive force and velocity.**

Paradox guns have small portion of their bore near the muzzle end rifled. **Musket** is a military shoulder firearm of 0.410 bore, which is effective up to 90 metres. Shot guns are effective upto 30 to 35 metres.

Carbine is a short-barreled rifle, which is effective up to 300 metres. Military rifle is effective up to 3000 metres. In **revolvers** ammunition is put in chambers (5 to 6) in metal cylinder (magazine) which revolves or rotates before each shot, to bring the next cartridge opposite the barrel. Effective range is 100 metres. In **automatic pistol** when cartridge is fired, the empty cartridge case is thrown out, and a new cartridge slips into breech automatically by spring. The cartridges (6 to 10) are contained in vertical magazine in the stock. The effective range is 100 metres. In **air rifles** and air pistols, compressed air is used to fire lead slugs.

Shotgun cartridge: (1) Length 5 to 7 cm. (2) A short metal cylinder is continuous with a card board or plastic cylinder. (3) The case is rimmed. (4) It is filled as follows from base: percussion cap (primary battery cup, detonator cap), gun powder, thick wad with cardboard discs lying in front and behind the shot, and cardboard disc. (5) The shot consists of single ball or up to several hundred small lead shots. (6) Rifled slugs are single missiles and are used in shotguns for big game hunting. They are similar in shape to blunt bullet with a deep hollow cavity in base. (7) The spiral grooves on slugs impart a spinning effect. (8) Some cartridges contain power piston which holds the shot inside a polythene cup.

Rifled weapon cartridge: (1) It consists of metal cylinder with flat base which projects as a rim, except pistol. (2) The primer cup (percussion cap) is fitted in circular hole, usually in the centre of the base. (3) The cylinder is elongated and its distal end tightly grips the base of projectile (bullet). (4) Gun powder lies in between detonator and bullet. (5) Usually there is no wad. (6) Many bullets have circumferential groove called **cannelure** near the base, into which the end of case is compressed.

Primers: Detonator caps are small metal cups containing priming mixture and anvil. The mixture contains lead peroxide, lead styphnate, tetrazene, barium nitrate, etc.

Powder: (1) Black powder consists of potassium nitrate 75%, sulphur 10% and charcoal 15%. Powder grains are black, coarse or fine without particular shape. One gram of powder produces 3,000 to 4,000 c.c of gas.

(2) Smokeless powder: (1) Nitrocellulose (single base), nitrocellulose and nitroglycerine (double base), nitrocellulose, nitroglycerine and nitroguanidine (triple base) produce much less flame and smoke. (2) One gram produces 12 to 13 thousand c.c of gas. (3) The colour varies from bright-orange to bluish-black and shape from minute globules, flakes, squares, rectangular, irregular disks, cylinders or threads. Semi-smokeless powder is a mixture of 80% black, and 20% smokeless type.

Bullets: (1) Traditional bullet consists of soft metal (lead and antimony) and has rounded nose. (2) In revolver and pistol, the bullet is short and the point ogival or rounded. (3) In rifle, the bullet is elongated with pointed end. (4) The full metal jacket bullet is covered with a tough heavy jacket (steel, copper, nickel, zinc) except at the base. (5) In semi-jacketed bullet a relatively thin jacket covers the base and cylindrical portion of bullet, leaving the nose partly or fully exposed. This is designed to expand or mushroom. (6) Incendiary bullets contain phosphorus.

Wounds from shotguns: Smoke extends up to 30 cm., flame up to 45 cm., unburnt and partially burnt powder grains up to 60 to 90 cm., cards travel for 2 metres, and wad 2 to 5 metres. **Character**

of wound depends on: (1) **Distance from which weapon is discharged:** (A) **Contact wound:** (1) Single, round or oval, large, often ragged because of tearing due to gases. Margins are charred by flame; contused, and abraded border is soiled with powder residue. (2) Severe disruption of deeper tissues occur due to expanding gases. (3) Smoke, flame and carbon particles are driven into the wound causing burning and tattooing. (4) If the contact is tight, muzzle impression (**copy or recoil abrasion**) is seen. (5) If muzzle is not pressed firmly, and also due to recoil of gun, flame, gas and soot escape sideways and cause burning and blackening. (6) If the part is clothed, smoke will escape sideways and may be found in each layer of clothing and skin. Cloth is singed at the margins. (7) Wound of entry and track appear pink due to CO in gases combining with Hb. (8) Cruciate, stellate or ragged lacerations are seen, especially if there is a thick bone immediately under skin. (9) Contact wounds on head produce marked disruption of margins, cruciate tearing of skin, often subsidiary linear tears in skin, extending from the margins of the wounds. (10) In contact or near contact wounds of abdomen, coils of small intestine may come out of the abdomen due to entry of gases into abdomen.

(B) **Close range:** (1) Within a distance of 30 cm, the skin around wound is singed by flame, blackened by smoke and tattooed by unburnt or partially burnt powder granules. (2) The deposit of smoke is known as smudging, fouling or blackening. This can be wiped off by wet cloth. (3) Tattooing is known as stippling or peppering. (4) The hair is singed. (5) If gun is fired at right angle to the body, burnt area is circular, and if fired at an angle it is oval, the direction of fire being indicated by nearness of wound to one or other end of burnt area. The end nearer the wound is the direction towards which the shot travelled. (6) The wound is similar to contact wound, though blackening and tattooing are more extensive. (7) If powder is smokeless, there may be greyish or white deposit on skin round the wound. (8) Wads will be found in the depth of the wound. (9) In the skull there is less destruction than at contact range. Bursting open of the skull is not seen. (10) The plastic cup type wad opens

up between 30 to 60 cm. so that four petals stick out, and a circular entrance wound is produced with a Maltese Cross pattern of abrasion encircling it. By 90 cm. air resistance folds back the petals and a single hole of entrance will be produced. (11) At distance of 60 to 90 cm. single, circular wound 3 to 4 cm in diameter is produced. There is no burning and blackening, but some amount of tattooing is seen. (12) The shots are scattered after entering the body and cause much damage. (13) Shotgun wounds at contact and close range cause much more destruction of tissues than rifled weapons.

(C) Near range: (1) Between 1 to 2 metres, single round hole, 3 to 4 cm; margins abraded and show some scalloping, often referred to as "rat hole". (2) At two metres wound of entry is irregular, shot mass begins to spread and individual pellet holes may be detected, which are round and show rim of abrasion at their margins. (3) As distance increases, main entrance defect becomes progressively smaller, and individual pellet holes increase in number.

(D) Long range: (1) At a distance of 4 metres, shots spread widely and enter body as individual pellets producing separate openings in an area of 10 to 15 cm. (2) Spread is almost double from unchoked barrel. (3) At 30 mts the pellets only penetrate skin or muscle. (4) If shotgun pellets pass through any target before striking the body, the pellets spread, e.g. window glass, screen or layers of clothing.

(2) Size of shot: Larger shot have greater penetrating power.

(3) Nature of explosives: Smokeless powder causes lesser blackening and tattooing. Shorter barrels produce greater deposits over larger areas.

A rough indication of range of discharge for cylindrical barrel is obtained by measuring diameter of wound, from outermost of individual pellet wounds in cm. and dividing by three, which gives result in metres.

Exit wounds: Usually shotgun pellets do not exit except: (1) Contact wounds. (2) Tangential wounds where some pellets have short track through the body. (3) Thin part of the body. (4) Wounds caused by buckshot or rifled slugs. Small separate wounds made by individual pellets may be seen.

WOUNDS FROM REVOLVERS AND PISTOLS: Flame extends up to 8 cm., smoke up to 30 cm; unburnt and partially burnt powder grains 60 to 90 cm.

(A) Contact shot: (1) The wound is similar to that caused by shotgun. (2) In loose or near contact shot, some gases escape with scattering of muzzle blast and an unusual arrangement of soot is seen on skin known as corona. **Corona** consists of circular zone of soot deposit surrounding the bullet defect, but separated from it by a band of skin without deposit of soot. This is due to the gas expanding about the muzzle, first at a velocity too high to allow for settling of soot, with subsequent loss of velocity at a shorter distance from the muzzle, allowing the soot to finally deposit on the skin. (3) Muzzle blast and negative pressure in the barrel following discharge may suck blood, hair, tissue fragments and cloth fibres several cm. back inside the barrel called "**back spatter**". (4) On the head, wound is large and irregular because of expansion of gases between scalp and skull. This results in undermined, ragged, curciform opening with everted margins. (5) Soot may be deposited on the bone, and also on inner surface of skull around bullet hole and on dura mater. (6) Fissured fractures radiate from skull defect.

(B) Close shot (up to 8 cm.): (1) The term "**point blank**" is used when the range is very close to or in contact with surface of the skin. (2) Wound is circular with inverted edges, surrounded by blackened, tattooed and burnt area. (3) Spread of smoke with a short-barreled weapon is much more than with a weapon having long barrel. (4) Wound track may be pink due to CO. (5) Hair is singed. (6) Abraded and grease collar are present.

(C) Near shot (60 to 90 cm.): (1) At 15 cm. lacerating and burning effects of gases are usually lost due to dispersion cooling of gases before they reach skin. (2) Wound is round, about the size of bullet with a bruised margin. (3) Blackening and tattooing is spread out over a large area, but there is no singeing of skin. (4) Abrasion and dirt collar are present.

(4) Distant shot: Entrance wound is smaller than bullet, circular, margins are inverted, there is no burning, blackening and tattooing. Abrasion, contusion and dirt collar are present.

Difference between entrance and exit wounds		
Trait	Entrance wound	Exit wound
(1) Size:	Smaller than diameter of bullet.	Bigger than bullet.
(2) Edges:	Inverted.	Everted, puckered or torn.
(3) Contusion, abrasion and grease collar:	Present.	Absent.
(4) Burning,	May be seen around the wound.	Absent.
(5) Bleeding:	Less.	More.
(6) Fat:	No protrusion.	May protrude.
(7) Tissues within wound:	May be cherry red due to CO of explosive gases.	Absent.
(8) Fibres of clothing:	Turned in and may be carried into the wound.	Turned out.
(9) Lead ring or metal ring:	May be seen around the wound by radiological examination.	Absent.
(10) Spectrography:	More metal is found around entrance wound, if bullet has only passed through the soft tissues.	The exit wound may contain more metal if a bone is struck nearer to it.

Abrasions collar: (1) As bullet strikes skin, it first indents and then stretches skin which is perforated. (2) The skin is abraded around the hole due to rubbing of gyrating body of the bullet against inverted epidermis (abrasion collar). (3) Bullet lubrication, gun oil from barrel, lead from surface of bullet, barrel debris, etc. produce a narrow ring on skin, around the defect (**grease or dirt collar**). (4) The abrasion collar surrounds dirt collar. (5) Some contusion is present in abraded collar, and as such, it is also called **contusion collar**. (6) If bullet strikes body at right angle, abrasion collar is circular and uniform, and if it strikes at an angle, the wound is round but marginal abrasion

is oval due to increased width on one side. (7) The collar is wider on the side from which bullet comes.

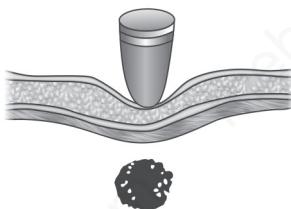
Skull: (1) Wound of entrance shows a punched-in hole in outer table. (2) On inner table a cone-shaped piece of bone is detached forming a crater that is larger than the hole on outer table, and shows bevelling (sloping surface). (3) Fissured fractures often radiate from defect. (4) At the point of exit, punched-out opening is produced in inner table and bevelled opening on outer table. (5) The exit wound is larger due to deformity and tumbling of bullet after entering the skull. (6) Asymmetry of bevelling indicates angle of fire.

Exit wounds: The variation in the shape and size of exit wounds are due to: (1) Bullet tumbles in the body and fails to exit nose-end first. (2) Bullet is deformed. (3) Bullet breaks up in the tissues and exits as several pieces. (4) Fragments of bone are blown out of body with the bullet. (5) Unsupported skin at the exit tears and breaks up into pieces.

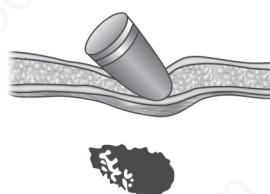
SHORED OR SUPPORTED EXIT WOUND: If the skin at the exit wound is firmly supported by an object, e.g. a belt, wrist band of trousers, brassiere, collar and tie, etc. or if the body is leaning against a wall, back of chair, etc. the exit wound appears as circular defect, surrounded by margin of abrasion resembling wound of entrance.

A bullet travelling in an irregular fashion instead of travelling nose on is called a **yawning bullet**. A bullet that rotates end-on-end during its motion is called **tumbling bullet**.

Bullet at right angle to body



Bullet at an acute angle



Abrasion collar of entrance bullet wound

RICOCHET BULLET: (1) Ricochet bullet is one which before striking the object aimed at, strikes some intervening object first, and then after rebounding from these hits the object. (2) Bullet may

ricochet before or after striking the body, and may produce a non-penetrating or a penetrating injury. (3) It may occur with inferior firearms and low velocity bullets. (4) The bullet may be deformed and flattened and produce a large, irregularly-oval, triangular or cruciate entrance wound with ragged margins. (5) Abrasion collar, burning, and blackening are absent. (6) Soil, fibres, paint, etc. may be found on nose of bullet. (7) Ricochet may occur inside the skull producing several tracks.

Multiple wounds (4 entrance and 4 exit) may be caused by a single shot, if the person is running or sitting in an unusual position.

In some cases, only **entrance wound is present, but bullet is not found in the body** due to (1) entering stomach may be vomited, (2) entering windpipe may be coughed up, (3) entering mouth may be spit out. (4) entering G.I. tract may be passed in faeces.

TANDEM BULLET: (1) Rarely, two bullets are found in body with only one entrance wound. (2) This occurs due to defect in weapon or due to faulty ammunition or with loaded firearm unused for several years. (3) When weapon is fired bullet does not come out. (4) When it is fired again, the second bullet may go off carrying the lodged bullet with it, and enter body through same wound. This is called **tandem or piggyback bullet**. The features caused by flame, smoke and gunpowder may be diminished or absent and the wound may appear as if caused by long range fire.

Souvenir Bullet: If a bullet is present for a long time in the body, there is no fresh bleeding in the surrounding area. A dense fibrous tissue capsule usually surrounds it. A tiny scar indicates the original entrance wound.

Identification of Weapon: (1) The firearms leave their signature on the cartridge case and on the bullet. (2) With all rifled firearms, the bullet is slightly larger than the barrel, and as it passes through the barrel, its sides are marked by rifling of barrel (**primary markings**). (3) They are most useful in identifying make and model of gun involved. (4) The surface of bullet is also grooved by irregularities on inner surface of barrel itself (**secondary markings**), which are specific for that particular weapon. (5) These irregularities are produced by sticking of particles of bullet to bore when shots are

fired, and is known as “**metallic fouling**”. (6) Bullet found in the body called **crime bullet or exhibit bullet** is compared under a comparison microscope with the one fired from suspected weapon known as **test bullet**. (7) The suspected weapon is fired using the same brand and type of ammunition into a roll of wool, or a bag of rags, or sand bag, or against white blotting paper. (8) Fresh pork skins, cleanly shaven are ideal for comparison with patterns on human skin.

BOMB EXPLOSION WOUNDS: When explosion occurs, a large volume of gas and energy are produced. (1) **Disruptive effects:** Severe damage or traumatic amputations are caused. When the victim is a few metres away or with smaller explosions, mutilation of a localised area occurs. (2) **Burns** are extensive which involve irregular areas of skin to different degrees. Tight clothing protects, so that beneath collars, bras, waist bands, socks and shoes the skin may be quite normal. (3) **Air blast:** A shock wave is produced which can toss the person through the air causing blunt injuries. Alveolar septa are torn producing haemorrhage and pulmonary oedema (**blast lung**). Homogeneous tissues like liver and muscle are not damaged. Intracranial haemorrhage, contusions of brain, heart injuries, ruptured stomach and bowel may occur. Death may occur from air embolism. (4) **Flying missiles:** Bomb pieces, gravel, glass, wood, brick, etc. cause bruises, abrasions and puncture lacerations intimately mixed on the skin. This triad of injury is diagnostic. (5) CO may cause asphyxia. (6) **Falling masonry** causes multiple injuries and **traumatic asphyxia**.

8

CHAPTER

REGIONAL INJURIES

Scalp: (1) Bruising of scalp is better detected by touch than by sight. (2) Multiple contusions of the scalp may fuse together, and often it is difficult to determine the number of blows inflicted. (3) Its firm edge often feels like the edge of a depressed fracture. (4) Scalp wound by blunt weapon resembles an incised wound.

SKULL: Fractures: (1) **Fissured fractures:** (1) These are linear fractures or cracks in bone involving whole thickness or inner or outer table only. (2) They are caused by forcible contact with broad resisting surface like ground, or agent having a relatively broad striking surface or from a fall on feet or buttocks. (3) They do not cross bony buttresses. (4) Temporal bone is most fragile and commonly fractures. (5) About 20% are not detected by X-ray.

(2) **Depressed fractures:** (1) They are caused by blows from heavy weapon with a small striking surface, e.g. stone, stick, hammer, axe. (2) The outer table is driven into diploe, inner table is fractured irregularly and to a greater extent and may be comminuted. (3) They are also called “fracture a la signature” (**signature fractures**), as the pattern resembles the weapon or agent which caused it. (4) Sometimes, it may involve outer table only. (5) Rarely, inner table only may be fractured.

(3) **Comminuted fractures:** (1) The bone is fractured into 3 or more pieces. (2) They are caused by a fall from a height on hard surface, vehicle accidents, and from blows by weapons with a large striking surface, e.g. axe, thick stick, etc. (3) They may result from

kick, etc. (4) When there is no displacement of fragments, it resembles a spider's web or mosaic. (5) Fissured fractures may radiate from area of comminution.

(4) Pond or indented fractures: (1) This is simple dent of skull, which is caused by obstetric forceps blade, a blow from a blunt object, or forcible impact against protruding object. (3) They occur in skulls which are elastic, i.e. infants. (3) Inner table is not fractured, but fissured fractures may occur in outer table.

(5) Gutter fractures: These are formed when part of thickness of bone is removed to form gutter, e.g. in oblique bullet wounds. Inner table may show irregular depressed fractures.

(6) Ring or foramen fracture: (1) (A) Fissured fracture encircles the skull and separates anterior third with middle and posterior third. (B) Usually, fracture runs 3 to 5 cm. outside foramen magnum at back and sides of skull and passes through middle ears and roof of nose, due to which skull is separated from spine. (2) They are rare and occur after falls from a height on to feet or buttocks. (3) A severe blow to vertex or forceful blow on chin in traffic accident may produce ring fracture.

(7) Perforating fractures: They are caused by firearms and pointed sharp weapons like daggers or knives and axe.

(8) Diastatic or sutural fracture: Separation of suture of skull occurs alone only in young persons due to a blow on head with blunt weapon, but is often associated with fracture.

Mechanism of cerebral injury: (1) A fatal brain injury may be caused without any damage to scalp or skull. (2) Brain injury may be caused by: (a) Penetration by a foreign object. (b) Distortion of the skull. When a localised segment of the skull undergoes deformation, shear strains may develop in brain tissue under the indentation, and a contusion may be produced in the surface layers of the brain. (3) Shaking of the infant as in child abuse may cause subdural haemorrhage. (4) The brain is easily distorted, but is incompressible. (5) Change in velocity, either acceleration or deceleration, with a rotational element causes brain damage. (6) Contusions and lacerations of brain are two degrees of same process. (7) Cerebral lacerations are caused by stretching and shearing forces within the

tissues produced by blunt force. (8) Lacerations are usually seen underneath skull fractures. (9) When parenchyma is completely disorganised it is termed pulpefaction.

CONTRECOUP INJURIES: (1) Coup (blow, impact) means that the injury is located under the area of impact and is caused directly by impacting force. (2) **Contrecoup means that the lesion is present in an area opposite the side of impact.** (3) They are produced mainly due to local distortion of the skull and sudden rotation of the head resulting from blow, which causes shear strains due to pulling apart of constituent particles of the brain. (4) A certain amount of shear may occur below the point of impact, particularly if the skull is fractured, which causes coup. (5) They are not seen if the head is well fixed and cannot rotate. (6) **Contrecoup injury is caused when moving head is suddenly decelerated by hitting a firm surface, e.g. striking of the head on the ground.** (7) When the head is suddenly arrested, the brain will be still in motion and strikes the skull. (8) Occipital injuries produce severe and extensive contrecoup injuries in the frontal region. The irregular bony prominences, especially orbital and cribriform plates, and lesser wings of sphenoid, contuse or lacerate the base of frontal lobes and tips of temporal lobes. (9) The second factor causing contrecoup injury is formation of a cavity or vacuum in the cranial cavity on opposite side of impact as the brain lags behind the moving skull. The vacuum exerts a suction effect which damages the brain. (10) A blow to the head produces coup contusions, while contrecoup contusions are either small or absent. (11) A fall on the head produces contrecoup contusions while coup contusions are small or absent. (12) Before 3 years, contrecoup injuries are rare.

CONCUSSION OF BRAIN: (1) **Concussion is a state of temporary unconsciousness** (due to complete or partial paralysis of cerebral function), **due to head injury, comes on immediately after injury, is always followed by amnesia, and tends to spontaneous recovery.** (2) **It occurs due to acceleration/deceleration of head.** (3) The violent head movement causes shearing or stretching of nerve fibres and axonal damage. (4) The person behaves automatically, but not rationally or responsibly. (5) The person has no recollection of accident or injury, although he can remember events up to or

within a few minutes of accident. (6) A post-traumatic amnesia from few minutes to days is seen. (7) Blows to neck or cervico-cranial junction produce brainstem concussion. (8) Diffuse axonal injury (functional abnormality of nerve cells and of their connections) causes concussion. (9) Death may occur without the patient regaining consciousness, or he may recover partially and then die suddenly. (10) **The victim may exhibit automatism and may commit some violent or criminal act.** (11) Autopsy is usually negative, but in some cases petechial haemorrhages may be found in the brain. (12) The confused mental state may resemble acute alcoholic intoxication.

Cerebral oedema is due to: (1) (a) Increase in intravascular pressure. (b) Increased permeability of cerebral vessels. (c) Decrease in plasma colloid osmotic pressure. (2) There is localised or diffuse abnormal accumulation of water and sodium, which increases the volume of the brain. (3) Focal oedema in the brain stem is usually fatal.

Extradural haemorrhage: (1) At the moment of impact the skull moves relative to the dura underneath it, dura is stripped from bone, and an empty extradural space is produced. (2) The vessel injured depends upon the site of trauma. (a) **Injury to middle meningeal artery is the commonest cause, which occur due to a blow to the lateral convexity of the head.** Less commonly, posterior meningeal artery near foramen magnum or anterior meningeal artery near cribriform plate are injured. (b) A blow over forehead involves anterior ethmoidal artery. (c) A blow on vertex may cause damage of sagittal sinus. (4) **It is the least common type of meningeal bleeding** (1 to 3%). (5) It is not common in first 2 years of life, but is common between 20 to 40 years. (6) Bleeding may occur due to fall from a small height or after a minor accident. (7) Fissured fracture is seen in 90% cases, but sometimes it is depressed. (8) Haematoma is directly under the site of surface injury, and usually covers motor area of brain and tends to run in middle fossa. (9) Clot is localised and causes localised concavity of surface of brain. Clot is oval or circular, 10 to 20 cm. in diameter, 2 to 6 cm. thick, weighs 30 to 300 g. and is adherent to dura. (10) Usually, 200 ml. is the minimum to cause death. (11) Injury causes bleeding and temporary unconsciousness. (12) This

is followed by a period of normal consciousness (**lucid interval**) of few hours to a week. (13) As pressure on brain increases, patient is first confused and may appear to be drunk. (14) Death occurs due to respiratory failure due to compression of brain stem.

Subdural haemorrhage: Causes: (1) Rupture of bridging or communicating veins. (2) Rupture of inferior cerebral veins. (3) Rupture of dural venous sinuses. (4) Injury to cortical veins. (5) Lacerations and contusions of brain and dura. (6) Drugs, such as heparin, warfarin, etc.

(1) Haemorrhage may occur from relatively slight trauma. (2) They may occur after fights or falls, especially in alcoholics, old persons and children. (3) It is commonly seen over upper lateral surface of cerebral hemispheres, and is usually supratentorial. (4) It is essentially venous or capillary and not arterial. (5) Volume of blood varies from few drops to 150 ml. (6) It is of three types: (a) Acute. (b) Subacute. (c) Chronic.

Subarachnoid haemorrhage: Causes: (1) Rupture of saccular Berry aneurysm, due to sudden rise in blood pressure due to emotional stress, etc. In an alcoholic involved in fight aneurysm may rupture. (2) Angiomas and arteriovenous malformations. (3) Rupture of vessels on surface of cerebral hemisphere. (4) Injuries to side of upper neck and jaw region producing damage to vertebral artery causes basal subarachnoid haemorrhage. (5) Blood dyscrasias.

(1) This is the most common form of traumatic intracranial haemorrhage. (2) In all cases of significant brain injury, some degree of subarachnoid haemorrhage is found. (3) It is mostly venous. (4) In mild form, it is present as splashes of haemorrhage over areas of contusion. (5) A slightly yellow discolouration of leptomeninges is seen as the subarachnoid haemorrhage becomes older. (6) It can be unilateral or bilateral, localised or diffuse. (7) In most cases it is diffuse overlying the cerebral hemispheres. (8) Mild or moderate subarachnoid haemorrhage does not produce any significant damage. (9) It is usually found over the orbital surface of the frontal lobes and the anterior third of the temporal lobes. (10) The blood mixes with C.S.F.

Intracerebral haemorrhage: Causes: (1) Capillary haemorrhages. (2) Angioma or malignant tumour. (3) Hypertension. (4) Laceration of

the brain. (5) Spontaneous haemorrhages in the region of basal ganglia by rupture of lenticulostriate artery commonly in middle aged and old persons. (6) Blow on the head.

(1) Bleeding is slow and in nature of oozing from venules or capillaries. (2) Haemorrhage into the brain due to trauma usually occurs near the surface. (3) Isolated haemorrhages in the frontal or occipital lobes are more likely to be due to trauma. (4) A single deep-seated haemorrhage is usually due to some disease.

Violence or disease: (1) Extradural haemorrhage is always caused by mechanical violence. (2) Subdural haemorrhage is almost always traumatic but may be caused by local inflammation. (3) Subarachnoid haemorrhage often occurs spontaneously from rupture of congenital aneurysms. (4) When a disease is present, sudden rise of B.P. due to physical exercise or excitement may rupture vessels and precipitate haemorrhage. (5) Usual source of haemorrhage is rupture of lenticulostriate branch of middle cerebral artery. (6) Rarely, bleeding occurs in pons or cerebellum. (7) Intracranial haemorrhage due to violence may occur without any fracture of skull or wound of scalp.

Post-traumatic automatism: (1) It is intimately associated with amnesia. (2) After an accident, the patient may speak and act in purposive manner, but does not remember them afterwards. (3) Amnesia following head injury is quite common and is usually associated with concussion.

SPINAL CORD: (1) Fracture of spine need not injure cord, but cord is rarely injured without associated fractures of vertebral column. (2) **Whiplash injury** is an exception to this rule. This is the injury sustained commonly by occupants of front seat. (3) When a vehicle suddenly stops, the forward thrust produces a state of acute hyperflexion, but this is converted into acute hyperextension as the forehead strikes windscreen which causes injury to cervical column. (4) In such cases, and also due to sharp blow against spinous process of an upper cervical vertebra (rabbit punch), fatal contusions and lacerations of spinal cord may occur without fracture of spine.

Concussion of spinal cord commonly occurs in railways and motor car collisions, and is known as "**railway-spine**". It occurs from

blows, compression from dislocation or fracture of vertebrae, damage by effusion of blood, fall from a height or a bullet injury. It produces temporary paralysis, affecting the arms and hands or bladder, rectum or lower extremities.

Liver is the most frequently damaged abdominal organ and is second only to brain in overall visceral susceptibility.

Lungs: (1) Major blows to chest produce contusions of lung surface, internal lacerations, small areas of bleeding in the lungs and traumatic cavitation. (2) After severe head injuries, where victim has been maintained for some time in a respirator, areas of collapse and haemorrhage with formation of hyaline membrane is seen "**respirator lung**". (3) Sudden compression of chest may produce **contrecoup contusions**.

Heart: (1) **Contrecoup contusions** are seen over posterior wall of left ventricle. (2) Blunt trauma insufficient to produce gross or microscopic damage can cause ventricular fibrillation or asystole. (3) **For death to occur due to cardiac tamponade 300 to 400 ml. of blood in pericardial sac is necessary.** (4) Cardiac injuries may cause death due to ventricular fibrillation, haemothorax, and cardiac tamponade.

FALL: (1) In fall from a height, tibias may be driven through soles of feet. (2) Calcaneum is usually fractured if heel is struck. (3) Sometimes, hip joints, pelvis or sacroiliac joint and lumbo-dorsal vertebrae are injured. (4) A fall on extended palm will produce fracture of head of radius or lower end of humerus.

TRAFFIC ACCIDENTS: PEDESTRIANS: Three patterns of injury are seen: (1) **primary impact injuries** (first part struck). (2) **Secondary impact injuries** (further injuries caused by vehicle). (3) **Secondary injuries** (injuries caused by victim's striking objects, such as ground).

(1) Primary impact injuries depend on position of person in relation to vehicle when struck, and relative heights of various parts of the vehicle. (2) If a person is struck from behind, and the foot is fixed, bumper injuries (fracture of tibia) occur. The fracture is usually spiral or wedge-shaped. (3) Frequently, bumper injuries are at different levels on two legs. (4) An impact against a mudguard or headlamp may result in fracture of pelvis or fracture-dislocation

of sacroiliac joint. (5) If person is facing vehicle, intra-abdominal and thoracic injuries are produced. (6) When he is thrown clear of the vehicle soon after the impact, he may sustain secondary injuries (abrasions, contusions, fractures, etc.) which vary greatly in severity. (7) Direct impact to the thorax may cause rupture of the aorta below the arch, and sometimes laceration or rupture of the heart. (8) If the victim is struck from behind, linear superficial tears of abdomen or inguinal regions are seen due to overstretching of skin. If the victim is run over by the vehicle, similar injuries may be produced due to overstretching of the skin. (9) If the pedestrian is thrown into the centre of the roadway, the person can be run over. (10) Tearing wounds may be caused by protruding objects, such as door handles, or with cuts from broken glass. (11) If a fast moving bus, truck or van having a straight and high front end hits an adult, the impact is higher, at hip or even shoulder level, and the victim will be pushed directly forwards in front of the vehicle. (12) In pedestrians, the head is injured by direct impact with the vehicle and also by striking the road. Both impacts produce fractures involving almost all parts of the skull, especially the base.

If the person is **run over** there may be (1) tyre marks, (2) grazes, (3) avulsion of skin, (4) burning of skin, (5) deep crushing of internal organs, (6) amputation of an extremity may occur.

Occupants of vehicle: (1) The driver slides forward. (2) Legs strike fascial parcel shelf and abdomen or lower chest strikes lower edge of steering wheel. (3) There is flexion of cervical and thoracic spines. (4) Head strikes windscreen and the person may be ejected. (5) The wheel rim may crush liver, spleen or kidney. (6) In some cases lungs are lacerated. (7) The throat may be crushed across horn ring or top of steering-wheel. (8) These are known as **steering-wheel impact type of injury**. (9) The front seat passengers will show same injuries except those caused by steering wheel. (10) **Whiplash injury may be seen in front seat occupants.** (11) There may be occupant ejection due to the door getting opened, and sustain multiple injuries. (12) Rarely, tail-gating may occur.

(1) **Rolling injuries** are produced when a vehicle with a low chassis rolled the victim along the roadway as it passed over him.

(2) They are mostly abrasions, grease soiling and burns from the exhaust system. (3) There may be fractures of various bones and patterned imprints caused by parts on the undersurface of the chassis.

Cyclists or motorcyclists: (1) Cycle is hit and the person is thrown violently to the ground. (2) In being thrown, they may injure groins or legs due to protruding objects. (3) Crash helmet reduces friction of the head against ground and makes deceleration less drastic. (4) When crash helmet is worn, crown may be protected, but whole head may be “egg-shelled” on to base or cervical spine. (5) Rarely chin strap may be drawn upwards and cause strangulation. (6) About 50% of helmetless motorcyclists sustain head injury. (7) The classical fatal injury in both motor cyclist and pillion passengers is fracture of skull. (8) The base is divided into two halves, each moving independently of each other like a hinge, the so-called **motor cyclist’s fracture**. (9) The motor-cyclist may drive into back of a large vehicle, e.g. truck, known as “**underrunning**” or “**tail-gating**”. (10) This may occur due to sudden and unexpected stoppage of the truck or when motor cyclist is at high speed in darkness.

Boxing injuries: (1) Subdural haemorrhage occurs in about one-third of fatal cases. (2) Deterioration in speed and co-ordination are chief symptoms of onset of **punchdrunk** (traumatic encephalopathy) condition. This is caused probably due to repeated blows to head which produce small haemorrhages and degenerative changes in brain. In extreme cases, there is slurred speech, defective memory, slow thought process, stiff limbs and finally dementia.

9

CHAPTER

MEDICOLEGAL ASPECTS OF WOUNDS

Homicide: It is killing of a human being by another human being.

Type: (I) **Lawful:** (1) Justifiable. (2) Excusable. (II) **Unlawful:** (1) Murder. (2) Culpable homicide, (a) amounting to murder, (b) not amounting to murder. (3) Rash or negligent homicide.

Justifiable homicide: This is the homicide which is justified in the circumstances which led to the killing of person. This may occur (1) in the administration of justice, like execution of death sentence, (2) the maintenance of justice, e.g. in suppressing riots or executing arrest or killing in course of violent crime, e.g. a woman who kills a person who attempts to rape her.

Excusable homicide: This is the homicide caused unintentionally by an act done in good faith. This includes (1) killing in self-defence when attacked, provided there is no other means of defence, (2) causing death by accident or misadventure, (3) death following lawful operation, (4) homicide committed by an insane person.

Culpable homicide: Culpable homicide is causing death by doing an act (1) with the intention of causing death, or (2) with the intention of causing such bodily injury as is likely to cause death, or (3) with the knowledge that such act is likely to cause death (S.299, I.P.C.).

Explanations: (1) A person who causes bodily injury to another who is suffering from a disorder, disease, or bodily infirmity which accelerates the death of a person, shall be deemed to have caused his death. (2) Where death is caused by bodily injury, the person who caused such bodily injury shall be deemed to have caused

death, although by using proper remedies and skilful treatment, the death might have been prevented. (3) The causing death of a child in mother's womb is not homicide.

Murder: Culpable homicide is murder (1) if the act by which the death is caused is done with intention of causing death, (2) if it is done with the intention of causing such bodily injury as is likely to cause death, (3) if it is done with the intention of causing bodily injury which is sufficient in the ordinary course of nature to cause death, or (4) if person committing the act knows that it is so dangerous that it must in all probability cause death or is likely to cause death (S.300, I.P.C.).

Exceptions: Culpable homicide does not amount to murder, if the act by which it is caused is done: (1) under grave and sudden provocation, (2) in good faith in right of private defence of person or property, (3) for advancement of public justice, (4) without premeditation, and (5) when person above the age of 18 years takes risk of death with his own consent.

Suicide: Attempt to commit suicide is punishable with imprisonment up to one year (S.309, I.P.C.) and abetment of suicide is punishable with imprisonment up to 10 years (S.306, I.P.C.).

DOWRY DEATHS

S. 304-B, I.P.C.: Where the death of a woman is caused by any burns or bodily injury, or occurs under abnormal circumstances within seven years of her marriage, and it is shown that soon before her death she was subjected to cruelty or harassment by her husband or any relative of her husband, for or in connection with, any demand for dowry, such death shall be called "dowry death", and such husband or relative shall be deemed to have caused her death. The punishment shall be imprisonment of not less than seven years, but may extend to life imprisonment.

S. 498-A, I.P.C.: Whoever being the husband or the relative of the husband of a woman, subjects such woman to cruelty shall be punished with imprisonment up to three years.

Dowry deaths occur either by murder of a married woman or she herself committing suicide being unable to bear harassment or cruelty for not fulfilling the promises by her parents or her relatives or of those interested in her marriage. Such murders are invariably

committed secretly, either in the house or at a place where outsiders may not witness it. The bride may be burnt or killed by various methods. The usual defence in all dowry death cases is that either the woman committed suicide, or death occurred accidentally due to burns while cooking food.

Inquest should be conducted by a Magistrate or police officer not below the rank of Deputy Superintendent of Police, and autopsy should be carried out by two doctors.

TORTURE

The World Medical Association (Declaration of Tokyo, 1975) defined torture in relation to detention and imprisonment as “The deliberate, systematic or wanton infliction of physical or mental suffering by one or more persons acting alone or on the orders of any authority, to force another person to yield information, to make a confession or for any other reason”.

Torture may be carried out by (1) Criminal and terrorist groups, and (2) By the police or other security force personnel during the detention and interrogation of prisoners and suspects.

Objects: (1) To obtain information if a person is suspected to have committed a crime or indulged in antinational or terrorist activities. (2) To obtain testimony incriminating others. (3) To sign a document confessing a crime. (4) To take revenge against a person or his family members, by rape, kidnapping, etc. (5) To spread terror in the community by militant groups or by dictators ruling the country. (6) To destroy the personality of individuals who raise their voices against dictatorial rule, or oppression in the society.

Methods: (I) PHYSICAL ABUSE: (1) Beating. (2) Telefons. (3) Beating on abdomen and head (4) Twisting of fingers. (5) Chewing hard on pieces of metals, stones. (6) Mutilation. (7) Disfiguring face or other parts of body. (8) Use of continuous high pitched sounds. (9) Forced immersion of head. (10) Tying plastic bag over head. (11) Suspension of the body by wrists. (12) Suspension of body by arms or neck. (13) Making to stand in hot sun on one leg for prolonged periods. (14) Burns. (15) Electric shock. Heated metal skewer inserted into the anus. (16) Perianal or rectal burns. (17) Dehydration. (18) Animal bites.

(II) MENTAL TORTURE: (1) Solitary confinement in a dark place. (2) Blindfolding for a long time, or frequent transfer from one place to another blindfolded. (3) Starving the victim. (4) Causing mental anguish by giving false information to victim regarding tragedy involving wife and children.

(III) SEXUAL TORTURE: (1) Infliction of injuries to private parts or introducing foreign bodies into the rectum or vagina, or mutilation of breasts or genitals. (2) Raping the victim or undressing before others, or sexually tortured by trained animals, etc.

Hurt: Hurt means bodily pain, disease or infirmity caused to any person (S.319, I.P.C.).

GRIEVOUS HURT: According to S.320. I.P.C. any of the following injuries are grievous. (1) Emasculation (loss of potency). (2) Permanent privation (loss) of sight of either eye. (3) Permanent privation of hearing of either ear. (4) Privation of any member or joint. (5) Destruction or permanent impairing of the power of any member or joint. (6) Permanent disfigurement of the head or face. (7) Fracture or dislocation of a bone or tooth. (8) Any hurt which endangers life, or which causes the victim to be in severe bodily pain, or unable to follow his ordinary pursuits for a period of twenty days.

Simple injuries: All injuries which are not grievous are simple.

Dangerous weapon or means: According to S.324 & 326, I.P.C. dangerous weapons or means include any instrument for shooting, stabbing or cutting or any instrument which used as weapon of offense is likely to cause death; fire or any heated substance; poison or corrosive substance; explosive substance.

Dangerous injuries are those which cause imminent danger to life, either by involvement of important organs or structures, or extensive area of the body. If no surgical aid is available, such injuries may prove fatal. Examples of injuries which endanger life are: stab on the abdomen or head or vital part, hurt causing rupture of spleen, squeezing testicles, incised wound on the neck, compound fracture of the skull, rupture of an internal organ, injury of a large blood vessel.

Assault: An assault is an offer or threat or attempt to apply force to body of another in a hostile manner (S.351, I.P.C.).

WOUND CERTIFICATE: All details of examination of injured person are entered in an **Accident Register**, which is a confidential document. The preliminaries like name, age, sex, date, time and place of examination, name of police constable accompanying, two identification marks, and brief statement of injured person is entered.

(1) Nature of each injury: (1) Abrasion, contusion, incised wounds, fracture, etc. are noted. (2) A lens should be used to examine wounds, and any foreign material should be noted.

(2) Size, shape and direction of each injury. (1) Tape should be used for measurements. (2) The shape of the wound, e.g. circular, oval, triangular, elliptical, etc., and bevelling of the edges noted. (3) The direction of the wound, i.e. horizontal, vertical, oblique, etc. should be noted with regard to the anatomical position of the body.

(3) On what part of body inflicted: Note with reference to an anatomical landmark, e.g. the midline, a bony structure, a joint, navel or nipple. Technical terms should be avoided as far as possible.

(4) Simple or grievous: If nature of any injury cannot be made out, such as head or abdominal injury, the patient should be kept under observation, and investigations carried out. In all injuries when a fracture of a bone is suspected, an X-ray examination should be done for confirmation.

(5) By what weapon inflicted, i.e. blunt, sharp, pointed, firearm, etc. In many cases, the examination of the wound and clothes give a fairly definite information about the kind of weapon. A foreign body found in a wound, e.g. a piece of glass, a piece of wood, the broken point of knife or bullet, etc. may help to identify the type of weapon.

(6) Whether weapon was dangerous or not.

(7) Remarks: General condition, such as conscious or unconscious, B.P., pulse, bleeding from ears, nostrils, mouth, etc., paralysis, shock, age of injuries should be noted.

When a dead body is brought to a hospital, it should not be examined for injuries, but it should be reported to police.

CAUSES OF DEATH FROM WOUNDS: (A) Immediate:

(1) Haemorrhage. 10 to 40% loss of total blood volume is fatal. (2) Reflex vagal inhibition. (3) Injury to a vital organ. (4) **Shock.** (a)

Traumatic shock is most common type. (b) **Burn** shock is caused from loss of plasma, absorption of necrotic tissue, and bacterial sepsis. (c) **Surgical** shock is due to combination of anaesthesia, loss of blood and plasma, emotional reactions, and infection. (d) **Cardiac** due to decreased cardiac output, reduced blood flow and deficient supply of oxygen to tissues. (e) **Septic** shock due to severe infection. (f) **Endotoxic** occurs in patients having Gram-negative infections.

(B) Remote causes: The victim may die after a varying period from remote causes. Assailant will be responsible if the victim dies of complications.

(1) Infection: Staphylococcus is the commonest organism of infection in wound resulting from trauma. **Specticaemia** is the presence of bacteria or their toxins in blood. **Bacteraemia** is the presence of bacteria in blood.

(2) Gangrene or necrosis.

(3) Neglect of injured person.

(4) Crush syndrome: Severe crushing of muscles, especially those involving the lower limbs, e.g. fallen masonry, vehicular accidents, etc. cause traumatic tubular necrosis.

(5) Surgical operation: (1) The assaulted person is not bound to submit himself for operation. (2) The assailant will be responsible if it is proved that the victim would have died even without operation, and operation was necessary, and was performed by competent surgeon with reasonable care and skill. (3) If the wound is not fatal and if it is proved that death was caused by application of harmful medicines, this cannot be regarded as murder.

(6) Natural disease: In a person suffering from fatty heart, miliary aneurysms, etc. slight injury may precipitate death.

(7) Supervention of disease from trauma, such as stricture or obstruction from fibrous scar in a hollow muscular organ, paraplegia, septic cystitis, etc.

(8) Thrombosis and embolism: (1) The most common sites of thrombosis are in deep femoral, popliteal and posterior tibial veins, and usually occur in trauma to lower limbs, esp. fractures of long bones leading to immobility and bed rest. (2) Thrombus develops in 10 to 20 days, detaches in part or whole and travels to

pulmonary artery. (3) Bullet and stab wounds of carotid arteries may injure intima, a thrombus may develop, followed by embolus of middle cerebral arteries. (4) Pulmonary embolus may cause death in few minutes due to vagal inhibition, acute asphyxia or right-sided heart failure. (5) Pulmonary emboli are cylindrical with parallel contours, often branch and frequently curved, and their shape does not correspond to shape of vessel.

(9) Fat embolism: Causes: (1) (a) Fracture of long bones, (b) injury to adipose tissue, (c) injection of oil into circulation, e.g. in criminal abortion, (d) in sickle cell anaemia. (2) The emboli enter pulmonary vessels. (3) Frozen sections of lungs are stained for fat with Sudan III, Scharlach R or osmic acid. (4) Pulmonary vessels are filled with globular fat emboli and obstruct the flow of blood through the lungs. (5) Death usually occurs about the tenth day from asphyxia due to impairment of gaseous exchange in the lung, but may be delayed up to 3 weeks. (6) Cerebral fat embolism develops when the fat emboli are forced through the pulmonary capillaries into the systemic circulation in sufficient quantity to affect the brain.

(10) Air embolism: Causes: (1) Incised wounds of lower cervical or clavicular region involving jugular or subclavian veins. (2) Wound of superior longitudinal sinus. (3) Crush injuries of chest. (4) Faulty technique in giving I.V. injection with gravity apparatus. (5) Injection of air and fluid into uterus for criminal abortion.

(1) Air is churned into frothy mixture in the right heart, which is driven into pulmonary artery and lung capillaries. (2) 100 ml. is necessary to produce fatal pulmonary air embolism. (3) Right ventricle is distended with air under pressure, and bright-red frothy blood is found in right side of heart. (4) Blood is fluid, viscera are congested, and petechiae are present in serous surface and white matter of brain. (5) Systemic air embolism occurs when air enters a vein of pulmonary system and carried to heart, brain, etc. This occurs in penetrating wounds of chest. (6) One to two ml. of air is enough to produce death. (7) Death occurs within a few minutes and is usually not delayed beyond 45 minutes. (8) Amniotic fluid embolism causes death by consumption coagulopathy.

Difference between antemortem and postmortem wounds

Trait	Antemortem wound	Postmortem wound
(1) Margins:	The edges are swollen, everted, retract and wound gapes.	Edges do not gape but closely approximated.
(2) Haemorrhage:	Abundant and usually arterial.	Slight or more, venous.
(3) Spurting:	Signs of spurting of arterial blood on the body, clothing or in its vicinity present.	No spurting of blood.
(4) Extravasation:	Staining of the edges of the wound and extravasation in neighbouring subcutaneous and interstitial tissues which cannot be removed by washing.	Edges and cellular tissues are not deeply stained.
(5) Coagulation:	Firmly coagulated blood in wounds and tissues present.	No clotting or soft clot.
(6) Vital reaction:	Signs of vital reaction present, i.e., inflammation and repair.	No signs of vital reaction.
(7) Enzyme histochemistry:	Increased activity of ATP, amino-peptidase, acid and alkaline phosphatase.	Diminished or no enzyme activity.

The signs of **vital reaction** are: swelling, effusion of lymph, leucocytic infiltration, pus formation, evidence of repair. **Healing by first intention** means, union of two granulating surfaces without infection.

10

CHAPTER

THERMAL DEATHS

Hypothermia is oral or axillary temperature of less than 35°C.

Trench foot and immersion foot occur due to prolonged exposure to severe cold (5 to 8°C) and dampness; seen in soldiers in winter warfare, especially in trenches, and in persons exposed to prolonged immersion. The extremities are affected.

Frostbite occurs due to exposure to extremes of cold (-2.5°C), and affects extremities, nose, ears and face. Necrosis with blister formation and gangrene occurs. Body temperature of 27°C or less, if maintained for 24 hours causes death from failure of vital centres due to anoxia.

Neonatal cold injury results from failure of metabolism to prevent a fall in temperature in a body exposed to cold environment. (1) There is swelling of extremities, particularly hands, feet and eyelids. (2) Respirations slow, shallow, irregular; face, hands, and feet are red. (3) Widespread pitting oedema of extremities. (4) There is haemorrhagic tendency, and localised hardening of skin, and subcutaneous tissue overlying oedematous parts.

Heat hyperpyrexia (heat stroke): (1) Rectal temperature is more than 41°C. (2) Neurological disturbances, such as psychosis, delirium, stupor, coma and convulsions. (3) If there is direct exposure to sun it is called sunstroke. (4) Precipitating factors are: high temperature, increased humidity, minor infections, muscular activity, and lack of acclimatisation. (5) If humidity is 100%, a temperature

of 32° C may lead to heat stroke. (6) **The mechanism is failure of cutaneous blood flow and sweating, leading to breakdown of heat-regulating centre in hypothalamus.** (7) Onset is sudden with collapse and loss of consciousness. (8) Skin is dry, hot and flushed, with complete absence of sweating. (9) Pupils contracted, pulse rapid, later irregular, breathing rapid, deep and of Kussmaul type, B.P. low. (10) Convulsions, coma and death in 5 minutes to 3 days. (11) Differential diagnosis of heat stroke includes, pontine haemorrhage, cerebral malaria, and meningitis. (12) **The classic triad of heat stroke consists of: hot, dry skin, hyperthermia (41 to 43°C), and neurologic disturbances.**

BURNS: A burn is an injury caused by application of heat or chemical substances to the external or internal surfaces of body which causes tissue destruction. Burn is caused by exposure to 44°C for 5 to 6 hours. At 65°C., 2 seconds are sufficient to produce burns.

Varieties: (1) **Heated solid body** produces blister and reddening. If contact is for some time, destruction or charring occurs. Epidermis is blackened, dry, wrinkled and hair singed. (2) **Flame** always causes singeing of hair and blackening of skin. Roasted patches of skin or deeper parts may be seen. (3) **Kerosene**, etc. causes sooty blackening. (4) **Explosions** (in mines, bombs) cause extensive burns and blackening and tattooing. (5) **X-ray and radium** burns vary from redness to dermatitis with shedding of hair and epidermis and pigmentation of surrounding skin. Severe exposure may produce burns with erythema, blistering or dermatitis, or ulceration with delayed healing and ill-formed scars. (6) **U.V. rays** produce erythema or acute eczematous dermatitis. (7) (a) **Corrosives** cause ulcerated patches, no blisters, hair is not singed and red line of demarcation absent. (b) They are uniform in character and have distinct colour. (c) Strong acids produce dark leathery burns. (d) Strong alkalis cause skin to slough and leave moist, slimy, greyish areas.

Degrees of Burns : (1) **Epidermal :** (a) Part is red. (b) Usually blister is formed covered by white, avascular epidermis and bordered by red, hyperaemic skin. (c) Hair is singed, pain is great. (d) Blister contains gas and protein containing fluid.

(2) Dermo-epidermal : (a) Whole thickness of skin is destroyed. (b) Burns are wrinkled, depressed areas of coagulated tissue, colour is brown or black, bordered by reddish, blistered skin. (c) Necrotic tissue separates within a week; pain and shock greater than epidermal burns.

(3) Deep : (a) There is gross destruction of skin, muscle, and even bone. (b) Burns are painless as nerve endings are destroyed. (c) Appearances are similar to second degree but more severe. (d) The burnt part may be completely charred.

For **cremation**, a body has to be incinerated for one-and-a-half hours at 1000°C. Ashes weigh 3 to 4 kg and contain bone fragments.

Estimation of surface area of body involved is worked out by **rule of nine**. 9% for head, and each upper limb, 9% for front of each lower limb, 9% for back of each lower limb, 9% for front of chest, 9% for back of chest, 9% for front of abdomen, 9% for back of abdomen, and 1% for external genitalia.

Causes of death : (1) Primary shock. (2) Secondary shock : 50% of deaths occur within 48 hours. (3) Toxaemia. (4) Sepsis. (5) Biochemical disorders. (6) Acute renal failure. (7) Oedema of glottis. (8) Accidents. (9) Pyaemia, gangrene, etc.

Autopsy : External : (1) **Flame burns** usually have a patchy distribution and vary in size and shape. (2) **Flash burns** occur due to sudden ignition or explosion of gases or fine particulate material, e.g. explosions of gases or ignition of highly inflammable liquids. All exposed surfaces are burned uniformly .(3) The burnt areas will be reddened and blistered and charred. (4) Blisters may be present either in main burn or as islands beyond the periphery. (5) Hair is singed. (6) Heat rigor may be found. (7) Portions of body where clothing is tight are comparatively unaffected. (8) Face is swollen and distorted, tongue protruded. (9) Skin detaches as glove. (10) Blisters of second degree cannot be distinguished from blisters seen in CO poisoning, deep coma, exposure to gasoline and putrefaction.

Pugilistic attitude (boxing, fencing or defence attitude) : (1) If body is exposed to great heat, legs are flexed at hips and knees, arms are flexed at elbows and held in front of body, all fingers are hooked like claws. (2) Opisthotonus is seen due to contraction of paraspinal

muscles. (3) Flexor muscles being bulkier than extensors contract more due to which joints of all limbs are flexed. (4) It occurs whether the person was alive or dead at the time of burning. (5) Stiffening is due to coagulation of proteins of the muscles and dehydration.

Heat ruptures: (1) occur either before or after death, due to splitting of soft parts. (2) Splits may be anywhere, but are usually seen over extensor surfaces and joints. (3) They are several cm. in length and resemble lacerations or even incised wounds. They can be differentiated by: (a) There is no bleeding in wound and no extravasation. (b) Intact vessels and nerves are seen. (c) Margins are irregular. (d) Bruising and vital reaction are absent.

In death due to burns it is difficult to assess body temperature, P.M hypostasis, and rigor mortis.

Internal : Heat haematoma (1) occurs when heat is sufficient to cause charring of skull. (2) **It resembles extradural haemorrhage, but there will not be any signs of blunt force injury.** (3) It consists of soft, friable clot of light chocolate colour, honeycomb appearance, 1 to 15 mm thick, and volume up to 120 ml. (4) Its distribution follows charring of outer table of skull. (5) The most common site is parieto-temporal region. (6) The blood may come from venous sinuses or diploic veins.

Thermal fractures of skull occur due to (1) Rapid increase in intracranial steam pressure; fragments are displaced outwards. (2) Rapid drying of bone with contraction; outer table is only involved. They are seen above temples. (3) They consist of several lines which radiate from a common centre. (4) They may cross a suture line.

(1) CO levels in the blood will be more than 10% and may reach 70 to 80%. (2) The blood is cherry-red which may change to brownish due to heat. (3) In death from suffocation, **aspirated blackish coal particles are seen in nose, mouth, larynx, trachea, bronchi, oesophagus and stomach.** (4) Such particles are embedded in frothy mucus which covers the congested mucosa. (5) **Presence of carbon particles and elevated CO saturation together are absolute proof that victim was alive when the fire occurred.** (6) Laryngeal oedema is caused by inhalation of flame or superheated air or inhalation of irritant gases. (7) The amount of oedema will decrease with P.M

interval, and only wrinkling of mucous membrane may be seen. (8) Haemoconcentration is present and there is some tissue oedema and excess of fluid in serous cavities. (9) Even in cases of severe external charring, the internal organs are usually well preserved. (10) Sometimes, brain, liver, lungs, etc. may be cooked, i.e. hardened and discoloured. (11) Inflammation and ulceration of Peyer's patches and solitary glands in intestines may be seen. (12) Rarely, ulcers are seen in duodenum (**Curling ulcers**) about tenth day, which are punched-out mucosal defects, which may be superficial or deep. (13) Petechiae of stomach and duodenum, often with erosions is a more common finding. (14) The spleen is enlarged and softened. (15) The liver may show cloudy swelling. (16) Kidneys may show cloudy swelling, capillary thrombosis and infarction. (17) The adrenals may be enlarged and congested. (18) Hemoglobinuria occurs when more than 30% of skin is burnt. (19) Cyanide levels in blood are less than 0.3 mg.%.

Age of burns : (1) Redness appears immediately and vesication in about one hour. (2) Exudate begins to dry in 12 to 24 hours. (3) Dry, brown crust is formed in 2 to 3 days. (4) Red inflammatory zone disappears in 36 to 72 hours, and pus may form under sloughs. (5) Superficial sloughs fall in 4 to 6 days and deeper sloughs within two weeks. (6) Scar is formed after several weeks.

Difference between antemortem burns and postmortem burns

Trait	Antemortem burns	Postmortem burns
(1) Line of redness :	Present.	Absent.
(2) Blister :	Contains serous fluid with proteins and chlorides. Base is red and inflamed.	Contains air and thin clear fluid. Base is dry hard and yellow.
(3) Vital reaction :	Marked cellular exudation and reactive changes in the tissue cells present.	Absent.
(4) Enzymes :	Peripheral zone of burns shows increase in enzyme reaction	Peripheral zone does not show increase in enzyme reaction.

SCALDS : (1) Scalds are produced by the application of liquid above 60°C or from steam. (2) Redness appears immediately, and blisters occur within a few minutes. (3) If blistered skin is removed, it will leave a pink raw surface which later becomes brownish, hard and dry. (4) Superheated steam soddens the skin which has dirty-white colour. (5) It is of 3 degrees (a) Erythema by vasoparalysis. (b) Blister formation. (c) Necrosis of dermis. (6) Scalded area is large but may be small if caused by splashing. (7) Streaks of liquid run downwards from main area causing lines of blisters. (8) Skin is sodden and bleached. (9) Red line present. (10) Vesicles over burnt area only. (11) Charring, singeing and ulceration are not seen. (12) Scar is thin and less contracted.

ELECTRICAL INJURIES : Alternating current is 4 to 5 times as dangerous as an equal voltage of direct current. Most deaths occur at more than 200 volts.

(1) Electric mark (Joule burn) : (1) It is specific and diagnostic of contact with electricity, and is found at point of entry of current. (2) It is round or oval, shallow crater, 1 to 3 cm. in diameter, and has a ridge of skin of about 1 to 3 mm high, around part or whole of their circumference. (3) Crater floor is lined by pale flattened skin. (4) In some marks, skin may break within or near margin of crater, resembling a broken blister. (5) Skin of mark is pale, but if contact is prolonged it may be brown or even black. (6) Rarely, mark may be seen as a circular hole penetrating up to bone simulating a bullet hole. (7) These marks are produced by conversion of electricity into heat within tissues. (8) It is usually found on the palmar side of the hand.

(2) Flash or spark burns (1) Resemble thermal burns. (2) They may be pinpoint or deeply seated and contracted. (3) Death may occur without any visible burning (a) when a hot wire is grasped with a wet hand, or (b) when a person is electrocuted in bath tub. (4) High tension electrical current may produce discrete lesions due to arcing from conductor to body without direct contact. (5) Multiple burns or punched-out lesions are produced due to arc dancing over large areas which present **crocodile flash** burns. (6) There can be blast effect from very high voltage discharges.

(3) Electrical burns or splits : (1) These splits are dry, hard, firm, charred, insensitive with ragged edges, and their shape is round, oval, linear, or irregular. (2) Skin may be wrinkled. (3) Rarely, localised oedema of a limb is seen. (4) Aseptic necrosis and sloughing occurs.

Autopsy : (1) Scene examination is much more important than autopsy. (2) Rigor mortis appears early. (3) Usually there are external marks of electric burning and contusion and laceration at the point of entrance and exit of the body. (4) In some cases, the lesions may extend through subcutaneous tissues and involve muscles and bone. (5) Severe convulsions may cause fractures of spine or limbs. (6) Any metallic object on the body will produce corresponding burns on the skin. (7) Asphyxial signs are present. (8) Petechial haemorrhages may be seen along line of passage of current, under endocardium, pericardium and pleurae. (9) There may be necrosis of intima or of complete wall of blood vessels. (10) Small balls of molten metal, derived from conducting electrode, so-called **current pearls** may be carried deep into tissues. (11) Heat will melt calcium phosphate, which is seen on X-ray as typical round density foci (**Bone pearls or wax drippings**).

Cause of death : (1) Paralysis of respiratory centre. (2) Ventricular fibrillation. (3) Cardiac arrest. (4) Rarely vagal inhibition.

Judicial electrocution : (1) In some states of U.S.A., death penalty is carried out in electric chair. (2) Person is strapped to a wooden chair and one electrode is put on shaven scalp, and other on right lower leg, and current of 2,000 volts and 7 amperes is passed for one minute. (3) After tetanic spasm and loss of consciousness, the same current is passed again for one minute.

LIGHTNING STROKE : (I) **Arborescent or filigree burns** (Lichtenberg's flowers) : (1) They are superficial, thin, irregular and tortuous, erythematous markings on skin resembling branches of tree, usually found over shoulders or flanks. (2) It may be caused due to (a) slight staining of the tissues by haemoglobin from lysed red cells along the path of electric current, or (b) rupture of smaller blood vessels at several places, or (c) due to minute depositions of

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copper in the dermis. (3) They indicate the paths taken by discharge and disappear in 1 to 2 days if person survives. **(II) Linear burns** vary from 3 to 30 cm, in length, and 0.3 to 2.5 cm. in width, and are often seen in moist creases and folds of skin. **(III) Surface burns** are true burns and occur beneath metallic objects. **Death** is always due to accident.

11

CHAPTER

STARVATION

Acute starvation occurs from complete stoppage of food, and chronic starvation from gradual deficient supply of food.

Acute : (1) Feeling of hunger for 30 to 48 hours, followed by pain in epigastrium. (2) After 4 to 5 days, general emaciation and absorption of subcutaneous fat begins to occur. (3) Eyes sunken, pupils dilated, lips dry and cracked, tongue coated and dirty, saliva thick and scanty, voice whispering, skin dry, rough, thin, inelastic, wrinkled, pigmented, abdomen concave, limbs thin, flaccid, progressive cardiovascular insufficiency, subnormal temperature, constipation, urine scanty, turbid with evidence of acidosis, extreme emaciation, offensive odour before death. (4) Intellect clear till death. (5) Loss of 40% of body weight is fatal.

Chronic : Hunger-pains, mental and physical lethargy, progressive loss of weight, polyuria, pigmentation, hypothermia, gross mental retardation, loss of self-respect, oedema of lower limbs.

Death occurs from exhaustion, circulatory failure or intercurrent infection.

Fatal period : 10 to 12 days if both water and food are completely withdrawn : 6 to 8 weeks or more if food alone is withdrawn.

Autopsy : (1) All organs and tissues show changes similar to premature senility. (2) All organs are reduced in size, fat is completely absent in subcutaneous tissues, omentum, mesentery, and about

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internal organs, which is never seen in wasting diseases. (3) Heart is small from brown atrophy; lungs collapsed, pale; G.I. tract shows atrophy of all coats; non-specific ulceration of bowel; gall bladder distended with bile, and urinary bladder empty; blood volume reduced with marked anaemia; osteomalacia.

CHAPTER 12

MECHANICAL ASPHYXIA

HANGING : (1) It is a form of asphyxial death caused by suspension of a person by ligature which encircles neck, the constricting force being weight of body. In partial hanging, bodies are partially suspended or are in a sitting, kneeling, lying down, prone or any other position. In typical hanging, ligature runs from midline above thyroid cartilage symmetrically upwards on both sides of neck to occipital region.

Causes of Death : (1) **Asphyxia** : Air is blocked due to compressive narrowing of lumens of larynx and trachea and forcing of tongue against posterior wall of pharynx and folding of epiglottis over entrance of larynx. (2) **Venous congestion** : Jugular veins are blocked, if ligature is broad and soft. (3) **Combined asphyxia and venous congestion** (commonest cause). (4) **Cerebral anaemia**, occurs with ligature made of thin cord which sinks deeply into tissues. (5) **Vagal inhibition**. (6) **Fracture or dislocation of cervical vertebrae**.

Delayed deaths occur due to : (1) Aspiration pneumonia. (2) Infections. (3) Oedema of lungs. (4) Oedema larynx. (5) Hypoxic encephalopathy. (6) Abscess brain. (7) Infarction brain.

Fatal period : 3 to 5 minutes.

Autopsy : External : Ligature mark in the neck is specific and important, which depends on : (1) Composition of ligature. (2) Width and multiplicity of ligature. (3) Weight of body suspended and degree of suspension. (4) Tightness of encircling ligature. (5) Length of

time body has been suspended. (6) Position of knot. (7) Slipping of ligature during suspension.

Ligature mark is a groove or furrow in tissues which is pale, but on drying becomes yellowish or yellow-brown and hard like parchment. In case of **fixed loop** with (1) a single knot in midline at back of head, mark is seen on both sides of neck, and is directed obliquely upwards towards knot, (2) a single knot in midline under chin, mark is seen on back and both sides of neck and is directed obliquely forwards towards knot, (3) when the knot is in region of one ear, on side of knot mark is directed obliquely upwards towards knot, and other side it is directed toward knot transversely.

Horizontal ligature mark is produced (1) When running noose is applied (above level of thyroid cartilage). (2) In hanging from low point of suspension. (3) In partial hanging when body leans forward. If a running noose fails to tighten, mark may resemble one produced by a fixed loop.

(1) Mark is above level of thyroid cartilage in 80%, at the level in 15% and below cartilage in about 5% of cases. (2) Width of groove is about, or slightly less than width of ligature. (3) The mark may be patterned. (4) Fresh mark is less clear but becomes prominent after drying for several hours. (5) Hanging may occur without visible ligature mark. (6) When nylon, silk or terylene clothes are used, mark may be only 2 to 3 mm wide. (7) A loop made of soft material, e.g. towel may not produce mark. (8) A thin line of congestion or haemorrhage may be seen along the edges of groove at some point. This does not indicate whether hanging was caused during life. (9) Abrasions with haemorrhage along the edges suggest suspension during life. (10) Hanging may occur when pressure is applied at front of neck. (11) Ligature mark is produced if a body is suspended within two hours after death. (12) Mark may disappear after several hours following removal of ligature. (13) Decomposition obliterates ligature mark.

Other signs : (1) Asphyxial signs present in 50% cases. (2) Neck stretched, elongated. (3) Face pale. (4) Asphyxial signs are marked if noose was placed high up. (5) In complete suspension, asphyxial signs are slight, petechial haemorrhages less common. (6) Saliva

may be found dribbling from angles of mouth, which is an important sign. (7) P.M lividity is seen in lower limbs and hands. (8) Eyes are protruded and firmer, conjunctivae congested and pupils dilated. (9) If the ligature knot presses on cervical sympathetic, the eye on the same side may remain open and its pupil dilated. It indicates antemortem hanging (**le facie sympathique**).

Internal : (1) Incision of groove may show small haemorrhages in the underlying layers of skin. (2) **Tissues under mark are dry, white and glistening.** (3) Platysma and sternomastoid rupture and intima of carotid arteries show transverse splits with extravasation of blood in 5 to 10%. (4) Hyoid bone is fractured in 15 to 20% of cases. Fracture is common in persons above 40 years and involves greater horns at junction of inner two-thirds and outer one-third. (5) **Superior horn of thyroid cartilage is fractured in about 40% of cases.** (6) Lungs are congested and oedematous. (7) Trachea is usually congested. Petechial haemorrhages may be found on epiglottis, in the larynx and trachea. (8) Internal organs are congested. (9) Subpleural ecchymoses may be found.

Unusual positions, e.g. where parts of body touched ground, kneeling or reclining, are almost diagnostic of suicide.

In **postmortem hanging**, marks of violence and signs of dragging may be found on body, but dribbling of saliva is not seen and fibres from the rope are not found on hands of victim.

Lynching : It is homicidal hanging. The name is derived from captain William Lynch who used to order hanging on the spot without trial in U.S.A. where a black rapist was used to be lynched by angry white mob. Sometimes, a suspect, accused or enemy is hanged by a rope from a tree, etc. by the mob.

Judicial hanging : (1) In India, legal death sentence is carried out by hanging the criminal. (2) The face is covered with dark mask, and person is made to stand on a platform which opens downwards when a bolt is drawn. (3) A rope to allow a drop of 5 to 7 metres is looped round neck with knot under angle of jaw. (4) On drawing the bolt, the person drops. (5) The stoppage of the moving body causes fracture-dislocation at the level of second and third, or third and fourth cervical vertebrae. (6) Upper cervical cord is stretched or

torn across, resulting in immediate unconsciousness, but heart beats and respiratory movements may continue up to 10 to 15 minutes, and spasmodic muscular jerking may occur for a considerable time.

STRANGULATION : It is a case of asphyxial death caused from constricting the neck by ligature without suspending the body.

Autopsy : External : (1) Ligature mark is well-defined, slightly depressed and seen about the middle or below thyroid cartilage. (2) It completely encircles the neck transversely and is more prominent at front and sides. (3) The mark may be interrupted at the front by presence of clothing or by victim's fingers. (4) A narrow ligature will produce a mark slightly narrower than diameter of ligature. (5) When nylon, silk or terylene fabrics are used, the mark may be only 2 to 3 mm wide. (6) The mark may be oblique as in hanging, if the victim was sitting and assailant applied ligature on neck while standing behind him, thus using force backwards and upwards, or if the victim has been dragged by a cord after he has been strangled in lying down posture. (7) The base is soft and pale or reddish. (8) Petechial haemorrhages are usually found immediately adjacent to mark, which is a confirmation that the mark was produced during life. (9) Reddening and congestion are also common immediately above and below the groove. (10) If the ligature used is soft and yielding and if it is removed soon after death, the mark in the neck may be very slight or absent. (11) If a rough ligature is used and if there is some movement of the rope on the skin during a struggle, the skin may show marked abrasions and haemorrhages. (12) The ligature mark is not obliterated by putrefaction, but is better preserved than the skin beyond it. (13) Even if mark is obscured, subcutaneous haemorrhages in relation to mark may be found.

Pseudo-strangulation : (1) Marks are produced from folds in the skin due to bending of head in infants and children in whom neck is short. (2) In short-necked adults on front of neck. (3) Decomposing bodies with tight collars, buttoned shirt at the neck, or other clothing round the neck. (4) In these cases, a deep groove resembling ligature mark of strangulation is produced due to the swelling of the tissues around the tight -fitting garment, as the body decomposes.

Internal : (1) Severe congestion and haemorrhage into tissues in and above the area constricted is seen. (2) There may be superficial haemorrhages under the ligature mark. (3) Neck muscles are usually lacerated. (4) Rarely, there is no external mark, but extensive bruising of deeper tissues may be found. (5) If ligature is tightly applied on the neck until death occurs, bruising will be absent. (6) Intima of carotid arteries is not damaged. (7) Hyoid bone may be fractured in older persons in 10 to 15% cases. (8) Fracture of thyroid cartilage is more common. (9) Bruising of tongue and floor of mouth occur. (10) Larynx, trachea and bronchi are congested, may show haemorrhagic infiltration, and contain forthy, blood stained mucus. (11) The lungs are markedly congested, oedematous, and show ecchymoses and larger subpleural haemorrhages. Silvery-looking spots under pleural surface are seen in more than 50% cases. (12) Internal organs are congested.

Difference between hanging and strangulation

Trait	Hanging	Strangulation by ligature
(1) Ligature mark :	It is oblique, does not completely encircle the neck. usually seen high up in the neck between the chin and larynx. The base is pale, hard and parchment-like.	It is transverse, completely encircling the neck below the thyroid cartilage. The base is soft and reddish.
(2) Abrasions and ecchymoses:	About the edges of ligature mark not common.	About the edges of the ligature mark are common.
(3) Bruising :	Of the neck muscles less common.	Of the neck muscles more common.
(4) Neck :	Stretched and elongated.	Not stretched or elongated.
(5) Subcutaneous tissues :	White, hard and glistening under the mark.	Ecchymosed under the mark.
(6) Hyoid bone :	Fracture may occur.	Fracture is uncommon.
(7) Thyroid cartilage:	Fracture is less common.	Fracture is more common.

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(8) Larynx and trachea:	Fracture rare.	Fracture may be found.
(9) Emphysematous bullae :	Not present on the surface of the lungs.	Very common on the surface of the lungs.
(10) Carotid arteries :	Damage may be seen.	Damage is rare.
(11) Face:	Usually pale and petechiae are not common.	Congested, livid and marked with petechiae.
(12) Signs of asphyxia :	External signs less marked.	External signs well-marked.
(13) Tongue :	Swelling and protrusion is less marked.	Swelling and protrusion is more marked.
(14) Saliva:	Often runs out of mouth.	Absent.
(15) Bleeding :	From the nose, mouth and ears not common.	From the nose, mouth and ears common.
(16) Involuntary discharge :	Of faeces and urine less common.	Of faeces and urine more common.
(17) Seminal fluid :	At glans is more common.	At glans is less common.

PALMAR STRANGULATION: The palm of one hand is placed horizontally across the mouth and nostrils without using the fingertips, its pressure being reinforced by placing the other palm on the top of it at right angles, the heel of the upper palm pressing up on the front of the neck. Diffuse bruising with fracture of thyroid may be seen. The face is congested with petechiae.

In cases of hanging, the hyoid bone is forced directly back-wards, due to which the divergence of greater horns is increased, which may fracture with outward displacement of the posterior small fragments.

Common methods of homicidal strangulation are : (1) Ligature strangulation. (2) Throttling. (3) Bansdola. (4) Garrotting. (5) Mugging.

BANSOLA : (1) One strong bamboo or stick is placed across front and another on back of neck and both ends are tied with rope due to which victim is squeezed to death. (2) Sometimes a stick is placed across front of neck and assailant stands with a foot

on each end of stick. (3) If a stick or foot is used, a bruise is seen in the centre of neck across the windpipe, corresponding in width to the substance used. (4) If two sticks are used, a similar mark will be seen on back of neck.

GARROTTING : (1) Victim is attacked from behind without warning. (2) **Throat may be grasped or a ligature is thrown over neck and quickly tightened by twisting it with a lever**, which causes sudden unconsciousness and collapse. (3) The assailant is then able to tie the ligature with one or more turns. (4) A single assailant can kill healthy adult in this way. (5) This method is usually used in lonely places to kill travellers and to rob them.

MUGGING : (1) **The neck of victim is held in bend of elbow from behind.** (2) **Pressure is exerted either on front of larynx, or at one or both sides of neck by forearm and upper arm.** (3) P.M appearances are those of ligature strangulation with a broad object. (4) There may be bruising behind the larynx and in the strap muscles of neck. (5) In some cases, neck may be pressed by foot or knee.

THROTTLING (manual strangulation) : Asphyxial death produced by compression of neck by human hands is called throttling.

Autopsy : External : (1) **The situation and extent of contusions on neck depend upon :** (a) relative positions of assailant and victim, (b) manner of grasping neck, (c) degree of pressure exerted upon throat. (2) **Bruises are produced by tips or pads of fingers.** (3) Shape is oval or round, but continued bleeding into contused area usually increases the size. (a) A grip from right hand from front produces a thumb impression on right side of victim's neck, usually under lower jaw or cornu of thyroid. Several finger marks are seen on left side of neck obliquely downwards and outwards, one below the other, but may be grouped together. (b) In a grip from behind victim, pressure is applied all round the neck. (c) When both hands are used thumb marks of one hand and finger marks of other hand are usually found on either sides of throat. Sometimes, both thumb marks are found on one side and several finger marks on opposite side. (d) A grip from both hands, one being applied to front and other to back, produces bruises on front and back of the neck.

(4) Bruises may be seen in a completely haphazard manner due to shifting of grip, or struggle of victim. (5) Fresh bruises are soft and red, but after several hours they appear brown, dry and parchment-like. (6) Pressure of nails produces crescentic abrasions. (7) If soft material is kept between hand and throat, or if pressure on the neck is maintained until after death of victim, bruising may be absent. (8) Signs of asphyxia are similar to those of ligature strangulation.

Internal : (1) **Bruises are found in the skin, fascia, on sheaths of muscles and in substance of thyroid gland.** Bruises are usually separate and involve muscles. In some cases, bruising may be absent externally, although deeper tissues may show extensive bruising. (2) Sternomastoid may be torn. (3) Muscles surrounding larynx show well-marked bruising. (4) In some cases, intima of carotid is ruptured. (5) Haemorrhages may be found in pharynx, tonsils, base of tongue and upper part of larynx. (6) Fracture of superior cornu of thyroid at its base is common, but fractures of body are rare. (7) Fracture of ala of thyroid cartilage occurs in midline obliquely or spirally, if pressure is much greater. This injury is more common in blows to front of neck, either by fist or edge of hand, punching, kicking, arm-locks or fall on to a ridged object, such as gate or chair-back. (8) Body of thyroid can break due to : (a) Karate blow to front of neck, (b) handle bar of a bicycle in traffic accident, (c) edge of chair or any projecting object. (9) **Fractures of hyoid bone with inward driving of distal fragment occurs in 30 to 50% of cases.** (10) Fracture of cricoid cartilage is seen only in fatal cases. (11) The lungs are congested, oedematous with subpleural haemorrhages. (12) Froth is present in bronchi. (13) Subarachnoid haemorrhage may be present.

Rapid or instantaneous death can occur due to vagal inhibition commonly in throttling, very often in hanging and less often in ligature strangulation.

Hyoid bone fractures : (1) **Inward compression** fractures are seen in throttling. (2) Fracture occurs at junction of outer one-third and inner two-thirds. (3) Posterior fragment is displaced inwards. (4) Periosteum is torn on outer side of bone only. (5) A fracture may also be seen at the joint between greater horn and body. (6) In some cases, bilateral inward, fractures may occur.

(2) **Anteroposterior compression** : (1) In cases of hanging, the hyoid bone is forced directly backwards, due to which the divergence of greater horns is increased, which may fracture with outward displacement of the posterior small fragments. (2) Periosteum is torn on inner side. (3) Fracture may occur either in greater horn or at its junction with body and it may be bilateral. (4) It may also be seen in ligature strangulation, run over motor vehicle accidents and blows on front of neck. (5) The fractured fragments are displaced outwards.

(3) **Avulsion fractures** (tug or traction fractures) : They occur due to muscular overactivity without direct injury to hyoid bone.

SUFFOCATION : It is that form of asphyxia which is caused by deprivation of oxygen either due to lack of oxygen in environment or from obstruction of air-passages at level of nose and mouth.

SMOTHERING : (1) It is caused by closing external respiratory orifices either by hand or other means, or by blocking cavities of nose and mouth by foreign substances such as cloth, paper, etc. (2) Suicidal smothering by hand is impossible. It can be caused by burying face in a mattress or by tying polythene bag over the head. (3) Most deaths are accidental due to : (a) In epileptic or intoxicated person by burying his face in a pillow, etc. (b) Falling into a large quantity of semisolid or finely divided material, like mud, ashes, grain, sand, etc. (c) Air-tight place, e.g. locked boxes or trunks. (d) Inhalation of irrespirable gases, e.g. CO, CO₂, hydrogen sulphide. (e) Application of plastic bags for experiment or autoerotic exercise. Homicidal smothering occurs due to closure of the mouth and nose by a hand or cloth, or pressing the face into a pillow.

Autopsy : (1) Obstruction by pillow, cushion, etc. may not leave any signs. (2) If nose and mouth are closed by hands, scratches or lacerations and bruises may be present around mouth and nose. (3) Asphyxial signs are severe.

Environmental Suffocation : (1) Death from hypoxic hypoxia may result from breathing in a vitiated atmosphere (deficient in oxygen). (2) CO, CO₂, methane, sulphureted hydrogen and sulphur dioxide are commonly found in vitiated atmosphere. (3) Deaths are always accidental. (4) It may occur in vicinity of limekilns

and wells or excavations in chalk rock. (5) In such cases, petechial haemorrhages are absent. (6) Congestion and cyanosis may or may not be present.

GAGGING : (1) This is a form of asphyxia which results from **pushing a cloth or soft object into the mouth sufficiently deep to block pharynx**, or from closure of mouth and nose by a cloth or similar material, which is tied around the head. (2) Collections of saliva, and excessive mucus with oedema fluid causes complete obstruction. (3) It is almost always homicidal and the victim is usually an infant. (4) Sudden death due to reflex vagal inhibition may occur. (5) It is usually resorted to prevent the victim from shouting for help, and death is usually not intended.

OVERLAYING (compression suffocation) : It occurs due to **compression of chest in an infant**, e.g. during sleep mother or other person under influence of alcohol rolling on and crushing infants.

CHOKING : (1) **It is a form of asphyxia caused by obstruction within air-passages.** It is almost always accidental. (2) Choking from objects being lodged in the throat is commonly seen in the very young, elderly, psychiatric patients, acutely intoxicated or physically weak, particularly where the ability to swallow or masticate is severely impaired. (3) The foreign body becomes arrested at or just below the vocal cords and may produce an inflammatory reaction with oedema.

Causes : (1) Inhalation of food during meal. (2) Regurgitation of clotted milk in infants. (3) Vomited matter may be inhaled by intoxicated, epileptic, while under anaesthesia, etc. (4) Impaction of a solid body, such as bolus of food, seeds, piece of meat, etc. (5) Inhalation of gauze packs inserted during operation. (6) Inhalation of rubber balloons by children during play. (7) Inhalation of objects like marbles, coins, etc. kept in mouth. (8) Impaction of large foreign body, bolus of food, or denture in oesophagus compressing trachea.

CAFE CORONARY : (1) A healthy but grossly intoxicated person (restaurant patron) taking a meal turns blue, coughs violently, collapses and dies. (2) Death appears to be due to heart attack. (3) At autopsy, large piece of poorly chewed food (bolus or piece of meat) may be found obstructing larynx. (4) Clinical signs of choking are absent due to absence of gag reflex caused by alcohol. (5) The

foreign body which caused the occlusion of air-passages will be found in mouth, throat, larynx or trachea. (6) When food or vomited material has been inhaled, particles of food material may be observed embedded in thick mucus in trachea and bronchus.

TRAUMATIC ASPHYXIA : It results from respiratory arrest due to mechanical fixation of chest, which prevents normal movements of chest wall. Fatal cases are only due to accident.

Causes : (1) Gross compression of chest and abdomen as in stampedes. Victim may fall on ground and crushed under feet. (2) Falls of earth or stone during tunnelling or in coal mine, etc, or building collapse. (3) Run over by a vehicle or crushed by machine. (4) Indirect compression due to thighs and knees being pressed against chest, so-called **jack-knife position**.

Autopsy : (1) Intense cyanosis of deep-purple or red colour of head, neck and upper chest, above level of compression is prominent feature. (2) Below this level skin is pale or slightly cyanosed. (3) Areas of pallor in areas of pressure, such as collars, buttons, folds in clothes etc. (4) Multiple injuries. (5) If patient survives, purple colour will disappear in 10 to 14 days. (6) Internal organs congested.

BURKING : It is a combination of homicidal smothering and traumatic asphyxia. A person under influence of alcohol was thrown to ground and Burke used to kneel or sit on chest and close nose and mouth with his hands and Hare used to pull him round the room by feet. They killed 16 persons in Edinburgh and sold bodies to anatomy department.

DROWNING : It is a type of asphyxia due to aspiration of fluid into air-passages caused by submersion in water or other fluid. Death can occur if only nose and mouth are submerged.

Types : (1) **Wet drowning** (primary drowning) : Water is inhaled into lungs ; death occurs due to cardiac arrest or ventricular fibrillation. (2) **Dry drowning** : Water does not enter lungs. Death occurs from immediate sustained laryngeal spasm due to inrush of water into nasopharynx or larynx. This is seen in 10 to 20% cases. (3) **Secondary drowning** (post-immersion syndrome; near drowning) : Death occurs in half to several hours after resuscitation from combined effects of pulmonary oedema, infective or chemical

pneumonitis, electrolyte disturbances, metabolic acidosis, severe infections or cerebral anoxia. (4) **Immersion syndrome** (hydrocution or submersion inhibition) : Death results from cardiac arrest from vagal inhibition due to : (a) cold water stimulating nerve endings of surface of body, (b) water striking epigastrium, (c) cold water entering ear drums, nasal passages, pharynx and larynx.

Pathophysiology : (1) **Fresh water** : (1) In drowning in fresh water (0.6% NaCl), water passes rapidly from lungs to blood, leading to haemolysis and dilution of blood, which may increase by 50% within a minute. (2) 2.5 litres of water may be inhaled and absorbed in 3 minutes. (3) Sodium, calcium, protein and haemoglobin are reduced; serum potassium increases. (4) Pulmonary oedema occurs (5) Oedema fluid contains serum proteins. (6) Cardiac arrhythmias occur. (7) Haemoglobinaemia and haemoglobinuria occur.

(2) **Sea water** (over 3% NaCl) : (1) Water is drawn from blood into lung tissues, and produces severe pulmonary oedema and hypernatraemia. (2) This causes haemoconcentration. (3) Salts from water in the lungs pass into blood stream. (4) Slow death occurs from asphyxia.

Causes of death : (1) Asphyxia. (2) Ventricular fibrillation. (3) Laryngeal spasm. (4) Vagal inhibition. (5) Exhaustion. (6) Injuries.

Fatal Period : 4 to 8 minutes.

Autopsy : External : (1) P.M hypostasis is light-pink due to oxygenation, but in some cases may be dusky and cyanotic. It is seen on face, upper part of front of chest, hands, lower arms, feet and calves. (2) R.M appears early. (3) Signs of asphyxia. (4) Petechiae are rare in skin. (5) **Fine, white, lathery froth or foam is seen at mouth and nostrils (characteristic external finding)**. Froth consists of protein and water. Froth is also seen in death due to strangulation, acute pulmonary oedema, electrical shock, epileptic fit, opium poisoning and putrefaction, but in all these cases quantity is less and bubbles are large. (6) **Cutis anserina** (goose skin, goose flesh) in which skin has granular and puckered appearance may be seen due to spasm of erector pilae muscles if the water is very cold. It is rarely seen in India. It can occur if a dead body is thrown into cold water soon after death. It is also produced by R.M of erector muscles.

(7) **If cadaveric spasm** develops, weeds, grass, twigs, leaves, etc. may be firmly grasped in the hand. This strongly suggests that the person was alive when he drowned. Damaged nails and abraded fingers has same significance. (8) **Washerwoman's hands:** Soddening of skin is first seen on fingertips in 2 to 4 hours, which spreads to palm and backs of fingers, and back of hand in that order in 24 hours. Wrinkling of skin begins shortly after immersion, bleaching of epidermis in 4 to 8 hours, and bleached, wrinkled and sodden appearance is seen in 24 hours. Similar changes are seen in feet.

Internal : (1) **Lungs are voluminous, cover pericardial sac and bulge out of chest when sternum is removed (ballooning).** On section, oedematous condition due to large amount of watery, frothy, bloodstained fluid (**emphysema aquosum**) is seen in 80% cases, which is presumptive evidence of death from drowning. (2) If the victim is unconscious at the time of drowning, mere flooding of lungs with water, but without formation of froth occurs which is known as **oedema aquosum**. (3) Lungs are usually moderately congested but may be pale. (4) Lungs feel doughy and pit on pressure. Alveloar walls may rupture and produce haemorrhages, which when present subpleurally are called **Paltauf's haemorrhages**. They are shining, pale bluish-red and may be small, or 3 to 5 cm. in diameter. They are present in 50% cases in lower lobes of lungs, and on anterior surfaces and interlobar surfaces. (5) Red and grey patches may be seen on surface, due to Paltauf's haemorrhages and patchy interstitial emphysema. (6) Petechial haemorrhages on surfaces of lungs are very rare or may be absent. (7) In **fresh water drowning**, lungs are ballooned but light, pale-pink, emphysematous, shape is retained and does not collapse after removal from body; on sectioning crepitus is heard, and there may be little froth and no fluid. (8) In **sea water drowning**, lungs are ballooned and heavy, weight up to two kg, purplish or bluish, sodden and jelly-like, tend to flatten out after removal from body; large amount of liquid and froth is present, and on section crepitus is not heard. If the body remains in water for several hours, differences in appearance between fresh and sea water drowning are not clear. (9) In many cases of drowning, relatively dry lungs (**dry-lung drowning**) are seen, due to absorption of water from

air-spaces into pulmonary circulation, but lungs are distended. This may occur if circulation continues for short time after removal of victim from water or if resuscitation is carried out. (10) **Hydrostatic lung**, resembling drowning lung is seen if body remains in water at a depth of two metres for 20 hours. (11) Air-passages up to secondary bronchi and beyond are filled with froth. (12) If there is delay in P.M, froth in lungs and air-passages and overdistension of lungs is not seen in most cases. (13) Fluid in air-passages may contain fine silt, sand, weeds, diatoms and various forms of algae, which is very characteristic. (14) Rarely, the person vomits during unconscious gasping phase of drowning, and stomach contents may be found in air-passages. (15) **Stomach** contains water in 70% of cases. (16) **Small intestine** may contain water in 20% cases, which is positive evidence as it depends on peristaltic movement. (17) **Haemorrhages** are found in middle ear in 50% cases. Haemorrhages in temporal bone or in mastoid air cells is seen in large number of cases. Temporal bone haemorrhages are also seen in deaths due to hanging, head injury and CO poisoning. (18) Water may be found in middle ears. (19) Internal organs are congested.

Sign of drowning : (1) In death due to laryngeal spasm asphyxial signs are present, but no water in lungs. Laryngeal spasm disappears after death due to primary relaxation. (2) In death due to vagal inhibition, signs of drowning will not be present. (3) In syncope, or when person is in a state of helplessness from drink or other causes, when person receives an injury during fall into water, signs will be slight. (4) In dry drowning P.M appearances are those of asphyxia.

DIATOMS : (1) They are microscopic unicellular algae which are impregnated with silica and contain chlorophyll and diatomin. (2) They resist heat and acid. (3) 15,000 species are present. (4) Size varies from two microns to one mm. (5) They occur in fresh and salt water, cultivated soils and on moist rocks. (6) Diatoms contained in drowning fluid pass from ruptured alveolar walls into lymph channels and pulmonary veins and enter left heart, and are found in lungs, brain, bone marrow, liver, muscle, etc. The bone marrow is highly suitable and reliable. (7) Five grams of bone marrow, liver or kidney

is put in a test tube and covered with five times of its volume of concentrated nitric acid and left for one day to allow digestion. This process chars, blackens and destroys organic matter but not diatoms which have silica shells. (8) The tube is centrifuged, supernatant acid poured off and replaced with distilled water and centrifuged. This process is repeated two or three times, and deposit examined under phase contrast or dark ground illumination. (9) Two litres of water is obtained from accident site and examined for diatoms. (10) Findings similar diatoms in water and body tissues is in favour of drowning. (11) Finding of diatoms is not absolutely diagnostic but is of greatest value in putrefaction.

Tests : (1) **Gettler Test** is of no value. (2) The specific gravity of plasma from left side of heart is less than that of right side in drowning. The reverse is seen in non-drowning cases. (3) Serum strontium is raised in drowning. (4) With decomposition water transudes into pleural cavities. (5) In advanced decomposition signs are completely absent.

Difference in lungs between fresh water and sea water drowning

Trait	Fresh water drowning	Sea water drowning
(1) Size and weight:	Ballooned but light.	Ballooned and heavy; weight up to 2 kg.
(2) Colour :	Pale pink.	Purplish or bluish.
(3) Consistency :	Emphysematos.	Soft and jelly-like.
(4) Shape after removal:	Retained; do not collapse.	Not retained; tend to flatten out.
(5) Sectioning:	Crepitus is heard. Little froth and no fluid.	No crepitus. Copious fluid and froth.

Duration of Submersion : The body floats in about 12 to 18 hours in summer, and 18 to 36 hours in winter in India. The body usually floats with spine uppermost, though obese persons may float face up. In advance putrefaction, the body usually floats belly up.

SEXUAL ASPHYXIAS : (1) Pressure on carotid vessels or partial obstruction of air-passages impairs consciousness and may lead to hallucinations of an erotic nature. (2) These cases are associated with

abnormal sexual behaviour, usually masochism and transvestism. (3) Victims are always male and usually young. (4) The scene is usually victim's own house.

Methods : (1) Hanging is most frequent form. (a) The neck is protected by padding. (b) Such persons are usually found naked, or may be wearing women's dress, wigs or make-up may be worn. (c) Frequently they tie their arms, legs, waist and genitalia with a rope (**bondage**). (d) Erotic or pornographic literature, nude photographs are spread over. (e) Mirror may be arranged to watch event or camera to make a photographic record. (2) Electrical stimulation by applying electrodes to genitals or on abdominal wall with a low voltage. (3) Head is covered with plastic or impervious bag, which is secured around neck by an elastic band. It is sometimes combined with "glue-sniffing". (4) Inhalation of stupefying substances, e.g. carbontetrachloride, or general anaesthetic.

CHAPTER 13

IMPOTENCE AND STERILITY

Impotence is the inability of a person to perform sexual intercourse. Sterility is the inability of male to beget children, and in female inability to conceive children. A person can be sterile without being impotent or he can be impotent without being sterile, or both may co-exist. **Frigidity is the inability to start or maintain sexual arousal pattern in female.**

Examination: Obtain complete history of previous illness, especially nervous and mental, and sexual history. A complete medical examination should be carried out. Private parts are tested for sensation.

Opinion: If male external genitalia are normal, it cannot be said that the person is impotent. In such case opinion should be given in **negative form, stating that from examination of male, he finds nothing to suggest that the person is incapable of sexual intercourse.**

Causes of impotence in male: (1) **Age:** (a) Power of erection may be present much earlier than puberty. (2) **Poor physical development of sex organs is common cause of impotence.** (3) In precocious development as in gonadal or adrenal tumours, sex organs are developed at an early age. (4) In advanced age ability to perform coitus may diminish. (5) Sperms are not found before puberty.

(2) **Defects of development and acquired abnormalities:** (1) Impotency occurs due to absence or non-development of penis. (2) Double penis and penis adherent to scrotum may cause difficulty in

coitus. (3) **If testes are removed before puberty impotence occurs, but if lost after puberty, potency is retained.** (4) Sterility is common in cryptorchids.

(3) Local diseases: (1) Temporary impotence may be caused by acute disease of penis, e.g. gonorrhoea, sores on glans. (2) Disease of testicles, epididymis or penis, such as cancer, sarcoma, syphilis, trauma, etc. may cause sterility, impotence or both. (3) Exposure to X-rays causes temporary sterility.

(4) General diseases: During acute illness impotence is common. (2) General diseases causing debility cause temporary impotence. (3) Endocrine diseases may produce impotence. (4) Hemiplegia, paraplegia, disseminated sclerosis, fracture vertebrae with cord injury may cause impotence. (5) Tumours or injury of cauda equina, and spina bifida produce impotence. (6) Excessive and continued use of some drugs, e.g. alcohol, opium, cannabis, tobacco, cocaine, etc. may cause impotence while the habit lasts. (7) Occupational exposure to lead and orchitis may cause sterility.

(5) Psychic causes: (1) Emotional disturbances, fear of impotence or fear of inability to complete act may cause temporary impotence. (2) Disgust of sexual act or dislike of partner may cause impotence. (3) **Quoad is a person who may be impotent with a particular woman, but not with others.** (4) Majority of cases of impotence have organic causes. (5) **Vasculogenic impotence is one of the most frequent causes of erectile failure** (about 40%). It may be due to poor arterial inflow into penis or excessive leakage of blood from the penis or both. (6) Other causes are diabetes mellitus (20%), psychogenic (12%), neurogenic (7%), malignancy, testosterone deficiency, trauma, etc. (20%).

Causes in female: (1) Age has no effect on potency. (2) A woman is usually fertile from puberty to menopause.

(2) Defects of development and acquired abnormalities:
(1) Occlusion of vagina, adhesion of labia, intersexuality cause impotence. (2) Conical cervix and absence of cervix, uterus, ovaries or tubes produce sterility.

(3) Local diseases: (1) Hyperaesthesia of vagina, prolapse of uterus or bladder and vulval and vaginal tumours produce temporary

impotence. (2) Gonorrhoea involving cervix, uterus, ovaries or tubes, diseases of ovaries and tubes, disorders of menstruation, rectovaginal fistula, leucorrhoea may cause sterility.

(4) General diseases: (1) As woman is passive agent, general diseases do not cause impotence. (2) Occupational exposure to lead and exposure to X-rays cause sterility.

(5) Psychic causes: (1) **Vaginismus is a spasmotic contraction of vagina due to hyperaesthesia causing active impotence.** (2) It is classical example of psychosomatic illness. (3) It may affect perineal muscles exclusively or may be felt as constriction of levator ani right up to vaginal fornices. (4) There is definite cramp-like spasm of adductor muscles. These muscle groups contract spastically. (5) **Hysterical hyperaesthesia co-exists with this condition,** which starts at vaginal introitus, but in extreme cases it may be present all over the vulva. (6) The spastic contraction of vaginal outlet is completely involuntary reflex, caused by imagined, anticipated or real attempts at vaginal penetration. (7) In a fully developed state, vaginal outlet is severely constricted and penetration by penis is impossible. (8) It can occur with equal severity in the woman who has borne children or in a virgin. (9) The **aetiological factors** are: (1) Male sexual dysfunction. (2) Specific episodes of prior sexual trauma. (3) Secondary to dyspareunia. (4) Rarely, personal dislike or general feeling of disgust at idea of coitus.

ARTIFICIAL INSEMINATION: It is artificial introduction of semen into vagina, cervix or uterus to produce pregnancy.

Types: (1) Homologous (semen of woman's husband is used (A.I.H.). (2) Donor (semen of any person other than husband is used (A.I.D.). (3) Pooled (semen of husband + semen of some other person (A.I.H.D.).

One ml. of semen is deposited by means of a syringe in or near cervix on several successive days, about the time of ovulation. Success rate is 70 to 75% within 3 to 4 months.

Indications: (1) Husband impotent. (2) Epispadiasis or hypospadiasis. (3) Husband sterile. (4) Rh incompatibility between husband and wife. (5) Husband suffering from hereditary diseases.

Precautions: (1) Consent of donor and his wife. (2) Identity of donor kept secret. (3) Donor should not know to whom semen is donated and its result. (4) Donor should be mentally and physically healthy. (5) Donor must not be relative of either spouse. (6) Race and characteristics of donor should resemble husband of woman. (7) Consent of woman to be inseminated and her husband in writing. (8) Pooled semen to be used. (9) Witness must be present.

Legal problems: (1) Parties not guilty of adultery. (2) Child becomes illegitimate. (3) Not a ground for nullity of marriage or divorce. (4) Risk of incest between children born of A.I. and children of donor.

CHAPTER 14

VIRGINITY, PREGNANCY AND DELIVERY

VIRGINITY : Virgin (virgo intacta) is a female who has not experienced sexual intercourse. Defloration means loss of virginity.

Genitals: (1) In a virgin, labia majora are thick, firm, elastic and rounded, lie in apposition and close vaginal orifice. (2) The labia minora are within labia majora. (3) Clitoris is small and vestibule narrow. (4) The posterior commissure and fourchette are intact. (5) Vagina is narrow and tight, mucosa is rugose, reddish, sensitive and walls are approximated. (6) The hymen is a fold of mucous membrane about one mm. thick, situated at vaginal outlet. The average adult hymen consists of folds of membrane. Hymen is intact. (7) The **types of hymen are :** (a) Semilunar or crescentic. (b) Annular. (c) Infantile. (d) Cribriform. (e) Vertical. (f) Septate. (g) Imperforate. (8) The margins of hymen are sometimes fimbriated, which may be mistaken for artificial tears. (9) **Natural notches** are usually (a) symmetrical, (b) occur anteriorly, (c) do not extend to vaginal wall, (d) covered with mucous membrane. (10) **Tears** caused by sexual intercourse or by foreign body are (a) usually situated posteriorly at one or both sides, or in midline, (b) usually extend to vaginal wall, (c) not covered with mucous membrane.

Causes of rupture of hymen : (1) Accident, e.g. fall on projecting substance. In these cases tearing of perineum occurs. (2) Masturbation. (3) Surgical operation. (4) Foreign body, e.g. sola pith. (5) Ulceration from diphtheria, fungus, etc. (6) Scratching due to irritation. (7) Sanitary tampons.

M.L. aspects : (1) Diagnosis of virginity is difficult. (2) Important signs are (a) Intact hymen. (b) Normal fourchette and posterior commissure. (c) Narrow vagina with rugose walls. These signs taken together may be regarded as evidence of virginity. (3) **The presence of unruptured hymen is a presumption, but is not an absolute proof of virginity.** (4) The hymen is usually ruptured at the time of first coitus, and at first has a torn appearance. (5) Hymen may not be ruptured even after repeated acts of coitus if it is loose, folded and elastic, or thick, tough and fleshy, which permit displacement, change of shape and stretching without rupture.

PREGNANCY : It results when ovum is fertilised by a sperm resulting in an embryo and foetus. It occurs usually between 14 to 45 years. **It has to be determined :** (1) when woman pleads pregnancy to avoid attendance in Court, (2) to avoid execution, when sentenced to death, (3) to claim succession to property, if husband dies, (4) to assess damages in seduction, (5) blackmails a man pleading pregnancy to compel marriage, (6) libel or slander of unmarried woman or widow, that she is pregnant, (7) to secure greater compensation when her husband dies due to negligence of some person, (8) in case of alleged concealment of birth and infanticide.

Diagnosis : (I) Presumptive signs : (1) **Amenorrhoea** is earliest and most important. (2) **Breast** changes are characteristic in primigravidae. (a) Breasts increase in size and become nodular after second month. (b) Superficial veins become more distinct, nipples more pigmented and more erectile. (c) Montgomery's tubercles are formed. (d) **Colostrum** is secreted in third month. (3) **Morning sickness** appears about end of first month and disappears 6 to 8 weeks later. (4) **Quickening :** From 16 to 20 weeks woman feels slight fluttering movements in her abdomen due to foetal movements. (5) **Pigmentation of skin :** Linea nigra is a dark line extending from pubis to umbilicus. (6) **Jacquemier's sign :** Mucosa of vagina changes from pink to violet deepening to blue due to venous obstruction after fourth week. (7) **Frequent micturition** during early weeks, and few weeks before term. (8) Easy fatigue. (9) **Salivation, prevented appetite.**

Difference between virginity and defloration.

Trait	Virginity	Defloration
(1) Hymen:	It is intact; the edges are distinct and regular with a narrow opening hardly allowing a small finger to pass.	It may be torn or intact; in the latter case it is loose, elastic, with a wide opening allowing passage of two or more fingers.
(2) Labia majora :	They are apposed to each other, fully developed and completely close the vaginal orifice.	They are not apposed to each other, not prominent and at the lower end vaginal orifice may be seen.
(3) Labia minora :	They are in contact and are covered by labia majora.	They are not in contact and are exposed and separated from labia majora.
(4) Fourchette :	Intact.	Torn or intact.
(5) Fossa navicularis:	Intact.	Disappears.
(6) The vagina :	It is narrow, the rugae more folded, and the vault more conical.	After repeated intercourse it usually grows in length, and the rugae are less obvious.

(II) Probable signs : (1) **Enlargement of abdomen** occurs gradually after 12 weeks. (2) Uterus fills pelvis by end of third month; at fifth month midway between symphysis and umbilicus; end of six months at umbilicus; midway between umbilicus and xiphoid at seventh month; at xiphoid by end of eighth month. (3) By 7 months, umbilicus becomes level with skin. (4) Red-coloured subcutaneous scars become visible over front of abdomen. (2) **Hegar's sign:** It is positive about sixth week. If one hand is placed on abdomen and two fingers of other hand in vagina, firm hard cervix is felt, and above it elastic body of uterus, and between the two isthmus is felt as a soft compressible area. This is the most valuable physical sign of early pregnancy. (3) **Cervix :** From second month, cervix progressively

softens from below upwards which is well marked by four months. This is known as "**Goodell's sign**". (4) **Intermittent uterine contractions** are easily felt after fourth month; each contraction lasts for one minute and relaxation for 2 to 3 minutes. (5) **Ballottement** : It is positive during fourth and fifth months. If sudden motion is imparted to abdominal wall, the rebound of foetus can be felt in a few seconds. (6) **Uterine souffle** is a soft blowing murmur, which is synchronous with pulse of mother. It is heard by auscultation just above inguinal ligament at end of fourth month. (7) **Biological tests** are based on reaction of test animals to chorionic gonadotropins contained in blood or urine. (8) **Immunological tests** are based on presence of chorionic gonadotropin and chorionic somatomammotropin. (1) Inhibition (indirect) latex slide test. (2) Direct latex slide test. (3) Radioimmunoassay. (4) ELISA test.

(III) **Positive signs:** (1) **Foetal parts** can be identified by 36 weeks, and foetal movements can be felt by 24 weeks. (2) **Foetal heart sounds** are heard between 18 to 20 weeks. The rate is about 160 at fifth and 120 at ninth month. Heart sounds are not heard: (a) when foetus is dead, (b) when liquor amni is excessive, (c) abdominal wall is very fat, (d) before 18 weeks of pregnancy. (3) **X-ray exam :** (1) Foetal parts are detected at about 15 to 16 weeks. (2) The shadows of skull, vertebral column, ribs and limbs can be seen. (3) Signs of foetal death are: (a) **Spalding's sign**. (b) Collapse of spinal column. (c) Presence of gas in heart and great vessels. (4) **Sonography :** Gestational ring is seen by 6 weeks; distinct echoes from the embryo within gestational ring by 7 weeks; foetal heart beat by 10 weeks and foetal head and thorax by 14 weeks.

PSEUDOCYESIS (spurious pregnancy): (1) It is usually seen in patients nearing menopause or in younger women who intensely desire children. (2) **Most women suffer from some form of psychic or hormonal disorders.** (3) Such patients may present all subjective symptoms of pregnancy and increase in size of abdomen due to deposition of fat, or tympanites. (4) The woman may imagine foetal movements. (5) In some cases, pregnancy had gone to full term and frank labour pains occurred, which stopped abruptly when patients

were told they were not pregnant. (6) Clinical and X-ray examination will solve the problem. (7) In rare cases, pregnancy may go as far as full term, without the woman knowing it.

Average period of pregnancy is 280 days from first day of last menstrual period, so that actual period is about 270 days. Children born after 210 days are **viable**, i.e. are born alive and able to survive.

Posthumous child is one born after death of its father, the mother being conceived by the said father. Legal issues involved are legitimacy, inheritance of property, and compensation case for slander against mother.

SUPERFECUNDATION : (1) It means fertilisation of two ova discharged from ovary at the same period by two separate acts of coitus committed at short intervals. (2) The incidence of twin pregnancy is about one-and-half percent, of which 70% are binovular twins, resulting from separate fertilisation of two ova. (3) Development of twins in uterus is parallel but not equal, depending on relative blood supplies. (4) Both ova do not always develop to maturity. (5) One foetus may be aborted early or die. (6) The dead foetus may be flattened by pressure and is referred to as **foetus compressus** or **foetus papyraceus**. (7) The spermatozoa causing fertilisation may be from different men. (8) The rare cases where two ova are fertilised by a white and black person, or persons with entirely different blood groups are the only certain examples of this condition.

SUPERFOETATION : (1) This means fertilisation of a second ovum in a woman who is already pregnant. (2) Later, two foetuses are born either at same time showing different stages of development, or two fully developed foetuses are born with interval of one to three months. (3) Cases where a second fully developed child was born a considerable time after the first have been explained on the assumption of twin pregnancy. (4) It is not only possibility but a reality. (5) Its occurrence in a bipartite or double uterus is certainly possible.

Legitimacy : A child is legitimate if born during continuance of legal marriage, or within 280 days after dissolution of marriage by divorce or death. A child is **illegitimate or bastard** if alleged father is

: (1) under age of puberty, (2) physically incapable to beget children, (3) did not have access to his wife during time the child was begotten, (4) blood groups of child and alleged father are not compatible.

AFFILIATION CASES : (1) A woman may allege a particular man to be father of her illegitimate child. (2) A first class magistrate can sanction a monthly allowance of any sum for maintenance of the child depending on the circumstances of the case, if the paternity is fixed. (3) In such cases blood group tests are useful, and DNA fingerprinting is conclusive.

SUPPOSITITIOUS CHILDREN : (1) It means fictitious children. (2) A woman may pretend pregnancy and delivery and later produce a child as her own, or she may substitute a male child for female child born of her, or for abortion. (3) In such cases, the woman should be examined for signs of pregnancy and delivery, and the age of child determined. (4) This is done for extorting money or for the purpose of claiming property. (5) The medical evidence is useful only when the age of the supposititious child does not correspond to the date of pretended delivery. (6) DNA fingerprinting will be conclusive.

ATAVISM: (1) **The child does not resemble its parents, but resembles its grand parents.** (2) This is due to inheritance of characteristics from remote instead of from immediate ancestors, due to chance recombination of genes. (3) Any mental or physical characteristic or tendency or disease peculiar to a remote ancestor may be inherited.

DELIVERY : It means expulsion or extraction of child at birth.

Signs of recent delivery in living : (1) Woman is pale, exhausted, ill-looking with slight fever. (2) Breasts are full, enlarged, tender and contain colostrum or milk. (3) Abdominal walls are pendulous, relaxed, wrinkled and show striae gravidarum, especially in flanks, which appear as irregular, pink, subcutaneous scars. (4) Upper part of uterus lies about 3 cm. below umbilicus soon after delivery. It goes down by 1.5 cm. per day. On sixth day it is between umbilicus and pubis, and returns to normal condition in nine weeks. (5) Labia are tender, swollen, bruised. (6) Vagina is smoothwalled, relaxed, capacious. (7) Perineum may be lacerated. (8) Cervix is soft, canal dilated, edges torn and lacerated. Internal os begins to close in 24

hours. External os is soft, admits two fingers; one finger is admitted at end of week and is closed in two weeks. (9) **Lochia** : It is a discharge from uterus which lasts for 2 to 3 weeks. During first 4 to 5 days, it is bright red and contains large clots (**lochia rubra**); next four days serous and pale (**lochia serosa**). After ninth day it is yellowish-grey or turbid (**lochia alba**). (10) Intermittent uterine contractions are present for 4 to 5 days.

Recent delivery in dead : (1) All local signs are present as in living. (2) Placental site appears as irregular, nodular, elevated area, 15 cm. in diameter; 4 cm. at end of second week, and 1 to 2 cm. at end of six weeks. Corpus luteum is found in one of the ovaries.

CHAPTER 15

SEXUAL OFFENCES

RAPE

S. 375, I.P.C.: A man is said to commit “rape” if he:

- (a) penetrates his penis, to any extent, into the vagina, mouth, urethra or anus of a woman or makes her to do so with him or any other person; or
- (b) inserts, to any extent, any object or a part of the body, not being the penis, into the vagina, the urethra or anus of a woman or makes her to do so with him or any other person; or
- (c) manipulates any part of the body of a woman so as to cause penetration into the vagina, urethra, anus or any part of body of such woman or makes her to do so with him or any other person; or
- (d) applies his mouth to the vagina, anus, urethra of a woman or makes her to do so with him or any other person, under the circumstances falling under any of the following seven descriptions:
 - (1) Against her will,
 - (2) Without her consent.
 - (3) With the consent, when her consent has been obtained by putting her or any person in whom she is interested, in fear of death or of hurt.
 - (4) With her consent, when the man knows that he is not her husband and that her consent is given because she believes that he is another man to whom she is or believes herself to be lawfully married.

(5) With her consent when, at the time of giving such consent, by reason of unsoundness of mind or intoxication or the administration by him personally or through another of any stupefying or unwholesome substance, she is unable to understand the nature and consequences of that to which she gives consent.

(6) With or without her consent, when she is under 18 years of age.

(7) When she is unable to communicate consent.

Sexual intercourse by a man with his own wife above 15 years is not rape.

Punishment: Rigorous imprisonment of not less than seven years, but may extend to life and also fine.

S.354-A, I.P.C.: Sexual harassment: (1) Physical contact and advances involving sexual overtures, (2) a demand or request for sexual flavours, (3) making sexually coloured remarks, (4) forcibly showing pornography, (5) any other unwelcome physical, verbal or nonverbal conduct of sexual nature (for offences of 1 & 2 imprisonment up to 5 years, or with fine or both; for 3, 4 and 5 imprisonment of one year or with fine or with both).

S.354-B, I.P.C.: Assault or use of criminal force to woman with intent to disrobe in public and even in private if force is used (imprisonment of not less than 3 years, may extend to 7 years and fine).

S.354-C, I.P.C.: Voyeurism: Imprisonment of not less than one year, may extend to 3 years and fine; for second and subsequent offences imprisonment of 3 to 7 years).

S.354-D, I.P.C.: Stalking: Whoever follows a person and contacts or attempts to contact such person to foster personal interaction repeatedly, despite a clear indication of disinterest by such person, or whoever monitors the use by a person of the internet, e-mail or any other form of electronic communication, or watches or spies on a person in a manner that results in a fear of violence or serious alarm or distress in the mind of such person, or interferes with the mental peace of such person, commits the offence of stalking (imprisonment of not less than one year, may extend to 5 years, and fine).

S.370, I.P.C.: Trafficking of person: Whoever for the purpose of exploitation (a) recruits, (b) transports, (c) harbours, (d) transfers,

(e) receives a person, by (1) using threats, (2) using force or coercion, (3) by abduction, (4) by fraud or deception, (5) by abuse of power, (6) by inducement, including giving payments or benefits, commits the offence of trafficking (imprisonment for 7 to 10 years).

S. 509, I.P.C.: Whoever intending to insult the modesty of any woman, utters any word, makes any sound or gesture, or exhibits any object, intending that such word or sound shall be heard, or that such gesture or object shall be seen by such woman, or intrudes upon the privacy of such woman, shall be punished with simple imprisonment up to 3 years and fine.

Statutory rape : It is normal physiologic intercourse with a girl below the age of 18 years even with her consent.

Custodial rape : Rape committed on woman in the custody of (1) police officer, (2) public servant, (3) management or staff of jail, (4) management or staff of hospital. Imprisonment not less than ten years or for life.

Rape on pregnant woman, or on a child below 12 years, or gang rape is punishable with imprisonment for ten years or for life.

Valid consent : (1) A female of 18 years and above can give valid consent, which must be free, voluntary, while she is of sound mind and not intoxicated. (2) Consent should be obtained prior to the act. (3) Even a prostitute cannot be forced to have intercourse against her will.

Consent is invalid when obtained by (1) fraud (impersonation of husband or misrepresentation of facts), (2) putting her or any person in whom she is interested in fear of death or hurt, (3) intoxicated or insane, or unconscious person, (4) below 18 years of age.

What constitutes rape? (1) Signs of resistance (struggle) are the chief evidence of absence of consent. (2) **The slightest penetration of penis within vulva (labia minora), with or without emission of semen or rupture of hymen constitutes rape.** (3) **Rape can be committed even when there is inability to produce erection of penis (impotent person).** (4) Rape can only be committed by a man; woman cannot rape a man, although she may be guilty of indecent assault upon him. (5) In India, there is no age limit under which a boy is considered physically incapable of committing rape. (6) No age of female is safe from rape.

Exam. of victim : Objects of examination are : (1) To search for physical signs, that will corroborate history given by victim. (2) To collect physical evidence. (3) To treat victim for injuries and against venereal diseases or pregnancy.

History : The history given by victim is recorded. (1) preliminary affairs, (2) date, time and place of offence, (3) exact relative positions of parties, (4) details of struggle or resistance, (5) any pain experienced, (6) ejaculation occurred or not, (7) appearance of any discharge, (8) bleeding from vagina, (9) calls for help, (10) events after assault, (11) whether consciousness was lost at any time. (12) time of first complaint. The degree of agreement of various statements will be strong proof of their truth or contrary.

Consent : (1) **The victim** should be examined only if there is a requisition from police or Court. (2) She cannot be examined without her consent. (3) Consent of guardian is necessary if she is insane or under 12 years.

Clothes are examined for blood and seminal stains, mud or grass stains, etc., soiling, tears and loss of buttons, etc. Foreign hair, fibres, etc., must be preserved.

General exam : Marks of violence may be found : (1) about mouth and throat, (2) about wrists and arms, (3) about inner sides of thighs and knees, (4) on back, (5) on breasts (bites). Damaged fingernails should be noted, and debris under nails should be removed and examined for epidermal cells, blood, fibres, etc.

Rape on virgin : (1) **Rupture of hymen occurs with first intercourse, which is the main evidence of rape.** The character and extent of injury depends upon : (a) nature of hymen, (b) disproportion between male and female parts, (c) extent of penetration, (d) amount of force used. (2) **Tearing usually occurs posteriorly at the sides, between 4 and 8 O' clock position,** or in midline. Several hymenal lacerations indicate first sexual intercourse. (3) **Margins of torn hymen are sharp and red which bleed on touch.** (4) After 3 to 4 days, edges are congested and swollen, which heal in one week, but do not unite. (5) **Rupture can be caused by fingers or foreign bodies, as such evidence of local injury is not proof of penetration.** (6) In absence

of hymenal tearing, usually there is abrasion and bruising of hymen and vaginal orifice. (7) For close examination of hymen (a) a glass rod with a small spherical head should be passed through hymenal orifice and passed round posterior surface of hymen, due to which edges are slightly everted, (b) finger is passed into rectum above perineal body, and posterior vaginal wall is pushed forwards and downwards, due to which hymen is clearly seen. (8) Fingernail scratches may be present on labia. (9) **Labia may be red and inflamed with slight oedema of vaginal introitus.** (10) Bruising and laceration of external genitals may be present with redness, swelling and inflammation. (11) Posterior commissure often ruptures. (12) Fourchette often tears and fossa navicularis disappears. (13) Bruising of vagina is frequently seen on anterior vaginal wall in lower third, and on posterior wall in upper third. (14) Laceration of vaginal wall or vault is rare, but occurs posteriorly if there is considerable disproportion between penis and vagina. (15) If there are no fresh injuries, vaginal exam. should be carried out. **Digital exam may show :** (a) areas of pain and tenderness in vagina, (b) some laxity of vaginal orifice (indicating previous penetration), (c) elongation of posterior fornix (indicating previous sexual intercourse), (d) number of fingers that can be introduced through hymenal orifice. (16) In most young women one finger may be inserted into vagina although hymen is intact. (17) Vaginal exam. helps to assess elasticity of hymen, and to determine degree of penetration which could be possible without its rupture. (18) If the vaginal opening is enough to admit two fingers easily, the possibility of sexual intercourse having taken place may be inferred.

Rape on deflorate women : (1) In deflorate women hymen is completely destroyed, vaginal orifice dilated, mucous membrane wrinkled and thickened. In such women, **complete penetration can occur without any evidence except semen.** (2) **In married women marks of violence to genitalia are less likely**, but may be seen if intercourse is violent. (3) **In case of resistance vagina may show laceration or bruising, and swelling and inflammation of vulva.** (4) Tearing or perforation of vagina may occur when it is thin or fragile. (5) **Presence of violence in other parts of body is chief evidence of rape.**

Rape on children : (1) Signs of general violence are not seen. (2) Usually penis is placed either within vulva or between thighs, as such hymen is intact, and there may be little redness and tenderness of vulva. (3) If violence is used and penis penetrates deeper, hymenal tear extends into or through the perineal body and often involves wall of anorectal canal. (4) Full vaginal penetration produces bruising of vaginal wall and tears of anterior and posterior vaginal walls. (5) Anterior tears can involve bladder. (6) Vaginal vault may rupture and there may be vaginal herniation of abdominal viscera.

Corroborative signs : (1) Presence of sperms in vagina is proof of sexual intercourse. (2) If assailant is suffering from venereal disease, he may transmit it to victim. (3) In gonorrhoea, an inflammation with muco-purulent discharge will be seen in 2 to 4 days. (4) In syphilis an indurated ulcer on external genitals may appear in three weeks. (5) Signs of struggle.

Time of rape can be determined from : (1) Wounds on victim. (2) Sperms in vagina. (3) Venereal disease in victim.

Rape is not a medical diagnosis, it is only a legal definition. **Medical proof of intercourse is not legal proof of rape.** The doctor should never make a diagnosis of rape.

Opinion : There are signs of recent vaginal penetration/recent sexual intercourse/general physical injury and /or intoxication and that the signs are consistent with the history given by the victim.

Dangers of rape : (1) Death may occur from : (a) shock due to fright, emotion, or blunt force, (b) haemorrhage from injuries, (c) suffocation if mouth and nose are closed by hands or throttling. (2) Mental derangements. (3) Disruption of victim's physical, social and sexual life.

False charges : They can be disproved by (1) medical evidence, (2) inconsistencies in statements of victim, (3) uncertainty as to consent, (4) lack of corroboration.

Exam. of accused : (1) Consent. (2) No delay. (3) Identification marks. (4) Time, date, place of exam, etc. (5) Age, development of genitals and physical development. (6) **General history taken, but specific history omitted.** (7) Mental state and general behaviour. (8) Influence of alcohol and drugs. (9) Exam. clothes for (a) tears

and loss of buttons, (b) hair, fibres and foreign matter, (c) cosmetic contact traces, (d) blood stains, (e) seminal stains, (f) mud and other stains, grass, etc. (10) Nail scrapings. (11) Matting of pubic hair. (12) Female hair on body and clothes. (13) Presence of V.D. (14) Marks of struggle. (15) **Genitals** : (a) Development of genital organs. (b) Note any scratches, abrasions or bruises caused by the victim. Tears or bruising of frenulum of prepuce in uncircumcised and abrasion of glans penis (usually rape on a child) in both circumcised and uncircumcised. (c) Penis is washed with saline, and material stained with Papanicolaou's stain. Vaginal and cervical cells and Barr bodies suggest recent intercourse. (d) Glans is cleaned with a filter paper, which is exposed to vapours of Lugol's iodine. The paper becomes brown if vaginal epithelial cells are present, because of glycogen. (e) In uncircumcised person absence of **smegma** (secretion of sebaceous glands) may indicate that intercourse might have been performed, but presence of smegma negatives possibility of complete penetration. Smegma usually requires 24 hours to collect.

M.L. Aspects : (1) Usually, it is not possible for man to have sexual intercourse with a healthy adult female in full possession of her senses against her will. (2) Rape may be committed without knowledge of woman while she is under influence of narcotics, anaesthetic, coma and possibly in hypnotic trance. (3) It is impossible to have complete sexual intercourse with a woman during her natural sleep without her knowledge. (4) Rape by impersonation of husband is possible when woman is sleeping. (5) Rape by fraud or misrepresentation are rare.

INCEST : (1) **Incest is sexual intercourse by a man with a woman, who is closely related to him by blood**, e.g. daughter, grand daughter, sister, step sister, aunt or mother, etc. (2) Instances between brother and sister, and father and daughter are common. (3) These cases usually have psychological features. (4) Incest occurs (a) between mental defectives, (b) under influence of alcohol, (c) cerebral disease, e.g. G.P.I., cerebral degeneration, etc., (d) where a brother and sister separated in childhood and meet later as strangers. (4) **In India, it is not a punishable offence.**

UNNATURAL OFFENCES : Voluntary sexual intercourse against order of nature with any man, woman, or animal is **unnatural sexual offence (S.377, I.P.C.)**. Punishment is imprisonment for up to 10 years or life. **Homosexuality** means persistent emotional and physical attraction to members of the same sex.

SODOMY : (1) Sodomy is the anal intercourse between two males or between a male and female. It is also called **buggery**. It is called **gerontophilia** when passive agent is an adult and **paederasty**, when passive agent is young boy, who is known as **catamite**. (3) A **pedophile** is an adult who repeatedly engages in sexual activities with children below the age of puberty. (4) It is sometimes called **Greek love**. (5) Any degree of penetration or any attempt at penetration are punishable. (6) When passive agent consents, both are punishable, but when it is done without consent only active agent is punishable. (7) False charges may be made for blackmail.

EUNUCH: In India, male prostitutes called '**eunuchs**', act as passive agents in sodomy. They grow long hair, dress like women, wear ornaments and adopt most of habits of women. Among them there are two groups who live separately : (1) **Hijrahs**, are those who have been castrated before puberty. When the wound heals, external genitals resemble superficially those of female. They develop feminine characters due to the resulting hormonal imbalance. (2) **Zenana** are those in whom genitals are intact.

Passive agent : Obtain consent and history of circumstances and nature of act. (1) Anal muscle is dilated, irritable and tender. (2) Loss of elasticity and tone of anal muscle. (3) Haematoma as a diffuse swelling of anal margin or localised. (4) Linear abrasions extending from anal margin into anus. (5) There may be triangular bruised tear at posterior margin. (6) Anal fissures. (7) Tearing of sphincter ani is rare. (8) Anal prolapse. (9) Blood stains and faecal matter around anus. (10) Lubricant matter, seminal fluid or venereal infection found at anus. (11) **The presence of combination of semen, faeces, soft paraffin, and pubic hair on clothes is almost diagnostic of sodomy.** (12) **Only proof of sodomy is presence of semen in anus.** (13) **Opinion** as to cause of dilation should be guarded; it should be stated that opinion is consistent with entry of penis.

Habitual passive agent : (1) Shaving of anal hair. (2) Skin about anus smooth, thickened. (3) Depression of buttocks towards anus. (4) Loss of tone of anal muscle. (5) Dilatation and laxity of anus. (6) Anal fissures, scars, etc. (7) Absence of fine wrinkles in anal mucosa. (8) Presence of V.D.

Active agent : (1) Peculiar smell of anal glands transferred to penis, and traces of faecal matter and lubricant on penis. (2) Abrasions on prepuce, glans penis, or tearing of fraenum. (3) Penis may be elongated and constricted at some distance from glans. (4) Blood and seminal stains. (5) Presence of V.D. (6) Marks of violence on body.

BUCCAL COITUS (coitus per os or sin of Gomorrah) : (1) The penis is introduced into mouth, usually of a young child. (2) Rarely faint teeth marks and abrasions may be seen on penis. (3) Death may result from aspiration of semen or impaction of penis in hypopharynx. (4) Semen may be found in respiratory tract or stomach. (5) Buccal swabs may show sperms up to nine hours. (6) It is punishable offence.

TRIBADISM (Lesbianism): (1) It is female homosexuality. (2) Sexual gratification of woman is obtained by another woman by simple lip kissing, generalised body contact, deep kissing, manual manipulation of breasts and genitalia, genital apposition, etc. (3) In some cases enlarged clitoris is used as an organ of passion, or some artificial penis or phallus may be used. (4) Many lesbians are masculine in type, possibly because of endocrine disturbances. (5) It is usually indulged in by women who are mental degenerates or those who suffer from nymphomania (excessive sexual desire). (6) They are morbidly jealous of one another, and when rejected may commit homicide, suicide or both. (7) It is not an offence in India.

BESTIALITY : (1) Bestiality is sexual intercourse by a human being with a lower animal, usually kept on farm or pets in households. (2) Calves and sheep are often involved. (3) Chicken, ducks and geese are also involved. (4) Other animals are cows, mares, she-asses and bitche. (5) Vaginal intercourse is common, but anus may be used. (6) Dogs or cats are common animals for females. (7) Usually the animal manipulates the genitalia with its mouth and actual coitus is very rare.

In **accused** findings may be : (1) Animal faeces, vaginal secretion or hair may be present on penis. (2) Tearing of fraenum. (3) Animal hairs on person or clothes. (4) Stains of dung or animal blood on clothes. (5) Injuries due to kicks, teeth or claws of animals.

Animal : (1) Human sperms in vagina. (2) Abrasions and lacerations on external genitals. (3) Gonorrhoeal discharges.

SEXUAL PERVERSIONS (deviation) : (1) **They are persistently indulged sexual acts, in which complete satisfaction is sought and obtained without sexual intercourse.** (2) **Paraphilia** is abnormal and unorthodox sex play by using unusual objects or parts of the body. (3) **Uranism** is general term for perversion of sexual instinct.

SADISM (active algolagnia): (1) **Sexual gratification is obtained or increased from acts of physical cruelty or causing pain upon one's partner**, which is common in men. (2) To obtain sexual pleasure, sadist may bite, beat, whip, produce cuts, etc. or ill-treat or torture his sexual partner in many other cruel ways. (3) Extremely sadistic attacks may be made in which the victim's nipples may be bitten off, articles such as bottles, candles or sticks are inserted into the vagina, cigarettes or lighters may be used to burn the skin, and blows which may rupture internal organs or cause fractures of bones. (4) Many are sociopathic, some schizoid and others inadequate personalities.

LUST MURDER : In extreme cases of sadism, murder serves as stimulus for sexual act and becomes equal of coitus, the act being accompanied by erection, ejaculation and orgasm. It is characterised by : (1) Periodic outbreaks. (2) Cutting or stabbing of breasts, genitalia or lower abdomen with sucking, licking or mouthing of wounds and biting of skin. (3) Sometimes, sexual intercourse with dying or injured victim. (4) Normal behaviour until next outburst. Mental disease is very common.

NECROPHAGIA : This is extreme degree of sadism in which the person after mutilating the body sucks or licks wounds, bites skin, drinks blood and eats flesh of his victim to derive sexual pleasure.

MASOCHISM (passive algolagnia): (1) This is opposite of sadism. Sexual gratification is obtained or increased by suffering of pain. (2) Masochists get pleasure by being beaten, tortured, abused, humiliated, degraded or dominated by their sexual partner, and they tend to place themselves repeatedly in self-defeating situations. (3) Such painful stimuli may entirely replace ordinary sex stimuli. (4) It is usually found in males, but is also seen in females. (5) Sadism and masochism are usually found as combination, with one type dominant over other. (6) The combining of these practices is called bondage. (7) They are found in all age groups and in all socio-economic levels.

NECROPHILIA : (1) In this, there is desire for sexual intercourse with dead bodies. (2) It is said to have sado-masochistic foundation and that decomposition, foul smell and coldness act as stimulants. (3) There is also no danger of rejection or resistance. (4) It is usually committed on a newly buried corpse or body awaiting burial. (5) The corpse may be mutilated following intercourse. (6) Necrophilia and necrophagia are punishable with imprisonment up to one year.

FETICISM: (1) The person experiences sexual excitement leading to orgasm, from parts of body of a woman or some article belonging to her, that normally has no sexual influence on mind, e.g. underclothing, brassiere, petticoat, stocking, shoes, etc. which acts as substitute for female love object. (2) The fetish may be only incidentally associated with human body, e.g. a flower. (3) In some cases a picture of fetish object provides sufficient stimulus. (4) Sometimes the act of stealing the article or touching it provides adequate sexual satisfaction. (5) It is almost exclusively seen in males. (6) They rarely commit violence or murder.

TRANSVESTISM (Eonism) : (1) It is usually found in males who obtain sexual pleasure by wearing female dress. (2) Whole personality is dominated by the desire to be identified with the opposite sex. (3) His dress, manners, occupational interests and associations are all designed to increase his feelings of being a woman. (4) There are varying degrees. (5) Sexuality with him is relatively unimportant. (6) Only small percentage are homosexuals.

(7) There is no hormonal disturbances or genital abnormality. (8) Psychologically, it may depend upon an individual's erotic attraction for opposite sex. (9) Many cases are associated with sado-masochism.

Sexual oralism is the obtaining of **sexual pleasure from application of mouth to sexual organs**. It is a common perversion both heterosexual and homosexual. **Fellatio** is the oral stimulation or manipulation of penis, either by male or female. **Cunnilingus** is oral stimulation of female genitalia.

MASTURBATION (onanism; ipsation): (1) is the deliberate self-stimulation, which affects sexual arousal. (2) In males, techniques are largely manual, by moving penis against a bed or other object. Hollow articles like bottles, test tubes, etc. may be used, or articles made of rubber or elastic which simulate female genitalia are used. (3) (a) In females, finger is gently and rhythmically moved over clitoris or labia minora, or steady pressure is applied over these parts with several fingers or whole hand. (b) Genitalia may be rubbed against a pillow or bed. (c) Sometimes fingers, wooden rods, glass tubes, metallic bars, etc. or artificial masculine genital parts made of rubber or plastic may be inserted into vagina. (4) **It is an offence only when practiced openly e.g. in telephone booths, lavatories, etc.**

EXHIBITIONISM : (1) It is wilful and intentional **exposure of genitalia in a public place in presence of others, to obtain sexual pleasure**. (2) It may or may not be accompanied by masturbatory acts. (3) It is done mostly by males, often to children or persons of opposite sex. (4) The act is impulsive and spontaneous. (5) Occasionally, women may expose in public. (6) Most of them are psychopathic or suffer from compulsion neuroses. (7) It is an obscene act under S. 294, I.P.C. with **imprisonment up to 3 months or fine**.

VOYEURISM (scopophilia): (1) It is the counterpart of exhibitionism. (2) **The voyeur (Peeping Tom) must see people undress to be sexually satisfied**. (3) The perversion is in the sexual dependence upon "looking", "seeing". (4) There is morbid desire to look at sexual organs or other usually clothed parts of body of one of the opposite sex, or to watch sexual intercourse as a source of sexual gratification. (6) It occurs in severe sociopathic personality disorder. (7) Usually, such persons do not commit a major sex crime. (8) It is rare in females.

Troilism is an extreme degree of voyeurism. It is sexual practice involving 3 persons, 2 of one sex and one of the opposite sex. A perverted husband gets sexual satisfaction by inducing his wife to sexual intercourse with another man and by watching the same.

FROTTEURISM : (1) It is contact with another person to obtain sexual gratification. (2) Sexual satisfaction is obtained by rubbing against persons in crowds. (3) It is uncommon and rarely occurs alone.

UNDINISM : Sexual pleasure is obtained by witnessing the act of urination by some one of same or opposite sex.

PYROMANIA : Sexual satisfaction is obtained by seeing flames and destruction of buildings.

INDECENT ASSAULT : (1) It is any offence committed on a female, with the intention or knowledge to outrage her modesty. (2) Usually, the act involves sexual parts of either or is sexually flavoured. (3) A man may kiss a woman, press breasts, touch or expose genitalia, or put a finger in vagina, play with vulva, etc. (4) Stripping naked a woman for medical exam. is regarded as assault. (5) He may attempt at exhibitionism or masturbation. Indecent offences between two males include (a) friction of penis on gluteal folds, (b) handling of male parts, (c) mutual masturbation. (6) Such assaults are punishable under S.354, I.P.C. with imprisonment up to two years.

SEMINAL FLUID : Dry stains have a greyish-white or yellow-grey colour. They stiffen cloth. When examined under filtered U.V. light, a bluish-white fluorescence is seen, which is not specific.

Florence test : (1) The stain is extracted by one% hydrochloric acid. (2) A drop is put on a glass slide and allowed to dry. (3) A coverslip is put over this and a drop of Florence solution (potassium iodide) is allowed to run under coverslip. (4) If semen is present, dark-brown crystals of choline iodide appear immediately. (5) They are rhombic, resembling haemin but are larger, arranged in clusters, rosettes, crosses, etc. (6) Choline originates from seminal vesicles. (7) It is not specific. (8) Negative reaction excludes semen.

Barberio's test : A saturated aqueous or alcoholic solution of picric acid when added to spermatic fluid, produces yellow needle -

shaped rhomboid crystals of spermine picrate. Reaction depends on presence of prostatic secretion.

Acid phosphatase test : (1) Seminal fluid contains much higher percentage of acid phosphatase than any other body fluid. (2) In humans it is greater than animals. (3) Undiluted semen has acid phosphatase activity of 340 to 360 Bodansky units per ml. (4) Its concentration gradually falls in vaginal secretions, but it can be recognised up to 36 hours after its deposition. (5) Concentration in excess of 100 Bodansky units with or without motile sperms indicate that ejaculation occurred within 2 hours of examination. (6) In humans acid phosphatase content is greater than in animals. (7) Dried stains give positive results for weeks or months. (8) The test is conclusive in absence of demonstrable sperms or in aspermia.

Creatine phosphokinase : Sperms contain high concentration of creatine phosphokinase, which is more than double than found in any other body fluid. The enzyme is stable and can be demonstrated even in six months old stains.

Prostate specific antigen (P 30) is a protein, which is found in vaginal fluid up to 27 hours after sexual intercourse.

Microscopic exam : (1) In a slide stained with methylene blue and eosin, posterior 1/2 to 1/3 of head is stained deep-red or pink, and anterior 1/2 to 2/3 appears unstained or faintly stained with basic dye. (2) The tail is stained pink. (3) Sperms disintegrate in seminal stains within a few months. (4) Head resists decomposition for some time. (5) Old stains of several years may give positive results. (6) Human spermatozoa vary from 50 to 55 microns in length and consist of head, neck and tail. (7) Head is oval, flattened, 5 microns in length. (8) The neck is very short; tail is long and tapered.

Absolute proof of semen is finding of at least one unbroken spermatozoon, or electrophoretic LHD isoenzyme detection of sperm. In absence of spermatozoa, a stain which gives fluorescence in U.V. light, positive precipitin test, a high level of acid phosphatase and a high creatine phosphokinase can be considered to be due to semen.

CHAPTER 16

ABORTION

Legally, abortion (miscarriage) means premature expulsion of foetus from mother's womb at any time of pregnancy, before term of pregnancy is completed.

Natural abortion occurs commonly in second or third month in 10 to 15% of all pregnancies. **Justifiable or therapeutic abortion is one which is done in good faith to save the life of woman.**

Criminal abortion is the induced destruction and expulsion of foetus from womb of mother unlawfully, i.e. when there is no therapeutic indication. It is usually induced before third month.

Medical Termination of Pregnancy Act (M.T.P.) 1971: Under the Act, pregnancy can be terminated: (1) **Therapeutic:** When continuation of pregnancy endangers life of woman, or may cause severe injury to her mental or physical health. (2) **Eugenics:** When there is risk of child being born with serious physical or mental abnormality. (3) **Humanitarian:** Pregnancy caused by rape. (4) **Social:** (a) Pregnancy resulting from failure of contraceptive methods in a married woman, which is likely to cause serious injury to her mental health, (b) when social or economic environment can injure mother's health.

Rules: (1) A qualified R.M.P. who has assisted in performance of 25 cases of M.T.P. can terminate pregnancy. (2) Private hospitals have to obtain licence from chief medical officer of district. (3) Consent of woman, or of her guardian is required in case of minor or an insane person. (4) Consent of husband is not necessary. (5) Abortion

cannot be performed on request of husband, if woman is not willing. (6) Woman need not produce proof of age; her statement that she is above 18 years is accepted. (7) It is enough for the woman to state that she was raped. (8) Professional secrecy has to be maintained. (9) M.T.P. should be done in Govt. hospital or a licensed private hospital. (10) If period of pregnancy is below 12 weeks, it can be terminated by a single doctor. (11) If it is below 20 weeks, two doctors must concur, that there is an indication; later any one doctor can terminate pregnancy. (12) In emergency, M.T.P. can be done by a single doctor, even without required training, even after 20 weeks, in a private hospital, which is not recognised.

Methods of procuring criminal abortion : (I) **Abortifacient drugs :** (1) **Drugs acting directly on uterus :** (A) (1) **Ecoblics :** **Ergot** is commonly used but fails during earlier months. (2) **Quinine** has direct action on uterus, but its action is uncertain. (3) **Lead** causes tonic contractions of uterus and has direct toxic effect on ovum. Death of foetus, and symptoms of lead poisoning may occur before abortion. (4) **Pituitary extract** has specific oxytocic effect on uterine muscle, but its action is significant only near term. (5) **Synthetic oestrogens** act only in large doses. (B) **Emmenagogues :** They increase menstrual flow and act when given in large and repeated doses. They are savin, borax, apiol, oestrogens.

(2) **Irritants of genito-urinary tract:** They produce reflex uterine contractions, e.g. oil of pennyroyal, oil of turpentine, cantharides, etc.

(3) **Irritants of G.I. tract :** Purgatives, rhubarb, senna, etc. are used. Tartar emetic is also used.

(4) **Systemic poisons**, such as lead, copper, mercury, etc., and organic irritants.

(II) **General violence :** It acts directly on uterus, or indirectly by producing congestion of pelvic organs, or haemorrhages between uterus and membranes. (1) Severe pressure on abdomen by kneading, blows, kicks, etc. and massage of uterus. (2) Violent exercise, e.g. horse riding, cycling, jumping from a height, etc. (3) **Cupping :** A mug is turned mouth downwards over a lighted wick and placed on hypogastrium, and mug is pulled, which causes partial separation of

placenta. (4) Very hot and cold hip baths alternately. (5) A general shakeup in advance pregnancy.

(III) Local violence : (1) **Syringeing :** (1) Enema syringe with a hand-bulb is used to inject fluid into uterus. (2) The suction valve is placed in a bowl of fluid and pressure applied on bulb. (3) A mixture of fluid and air is forced into uterine cavity, which detaches parts of amniotic sac and placenta, followed by haemorrhage, uterine contraction and abortion. (4) Irritating substances may be added to the fluid. (5) Death may occur from vagal inhibition or air embolism.

(2) **Rupturing of membranes** by introduction of probe, stick, pencil, umbrella rib, wire, glass rod, screw driver, etc. (2) Abortion occurs from few hours to 2 to 3 days, due to escape of liquor amnii. (3) Instruments can break or perforate vaginal or uterine wall.

(3) **Dilatation of cervix :** (1) Foreign bodies left in cervical canal, such as pessaries, laminaria or sea tangle tent, or obturator, irritate uterine mucosa, and produce congestion and contraction. (2) A compressed sponge may be introduced into cervix. (3) Slippery elm bark occurs in soft, flat pieces about 3 mm. in thickness. The pieces are inserted into cervical canal, which absorb moisture and dilate cervical canal within few minutes.

(4) **Abortion stick :** (1) This is a thin wood or bamboo stick, 12 to 18 cm., long. (2) It is wrapped at one end with cotton wool or cloth and soaked with juice of marking nut, calotropis, abrus or a paste of arsenious oxide or red lead and introduced into vagina or os by professional abortionists, and retained there till uterine contractions begin.

(5) **Air insufflation:** Air is introduced into vagina and uterus by pumps, syringes, and oral-genital contact.

(6) **Electricity :** Negative pole is placed over cervix and positive over sacrum or lumbar vertebrae and current passed.

(7) **Curettage :** Dilatation and curettage under general anaesthesia.

(8) **Pastes** containing iodine or thymol or mercury are injected from a collapsible tube with a uterine applicator, which detach parts of placenta from uterine wall.

Therapeutic methods : (1) Low rupture of membranes. (2) Utus paste injection. (3) Dilatation of cervix and oxytocic infusion.

Distinction between natural and criminal abortion.

Trait	Natural abortion	Criminal abortion
(1) Cause:	Predisposing diseases.	Pregnancy in unmarried women or widows.
(2) Marks of violence:	Not present on the abdomen.	May be present on abdomen.
(3) Genital organs:	Injuries are not present.	Injuries, such as contusions, lacerations, perforations, etc., may be seen in uterus or its contents and vagina.
(4) Foreign bodies:	Not present in genital tract.	May be present in genital tract.
(5) Toxic effect of drugs:	Absent.	Erosions and inflammation of vagina and cervix. The G.I. or urinary tract may show signs of irritation.
(6) Infection:	Rare.	Frequent.
(7) Foetus:	Wounds absent.	Rarely wounds may be present.

(4) Dilatation and curettage. (5) prostaglandins, PGE₂, and PGF₂, given i.v., orally or by intravaginal application. (6) Amniotic fluid replacement. (7) Abdominal hysterotomy. (8) **Vacuum aspiration :** (1) This is done during first three months. (2) Cervix is dilated and cannula is introduced into the uterine cavity. (3) Between 8 to 12 weeks 9 mm. cannula is sufficient. (4) A negative pressure of 0.4 to 0.6 kg/sq. cm. is created in uterine cavity by means of a vacuum pump for evacuation of contents. (5) The contents are broken up by aspiration and collected in a bottle connected to the cannula.

Doctor's duties in criminal abortion : (1) Professional secrecy should be maintained. (2) Ask patient to make a statement about induction of criminal abortion. If she refuses, he should not pursue the matter. (3) Treat her to the best of his ability. (4) Must consult a professional colleague. (5) If she is serious, he must arrange to

record dying declaration. (6) If she dies, police should be informed, and death certificate should not be issued.

Causes of death : (I) **Immediate** : (1) Vagal inhibition. (2) Haemorrhage. (3) Air embolism. (4) Fat embolism. (II) **Delayed** (48 to 72 hours) : (1) Septicaemia. (2) Pyaemia. (3) General peritonitis. (4) Confined local infection and toxæmia. (5) Tetanus. (III) **Remote**: (1) Jaundice and renal failure. (2) Bacterial endocarditis. (3) Pulmonary embolism.

17

CHAPTER

INFANT DEATHS

(1) **Infanticide** means unlawful killing of a child under age of one year. (2) Only mother can be charged with this offence in England. (3) In India, this is not applicable, and is considered as murder. (4) Infanticide does not include death of foetus during labour, when it is destroyed by craniotomy or decapitation. (5) **Foeticide** is the killing of foetus prior to birth.

STILLBIRTH: (1) A stillborn child is one which is born after 28 weeks of pregnancy, and which did not breathe or show any other signs of life, after being completely born. (2) The child was alive in uterus, but dies during birth. (3) Stillbirths occur frequently among illegitimate, immature, male children in primiparae. (4) Incidence is about 5%. (5) It is born in a sterile condition, and as such putrefaction starts on surface and extends inwards. (6) Signs of prolonged labour, i.e. oedema and bleeding into scalp, caput succedaneum and severe moulding of head indicate stillbirth.

DEADBIRTH: A deadborn child is one which had died in uterus and shows one of the following signs.

(1) **Rigor mortis** at delivery.

(2) **MACERATION:** (1) It is a process of aseptic autolysis, and is the usual change. (2) This occurs when dead child remains in uterus for 3 to 4 days surrounded with liquor amnii but exclusion of air. (3) If air enters putrefaction occurs. (4) Maceration is not seen if child is born within 24 hours after death. (5) Skin slippage is seen in 12 hours after death. (6) Body is soft, flaccid and flattens out. (7) Odour

is sweetish, disagreeable. (8) Skin is red or purple. (9) Large blebs containing serous or serosanguineous fluid are present. (10) Tissues are oedematous. (11) Abdomen distended. (12) Bones are flexible and readily detached from soft parts. (13) Skull bones are separated and brain is greyish-white and pulpy. (14) All viscera become soft, oedematous and lose their morphology except lungs and uterus. (15) The umbilical cord is red, smooth, thickened and soft. (16) **Gas in aorta (in 12 hours) of foetus indicates foetal death.** (17) **Collapse of the vertebral column occurs.**

Spalding's sign : (1) **Loss of alignment and overriding of bones of cranial vault** occurs due to shrinkage of cerebrum after death of foetus. (2) The sign will develop earlier with a vertex presentation than with a breech. (3) It may be detected within a few days of death of foetus, but often takes 2 to 3 weeks.

(3) Mummification : It occurs when foetus dies from (a) deficient supply of blood, (b) when liquor amnii is scanty, (3) when no air enters uterus.

Viability of infant : Viability means physical ability of foetus to lead a separate existence after birth apart from its mother, by virtue of certain degree of development. A child is viable after 210 days of intrauterine life, and in some cases after 180.

Livebirth means child showed signs of life when only part of child was out of mother, though the child may not have breathed or completely born. Killing of such a child is murder.

Signs of livebirth : In civil cases, hearing a cry, seeing movements of body or limbs, muscle contraction, etc., are accepted as proof of livebirth. In criminal cases, signs of live birth have to be demonstrated by P.M. exam. of child.

(I) Shape of chest : Before respiration chest is flat; after respiration it expands and becomes arched or drum-shaped.

(II) Position of diaphragm : Abdomen should be opened before thorax. Before respiration highest point of diaphragm is about the level of fourth or fifth rib, and after respiration at sixth or seventh rib.

(III) Lungs : (1) **Volume :** Unrespired lungs appear smaller and collapsed; after respiration they fill pleural cavities. (2) **Margins:** Before respiration are sharp which become rounded after breathing.

Bullae along the margins indicate struggle to breathe. **(3) Consistency:**

Before respiration lungs are dense, firm and non-crepitant like liver.

After respiration they are soft, spongy, elastic and crepitant. **(4) Colour and expansion of air sacs :**

(a) Before respiration, uniformly reddish-brown, bluish or deep-violet, and surface of lobules is marked with shallow furrows. On section little frothless blood exudes on pressure.

(b) After respiration, air-cells become distended with air; vesicles become raised above surface, giving it a fine mosaic appearance. The colour becomes light red, and whole lung has mottled or marbled appearance. (5) Amount of blood into the lungs after respiration is about twice than before respiration. **(6) Weight :** **(a) Static or Fodere's test :**

Average weight of both lungs before respiration is 30 to 40 g. and after respiration from 60 to 66 g. **(b) Plouquet's test :**

After respiration weight of lungs is almost doubled from 1/70 of body weight before respiration to 1/35 after respiration.

Hydrostatic test : (1) The specific gravity of lungs before respiration varies from 1040 to 1050 and after respiration about 940. (2) Lungs are separated after tying bronchi. (3) Each lung is placed in water. (4) If these float, each lung is cut into 12 to 20 pieces and placed in water. (5) If these pieces float, they are each squeezed in between thumb and index finger under water, to see if any bubbles of air escape, and if they still persist to float. (6) Pieces are wrapped in cloth and squeezed by putting a weight to remove tidal air. (7) The pieces are again put in water, and if they continue to float due to presence of residual air, it indicates that respiration has taken place. (8) If some pieces float, while others sink, it shows feeble respiration.

The **expanded lungs** may sink from : (1) Disease. (2) Atelectasis.

The **unexpanded lungs** may float from : (1) Putrefactive gases. (2) Artificial inflation.

Hydrostatic test is not necessary when : (1) Foetus is born before 180 days of pregnancy. (2) Foetus is a monster. (3) Foetus is macerated or mummified. (4) Umbilical cord has separated and scar formed. (5) Stomach contains milk.

A child may breathe (1) while in the womb, after rupture of membranes (**vagitus uterinus**), (2) while its head is in vagina (**vagitus vaginalis**), (e) while head is protruding from the outlet. A

child which had breathed in a womb or vagina may die from natural causes, before it is completely born. Therefore, **proof of breathing is not proof of livebirth.**

Microscopic exam, helps to know extent of respiration and the presence of pulmonary disease or abnormality. Lining of alveoli by flattened epithelium does not indicate that respiration has taken place. The struggle to breathe may result in (1) Incomplete lung expansion, (2) suboxia and cyanosis, (3) subpleural petechial haemorrhages, (4) oedema of mediastinum, and often of lungs.

(IV) Stomach and intestines : (1) The stomach and intestines are removed after tying double ligatures at each end. (2) If respiration has taken place, they float in water. This is known as **Breslau's second life test, or stomach-bowel test.** This is not of much value. (3) **When dissected under water, stomach shows mucus, saliva and air-bubbles if respiration has taken place, and only mucus if breathing has not occurred.** (4) Blood, meconium or liquor amnii in the stomach indicate that child was alive at or shortly before birth.

(V) Middle ear : Before birth, middle ear contains gelatinous embryonic connective tissue. After respiration air replaces gelatinous substance (**Wredin's test**). This is not reliable.

Other signs: (1) **Blood :** Nucleated red cells disappear in 24 hours. Foetal haemoglobin is about 80% before birth, rapidly decreases to 8% at third month.

Difference in lungs before and after respiration

Trait	Before respiration	After respiration
(1) Weight:	1/70 of body weight.	1/35 of body weight.
(2) Volume:	Normal or small.	Larger, and cover the heart.
(3) Consistency:	Dense, firm, non-crepitant.	Soft, spongy, elastic, crepitant.
(4) Margins:	Sharp.	Rounded.
(5) Colour:	Uniformly reddish-brown or bluish-red.	Mottled or marbled appearance.
(6) Air vesicles:	Not inflated.	Inflated.
(7) Section:	Little frothless blood exudes on pressure.	Abundant frothy blood exudes on section.
(8) Floatation:	Whole and parts sink in water.	Expanded areas or whole float in water.

(2) Meconium : It is **green, sticky substance consisting of thickened bile and mucus.** It is completely excreted from large bowel in 24 to 48 hours after birth, but in breech presentation and in severe anoxia, it may be excreted completely before birth. Stains are brownish-green, stiffen cloth and reaction is acid.

(3) Caput succedaneum : (1) This is **an area of soft swelling that forms in scalp over presenting part of head.** (2) In vertex presentation the elevated rounded area corresponds to portion of scalp surface that is exposed within the opening of dilated cervix during labour. (3) The affected part of scalp is swollen to 3 to 4 times due to oedema and congestion. (4) It gradually decreases within a week, often disappearing during one to two days.

(4) Cephalhaematoma : (1) **This is a localised accumulation of blood, between periosteum and bone surface.** (2) **It is limited to periosteal sheath of a single bone, commonly right parietal bone and never crosses a suture line.** (3) It is seen in less than one precent cases; size varies from one to 5 cm. (4) The haematoma swelling often tends to increase during the first day or two after birth as more and more blood accumulates, but gradually shrinks in about two weeks as the blood is absorbed.

(5) Skin : (1) At first bright-red; darker on second or third day, then brick-red, yellow and normal in about a week. (2) **Vernix caseosa** (white cheesy substance produced by sebaceous glands) covers skin mostly in axilla, inguinal region, folds of neck, buttocks and persists for one to two days. (3) It is removed by washing. (4) Skin of abdomen sheds in flakes during first three days.

(6) Umbilical cord : (1) Blood clots in cut end two hours after birth, and vessels begin to be obliterated in 24 hours. (2) Cord attached to child shrinks and dries in 12 to 24 hours, and an inflammatory ring forms at its base in 36 to 48 hours. (3) It contracts and mummifies on second or third day. (4) It falls off on fifth or sixth day and leaves an ulcer, which leaves a scar in 10 to 12 days.

(7) Circulation : Umbilical arteries are closed by third day. Umbilical veins and ductus venosus are closed on fourth day. Ductus arteriosus closes by tenth day, and foramen ovale by second or third month.

During birth, death may occur due to : (1) Prolonged labour. (2) Prolapse of cord or pressure on cord producing asphyxia. (3) Twisting of the cord round the neck causing strangulation, or knot on cord. (4) Injuries to mother, e.g. heavy blows, kicks on abdomen, fall from a height. (5) Death of mother. **Child can be saved if delivered within 5 to 10 minutes of mother's death.**

Death may occur after birth from **suffocation**, when membranes cover head during birth (can survive for 20 to 30 minutes), or submerged in discharges.

PRECIPITATE LABOUR : (1) **Labour terminating in a very short time** is called precipitate labour. (2) Delivery occurs suddenly and rapidly without mother's knowledge. (3) Foetus is normal or premature. (4) It is possible in multiparae with large roomy pelvis, but is extremely rare in primiparae. (5) Sometimes, a woman may not be able to distinguish the sense of fullness produced by the descent of a child, from the feeling of bulky evacuation. (6) Child may die from: (a) suffocation by falling into lavatory pan, (b) head injury and fracture of skull with subdural haemorrhage often bilateral, by a fall on a hard floor. (c) haemorrhage from torn end of cord. The average length of cord is 50 cm. (7) The cord is torn most commonly at foetal end than the placental end, but is not torn in its middle. (8) Torn edges are ragged. (9) Caput succedaneum and moulding of head are absent. (10) Usually fissured fractures occur limited to parietal bones, but may extend to frontal and squamous parts of temporal bone.

M.L.I.: (1) Mother or relatives may be accused of infanticide. (2) In a case of infanticide, death may be attributed to precipitate labour.

Criminal causes: (A) **Acts of commission:** (1) Suffocation. (2) Strangulation. (3) Drowning. (4) Burning. (5) Blunt head injury. (6) Fracture and dislocation of cervical vertebrae. (7) Wounds. (8) Poisoning. (B) **Acts of omission or neglect.** (1) Failure to provide proper assistance during labour. (2) Failure to clear air passages. (3) Failure to tie cord. (4) Failure to protect child from heat or cold. (5) Failure to supply proper food.

BATTERED BABY SYNDROME (non-accidental injury of childhood): (1) It is also known as child abuse syndrome. Caffey's syndrome and maltreatment syndrome in children. (2) It is very rare

in India. (3) **A battered child is one who has received repetitive physical injuries due to non-accidental violence, produced by a parent or guardian.** (4) There may also be non-accidental deprivation of nutrition, care and affection. (5) **The classical features are :** (a) obvious disagreement between nature of injuries and explanation offered by parents, (b) delay between injury and medical attention, (c) repetition of injuries at different dates. (6) Age of child is usually less than three years; slightly more in males; one child of a family, usually eldest or youngest and often unwanted; parents are young between 20 to 30, belong to lower social class and lower education; history of family disharmony, emotional or financial problems; suffer from guilt amnesia; mother low I.Q. often pregnant; parents uncooperative; episodic infliction of injuries. Subdural haemorrhage is common due to shaking of infant (**infantile whiplash syndrome**).

Injuries: (1) Soft tissue injuries such as bruises, abrasions and lacerations of different ages are common. (2) Bite marks, burns of various parts, subdural haemorrhage, damage to internal organs, epiphyseal separation or periosteal shearing and haemorrhage, metaphyseal fragmentation, long bone fractures, fracture ribs, etc. are seen. (3) The most characteristic lesion is laceration of mucosa inside the upper lip, often near centre line where the frenulum may be torn.

MUNCHAUSEN'S SYNDROME: It is feigning illness or injury and going from hospital to hospital for unnecessary investigations and treatment. These patients appear to be compulsively driven to make their complaints. The person is aware that he is acting an illness, but he cannot stop the act.

Munchausen's syndrome by proxy: In this the actions of one person (usually mother) who inflicts harm against another person (usually an infant or a small child) in an attempt to gain sympathy and attention for both her own and child's suffering. It is a peculiar and dangerous type of child abuse. The mother is involved in more than 90% cases.

Methods of production of illnesses: (1) The mother pricks her finger and adds blood to the urine of the child. (2) The mother gives insulin to the child and takes to hospital with hypoglycaemia. (3) Vomiting: allegation or by ipecac. (4) Diarrhoea: laxatives or

salt poisoning: (5) Rash : scratching or intoxication, etc., (6) Fever: Alleged.

SUDDEN INFANT DEATH SYNDROME (SIDS): (1) SIDS or cot or crib deaths are sudden and unexpected death of healthy infant, whose death remains unexplained after a complete autopsy. (2) Incidence is 0.2 to 0.4% of livebirths. (3) Age two weeks to two years, but majority of cases occur between 6 weeks to 6 months. (4) Occurrence is world wide. (5) Male to female ratio 3 : 2. (6) There is increased risk in twins, who are premature and of low birth weight. (7) When put to bed, child is healthy or has minor upper respiratory infection or minor G.I. disturbances. (8) They are major cause of death in infants in first 6 months of life. (9) P.M. findings are negative. (10) Death always occurs during sleep at all times of night with moderate increase in early morning hours. (11) Death may result from a number of causes. (12) Some infants have prolonged "sleep apnoea", which makes them susceptible to hypoxia, which leads to bradycardia and cardiac arrest. (13) Other hypotheses are: respiratory infection, laryngeal spasm, sensitivity to cows milk, parathyroid deficiency, antibody deficiency, metabolic disorders, bacterial or viral infection.

CHAPTER 18

BLOOD STAINS

Blood stains are examined in State Forensic Science Laboratory. Stained article is dried at room temperature. Extra heat should not be used. **If stains are not dried, putrefaction sets in.**

Solvents for blood stains are : (1) 10% solution of potassium cyanide, (2) 10% solution of glycerine, (3) weak solution of ammonia.

Rust stains, synthetic dye stains, certain mineral and vegetable stains resemble blood stains.

(1) Fresh stains are bright-red, which become reddish-brown in 24 hours, brown within few days, and black after long time. (2) Fresh stains are moist and sticky, and stiffen cloth on drying. (3) A drop of blood dries in 1 to 2 hours. (4) The fresher the blood, more easily it dissolves in water. (5) Fluorescence decreases as the stain becomes older. (6) Sex can be determined from presence of sex chromatin. (7) Blood effused during life can be removed in scales on drying, due to presence of fibrin. (8) Blood flowed after death tends to break up into powder on drying.

Chemical exam: Chemical tests depend on presence in blood of enzyme peroxidase. (1) **Benzidine test :** Cut out a small piece of stained material or tease out fibres from the stained fabric and place it on porcelain tile. Add a drop of saturated solution of benzidine in glacial acetic acid, and then a drop of 10 volumes hydrogen peroxide. If the blood is present, dark blue colour is produced immediately. This is the best preliminary test for blood, and it detects blood when present in a dilution of one part of blood in three lakhs. If positive

reaction is obtained, it is not proof of presence of blood, but a negative reaction excludes blood. (2) **Phenolphthalein (Kastle-Meyer) test:** Stain is extracted with distilled water. To an extract, 10 to 20 drops of phenolphthalein reagent is added, and then a drop or two of 10 volumes of hydrogen peroxide. If blood is present a pink or purple colour develops immediately. It is extremely delicate and detects blood in a dilution of one part in five millions, but is not specific.

RED CELLS: (1) Intact red cells are seen only when stains are fresh, or when clot is available. (2) Red cells are circular, biconcave, non-nucleated discs in all mammals except camels. (3) In camels, they are oval, biconvex, but non-nucleated. (4) In birds, fishes, amphibia, and reptiles they are oval, biconvex and nucleated.

Haemin crystal (Teichmann's) test: (1) A small crystal of sodium chloride and 2 to 3 drops of glacial acetic acid are placed on small piece of suspected stain on a glass slide. (2) A coverslip is applied and acid is evaporated by heating over a small flame. (3) It is cooled and examined under microscope. (4) Faintly-yellowish to brownish-black rhombic crystals of haemin or haematin chloride, arranged single or in clusters are seen if blood is present.

Haemochromogen crystal (Takayama) test: (1) Put a small piece of suspected material on a glass slide, add 2 to 3 drops of Takayama reagent and cover with a coverslip. (2) Pink, feathery crystals of haemochromogen or reduced alkaline haematin arranged in clusters, sheaves, etc. appear in one to 6 minutes. (3) It is delicate, more reliable even with old stains.

Spectroscopic examination : It is most delicate and reliable test for both recent and old stains. Less than 0.1 mg. of blood is sufficient. The stain is extracted with water, diluted and put into a glass test tube, which is then put between spectroscope and source of light. The solution absorbs some of the rays from the spectrum, producing characteristic dark absorption bands, which vary with type of blood pigment present.

PRECIPITIN TEST : (1) It determines whether blood is from human being or lower animal. (2) When human serum is injected in an animal, the animal becomes immunised against human proteins and antibodies develop in its blood. (3) If human serum is then brought

into contact with this animal serum, the antibodies in the animal serum react with proteins in human serum, and a visible precipitate is formed. (4) A suitable antiserum should react immediately or within a minute on 1 : 1000 dilution.

Technique : (1) Blood is extracted which should be clear, and diluted 1:100 with normal saline. (2) Two drops of undiluted antiserum are added to 0.75 ml. of dilute stain extract in a small tapering test tube. (3) Antiserum slowly settles down to bottom, and at junction of two fluids a white ring appears in case of positive reaction, which should begin in ten minutes and should be read in half hour. (4) It is a specific protein test. (5) The origin of skin, flesh, bone, saliva, milk, and semen is determined by this test.

Gel diffusion and double diffusion in agar gel are also used to detect human blood.

M.L. aspects of blood groups: (1) A blood group antigen cannot appear in a child unless present in one or other parents. (2) If an individual is homozygous for a blood group factor, it must appear in the blood of all his children. (3) If a child is homozygous for a factor, the gene for the same must have been inherited by it from each of its parents. (4) Blood group characters are specific to individual and are unchanged throughout life.

Group specific substances : (1) The antigens of ABO system are also present in body tissues in a lipoidal form. (2) In about 80%, they appear in a water-soluble form and are present in all body fluids except C.S.F. (3) Persons who possess water-soluble form are known as "secretors". (4) Secretors posses H antigen on their red cells. (5) M and N antigens are present in body tissues in water-soluble form. (6) Rh antigens are found in body fluids, except amniotic fluid.

Blood groups can be determined from soft tissues, hair, nails, dental tissue and bone.

HLA consists of protein substances on surface of wide variety of tissues and organs, tumours, white cells and platelets. (2) They are present on placenta at term and in foetal tissues at six weeks. (3) They are found on lymphocytes and granulocytes.

M.L. aspects: (I) Disputed paternity: The blood groups used to determine paternity are: (1) Red cell antigens: ABO, MNS, Rh,

Kell, Lutheran, Duffy and Kidd. (2) **White cell antigens:** HLA-A, B, C, D and DR. (3) **Serum protein polymorphism:** Haptoglobins, GC groups, Ag groups, Gm, Inv, Km system, serum lipoproteins, abnormal haemoglobins. (4) **Red cell enzyme polymorphism.**

These tests may exclude a certain person as the possible father of child, but they cannot definitely establish paternity.

(2) **Disputed maternity** can be settled.

(3) **Crimes:** (1) Bloodstains may be found on clothing and person of suspect. (2) If the characteristics of victim's blood are similar with those of the suspect, an association is established between suspect and victim. (a) Blood stains may be found at scene of house-breaking, murder, accident, etc. (b) Under fingernails of assailant in throttling. (c) Under fingernails of victim in case of struggle. (d) On vehicles in traffic accidents.

(4) **Body fluids:** Blood group agglutinogens are present in body secretions, which may be corroborative evidence of accused.

(5) **Identity :** If a person has rare blood group, it helps in identity.

(6) **Cause of death :** In incompatible blood transfusion, cause of death can be determined. Poisons can be detected in blood.

DNA fingerprinting : (1) About 5% of DNA is used for genetic coding, the rest being redundant or silent segments (stutters; hypervariable regions; minisatellites). (2) Of these redundant segment, there may be 200 to 14,000 repeats of each identical sequence on each DNA strand, which are called repetitive DNA. (3) The length, constitution and number of repetitive sequences are different for each person, but are unique for an individual, and are stably inherited in a Mendelian fashion. (4) **This method is as unique as fingerprints to an individual.** (5) DNA can be extracted from blood, semen, tooth pulp, bone marrow, hair roots, muscle, skin, etc. (6) It is cut into fragments at specific base sequences by a restriction enzyme, and repeated several times. (7) Next, double stranded DNA are denatured into single strand. (8) DNA fragments are then separated by gel electrophoresis that spreads fragments into bands. (9) These are transferred to nitrocellulose sheets by Southern blotting technique. (10) The membrane is then exposed to DNA probe (radioactive phosphorus 32), which binds to core sequences. (11) X-ray film is put

in direct contact with probe-labelled membrane to detect radioactive patterns, which appear as series of 30 to 40 parallel bands or bars. (12) This is compared with other samples. (13) The chances of two persons sharing same sequence is one in thirty thousand billions.

M.L. Imp: (1) DNA fingerprinting can match blood on weapon against that of victim. (2) Hair roots on weapon can be matched with blood of victim and accused. (3) Seminal fluid from the victim can be matched with blood of accused. (4) It can exonerate a person falsely implicated in a crime. (5) Paternity is established positively. (6) It can trace pedigrees. (7) Identity of unknown person can be made by matching prints with suspected parents or close relatives.

CHAPTER 19

FORENSIC PSYCHIATRY

Psychiatry deals with study, diagnosis, and treatment of mental illness. **Forensic psychiatry** deals with application of psychiatry in **administration of justice**. Insanity is disease of mind or personality, in which there is derangement of mental or emotional processes, intelligence is weakened and perverted. The law has not defined insanity.

APHASIA: Loss of ability to express meaning by use of speech or writing (motor), or to understand spoken or written language (sensory aphasia).

DELIRIUM: (1) It is a disturbance of consciousness in which orientation is impaired, critical faculty is blunted, and thought content is irrelevant or inconsistent. (2) In the early stage the patient is restless, uneasy and sleepless. He then completely loses self-control, becomes excited and talks furiously. (4) Delusions and sometimes hallucinations are present. (5) It usually occurs in high fevers and sometimes due to overwork, mental stress, metabolic diseases, cerebral tumours or drug intoxication. (6) A person may become impulsive and violent and may commit suicide. (7) Such person is not responsible for his criminal acts.

DELUSION: (1) It is false belief in something which is not a fact, and which persists even after its falsity has been clearly demonstrated. (2) A normal person can correct delusion by his reasoning power, by his past experience and by being convinced by others. (3) It is a disorder of thought which is under control of emotional but not rational forces.

Types: (1) **Grandeur or exaltation:** Person imagines himself very rich while he is pauper. (2) **Persecution:** Imagines that attempts are being made to poison him. Delusions of grandeur and persecution are common and often present together. (3) **Reference:** The person believes that people, things, events, etc. refer to him in a special way, or items in radio or newspaper are referring to him. (4) **Influence:** Imagines that his thoughts, feelings and actions are being influenced and controlled by radio, hypnotism, telepathy, etc (5) **Infidelity:** Imagines his wife to be unfaithful, while she is chaste. (6) **Self-reproach:** The person blames himself for the past failures and misdeeds which are often of no importance. (7) **Nihilistic:** He declares that he does not exist or that there is no world. (8) **Hypochondriacal:** The person believes that there is something wrong with his body, though he is healthy. Other types are of self-reproach, jealousy, religion, etc.

Delusion is not an isolated disorder, but is an indication of deep-seated widespread disorder. **He is not fully responsible for his antisocial acts.**

Erotomania: (1) **It is a delusion in which a person believes that someone is deeply in love with him/her.** (2) He develops an obsession for a particular person and starts believing that other person is reciprocating. (3) The other person is usually of higher status, famous or superior at work. (4) The erotomaniac tries to get close with the person through telephone calls, letters, gifts, visits, etc. (5) The person is otherwise normal.

HALLUCINATION: **It is a false sense perception without any external object or stimulus to produce it.** It is purely imaginary.

Types: (1) **Visual:** A person imagines of being attacked by a lion when it does not exist. (2) **Auditory:** Hears voices and imagines that a person is talking to him when no one is present. (3) **Olfactory:** Smells pleasant or unpleasant odour when none is present. (4) **Gustatory:** Feels sweet, sour or bitter taste, though no food is present. (5) **Tactile:** Imagines rats and mice crawling on his bed, when there are none. (6) **Psychomotor:** Feeling of movement of some part of body in absence of such movement.

(1) Hallucinations occur in fevers, intoxications and insanity. (2) Visual and auditory are most common. (3) A person suffering from unpleasant hallucinations may commit suicide or homicide.

ILLUSION: is a **false interpretation by senses of external object or stimulus which has a real existence**, e.g. seeing a dog and mistaking it for lion, hears notes of birds and imagines them to be human voices, or imagines a string hanging in his room to be snake, etc. (2) A sane person is capable of correcting false impressions but insane person continues to believe in the illusion even though real facts are pointed out.

IMPULSE: (1) **Is a sudden and irresistible force compelling a person to conscious performance of some action without motive or forethought.** (2) A sane person can control impulse. (3) An insane person having no judgement, no reasoning power and no capacity to understand facts, may do things on impulse. (4) They are usually seen in imbecility, dementia, acute mania and epilepsy.

Types: (1) **Kleptomania:** irresistible desire to steal articles of little value. (2) **Pyromania:** to set fire to things. (3) **Dipsomania:** to alcholic drinks at periodic intervals. (4) **Mutilomania:** mutilate animals. (5) **Sexual.** (6) **Suicidal and homicidal.**

OBSSESSION: (1) **In this a single idea, thought or emotion is constantly entertained by a person which he recognises as irrational, but persists in spite of all efforts to drive it from his mind.** (2) **It is a disorder of content of thought.** (3) It is a borderline between sanity and insanity. (4) They usually occur in neurotic people. (5) These ideas are usually associated with some sort of dread and fear. (6) A wife may believe her husband to be unfaithful inspite of proof to the contrary. (7) A person may go to bed at night after securely bolting the door of his room, but soon gets up to see he had done so. A sane person may do it once or twice, but an insane person does not sleep, and spends whole night in frequently seeing whether door is bolted or not.

Phobia is an excessive or irrational fear of a particular object or situation.

LUCID INTERVAL: (1) **It is a period during which all symptoms of insanity disappear completely.** (2) The person is able

to judge his acts soundly, and he becomes legally liable for his acts. (3) In mania and melancholia lucid intervals are common. (4) It occurs frequently, and preceding and following symptoms are those of insanity.

PSYCHOPATH: (1) **Is a person who is neither insane nor mentally defective, but fails to conform to normal standards of behaviour.** (2) They have abnormal personality, persistently behave in an antisocial or disruptive manner, and are unable to appreciate normal implications of their actions. (3) The person retains a child-like selfishness. (4) They can plan and implement their antisocial acts in an effective way. (5) The basic defect is moral, rather than psychological or neurological.

PSYCHOSES: **They are characterised by a withdrawal from reality, a living in a world of fantasy.** (2) It is a disease entity with physical basis which is determined genetically, and is a major disease. (3) Empathy, contact with reality and insight are absent.

NEUROSES: (1) **The patient suffers from emotional or intellectual disorders, but he does not lose touch with reality.** (2) They occur mostly in the form of anxiety, depression, or hysteria. (3) They are reaction to stressful circumstances due to adverse childhood experiences. (4) Empathy, contact with reality and insight are present. (5) It is a minor disease.

Mental subnormality (amentia): It is characterised by incomplete maturation of attention, perception, cognition, and social adaptability due to arrested mental development. (1) **Idiots are persons so defective in mind from birth or from early age that they are unable to guard themselves from ordinary physical dangers.** Mentality is that of a child of 3 years. I.Q. 0 to 20. (2) **Imbeciles:** They are incapable of managing themselves or their affairs, and are incapable of being taught. I.Q. 20 to 50. Mentality 3 to 7 years. (3) **Feeble-minded (Moron):** Mental age 6 to 11. I.Q. 20 to 50.

Dementia is a condition in which there is degeneration of mental faculties after they have been fully developed.

Post-epileptic insanity : (1) Stupor following epileptic fit is replaced by automatic acts of which patient has no recollection. (2) He is confused and terrified by visual and auditory hallucinations and delusions of persecution, and commit crimes like thefts, burning

of property, sexual assaults and murders. (3) These crimes are involuntary, automatic and unpremeditated. (4) He never attempts to conceal them at the time of committing, but may try to conceal them on regaining consciousness. (5) Automatic act tends to be of the same type in each attack.

SCHIZOPHRENIA : It is a condition of split personality, in which the patient loses his contact with his environment. It is primarily a disorder of thinking (cognition). It is characterised by : (1) Splitting of different psychic functions. (2) Disorders of thought. (3) Disorders of effect. (4) Delusions. (5) Hallucinations. (6) Personality deterioration.

Types : (1) Simple. (2) Hebephrenia. (3) Catatonia. (4) Paranoia. (5) Schizo-effective, and (6) Pseudo-neurotic.

Affective type : These are of hereditary origin affecting young adults and form a major group of all psychiatric illnesses.

Manic-depressive psychosis : (1) **Manic phase** is a condition of exaltation of emotions and intellect. (A) Acute mania is characterised by euphoria, or irritable mood, excitement, loss of self-control, flight of ideas, and great muscular activity. Mood is elated, attention is fleeting and there is high degree of distortion. (B) Hypomania is a mild form.

(2) **Depressive phase (melancholia) :** It is an intense feeling of depression or misery without any cause. The sadness of mood is reflected in posture, movements and facial expressions. He retires from his usual social activities, avoids friends. Suicide is well planned and is of great danger to the patient. Homicidal and suicidal tendencies co-exist.

Diagnosis of insanity : (1) The person should be kept under observation, which should not exceed ten days, but with permission of Magistrate, he may be detained for further periods of ten days up to a maximum of 30 days. (2) Violent or criminal persons should be kept in a prison. (3) The person should be watched during different times of day, when he is alone, in company and while he is working, eating, reading or writing and when he is not aware of the fact of being observed.

Difference between real and feigned insanity

Trait	Real insanity	Feigned insanity
(1) Onset:	Gradual.	Sudden.
(2) Motive:	Absent, e.g., no history of commission of crime.	Present, e.g., commission of crime.
(3) Predisposing factors:	Usually present, e.g., history of insanity in parents or of sudden monetary loss, grief, etc.	Absent.
(4) Signs and symptoms:	Uniform and present whether the patient is being observed or not.	Present only when conscious of being observed; variable and always exaggerated.
(5) Facial expression:	Peculiar, e.g., vacant look or fixed look of excitement.	No peculiarity, frequently changing, exaggerated and voluntary.
(6) Insomnia:	Present.	Cannot persist.
(7) Exertion:	Patient can stand exertion of fatigue, hunger and sleep, for several days.	Cannot stand exertion for more than a few days and breaks down.
(8) Habits:	Dirty and filthy.	Not dirty and filthy.
(9) Frequent exams :	Does not mind.	Resents for fear of detection.

Certification : Three examinations on different days and different hours are usually recommended, because a person may behave peculiarly at a single examination, either due to effect of drugs or due to delirium caused by fever.

Mental Health Act, 1987: Mentally ill person is defined “a person who is in need of treatment by reason of any mental disorder other than mental retardation”.

RESTRAINT OF INSANE : **(1) Immediate restraint:** This is done in case of: (1) insane person who is dangerous to himself or to others, (2) persons suffering from delirium, (3) delirium tremens. It is done under personal care of attendants, e.g. by safely locking up in a room, as long as danger exists.

(II) Admission in psychiatric hospital: (1) **Admission on voluntary basis:** Any major person, who considers himself to be mentally ill person, may request medical officer-in-charge of psychiatric hospital or nursing home, for admission and treatment. (2) In case of minor, guardian may make such request. (3) He may be admitted if officer-in-charge is satisfied that he requires treatment.

(2) Admission under special circumstances: (1) If mentally ill person cannot express his willingness to be admitted in a hospital, a relative or friend can make application in prescribed form, and attach two medical certificates, one of which shall be by a Government medical officer. (2) If medical certificates are not submitted, officer-in-charge can get the mentally ill person examined by two doctors working in the hospital. (3) Such person can be admitted for 90 days.

(3) Reception order on application : (A) Officer-in-charge of psychiatric hospital can make an application to Magistrate in case of mentally ill person who is undergoing treatment under a temporary treatment order, if he is satisfied that (a) treatment has to be continued for more than six months, or (b) in the interest of health and personal safety of mentally ill person or for protection of others. (B) (1) The spouse of mentally ill person or any relative can make an application in prescribed form to the Magistrate. (2) The applicant must be major, must have personally seen patient within 14 days of date of application, and should mention manner of relationship. (3) The application should be verified and signed by the applicant. (4) Two medical certificates issued by two doctors, who have separately examined patient within ten days of presentation of application should be submitted. (5) Each doctor should certify that the person is suffering from mental disorder of such a nature and degree as to be detained in a psychiatric hospital, in the interest of health and personal safety of that person, or for protection of others. (6) The Magistrate will examine the contents of application, and if he is satisfied, he may pass a Reception Order immediately, or he may fix a date for consideration of petition. (7) The petition must be considered in private, in the presence of petitioner, alleged mentally ill person and his representative. (8) If Magistrate is satisfied, he passes a Reception Order, which is valid for 30 days.

(4) Reception Order on production of mentally ill person before Magistrate: (A) (1) An officer-in-charge of a police station can arrest a **wandering or dangerous mentally ill person** and produce him before Magistrate. (2) A wandering mentally ill person is one who wanders aimlessly, and a dangerous mentally ill person is one who because of his violent behaviour is dangerous to himself or others. (3) The Magistrate may send him for medical examination, and if he is satisfied he may pass a Reception Order. (B) (1) An officer-incharge of a police station or any person can report to a Magistrate, if he believes that any person is mentally ill, **and not kept under proper care and control, or that he is cruelly treated or neglected.** (2) In such case, Magistrate may order to produce mentally ill person and summon guardian and order for proper care and treatment. (3) If there is no one legally bound to maintain mentally ill person, Magistrate may pass an order for admission in a psychiatric hospital.

(5) Admission after judicial inquisition: (1) If a person possessing property is alleged to be mentally ill, the District Court may order inquiry upon application made by any relative. (2) The Court, if it is satisfied may order to admit such person in psychiatric hospital.

(6) Admission of an escaped mentally ill person: A mentally ill person escaping from a psychiatric hospital, can be retaken by any police officer, or any officer or servant of psychiatric hospital, and readmitted into such hospital.

Discharge of mentally ill person: (1) Voluntary patient should be discharged within 24 hours of receipt of request for discharge made by patient or guardian. (2) A person admitted on an application by a relative or friend can apply to Magistrate, who will enquire and allow discharge. (3) Officer-in-charge of psychiatric hospital can discharge on recommendation of two medical officers. (4) A person detained under Reception Order made on application or the person on whose application admission order was made, applies in writing. (5) If a person detained on Reception Order is subsequently found by any judicial inquisition to be of sound mind, he is to be discharged.

CIVIL RESPONSIBILITY: (1) **Management of property and affairs :** (1) If any relative gives an application to the court and

submits a medical certificate stating “that mental illness is of such a degree as to make him incapable of managing his property and affairs”, the court will conduct an enquiry, and appoint a manager to look after the property. (2) The court may order sale or disposal of property, for payment of his debts and expenses. (3) Later if it is reported that mental illness has ceased, Court orders an enquiry, and if it is satisfied, it will order all proceedings in mental illness to cease.

(2) Contracts : (1) Contract is invalid if one of the parties was mentally ill at the time of making contract. (2) If mental illness develops subsequent to contract, it will be valid, unless performance of services becomes impossible. (3) A mentally ill person is responsible for payment of simple necessities of life, but he is not responsible if order is grossly excessive or unreasonable. (4) Contracts made during lucid interval are valid.

(3) Marriage contract: A marriage is invalid if at the time of marriage, either party (i) is incapable of giving valid consent due to mental illness, (ii) has been suffering from recurrent attacks of mental illness or epilepsy.

(4) Evidence : An mentally ill person is not competent to give evidence, if he cannot understand the necessity of telling truth due to mental illness. He will be competent during lucid interval.

(5) Consent : Consent to sexual intercourse, hurt, etc. is not valid, if mentally ill person is unable to understand the nature and consequences of that act.

(6) TESTAMENTARY CAPACITY: (1) It is the mental ability of a person to make a valid will. (2) Requirements of valid will are: (a) written and properly signed and witnessed document must exist, (b) person should be major, (c) of sound disposing mind, (d) at time of making will, force, undue influence, or dishonest representation of facts should not have been applied by others. (3) **Holograph will** is one written by a testator in his own handwriting. (4) The testator is said to be of sound mind if he is capable of disposing of his property with understanding and reason. (5) The most important thing to determine is whether at the time of making will, the testator understood the business in which he was engaged, and how he wanted to dispose of his property. (6) The doctor should take history and

make complete examination before certifying. (7) **A valid will** can be made by: (a) a person affected by an insane delusion, if delusion is not related to disposal of property or persons affected by will, (b) during lucid interval, (c) person of extreme age, feeble health with defective memory, (d) a person suffering from aphasia, agraphia, and alexia, or who is blind, if he can make clear by gestures that he wishes to make a will. (8) **A will is invalid:** (a) when made by persons in extremis, (b) will executed by a dying person during delirium, (c) when drunkenness has caused a temporary loss of reasoning powers.

CRIMINAL RESPONSIBILITY: (1) A person may plead mental illness to avoid trial, conviction and capital punishment. (2) If mental illness is found, accused person is found “not guilty”, and is ordered to be kept in a psychiatric hospital. (3) The law presumes that: (a) every person is sane, (b) for every criminal act, there must be criminal intent or mind, **mens rea** (criminal mind) motivating it.

Tests: (1) Mc Naughten rule (right or wrong test; legal test):

Daniel Mc Naughten was schizophrenic, who had delusional belief that he was being persecuted by Sir Robert Peel (prime minister of England). By mistake he shot and killed Edward Drummond, the prime minister's private secretary. Mc Naughten was acquitted as medical evidence showed him to be of unsound mind. The public reaction was unfavourable. The House of Lords appointed a full bench of 14 Judges, to determine criminal responsibility of mentally ill person. The rule is “**An accused person is not criminally responsible, if it is proved that at the time of committing crime, he was suffering from such a defect of reason from disease of mind, that he did not know nature and quality of act he was doing, or that what he was doing was wrong**”.

Under S.84, I.P.C. this legal test has been accepted in India.

Examples : If due to insane delusion: (1) a person thinks that another man is attempting to kill him, and in self-defence he kills that person, he is not responsible, (2) a person thinks another to be a wild animal and kills him, he is not responsible, (3) a person thinks that another person had caused a serious injury to his character and fortune and kills him, he becomes responsible, because under the law no one can kill a person in revenge.

(2) **Durham rule.** (3) **Curren's rule.** (4) **Irresistible impulse test.** (5) **American law institute test (A.L.I.).**

Insanity and murder: (1) In criminal cases where insanity is pleaded as a defence, the defence has to prove it. (2) The doctor should obtain detail history from accused person, and carry out physical exam. and investigations. (3) There is no motive, no pre-arrangement and pre-planning, no accomplices, he does not try to destroy evidence, and after the crime, he may notify police. (4) The psychiatrist's task becomes difficult with increase in interval between alleged crime and his examination. (5) All mental disorders do not free a person from criminal responsibility for his acts. (6) If disorders impair cognitive faculties of accused, i.e. faculty of understanding the nature of his act and its consequences, he is not held responsible. (7) If insanity affects only emotions and will, but not cognitive faculties, the person is held responsible for his acts. Only persons who are completely incompetent, demented or wild, are considered as lacking ability to have a guilty intention.

Automatism : (1) It is conduct of a person whose consciousness is impaired to such an extent that he is not fully aware of his actions. (2) There may be no consciousness at all of the actions, or the awareness may be below level of normal consciousness. (3) Main factors producing automatism are : (1) Epilepsy (mentally ill automatism). (2) Concussion or cerebral disease. (3) Hypoglycaemia. (4) Somnambulism (non-mentally ill automatism).

Somnambulism: (1) It means, walking during sleep. A person leaves his bed and walks in the house or out of house without any awareness of his actions, but rarely injures himself. (2) He is not asleep but in a state of dissociated consciousness, in a hallucinatory state, unrelated to his immediate environment. (3) Such persons are usually well-adjusted in life, socially well-behaved, and not aggressive. (4) The crime is not wilful or premeditated. (5) The mental faculties are partially active. (6) He may commit suicide, fall in a well, meet with an accident or commit crime. (7) There is no recollection of the event, but in some cases the events of one fit are remembered in a subsequent fit and carried out similarly. (8) Such person is not criminally responsible.

If a crime is committed due to **impulse**, the person is criminally responsible. A person committing a crime under **hypnotism or mesmerism** is responsible for his acts.

Drunkenness: (1) An act done by a person who is incapable of knowing nature of act due to intoxication is not an offence, if the thing which intoxicated him was administered to him without his knowledge and against his will. (2) An intoxicated person (voluntary drunkenness) is criminally responsible if he has the intention or knowledge of committing a crime.

A person is not responsible for his criminal acts done during post-traumatic automatism, twilight state, delirium and oneiroid states.

CHAPTER 20

ARTEFACTS

Artefact is any change caused or feature introduced in body after death, that is likely to lead to misinterpretation of medicolegally significant antemortem findings.

(1) **Agonal** : Regurgitation and aspiration of gastric contents; oesophagogastric malacia.

(2) **Resuscitation** : Injection marks, defibrillator mark, external massage of chest causing rib fractures, and lacerations of internal organs.

(3) **Handling of body** : Fracture of ribs, contusion of occipital region.

(4) **Rigor mortis** : Partial breaking due to handling; heart simulating hypertrophy.

(5) **P.M. lividity** : Some poisons change colour; hypostasis of internal organs may resemble disease, such as coronary occlusion, pneumonia, intestinal strangulation.

(6) **Burns** : Heat ruptures, heat haematoma, fat droplets in pulmonary vessels, pseudo-strangulation mark due to tight collar.

(7) **Animal and insect bites.**

(8) **Decomposition** : (a) Pseudobruising, (b) simulate obesity, (c) P.M. purge, (d) groove in neck due to buttoned shirt, (e) congested appearance of internal organs, (f) P.M. digestion of stomach, (g) blebs mistaken for burns, (h) air in right heart mistaken for air embolism, (i) separation of sutures of skull in a child, (j) fissures or splits in skin simulate AM lacerations, (k) holes produced from maggots resemble bullet holes.

- (9) **Air in blood vessels** due to pulling of dura in sagittal line.
- (10) **Skull fractures** due to use of chisel and hammer while removing skull cap.
- (11) **Visceral damage** due to rough handling of brain and liver.
- (12) **Extravasation of blood** due to cutting of vessels during autopsy.
- (13) **Fracture hyoid bone** due to block removal of viscera.
- (14) **Toxicological** due to contamination of viscera with stomach contents during autopsy; faulty storage or use of preservatives.

CHAPTER 21

FORENSIC SCIENCE LABORATORY

Forensic science is the study and application of scientific examination and evaluation of evidences for legal purposes.

Physical evidence includes any and all objects, living or inanimate, solid, liquid or gas, and the relationship between all objects as they relate to the problem in question, e.g. crime. Knife, burglar tool, signature, firearms, bullets, blood and seminal stains, poisons, fingerprints, hair, fibres, glass, paint, oil, dust, microscopic fragments of all types, bacteria, etc. and even odour are all physical evidence. Physical evidence is often (1) the decisive factor in determining guilt or innocence, (2) it can be a material aid in locating the criminal.

Locard's Exchange principle : When any two objects come into contact, there is always a transfer of material form each object on the other. Traces from scene may be carried away on clothes or tools of criminal, and at the same time, traces from all or any of these may be left at the scene. Wherever a criminal goes, whatever he touches, and whatever he leaves will serve as silent evidence against him, e.g. fingerprints, hair, fibres from clothes, broken glass, paints, blood or seminal stains. It is actual evidence and its presence is absolute proof of crime. Physical evidence cannot be wrong and completely absent.

(1) Lie detection : Polygraph : (1) **It is an instrument used to detect lies.** (2) Polygraph makes a continuous record of B.P., pulse, respiration and electrodermal reaction changes in response to stimuli in the form of questions. (3) It is based on theory that when person tells a lie in answer to a question and there is fear that lie will

be detected, the fear results in stimulation of sympathetic nervous system, which results in certain physiological changes, some of which may be easily recorded. (4) Ten questions are framed with mutual consent of person to be examined and the examiner. (5) Relevant and irrelevant questions are mixed up which demand "Yes" or "No" answer. (6) A question is asked every 20 to 25 seconds, and polygraph chart recorded in 3 to 4 minutes. (7) The test is repeated twice or thrice. (8) Truth or lie can be correctly recorded in 80 to 90% cases. (9) Offenders, suspects, complainants, witnesses and informants are examined.

(2) Brain Mapping (Brain Fingerprinting) : (1) It is based on the theory that the suspect's reaction to the details of an event or activity will reflect, if the suspect had prior knowledge of the event or activity. (2) The equipment called "electrocap" is fixed on the suspect's head for recording EEG. (3) The suspected person is questioned about the crime and shown visuals of crime scene, such as victim, weapon, time, place and how he committed the crime along with irrelevant photographs, etc. (4) Another computer keeps track of neuro-impulses. (5) The intensity of brain waves shoots up whenever a question or visual stimuli matches the information stored in the brain, if suspect has really committed the crime. (6) It depends upon cognitive brain responses, but not on emotional responses. (7) It is said to be 100% accurate.

(3) Narco-analysis (Truth serum drugs): The principle is that at a point very close to unconsciousness, the person will be mentally incapable of resistance to questioning and incapable of inventing falsehoods that he had used to conceal guilt. The methods used are: (1) Half mg. of scopolamine hydrobromide s.c., followed by one-fourth mg. every 20 minutes for an average of 3 to 6 injections, until person reaches proper stage for questioning. (2) Sodium amyta or sodium pentothal 2.5 to 5% solution. i.v. at a rate not to exceed one ml/m. until proper stage is reached. In a state of relaxation, the suspect is susceptible to suggestion and reveals repressed feeling or memories.

TOXICOLOGY

CHAPTER 22

GENERAL CONSIDERATIONS

A **poison** is a substance (solid, liquid or gaseous) which if introduced in the living body, or brought into contact with any part thereof will produce ill-health or death, by its systemic or local effects or both. **Toxicology** is the science dealing with properties, actions, toxicity, fatal dose, detection, estimation, and treatment of poisons. “**Forensic toxicology**” deals with medical and legal aspects of harmful effects of chemicals on human beings.

Acts: (1) Poisons Act, 1919. (2) Drugs and Cosmetics Act, 1940. (3) Drugs and Cosmetics rules, 1945. These rules have classified drugs into Schedules. (4) Drugs Control Act, 1950. (5) Drugs and Magic Remedies Act, 1954. (6) Narcotic Drugs and Psychotropic Substances Act, 1985: A **psychotropic drug** is one that alters mental function by its action. A **narcotic drug** means cocoa leaf, cannabis, poppy straw, etc. This lists 77 psychotropic substances, e.g. amphetamine, tranquilisers, barbiturates, etc.

Ideal homicidal poison: (1) It should be cheap, easily available, colourless, odourless and tasteless, capable of being administered either in food, drink or in medicine without producing any visible change, highly toxic, signs and symptoms should resemble natural disease, there should not be any antidote and no P.M. changes, should not be detected by chemical tests and must be rapidly destroyed in the body. (2) Fluorine and thallium satisfy several of above criteria. (3) Arsenic and aconite are commonly used as homicidal poisons.

Stupefying: Datura, cannabis, chloral hydrate.

Abortifacients: Calotropis, oleanders, aconite, ergot, lead, arsenic, mercury, croton, semecarpus, cantharides, etc.

A **love philter** is a drug which is supposed to increase the love between giver and taker. All aphrodisiacs such as cantharides, arsenic, alcohol, opium, cocaine and cannabis are supposed to act as love philters.

Ideal suicidal poison: (1) Cheap, easily available, toxic, tasteless or pleasant taste, easily taken in food or drink and cause painless death. (2) Opium and barbiturates satisfy several criteria. (3) Organophosphorus compounds are commonly used.

Cattle poisons: Abrus, calotropis, oleanders, organophosphates, arsenic, zinc phosphide, strychnine, aconite, etc.

Arrow poisons: Abrus, croton oil, aconite, strychnine, curare, calotropis, snake venom, etc.

Classification: Poisons may be classified according to chief symptoms which they produce: **(1) Corrosives:** (1) **Strong acids:** (a) **Mineral** or inorganic acids: Sulphuric, nitric, hydrochloric. (b) **Organic acids:** Carbolic, oxalic, acetic, salicyclic. (2) **Strong alkalis:** Hydrates and carbonates of sodium, potassium and ammonia. (3) **Metallic salts:** Zinc chloride, ferric chloride, copper sulphate, silver nitrate, potassium cyanide, chromates, bichromates.

(II) Irritants: (1) **Agricultural.** (2) **Inorganic:** (a) **Non-metallic:** Phosphorus, iodine, chlorine. (b) **Metallic:** Arsenic, antimony, copper, lead, mercury, silver, zinc. (c) **Mechanical:** Powdered glass, diamond dust, hair. (3) **Organic:** (a) **Vegetable:** Abrus, castor, croton, calotropis, aloes. (b) **Animal:** Snake and insect bites, cantharides, ptomaines.

(III) Systemic: (1) **Cerebral:** (a) **CNS depressants:** Alcohols, general anaesthetics, opioid analgesics, hypnotics, sedatives. (b) **CNS stimulants:** Cyclic antidepressants, amphetamine, methyl phenedate. (c) **Deliriant:** datura, belladonna, hyocyamus, cannabis. (2) **Spinal:** Nux vomica, gelsemium. (3) **Peripheral:** Conium, currare. (4) **Cardiovascular:** Aconite, quinine, oleanders, tobacco, hydrocyanic acid. (5) **Asphyxiants:** CO, CO₂, hydrogen sulphide.

(IV) Miscellaneous: Food poisoning, botulism.

Routes of Administration: In order of rapidity of action: (1) Inhaled in gaseous or vaporous form. (2) Injection into blood vessels. (3) Intramuscular injection. (4) Application to a wound. (5) Serous surface. (6) Bronchotracheal mucous membrane. (7) Introduction into stomach. (8) Natural orifices, e.g., rectum, vagina, urethra, etc. (9) Skin. Organophosphates, nicotine, insecticides, some organic solvents and lewisite gas can penetrate the skin and produce death. Other substances which are absorbed through the skin are: phenol, endrin, HCN, cantharidin, mercury, vitamin D and K, etc.

Action of poisons: (1) **Local:** (a) Chemical destruction by corrosives. (2) Congestion and inflammation by irritants. (3) Effects on motor and sensory nerves, e.g., tingling of skin and tongue by aconite, dilation of pupils by datura.

(2) **Remote:** Poison absorbed into the system through the blood, and then exerts a specific action on certain organs and tissues, e.g., cantharides acting on kidneys produces convulsions.

(3) **Combined:** Drugs like carbolic acid, oxalic acid, phosphorus, etc., have local and remote actions.

Types: (1) **Fulminant Poisoning:** is produced by massive dose. Death occurs rapidly, sometimes without producing symptoms. (2)

Acute poisoning is caused by an excessive single dose or several smaller doses taken over short interval of time. (3) **Subacute poisoning** shows features of both acute and chronic poisoning.

(4) **Chronic poisoning** is caused by smaller doses over a period of time, resulting in gradual worsening. The poisons which are commonly used for the purpose of chronic poisoning are arsenic, phosphorus, antimony and opium. (5) **Self-poisoning** (attempted suicide, parasuicide or pseudocide) is a conscious, often impulsive manipulative act, undertaken to rectify any intolerable situation. Most persons are psychologically disturbed.

Diagnosis of poisoning in the living: Suspicion of poisoning arises when symptoms appear (1) suddenly in a healthy person, (2) immediately or within a short period after food and drink, (3) are uniform in character, and rapidly increase in severity, (4) when several persons eat or drink at the same time from the same source of poison,

all suffer from similar symptoms at or about the same time, (5) the detection of poison in food taken, in the vomit or in the excreta is strong proof of poisoning.

Collect: (1) Stomach wash. (2) Ten ml. blood. (3) Urine 30 ml.

Diagnosis of chronic poisoning: (1) The symptoms are exaggerated after eating of suspected food, fluid, or medicine. (2) Malaise, cachexia, depression and gradual deterioration of general condition of the patient. (3) Repeated attacks of diarrhoea, vomiting, etc. (4) When the patient is removed from his usual surroundings, the symptoms disappear. (5) Traces of poison may be found in urine, stool or vomit.

Poison Information Centres: National Poisons Information Centre has been established in AIIMS, New Delhi and National Institute of Occupational Health at Ahmedabad. They provide toxicity assessment and treatment recommendations over the telephone throughout the day for all kinds of poisons.

Diagnosis in the dead: (1) **Autopsy: External:** (1) The surface of the body and clothes may show stains or marks of vomit, faeces or the poison itself. The colour changes in the corroded skin and mucous membrane are: (1) sulphuric acid and hydrochloric acid: grey, becoming black from blood, (2) nitric acid: brown, (3) hydrofluoric acid: reddish-brown, (4) carbolic acid: greyish-white, (5) oxalic acid: grey, blackened by blood, (6) cresols: brown leathery, (7) caustic alkalis: greyish-white, (8) mercuric chloride: bluish-white, (9) zinc chloride: whitish, (10) chromic acid and potassium chromate: orange, leathery. (2) **Colour of P.M. staining.** (3) **Smell about mouth and nose:** (a) **Garlic-like:** Phosphorus, arsine gas, arsenic (breath and perspiration), thallium, selenium, parathion, malathion, (b) **Sweet or fruity:** Ethanol, chloroform, nitrites. (c) **Acrid:** Paraldehyde, chloral hydrate. (d) **Rotten eggs:** Hydrogen sulphide, mercaptans, disulfiram. (e) **Musty or fishy:** Zinc phosphide. Other substances are cyanides, phenol, opium, ether, camphor, etc. (4) **The natural orifices,** e.g. mouth, nostrils, rectum, and vagina may show the presence of poisonous material or the signs of its having been used. (5) Injection marks.

Internal: (1) **Smell:** The skull should be opened first to detect unusual odours in the brain tissues. This is useful in cyanide, alcohol, phenol, cresol, ether, chloroform and camphor poisoning.

(2) **Mouth and throat** for any evidence of inflammation, erosion or staining.

(3) **Oesophagus:** Corrosive alkalis produce marked softening and desquamation of the mucous membrane.

(4) **Upper respiratory tract:** Oedema of glottis, and congestion and desquamation of the mucous membrane of the trachea and bronchi may be seen in corrosive acid or alkali poisoning when it enters the respiratory tract.

(5) **Stomach:** (a) **Hyperaemia** of the mucous membrane is caused by an irritant poison. It is usually patchy and of a deep crimson colour. The ridges are more involved. The mucosa is covered with a sticky secretion and shows small haemorrhagic foci. (b) **Softening** of mucous membrane of stomach is caused by corrosive or irritant poisons, chiefly alkaline corrosives. (c) **Ulcers:** Ulceration due to corrosive or irritant poisons is seen as an erosion, with thin, friable margins. The surrounding mucosa is softened due to inflammation, and there is diffuse hyperaemia. (d) **Perforation:** Perforation is occasionally observed when the strong mineral acids have been taken, especially sulphuric acid. The stomach is blackened and extensively destroyed, the opening is irregular, the edges sloughing, and the adjacent tissues easily torn. The acid escapes into the abdomen and causes peritonitis.

(6) **The duodenum and Intestines:** The only characteristic change is colitis, which occurs in mercury poisoning.

(7) **Liver:** Arsphenamine, chloroform, trinitrotoluene, carbon tetrachloride and senecio may produce liver necrosis. Arsenic, carbon tetrachloride, amanita phalloides, yellow phosphorus, iodine and rarely ferrous sulphate produce a fatty liver. Jaundice may arise in poisoning by phosphorus, senecio and potassium chlorate, due to acute haemolytic anaemia.

(8) **Kidneys:** Parenchymatous degenerative changes are commonly found in irritant metal and cantharidin poisoning. Extensive necrosis of proximal convoluted tubules may be found from poisoning by mercuric chloride, phenol, lysol and carbon tetrachloride.

(9) Heart: Subendocardial haemorrhages in the left ventricle occur in most cases of acute arsenic poisoning.

Failure to Detect Poison: The possible explanations of negative findings are: (1) The poison may have been eliminated by vomiting and diarrhoea, e.g. in irritant poisons. (2) The whole of the poison has disappeared from the lungs by evaporation or oxidation. (3) The poison after absorption may be detoxified, conjugated, and eliminated from the system. (4) Some vegetable alkaloidal poisons cannot be detected by chemical analysis. (5) Some drugs are rapidly metabolised, making extraction difficult. (6) Biological toxins and venoms which may be protein in nature cannot be separated from body tissues. (7) Some organic poisons especially alkaloids and glucosides may by oxidation during life or due to faulty preservation or a long interval, or from decomposition of the body may deteriorate and cannot be detected chemically. (8) Many drugs may be present in very small quantity. (9) Insufficient material for analysis.

(III) Experiments on Animals: Cat and dog are affected by poisons almost in the same way as man. They may be fed with suspected food, or with the poison after it is separated from the viscera and the symptoms noted.

(IV) Circumstantial Evidence: Such evidence may consist of motive, the evidence of witnesses about the recent purchase of the poison, his behaviour before and after the commission of the offence, and the recovery of poison from the possession of the accused.

Drug Automatism: According to this hypothesis, the patient develops a state of toxic delirium or amnesia after ingesting one or several doses of a drug (usually depressant drugs, barbiturates and alcohol), and in the delirious or automatism state, takes additional doses of the drug without realising it.

Duties of medical practitioner in case of suspected poisoning:

The duties are (I) **Medical:** Care and treatment of the patient. (II) **Legal:** Assist the police to determine the manner of death. (1) Note preliminary particulars of the patient, i.e. age, sex, address, date and time, identification marks, etc. (2) In case of suspected homicidal poisoning, the doctor must confirm his suspicion. For this he must (a) collect vomit and urine and submit for analysis. (b) Observe and

record the symptoms in relation to food. (c) Consult in confidence senior doctor. (d) Either remove the patient to hospital, or appoint nurses of his confidence. (e) Keep detailed records of symptoms and signs observed and treatment given from time to time. (3) If a private practitioner is convinced that the patient is suffering from homicidal poisoning, he is bound under S.39, Cr.P.C. to inform the police officer. (4) If he is sure that the patient is suffering from suicidal poisoning, he is not bound to inform police. (5) If the doctor is summoned by investigating police officer, he is bound to give all information. (5) A Government medical officer has to report to police all cases of suspected poisoning, whether suicidal, homicidal or accidental treated in the hospital. (6) If the condition of the patient is serious, he must arrange to record the dying declaration. (7) If patient dies, he should not issue death certificate but he should inform the police.

TREATMENT OF POISONING: (I) Immediate resuscitative measures should be adopted to stabilise respiration, circulation and to correct CNS depression (ABCD of resuscitation). **(II) Removal of unabsorbed poison from body.** **(i) Inhaled poisons:** The patient must be removed into fresh air, artificial respiration and oxygen given. The air-passages should be kept free from mucus by postural drainage or by aspiration.

(ii) Injected poisons: If a poison has been injected subcutaneously from a bite or an injection, a tight ligature should be applied immediately above the wound. The wound should be excised, and the poison neutralised by suitable chemical substance.

(iii) Contact poisons: If the poison is applied to the skin or wound or is inserted into the vagina, rectum, or urinary bladder, it should be removed by washing with water or should be neutralised by specific substance.

(iv) Ingested poisons: (1) **Gastric lavage** is useful within three hours after ingestion of a poison. (2) It is done using a stomach tube (Ewald or Boas tube), or ordinary soft, non-collapsible rubber tube of one cm diameter and 1.5 metres length, with a funnel attached at one end and a mark about 50 cm. from the other end, which should be rounded with lateral openings. (3) Dentures must be removed and a mouth gag used in patients whose mouth cannot be kept open while

passing the tube. (4) Patient should be lying on his left side or prone with head hanging over the edge of the bed, and face down supported by an assistant, so that the mouth is at a lower level than pharynx. (5) The end is lubricated with olive or sweet oil, or glycerine and is passed into the stomach by depressing the tongue with the finger and slowly passing it downwards till the fifty cm. mark is reached. (6) About 250 ml. of warm water (35°C) should be passed through the funnel held high up above the patient's head. (7) When funnel is empty, compress the tube below it between the finger and thumb, and lower it below the level of the stomach; its contents will be emptied by siphon action on releasing pressure on the rubber tubing. (8) Preserve this for chemical analysis. (9) Gastric lavage may be done with water; 1:5000 potassium permanganate; five percent sodium bicarbonate, four percent tannic acid; one percent sodium thiosulphate; one percent sodium or potassium iodide; one to three percent calcium lactate; saturated lime water or starch solution. (10) Next, use about half litre of suitable solution and repeat till clear and odourless fluid comes out. (11) A small quantity of fluid containing the antitode is left behind in the stomach, so that it may neutralise whatever small quantity of the poison is left behind in the stomach. (12) Ryle's tube or number 10 to 12 French catheter can be used for infants and children and about 25 cm. is necessary to reach stomach.

Contraindications: (1) **The only absolute contraindication is corrosive poisoning (except carbolic acid) due to danger of perforation.** In the following conditions stomach wash can be done by taking proper precautions. (1) Convulsant poisons, after controlling the convulsions. (2) Comatose patients. The airways should be sealed by cuffed intubation and lavage done. (3) Volatile poisons which may be inhaled. (4) Upper alimentary disease, e.g. oesophageal varices. (5) In patients with marked hypothermia and haemorrhagic diathesis.

Emetics: (1) Ipecac powder 1 to 2 g. or 30 ml. ipecac syrup for adults, 15 ml (1 to 2 years); 10 ml. (9 to 12 months); 5ml (6 to 9 months); followed by several glasses of water produces vomiting in 90 to 95% of patients within 20 to 30 minutes. (2) The dose is repeated if vomiting does not occur in half hour. (3) This is the only and best method of producing vomiting. (4) Stimulation of back of throat with

finger, leaf, twig or a wooden tongue depressor is usually ineffective and may be dangerous. (5) **Household emetics**, i.e. mustard powder and common salt are not effective and can lead to complications. (6) Copper sulphate, tartar emetic, zinc sulphate and apomorphine are obsolete.

Contraindications: (1) Same as for stomach wash, and (1) severe heart and lung diseases. (3) Advanced pregnancy.

(III) Antidotes: **Antidotes are substances which counteract or neutralise the effects of poisons.** (a) **Mechanical or physical antidotes:**

They neutralise poisons by mechanical action or prevent their absorption. (1) **Activated charcoal** is fine, black, adourless powder. It can be used by mixing with water to form a soap-like slurry. Four to eight g. acts mechanically by adsorbing and retaining within its pores organic and also to a less degree, mineral poisons and thus delays the absorption from the stomach. (2) **Demulcents** are substances which form a protective coating on the gastric mucous membrane, e.g. milk, starch, egg-white, mineral oil, milk of magnesia, aluminium hydroxide gel, etc. Fats and oils should not be used for oil-soluble poisons, such as kerosene, phosphorus, organophosphorus compounds, DDT, phenol, turpentine, aniline, acetone, carbontetrachloride, etc. (3) **Bulky food** acts as mechanical antidote to glass powder by imprisoning its particles within its meshes.

Multidose activated charcoal: It facilitates the passage of substances from plasma into the intestinal lumen (by creating a concentration gradient between blood and bowel fluid), where the concentration of toxin has been significantly lowered by intraluminal charcoal adsorption, and significantly decreases half-life of several drugs. Initial loading dose is 1 to 2 g/kg. Repeat doses of 0.5 to one g/kg are given at 4 to 6 hour intervals. It can also be given by continuous infusion of 0.25 to 0.5 g/kg/ hour through a nasogastric tube.

(b) Chemical Antidotes: They counteract action of poison by forming harmless or insoluble compounds or by oxidising poison when brought into contact with them. (1) Dialysed iron is used to neutralise arsenic. (2) Albumen precipitates mercuric chloride. (3) Common salt decomposes silver nitrate by direct chemical action, forming insoluble silver chloride. (4) Alkalies for acids and acids for alkalies are

not advisable. (5) Potassium permanganate has oxidising properties. 1:5000 solution is used in poisoning for opium, strychnine, cyanides, barbiturates, atropine, phosphorus. When it reacts with the poison in the stomach it loses its pink colour. (6) A solution of tincture iodine or Lugol's iodine, fifteen drops to half a glass of warm water precipitates most alkaloids, lead, mercury, silver, quinine and strychnine. (7) One teaspoonful of tannic acid in water precipitates apomorphine, cinchona, strychnine, nicotine, cocaine, aconite, pilocarpine, lead, silver, aluminium, cobalt, copper, mercury, nickle and zinc.

Universal antidote consists of (1) activated charcoal (or burnt toast) two parts. (2) magnesium oxide one part, (3) tannic acid (or strong tea) one part. It is not recommended.

(c) Physiological or pharmacological Antidotes: (1) These act on the tissues of the body and produce symptoms exactly opposite to those caused by the poisons. (2) They are used after poison is absorbed into circulation. (3) Atropine and physostigmine are two real physiological antidotes, as both of them affect nerve endings and produce opposite effects on the heart rate, state of the pupils, and glandular secretory activity. (4) Others are: barbiturates and picrotoxin or amphetamine; strychnine and barbiturates; cyanides and amyl nitrite.

Chelating agents: They inactivate a metallic ion with formation of an inner ring structure in the molecule, the metallic ion becoming a member in the ring.

(A) B.A.L. (British anti-lewisite; dimercaprol): (1) It is used in arsenic, lead, copper, mercury,, bismuth, gold and other heavy metals. (2) Many heavy metals have great affinity for sulphhydryl (-SH) radicles and combine with them in tissues, and deprive the body of the use of respiratory enzymes of tissue cells. (3) Dimercaprol has two unsaturated sulphhydryl groups which combine with metal, and thus prevent union of metal with the -SH group of the respiratory enzyme systems. (4) In severe poisoning a dose of three to four mg/kg is given. (5) Three ml. of 10% B.A.L. and 20% benzyl benzoate in arachis oil is injected deep intramuscularly fourth hourly for the first two days, and then twice daily for ten days or till recovery. (6) It is not used when liver is damaged.

(B) E.D.T.A. (ethylenediamine tetra-acetic acid; calcium disodium versenate): (1) It is effective in lead, mercury, copper, cobalt, iron, nickel, cadmium poisoning. (2) The usual dose is 25 to 35 mg/kg. body weight in 250 to 500 ml. of 5% glucose or normal saline i.v. over a one to two hour period twice daily for five days, and may be repeated after two to three days. (3) It is superior to B.A.L. for the treatment of poisoning by arsenic and mercury.

(C) Penicillamine (cuprimine): (1) It is given in a dose of 30 mg/kg. body weight orally for seven days. (2) One to three g. can be given in slow normal saline drip daily for two to four days. (3) It is the chelating agent of maximum efficiency for heavy metals.

(D) DMSA (succimer): (1) It is used in lead, mercury and arsenic poisoning. (2) It is superior to EDTA in the treatment of lead poisoning. (3) It is given in a dose of 10 mg/kg. orally every 8 hours for 5 days, followed by same dose every 12 hours for 14 days. (4) A combination of succimer and EDTA is more effective.

(E) DMPS is used in mercury, lead and arsenic poisoning. Dose 5 mg/kg. i.v. in 6 divided doses, followed by 100 mg. orally twice a day for 10 days.

(F) Desferrioxamine 8 to 12 g. orally for poisoning by iron.

(IV) Elimination of poison by Excretion: **(1) Renal Excretion:** Salicylates and phenobarbitone can be easily excreted in alkaline urine. Amphetamine, quinine and quinidine can be easily excreted in acid urine. **(2) Purgatives.** **(3) Diaphoretics:** In most cases application of heat (blankets, hot water) will cause adequate perspiration. A very abundant diaphoretic action will be produced by five mg. of pilocarpine nitrates s.c.

(4) Peritoneal dialysis: (1) Alcohols, long-acting barbiturates, chloral hydrate, salicylate, bromides, inorganic mercury, theophylline, and sodium chlorate are effectively removed by peritoneal dialysis. (2) It is only 10 to 25% as effective as haemodialysis. (3) Exchange transfusion especially in children is useful in barbiturate, CO and salicylate poisoning.

(5) Haemodialysis: (1) It is very useful for removing ethanol, methanol, ethylene glycol, chloral hydrate, trivalent arsenic,

acetaminophen, phenobarbital, bromides, salicylates, fluoride, sodium chlorate, digitalis, methaqualone, and thiocyanates. (2) Haemodialysis should be done (a) when normal route of excretion of a compound is impaired, (b) when blood concentration of lethal substance is in toxic range, (c) patient is progressively deteriorating. (3) Haemodialysis is superior to charcoal haemoperfusion in poisoning by salicylates, methanol, ethylene glycol.

(6) Charcoal haemoperfusion: Many drugs are actively adsorbed by coated charcoal. They include barbiturates, salicylates, paraquat, phenytoin, theophylline, chloral hydrate, digitalis, glutethimide, pentobarbital, carbamozepine and paracetamol.

CHAPTER 23

AGRICULTURAL POISONS

ORGANOPHOSPHORUS POISONS: They are derived from phosphoric acid and form two series of compounds. (A) **Alkyl phosphates:** (1) HETP. (2) TEPP (teton). (3) OMPA. (4) Dimefox. (5) Isopestox. (6) Malathion (kill bug; bugsoline). (7) Sulfotepp. (8) Demeton. (9) Tichlorfon. (B) **Aryl phosphates:** (1) Parathion (Follidol, kill phos; ekato). (2) Paraoxon. (3) Methyl- parathion (metacide). (4) Chlorothion. (5) Diazinon (Tik 20; diazion).

Absorption: It is absorbed by inhalation, through the skin, mucous membranes and the G.I. tract.

Action: (1) Organophosphorus compounds are powerful inhibitors of carboxylic esterase enzymes, including acetylcholinesterase. (2) They bind firmly to the esterase enzyme, inactivating it by phosphorylation, at the myoneural junctions and synapses of the ganglia. (3) Organic phosphates inhibit AChE in all parts of the body due to which acetylcholine accumulates at the parasympathetic, sympathetic and somatic sites and transfer of nerve impulses across synapses at the autonomic ganglia at the nerve-muscle junction is prevented. (4) They are also called cholinesterase inhibitors. This produces a syndrome of overactivity due to unhydrolysed acetylcholine. (5) Symptoms appear in both sympathetic and parasympathetic nervous system.

Symptoms: With massive ingestion or inhalation, symptoms may begin within five minutes, or may be delayed for half to one hour and are at maximum in two to eight hours.

(I) Muscarinic manifestations: These symptoms can be easily remembered by the acronym SLUDGE: Salivation, lachrymation, urination, defaecation, G.I. distress, and emesis. **Bronchial tree:** Bronchoconstriction, increased bronchial secretions, dyspnoea, cyanosis, pulmonary oedema. **G.I.:** Anorexia, nausea, vomiting, cramps, diarrhoea, faecal incontinence, tenesmus. **Sweat glands:** Increased sweating. **Salivary glands:** Increased salivation. **Lacrimal glands:** Increased lacrimation. **C.V.S:** Bradycardia, hypotension. **Pupils:** Miosis, occasionally unequal or dilated. **Ciliary body:** Blurred vision. **Bladder:** Urinary incontinence.

(II) Nicotinic manifestations: (1) Striated muscle: muscular fasciculations, cramps, weakness, areflexia, muscle paralyses. (2) Sympathetic ganglia: Hypertension, tachycardia, pallor, mydriasis.

(III) CNS manifestations: Restlessness, emotional lability, headache, tremors, drowsiness, confusion, slurred speech, ataxia, generalised weakness, coma, convulsions, depression of respiratory and cardiovascular centres.

Porphyriaemia, resulting in **chromolachryorrhoea** (shedding of red tears) due to accumulation of porphyrin in the lachrymal glands is seen rarely.

Fatal Dose: TEPP, HETP, OMPA, Parathion: 80mg. i.m. or 175 mg. orally. Malathion and diazinon: one g. orally.

Fatal Period: Usually within 24 hours.

Cause of Death: Death is caused by paralysis of respiratory muscles, respiratory arrest due to failure of respiratory centre, or intense bronchoconstriction.

Diagnosis: Give two mg. of atropine. In a normal person this causes marked atropinisation, but in a case of poisoning by organophosphorus compound, symptoms are relieved without atropinizing. Estimations of cholinesterase are confirmatory.

Treatment: (1) The patient is removed from the source of exposure, the contaminated clothing removed, and the exposed areas are washed with soap and water or some alkaline solution. (2) Administer oxygen and aspirate secretions. (3) When cyanosis is present, maximal oxygenation should be achieved before atropine is given. (4) Stomach should be washed with 1:5,000 potassium

permanganate solution. (5) **Atropine sulphate arrests the muscarine and CNS effects.** Two to four mg. is given i.v. (paediatric dose 0.05 mg/kg.) as a test dose. This dose may be doubled every five to ten min. until muscarinic symptoms are relieved. Atropine should be continued until the tracheobronchial tree is cleared of the secretions and most secretions are dried. The average patient requires 40 mg. per day but as much as 1000 mg/day has been used. It can be given in continuous infusion. (6) **Specific cholinesterase reactivators like diacetyl monoxime (DAM), or 2-pyridine alodoxime methiodide (pralidoxime iodide, 2-PAM), and pralidoxime chloride (protopan, 2-PAM chloride) act by competing for the phosphate moiety** of organophosphorus compound and release it from the cholinesterase enzyme. Its action is marked at nicotinic sites. It also lessens muscarine and CNS symptoms. The adult dose is one to two g.i.v. as a five percent solution given over half-an-hour. This dose should be repeated at 6 to 12 hour intervals for 24 to 48 hours. Maximum dose should not exceed 12 gm. in a 24 hours period. (7) **Pralidoxime and atropine work synergistically**, and should be used together. (8) Obidoxime chloride 250 mg. i.v. or i.m. is more potent, but its toxicity is slightly greater. (9) Symptomatic.

Prophylaxis: The precautions to be taken are: (1) Protective clothing. (2) The face and the hands should be thoroughly washed after spraying with soap and water. (3) Not more than two hours spraying a day should be done by a worker. (4) The workers should not smoke, chew or drink in the spraying area.

P.M. appearances: (1) Signs of asphyxia are found. (2) The face is congested and there is cyanosis of the lips, fingers and toes. (3) Blood stained froth is seen at the mouth and nose. (4) The stomach contents may smell of kerosene. (5) The mucosa of the stomach is congested with submucous petechial haemorrhages. (6) Respiratory passages are congested and contain frothy, haemorrhagic exudate. (7) The lungs show gross congestion, excessive oedema and subpleural petechiae. (8) The internal organs, brain and meninges are congested; petechial haemorrhages are present. (9) The cholinesterase in erythrocytes and at myoneuronal junctions is below normal.

CARBAMATES: (1) They are marketed in the form of dust or solutions, such as aldicarb (Temik), aminocarb (Matacil), aprocarb (Baygon), carbaryl (Sevin), carbofuran (Furaxdan). (2) Absorption occurs through all routes. (3) They will spontaneously hydrolyse from the cholinesterase enzymatic site within 48 hours and as such toxicity is limited. (4) All other clinical manifestations are similar to organophosphates.

Treatment: Atropine is the specific antidote. Pralidoxime may diminish the severity of symptoms and help prevent some morbidity.

PARAQUAT

It is a dipyridylium compound and used as herbicide and weed-killer. It is produced commercially as a brownish concentrated liquid of the dichloride salt in 10 to 30% strength, under the trade name, 'Gramoxone' and as brown granules called "Weedol" at about 5% strength. Deaths by inhalation while spraying are very rare.

Absorption and excretion: Absorption through inhalation, skin or eye contact is minimal. Five to ten percent of the dose is absorbed, and the rest is excreted in the faeces. It is distributed to all the organs. More than 90% of the absorbed paraquat is excreted unchanged in the urine within the first twentyfour hours.

Fatal Dose: Three to five gm.

Fatal Period: 2 to 7 days.

Signs and symptoms: **Local:** Irritation and inflammation of skin, nails, cornea, conjunctivae and nasal mucosa. **G.I.T.:** Oropharyngeal ulceration and corrosion, nausea, vomiting, haematemesis, diarrhoea, painful mucosal ulceration, dysphagia, aphonia, perforation of oesophagus, mediastinitis and pneumothorax. **Renal:** Oliguria or non-oliguric renal failure due to acute tubular necrosis. **Lungs:** Cough, haemoptysis, dyspnea due to pulmonary oedema, haemorrhage or fibrosis. **Liver:** Centrilobular hepatic necrosis and cholestasis. **C.V.S.:** Hypovolaemia, shock, arrhythmias. **C.N.S.:** Late coma, convulsions, cerebral oedema.

Cause of death: Death occurs from multiorgan failure or corrosive effects in the G.I. tract. Death from oesophageal perforation and mediastinitis can occur within two to three days of ingestion.

In ingestions of less than three gm death occurs from five days to several weeks.

Treatment: (1) Gastric lavage. (2) One litre of 15 to 30% aqueous suspension of Fuller's earth or 7% bentonite are given to adsorb paraquat, followed by 200 ml of 20% mannitol. (3) If the above adsorbents are not available, activated charcoal can be given. (4) Haemodialysis and haemoperfusion is useful if done within 12 hours of ingestion. (5) Remove all clothing and wash the patient thoroughly with soap and water.

Postmortem appearances: There may be ulceration around the lips and mouth. The stomach may show erosions. The kidneys may show cortical pallor and diffuse tubular damage. Progressive lung damage may cause death within two weeks. Diffuse pulmonary oedema and haemorrhages occur. Within a few days repair begins. If patient continues to survive, the alveoli begin to fibrose. The lungs may be mistaken for a diffuse pneumonia. There may be a fibrinous pleurisy.

ENDRIN: (1) Endrin is a polycyclic, polychlorinated hydrocarbon. (2) Its taste is bitter. (3) It is also called "plant penicillin", because of its broad spectrum of activity against various insect pests. (4) It is mixed with petroleum hydrocarbon such as aromax, which smells like kerosene.

Symptoms: These begin within one to six hours. They are salivation, nausea, vomiting, abdominal pain, hoarseness of voice, coughing, froth at the mouth and nose, dyspnoea, headache, giddiness, restlessness, hyperirritability, dilated pupils, incoordination, ataxia, mental confusion, tremors, tonic and clonic convulsions, coma and death due to respiratory failure.

F.D.: Five to six g. **F.P.:** One to several hours.

P.M.Appearances: The mouth and stomach contents smell of kerosene. Signs of asphyxia are present.

Treatment: There is no specific antidote.

ZINC PHOSPHIDE: It is a steel-grey crystalline powder with a garlicky odour. It reacts with the acid in the stomach and liberates phosphine. The symptoms are: vomiting, diarrhoea, cyanosis, fever, respiratory distress and death.

F.D.: Five g. **F.P.** One day.

P.M. Appearances: Garlicky odour in stomach contents. Blood is cherry-red. Lungs are congested and oedematous. Liver shows fatty degeneration and necrosis.

ALUMINIUM PHOSPHIDE (ALP) is a solid fumigant pesticide, insecticide and rodenticide. **On coming in contact with moisture ALP liberates phosphine. It has garlicky odour.**

Absorption and Excretion: Phosphine is rapidly absorbed from the G.I. tract and from the lungs after inhalation. Phosphine is oxidised slowly to oxyacids and excreted in the urine as hypophosphite and through the lungs.

Action: Phosphine inhibits cytochrome oxidase.

F.D.: One tablet. **F.P.:** one hour to 4 days. Majority die within 24 hours.

Symptoms: Moderate and severe poisoning produces: **G.I.T.:** nausea, vomiting, diarrhoea, retrosternal pain. **C.V.S.:** Hypotension, shock, arrhythmias, myocarditis, pericarditis, acute congestive heart failure. **R.S.:** cough, dyspnoea, cyanosis, pulmonary oedema, respiratory failure. **Hepatic:** Jaundice, hepatitis, hepatomegaly. **Renal** failure. **C.N.S.:** Headache, dizziness, altered mental state, restlessness, convulsions, acute hypoxic encephalopathy, coma.

P.M. Appearances: Garlic-like odour is present at the mouth and nostrils and in the gastric contents. Blood stained forth is found at the mouth and nostrils. The lungs, liver, spleen, kidneys and brain are congested.

Treatment: (1) Gastric lavage with potassium permanganate. (2) Activated charcoal. (3) There is **no specific antidote.**

CHAPTER 24

CORROSIVE POISONS

They act by extracting water from the tissues, and coagulate cellular proteins, and convert haemoglobin into haematin.

SULPHURIC ACID (oil of vitriol).

Symptoms: (1) The lips are usually swollen and excoriated, and brown or black streaks may be found from angles of the mouth to the sides of the chin. (2) There is corrosion of mucous membranes of mouth, throat and oesophagus, immediate burning pain and dysphagia. (3) Eructation, nausea and vomiting occur. (4) The vomit is brown or black, mucoid, strongly acid and may contain shreds of the charred wall of the stomach. (5) Thirst is intense. (6) Teeth are chalky-white. (7) Tongue becomes swollen, sodden and black. (8) The abdomen becomes distended and very tender. (9) The voice becomes hoarse, and the pupils usually dilated. (10) If person recovers, late oesophageal, gastric and pyloric strictures and stenoses may develop.

Fatal dose: 5 to 10 ml. **F.P.** 12 to 24 hours.

Cause of Death: (1) Circulatory collapse. (2) Spasm or oedema of glottis. (3) Collapse due to perforation of stomach. (4) Toxaemia.

Treatment: (1) The acid should be immediately diluted and neutralised in situ by giving one-fourth litre of water or milk, mixed with four tablespoonfuls of calcium or magnesium oxide, aluminium hydroxide gel or calcined magnesia. (2) Alkaline carbonates and bicarbonates, which liberate CO₂ should not be used, as they cause gastric distention and sometimes rupture. (3) Give demulcents. (4) Prednisolone sixty mg./day may be given in divided

doses to prevent oesophageal stricture and for shock. (5) Later, three to four cm. diameter mercury-filled bougie should be passed daily if stricture develops. (6) Tracheostomy. (7) Give nothing by mouth. (8) Nutrient substances are given by i.v. route for about a week. (9) Then try liquids, soft food and finally a regular diet. (10) Skin burns are washed with water, and a paste of magnesium oxide is applied.

P.M. Appearances: (1) Corrosion of mucous membranes of lips, mouth and throat and of the skin over the chin, angles of the mouth and hands is seen. (2) The necrotic areas are at first greyish-white, but soon become brown or black and leathery. (3) The upper digestive tract is inflamed and swollen by oedema and severe interstitial haemorrhage, even when corrosion is absent. The greater part of stomach may be converted into soft, spongy, black mass. (4) The mucosal ridges are more damaged than the intervening furrows. (5) In the damaged area, the mucosa or even the whole thickness of the stomach wall has a brown or black colour. (6) Perforation may occur, and chemical peritonitis and corrosion of organs is seen. (7) Corrosion or severe inflammation of the larynx and trachea may be present.

VITRIOLAGE (vitriol throwing): **Throwing of sulphuric acid on another individual is known as vitriolage.** (2) Jealous or disgruntled persons may throw a corrosive to disfigure and harm their enemies. (3) Blindness may occur if the eyes are involved. (4) Death may result from shock or toxæmia, if extensive area is involved. (5) The burns are painless, and penetrating. (6) Repair is slow and the scar tissue causes contracture. (7) Sometimes, corrosive alkali or juice of marking nut or calotropis is used to disfigure the face.

Treatment: (1) The affected part is washed with plenty of water and soap and a thick paste of magnesium oxide or carbonate is applied. (2) The eyes are washed with water and irrigated with dilute sodium bicarbonate solution. (3) Later, a few drops of olive oil or castor oil is put into eyes.

NITRIC ACID (aqua fortis, red spirit of nitre). In concentrated form, it combines with organic matter and produces an yellow discolouration of tissues, due to the production of picric acid (**xanthoproteic reaction**).

Symptoms are those of poisoning by sulphuric acid. (2) It causes yellow discolouration of the tissues, including the crown of the teeth and yellow stains on the clothing.

F.D.: 10 to 15 ml. **F.P.:** 12 to 24 hours.

P.M. Appearances are same as sulphuric acid except tissues are stained yellow.

HYDROCHLORIC ACID (muriatic acid):

Symptoms: It does not usually corrode or seriously damage the skin, but readily destroys mucous membrane which is at first grey or grey-white, and later becomes brown or black.

F.D.: 15 to 20 ml. **F.P.:** 12 to 24 hours.

OXALIC ACID: It is used as a bleach to remove stains, and for removing writing and signature illegally.

Action: Local: (1) Crystals and concentrated solution of oxalates are corrosive. (2) They rarely damage the skin, but readily corrode the mucous membrane of the digestive tract. (3) They do not lose their poisonous properties when diluted.

Systemic: (a) **Shock:** Large doses cause rapid death from shock.

(b) **Hypocalcaemia:** Those who survive for a few hours develop hypocalcaemia. (c) **Renal damage:** Tubular nephrosis or necrosis and death from uraemia in 2 to 14 days.

F.D.: 15 to 20 g. **F.P.:** One to two hours

Symptoms: (a) Fulminating poisoning: (1) Large concentrated doses of 5 g. or more produce immediate symptoms and death within minutes. (2) There is burning, sour, bitter taste in the mouth with a sense of constriction around the throat and burning pain from the mouth to the stomach. (3) Pain is very severe all over the abdomen. (4) Nausea and eructations are followed by vomiting which may be persistent. (5) Vomit has a coffee-ground appearance. (6) Diarrhoea will occur if life is prolonged.

(b) Acute Poisoning: (1) When the patient survives for a few hours, the symptoms are those of hypocalcaemia, and less by digestive upset. (2) There may be numbness and tingling of the fingertips and legs. (3) Signs of cardiovascular collapse appear.

(c) Delayed Poisoning: The symptoms are of uraemia. There may be metabolic acidosis and ventricular fibrillation.

Treatment: (1) The stomach is washed using calcium lactate or gluconate. (2) **The antidote is any preparation of calcium** which converts the poison into insoluble calcium oxalate, e.g. lime water, calcium lactate, calcium gluconate, calcium chloride, a suspension of chalk in water or milk. (3) Calcium gluconate 10%, 10 ml. i.v. at frequent intervals. (4) Parathyroid extract hundred units i.m. in severe cases. (5) Symptomatic.

P.M. Appearances: (1) Used in strong solution, the mucous membrane of the tongue, mouth, pharynx and oesophagus will be whitened as if bleached, and has a scalded appearance. (2) The inner surface of the oesophagus is corrugated. (3) The mucous membrane of the stomach is reddened or punctate from erosions or almost black. It may be softened in patches. (4) Many dark-brown or black streaks run along the length of the stomach over the mucous membrane, often with intercommunicating branches. (5) The stomach contents are gelatinous and brownish. (6) The kidneys are swollen by oedema, congested, and the tubules are filled with oxalate crystals.

Absorption: It is absorbed from the alimentary tract, respiratory tract, rectum, vagina, serous cavities, wounds and through skin.

Elimination: Phenol is converted into hydroquinone and pyrocatechol in the body before being excreted in the urine. A trace is excreted by the lungs, salivary glands, skin and stomach.

CARBOLIC ACID

F.D.: 10 to 15 g. **F.P.:** 3 to 4 hours.

Symptoms: Poisoning by carbolic acid is known as carbolism.

Local: (1) Skin: (1) It causes burning and numbness and a white opaque eschar which is painless and falls off in a few days. (2) **G.I.T.** (a) Hot burning pain extends from the mouth to the stomach, followed by tingling and later anaesthesia. (b) Deglutition and speech become painful and difficult. (c) The lips, mouth and tongue are corroded, which soon become white and hardened. (3) **R.S.:** Pulmonary and laryngeal oedema develop due to irritation.

Systemic Effects: (1) Phenol is depressant of nervous system, especially the respiratory centre. (2) Headache, giddiness, tinnitus, muscular spasm and later collapse, unconsciousness and coma occur. (3) Pupils are contracted, breathing is stertorous, pulse is rapid, feeble

and irregular, face covered with cold sweat, and there is cyanosis. (4) There is a strong odour of phenol in breath.

Urine: (1) It is scanty and contains albumin and free haemoglobin; suppression may follow. (2) It may be colourless or slightly green at first, but turns green or even black on exposure to air. (3) In the body, phenol is partly oxidised to **hydroquinone** and **pyrocatechol**, which with unchanged phenol are excreted in the urine, partly free and partly in unstable combination with sulphuric and glucoronic acids. (4) **The further oxidation of hydroquinone and pyrocatechol in the urine is the cause of green colouration. This is known as carboluria.**

The hydroquinone and pyrocatechol may cause pigmentation in cornea and various cartilages, a condition called oochronosis.

Treatment: (1) The stomach should be washed with luke warm water containing charcoal, olive oil, castor oil, magnesium or saccharated lime with which phenol combines and forms harmless products. (2) When lavage is completed, 30 g. of magnesium sulphate or a quantity of medicinal liquid paraffin should be left in the stomach. (3) Activated charcoal in usual dose. (4) Saline containing 7 g. of sodium bicarbonate per litre is given i.v. to dilute carbolic acid in blood and to encourage excretion by producing diuresis. (5) Demulcents. (6) If phenol falls on the body, the area is washed with soap and water. (7) Olive oil, or methylated spirit or ethyl alcohol act as solvents.

P.M. Appearances: External: (1) Corrosion of the skin has a greyish or brown colour. (2) The tongue is usually white and swollen, and there is a smell of phenol about the mouth. (3) The mucous membrane of the lips, mouth and throat is corrugated, sodden, whitened or ash-grey with small submucous haemorrhages.

Internal: (1) The mucosa of the oesophagus is tough, white or grey, corrugated and arranged in longitudinal folds. (2) The stomach mucosal folds are swollen and covered by opaque, coagulated grey or brown thickened mucous membrane. The intervening furrows are less damaged, dark-red and not opaque. The mucous membrane is thickened and looks leathery. (3) The liver and spleen usually show a whitish, hardened patch where the stomach has been in contact with them due to transudation of phenol. (4) The kidneys show

haemorrhagic nephritis in cases of delayed death. (5) The brain is congested and may be oedematous. (6) The blood is dark and semifluid or only partially coagulated.

CAUSTIC ALKALIS: Action: Strong alkalis absorb water from the tissues and precipitate proteins. **Alkalis produce liquefaction necrosis and saponification of fats.**

Symptoms: (1) When strong alkali is ingested, abrasions, blisters and brownish discolouration are seen on the lips and skin around the mouth. (2) The mucosa of digestive tract is swollen and a grey slough readily detached, lies over the inflamed tissues. (3) Oesophageal stricture formation is a major long-term complication. (4) Ammoniacal vapour when inhaled, causes congestion and watering of the eyes, violent sneezing, coughing, choking and suffocation.

F.D.: Potassium or sodium hydioxide five g.; Potassium and sodium carbonate and ammonia 30 g.; **F.P.:** Usually 24 hours.

Treatment: (1) Neutralise poison by giving vegetable acids, e.g., acetic, citric, or tartaric acid mixed with large quantity of water. (2) Demulcents.

P.M. Appearances: (1) The marks about the mouth become dark in colour and parchment-like after death. (2) Alkalies produce a soft, oedematous, translucent, soap-like, swollen eschar, red-brown from absorption of altered blood pigment. (3) The sloughs are mucilaginous. (4) Charring is not seen. (5) **Alkalies most severely affect the squamous epithelium of the oesophagus**, although stomach is involved in 20% cases. (6) Mucosa may be brownish due to formation of alkali haematin. (7) **Acids produce more damage to the stomach than the oesophagus.**

CHAPTER 25

METALLIC POISONS

ARSENIC: **Action:** It combines with the sulphhydryl enzymes and interferes with cell metabolism. Locally it causes irritation of the mucous membranes and remotely depression of the nervous system.

Symptoms: (1) **The fulminant type:** Large dose when rapidly absorbed causes death in one to 3 hours from shock and peripheral vascular failure.

(2) **The gastroenteric type:** (1) It resembles bacterial food poisoning. (2) Symptoms usually appear half to one hour after ingestion. (3) There is sweetish metallic taste. (4) **G.I.T.:** Constriction in the throat and difficulty in swallowing; burning and colicky pain in oesophagus, stomach and bowel occur. Intense thirst and severe vomiting which may be projectile are the constant symptoms. The stools are expelled frequently and involuntarily and are dark-coloured, stinking and bloody, but later become colourless, odourless and watery resembling rice-water stools of cholera. (5) **Hepatic:** Fatty infiltration. (6) **Renal:** Oliguria, uraemia. Urine contains albumen, red cells and casts. (7) **C.V.S.:** Acute circulatory collapse with vasodilation, increased vascular permeability, ventricular tachycardia, ventricular fibrillation. (8) **C.N.S.:** Headache, vertigo, hyperthermia, tremors, convulsions, coma, general paralysis. (9) **Skin:** Delayed loss of hair, skin eruptions.

(3) **Narcotic type:** G.I. symptoms are slight. There is giddiness, formication and tenderness of the muscles, delirium, coma, and death.

F.D.: 100 to 200 mg. **F.P.:** One to two days.

Treatment: (1) Emetics. (2) The stomach should be emptied and then repeatedly washed with large amount of warm water and milk. (3) **Freshly precipitated hydrated ferric oxide (arsenic antidote)** is given in tablespoonful dose at short intervals for two to three days. This forms a sparingly soluble ferric arsenite. (4) Tablespoonful dose of dialysed iron may be used as substitute. (5) If none of these is available **calcined magnesia mixed with an equal quantity of activated charcoal** may be given. (6) The stomach should be washed out at intervals to remove iron compounds, and adherent arsenic. (7) Butter and greasy substances prevent absorption. (8) **B.A.L.** 3 to 5 mg/kg. i.m. every 4 hours for 2 days and then twice daily for 7 to 10 days. (9) **Calcium disodium versenate is superior to B.A.L. in some respects.** (5) **Penicillamine** 100 mg/kg. daily in 4 divided doses for 5 days.

Differences between arsenic poisoning and cholera

Trait	Arsenic poisoning	Cholera
(1) Pain in throat:	Before vomiting	After vomiting.
(2) Purging:	Follows vomiting.	Precedes vomiting.
(3) Stools:	Rice-water in the early stages, and later bloody.	Rice water and passed in continuous involuntary jet.
(4) Tenesmus:	Present.	Absent.
(5) Vomited matter:	Contains mucus, bile and blood.	Watery without mucus, bile and blood.
(6) Voice:	Not affected.	Rough and whistling.
(7) Conjunctivae:	Inflamed.	Not inflamed.
(8) Excreta:	Arsenic present.	Cholera vibrio present.

P.M. Appearances: (1) The eyeballs are sunken and the skin is cyanosed. The body may be shrunken due to dehydration. (2) The lesions are mainly found in stomach. The mucosa is swollen, oedematous and red either generally or in patches, especially in the pyloric region. There may be lines of redness running along the walls or curved lines of submucous haemorrhages. Usually groups of petechiae are seen scattered over the mucosa, and sometimes large submucosal and subperitoneal haemorrhages. (3) **The stomach mucosa resembles red velvet.** (4) Small acute ulcerations or large erosions may be found, especially at the pyloric end. (5) A mass of

sticky mucus covers the mucosa. (6) The liver, spleen and kidneys are congested, enlarged and show cloudy swelling and occasionally fatty change. (7) The lungs are congested with subpleural ecchymoses. (8) Nephritis, particularly of glomerular type is frequent. (9) Haemorrhages may be found in the abdominal organs, mesenteries, and occasionally in the larynx, trachea and lungs. (10) There may be oedema of brain with patchy necrosis or haemorrhagic encephalitis. (11) The meninges are congested. (12) Subendocardial petechial haemorrhages of the left ventricle are common in arsenic poisoning and may be found even when the stomach does not show signs of irritation.

Chronic poisoning: C.N.S.: Polyneuritis, optic neuritis, anaesthesia, paraesthesia. **Skin:** Pigmentation consists of a finely mottled brown change mostly on the temples, eyelids and neck (**raindrop type of pigmentation**) which persists for many months. There may be a rash. In prolonged contact, hyperkeratosis of the palms and soles with irregular thickening of the nails and development of bands of opacity in the fingernails called **Aldrich-Mees lines** is seen. **G.I.Tract:** Cirrhosis of the liver, nausea, vomiting, abdominal cramps, diarrhoea, salivation. **C.V. System and kidney:** Chronic nephritis, cardiac failure, dependent oedema. **General:** Anaemia and weight loss.

Absorption: It is absorbed from the alimentary tract and from the skin when applied in suitable vehicle.

Distribution: (1) In the early stage, it is found in greatest quantity in the liver followed by kidneys and spleen. (2) **Arsenic is excreted into the stomach and intestines after absorption even when given by routes other than mouth.** (3) In cases in which life is prolonged, it is found in the muscles for days, in the bones for weeks, and in keratin tissues, hair, nails and skin for months.

Elimination: It is eliminated mainly by the kidneys, but also in the faeces, bile, sweat, milk and other secretions.

Tolerance: Some people take arsenic daily as a tonic or as an aphrodisiac and they acquire tolerance up to 0.3 g. or more in one dose. Such people are known as **arsenophagists**.

Poisoning: Homicide: The **disadvantages are:** (1) it delays putrefaction, (2) can be detected in completely decomposed bodies, (3) can be found in bones, hair and nails for a long time, (4) can be detected in charred bones or ashes. Sometimes, it is given mixed with tobacco cigars for homicide or to rob.

P.M.Imbibition of Arsenic: In exhumations the possibility of imbibition of arsenic from the stomach into neighbouring viscera and also contamination from the surrounding earth should be remembered. Arsenic found in the soil is usually an insoluble salt. Keratin tissues absorb arsenic by contamination from outside.

MERCURY: It forms two series of compounds: (1) Mercuric, which are soluble and intensely poisonous, and (2) mercurous, which are much less soluble and less active. Metallic mercury is not poisonous if swallowed.

Symptoms: (1) Acrid metallic taste and a feeling of constriction in the throat, hoarse voice, difficulty in breathing. (2) The mouth, tongue and fauces become corroded, swollen and show a greyish-white coating. (3) Nausea, retching, vomiting and diarrhoea with blood stained stools and tenesmus. (4) Circulatory collapse occurs soon. (5) If a person survives, second phase begins in one to three days; glossitis, and ulcerative gingivitis appear within 24 to 36 hours. (6) Severe infection, loosening of teeth and necrosis of the jaw may occur. (7) In two to three days, renal tubules show necrosis and produce transient polyuria, albuminuria, cylindruria, uraemia and acidosis. (8) Recovery may occur within 10 to 14 days. (9) After many days membranous colitis develops and produces dysentery, tenesmus, ulceration of colonic mucosa and haemorrhage.

F.D.: One to 2 g. **F.P.:** Three to 5 days.

Treatment: (1) Give egg-whites, milk or activated charcoal to precipitate mercury. (2) **Gastric lavage with 5% solution of sodium formaldehyde sulphoxylate.** This reduces mercuric chloride to metallic mercury. (3) **B.A.L. is the chelator of choice.** (4) Penicillamine. (5) Sodium or magnesium sulphate. (6) Demulcents. (7) High colonic lavage with 1:1000 solution of sulphoxylate twice daily.

P.M. Appearances: (1) The mucosa of the G.I. tract shows inflammation, congestion, coagulation and corrosion. (2) If the person survives for few days, the large intestine shows necrosis, due to the re-excretion of mercury into the large bowel. (3) Acute tubular and glomerular degeneration or haemorrhagic glomerular nephritis is seen. (4) The liver shows cloudy swelling or fatty change.

Chronic Poisoning: (1) The symptoms are salivation, inflammation of gums and occasionally a blue line at their junction with teeth, sore mouth and throat, loosening of teeth, gastrointestinal disturbances, fine tremors of the tongue, hands, arms and later of legs, anaemia, anorexia, loss of weight and chronic inflammation of kidneys. (2) Tremors occur first in the hands, then progress to lips and tongue and finally involve arms and legs. The tremor is moderately coarse with jerky movements. The advanced condition is called **hatter's shakes or glass blower's shakes**, because they are common in persons working in glass blowing and hat industries. (3) There may be mental disturbances. (4) **Mercurial erethism** is seen in persons working with mercury in mirror manufacturing firms. This term is used to refer to the psychological effects of mercury toxicity which include anxiety, depression, shyness, timidity, irritability, loss of confidence, mental depression, delusions and hallucinations, or suicidal melancholia, or manic depressive psychosis, emotional instability, loss of memory and insomnia. (5) **Mercurial lentis** is a peculiar eye change due to exposure to deposit of mercury through the cornea on the anterior lens capsule. Slit-lamp examination demonstrates a malt-brown reflex from the anterior lens capsule. It is bilateral and has no effect on visual acuity.

Acrodynia or Pink disease is thought to be hypersensitivity reaction especially in children. This can be caused by chronic mercury exposure in any form. There is irritation of hands and feet usually followed by desquamation, loss of hair, hyperkeratosis and excessive sweating.

LEAD: Action: At the cellular level, lead interacts with sulphhydryl groups and interferes with the action of enzymes necessary for haem synthesis and for haemoglobin and cytochrome production.

F.D.: 20 g. lead acetate; 40 g. lead carbonate. **F.P.:** one to 2 days.

Chronic Poisoning (plumbism): Causes: (1) Inhalation of lead dust and fumes. (2) Continuous absorption of minute amounts from drinking water stored in lead cisterns, from tinned food contaminated with lead from the solder and from constant use of hair dyes and cosmetics containing lead. (3) Absorption through raw or intact skin. (4) Use of ghee stored in brass or copper vessels lined inside with tin in which oleate of lead is formed and also by taking food cooked in tinned vessels. (5) Absorption of vermillion applied to the scalp. Chronic poisoning results from a daily intake of one to two mg. of lead.

Symptoms: (1) **Facial Pallor:** The facial pallor particularly about the mouth is one of the earliest and most consistent sign. (2)

Anaemia: (a) There may be polycythaemia with polychromatophilia in early stages, but later there is anaemia which is associated with polychromasia, punctate basophilia, reticulocytosis, poikilocytosis, anisocytosis, nucleated red cells and an increase in mononuclear cells, whereas polymorphonuclear cells and platelets are decreased.

(b) **Punctate basophilia or basophilic stippling** means the presence of many dark-blue coloured, pinhead sized spots in the cytoplasm of red blood cells, due to toxic action of lead on porphyrin metabolism. Reticulocytes and basophilic stippled cells result from the inhibition of 5-pyrimidine nucleotidase, an impaired ability to rid the cells of RNA degradation products, and the aggregation of ribosomes. (3)

Lead line: (a) A stippled blue line, called **Burtonian line**, is seen on the gums in 50 to 70% of cases. (b) It appears due to subepithelial deposit of granules at the junction with teeth, only near dirty or carious teeth, within a week of exposure, usually on upper jaw. (c) It is due to formation of lead sulphide by the action of hydrogen sulphide formed by decomposed food in the mouth. (d) A similar blue line may be seen in cases of poisoning by mercury, copper, bismuth, iron and silver. (4) **Colic and constipation:** (a) It is usually later symptom. (b) Colic of intestines, ureters, uterus and blood vessels occur in 85% of cases. (c) The colic occurs at night and the pain may be very severe. (d) Individual attacks last only a few minutes, but may recur for several days or weeks. (e) Constipation is usual.

(5) **Lead palsy:** (a) It usually occurs late and is seen in less than

10% of cases. (b) There may be tremors, numbness, hyperaesthesia, and cramps before the actual muscle weakness. (c) It is commoner in adults than in children and men are particularly affected. (d) The muscle groups affected are those most prone to fatigue. (e) Usually, the extensor muscles of the wrist (wrist drop) are affected but rarely muscles of eye or intrinsic muscles of hand or foot are affected. (f) The paralysis is associated with degeneration of the nerve and atrophy of the muscles. (g) Recovery may be complete but is usually slow.

(6) **Encephalopathy:** (a) Lead encephalopathy in some form is said to be present in almost every case of plumbism. (b) It is common in children. (c) The symptoms are vomiting, headache, insomnia, visual disturbances, irritability, restlessness, delirium, hallucinations, convulsions, coma and death. (7) **C.V.S. and kidneys:** Lead causes vascular constriction leading to hypertension and permanent arteriolar degeneration. Chronic arteriosclerotic nephritis and interstitial nephritis occur. (8) **Reproductive system:** Menstrual derangements, such as amenorrhoea, dysmenorrhoea, menorrhagia, sterility of both sexes and abortion (between 3 to 6 months) are frequent. (9) **Other systems:** They are dyspepsia, emaciation, irritability, headache, vertigo, loss of hair and drowsiness.

Diagnosis: (1) History. (2) Clinical features. (3) Erythrocyte protoporphyrin (EP), commonly assayed as zinc protoporphyrin (ZPP) are usually below 35 µg/dL. (4) X-ray evidence of increase radio-opaque bands or lines at the metaphyses of long bones is seen in children. (5) Basophilic stippling.

Treatment: (1) Sodium bicarbonate 20 to 30 g. a day divided in 4 or 5 portions. (2) Magnesium or sodium sulphate 8 to 12 g. will change unabsorbed lead salts to the highly insoluble lead sulphate and hasten its passage in the stools. (3) **Calcium disodium versenate acts as an ion exchanger.** (4) **BAL** four mg/kg of body weight every four hours. (5) Pencillamine 0.3 to 0.5 g. orally one to five times daily is very effective in excretion of circulating lead but is not as effective as EDTA. (6) DMSA (Succimer) is superior to EDTA. (7) A diet poor in calcium, and ammonium chloride one g. ten times daily is given. By this lead deposited in the bones is mobilised into the blood and excreted. High doses of parathormone have similar effects.

Distribution: (1) Lead is normally present in almost all tissues. (2) It is a typical cumulative poison. (3) The bones contain large amounts and also hair and nails. (4) Lead is excreted largely in the faeces and to a small extent in urine.

COPPER: Copper as a metal is not poisonous. Copper compounds are powerful inhibitors of enzymes. (1) Copper sulphate (blue vitriol) occurs in large, blue crystals. (2) Copper subacetate (verdigris), occurs in bluish-green masses or powder.

Symptoms: (1) Symptoms appear in 15 to 30 minutes. (2) There is metallic taste, increased salivation, burning pain in the stomach with colicky abdominal pain, thirst, nausea, eructations and repeated vomiting. (3) The vomited matter is blue or green. (4) There is diarrhoea with much straining; motions are liquid and brown but not bloody. (5) Oiluria, haematuria, albuminuria and uraemia may occur. (6) In some cases paralysis of limbs is followed by drowsiness, insensibility, coma and death.

F.D.: Copper sulphate 30 g; copper subacetate 15 g.

F.P.: One to three days.

Treatment: (1) Stomach wash with one percent solution of potassium ferrocyanide forms an insoluble cupric ferrocyanide. (2) N-penicillamine is very effective. (3) E.D.T.A. (4) B.A.L. (5) Demulcent drinks.

P.M.Appearances: (1) The skin may be yellow. (2) Greenish-blue froth at mouth and nostrils. (3) The gastric mucosa and stomach contents are greenish or bluish. (4) The gastric mucosa may be congested, swollen, inflamed, and occasionally eroded. (5) The liver may be soft and fatty.

Poisoning: (1) Accidental, esp. in children. (2) Abortifacient. (3) Cattle poison. (4) Food contaminated with verdigris formed in copper cooking vessels.

Metal Fume Fever: (1) It is caused by inhalation of fumes of zinc, copper, magnesium, nickel, mercury, lead and other heavy metals. (2) The syndrome resembles a flu-like illness which starts 6 to 8 hours after exposure to fumes with fever, chills, cough, dyspnoea, cyanosis, myalgia, salivation, sweating and tachycardia. (3) Symptoms subside in about 36 hours after stoppage of exposure.

Methaemoglobinaemia is caused by amyl nitrite, nitroglycerin, nitrous gases, chloroquine, primaquine, silver nitrate, aniline, benzocaine, sulphonamides, naphthalene, phenacetin, pyridium, trinitrotoluene, bromates, chlorates, pyrogallol.

Treatment: Treatment is necessary if the methaemoglobin level is more than 30%. **Methylene blue is specific antidote.**

NITRATES: Action: Relaxation of smooth muscle, especially of small blood vessels and conversion of haemoglobin to methaemoglobin.

F.D.: Sodium nitrate one to two g.; nitroglycerine 200 mg.

F.P.: few hours to few days.

Symptoms: Low B.P., headache, vertigo, palpitations, visual disturbances; skin is flushed and perspiring, vomiting, colick, bloody diarrhoea; slow pulse; paralysis, coma convulsions; death due to circulatory collapse.

Treatment: (1) Stomach wash. (2) **Methylene blue one percent** solution, one two mg/kg. i.v., or fifty mg/kg. orally converts methaemoglobin to haemoglobin. (3) Transfusion with whole blood. (4) Oxygen and artificial respiration.

CHAPTER 26

INORGANIC IRRITANT POISONS

PHOSPHORUS: White phosphorus occurs as white or yellow, translucent waxy cylinders. Smell and taste is garlicky, luminous in dark, oxidises and emits white fumes, ignites at 34°C., and as such kept under water, and is highly toxic. Red phosphorus is reddish-brown, amorphous, solid mass. It is tasteless, odourless, non-luminous, non-oxidised, non-inflammable and non-toxic.

Action: It is protoplasmic poison which affects cellular oxidation.

(1) **Fulminating poisoning** is seen when a dose exceeding one g. is taken. These patients usually die within 12 hours due to shock.

(2) **Acute Poisoning:** (A) **First stage:** Burning pain in throat and abdomen, with intense thirst, nausea, vomiting, diarrhoea. Breath and excreta have garlic-like odour. Luminescent vomit and faeces are diagnostic. Skin contact produces painful penetrating second and third degree burns.

(B) **Second stage** is symptom-free lasting for two or three days.

(C) **Third Stage:** (1) Symptoms of systemic toxicity occur from absorbed poison. (2) There is nausea, prolonged vomiting, diarrhoea, haematemesis, liver tenderness and enlargement, jaundice, pruritus. (3) Haemorrhages occur into skin, mucous membrane and viscera, due to injury to blood vessels and inhibition of blood clotting. (4) Renal damage results in oliguria, haematuria, casts, albuminuria and sometimes anuria. (5) Convulsions, delirium and coma. (6) Death

may result from shock, hepatic failure, CNS damage, haematemesis or renal insufficiency.

F.D.: 60 to 120 mg. **F.P.:** 2 to 8 days.

Treatment: (1) **Gastric lavage using 1:5000 solution of potassium permanganate** oxidises phosphorus into phosphoric acid and phosphates, which are harmless. (2) **Activated charcoal** adsorbs the poison. (3) **Vitamin K 20 mg.** i.v. in repeated doses. (4) Wash out the bowel and repeat at intervals for several days. (5) Oil and fats should be avoided. (6) If renal failure is severe, peritoneal or haemodialysis may be required.

P.M. Appearances: (1) In acute poisoning, the body usually shows signs of jaundice. (2) The gastric and intestinal contents may smell of garlic and be luminous. (3) The mucous membranes of the stomach and intestine are yellowish or greysih-white in colour, and are softened, thickend, inflamed and corroded or destroyed in patches. (4) Multiple smaller or larger haemorrhages are seen in the skin, subcutaneous tissues, muscles, and serosal and mucosal membranes. (5) The liver becomes swollen, yellow, soft, fatty and is easily ruptured. (6) **In persons who survive for a week or longer, the appearances of acute yellow atrophy are present.** (7) The kidneys are large, greasy, yellow and show haemorrhages on the surface. (8) The heart is flabby, pale and shows fatty drgeneration. (9) Fat emboli may be found in the pulmonary arterioles and capillaries.

Chronic Poisoning: The frequent inhalation of fumes over a period of years causes necrosis of the lower jaw in the region of a decayed tooth. At first there is toothache, which is followed by swelling of jaw, loosening of the teeth, necrosis of gums, and sequestration of bone in the mandible. This condition is known as **phossy jaw, in which osteomyelitis and necrosis of the jaw occurs, with multiple sinuses discharging foul-smelling pus.**

Poisoning: (1) Accidental poisoning in children may occur due to chewing of fireworks or eating rat paste. (2) Occasionally used for homicide mixed with alcohol, coffee, etc. (a) Taken by mouth or introduced into the vagina to produce abortion. (4) For arson, white phosphorus covered with dung or wet cloth is thrown on huts. When the covering becomes dry, the roof catches fire.

CHAPTER 27

ORGANIC IRRITANT POISONS

RICINUS COMMUNIS: (1) Entire plant is poisonous, containing **toxalbumen ricin**. (2) The seeds are rich in purgative oil. (3) The 'press cake' contains ricin and is poisonous whereas castor oil is not poisonous. (4) The unbroken seeds are non-poisonous when swallowed and also when cooked.

Toxalbumen or Phytotoxin is a toxic protein, which resembles bacterial toxin in action and causes agglutination of red cells with some haemolysis and is antigenic. **Phytotoxin** is a toxin produced by a plant. **Ricin, crotin and abrin are phytotoxins**. Animal toxalbumens are snake and scorpion venoms.

Symptoms: Symptoms include salivation, nausea, vomiting, bloody diarrhoea, abdominal pain, thirst, cramps in calves and abdominal muscles, drowsiness, delirium, convulsions, shallow breathing, uraemia and jaundice, dehydration, collapse and death. **Ricin is excreted by intestinal epithelium.**

F.D.: 5 to 10 seeds; ricin six mg. **F.P.:** Two to several days.

P.M. Appearances: Ricin produces haemorrhagic inflammation of the G.I. tract even when given subcutaneously. Haemorrhages occur in internal organs.

CROTON TIGLIUM (jamalgota or naepala): (1) Seeds contain crotin, a toxalbumen which is not expressed with oil. Crotonoside, is also present. (2) The oil contains a powerful vesicating resin. (3) Applied to skin, oil produces burning, redness and vesication. (4) It is used as abortifacient and arrow poison.

F.D.: 4 to 5 seeds; one to two ml. of oil.

F.P.: Six hours to three days.

ABRUS PRECATORIUS: (1) The seeds are egg-shaped, brightscarlet colour with a large spot at one end, 8 mm. long and 6 mm. broad, and weigh 105 mg. on an average. (2) The seeds contain active principle abrin, a toxalbumin, which is similar to viperine snake venom; also abrine, abralin and haemoglutin. (3) All parts of the plant are poisonous.

Symptoms: (1) When an extract of seeds is injected under the skin of the animal, inflammation, oedema, oozing of haemorrhagic fluid from the site of puncture and sometimes necrosis occurs surrounding the site of injection. (2) The animal does not take food and drops after 3 to 4 days, becomes cold and drowsy or comatose and dies. (3) **The symptoms resemble those of viperine snake bite.**

F.D.: 90 to 120 mg. by injection. **F.P.:** 3 to 5 days.

Poisoning: (1) **The seeds are used for killing cattle and rarely for homicide.** (2) The seeds are decorticated and alone or mixed with datura, opium and onion are made into paste with spirit and water, and small sharp-pointed needles or “**suis**” are prepared which are then dried in the sun. (3) The needles are 15 mm. long and weigh 90 to 120 mg. (4) Two needles are inserted by their base into holes in a wooden handle. (5) A blow is struck to the animal with great force which drives the needle into the flesh. (6) For homicide, the needle is kept in between two fingers, and the person slapped. (2) Abortifacient and arrow poison.

ERGOT: Ergot is dried sclerotinum of the fungus claviceps purpurea, which grows on cereals like rye, barley, wheat, oats, etc. It gradually replaces the grain forming a curved, dark-purple or black compact mass. It contains about thirty alkaloids, but ergotoxine, ergotamine and ergometrine are important.

Chronic poisoning (ergotism): There is tingling and numbness of the skin, vasomotor disturbances leading to dry gangrene of fingers, toes, ears, nose, etc. and sensation of insects creeping under skin.

F.D.: 2 to 10 g. **F.P.:** One to several days.

CAPSICUM ANNUM: They have a pungent odour and taste and are used as condiment. **They are not fatal.** The active principles are capsaicin and capsicin.

Criminal use: (1) Powder is thrown into the eyes to facilitate robbery. (2) Torture.

SEMECARPUS ANACARDIUM (Marking nuts; bhilawa): It contains an irritant juice which is brownish, oily and acrid but turns black on exposure to air. **The active principles are semecarpol and bhilawanol.**

Symptoms: (1) **Applied externally, the juice** causes irritation and a painful blister which contains acrid serum which produces eczematous eruptions of surrounding skin with which it comes into contact and there is itching. **The lesion resembles a bruise.** (2) Taken by mouth, it produces blisters on throat and severe G.I. irritation, dyspnoea, tachycardia, cyanosis, delirium.

F.D.: 5 to 10 g. 6 to 8 seeds. F.P.: 12 to 24 hours.

CALOTROPIS: Calotropis gigantea (akdo, madar) has purple flowers and calotropis procera has white flowers. The active principles are uscharin, calotoxin, calactin and calotropin. The leaves and stalk when incised yield thick milky juice.

Symptoms: Applied to the skin, it causes redness and vesication. When taken by mouth, the juice produces burning pain in throat and stomach, salivation, stomatitis, vomiting, diarrhoea, convulsions and death.

F.D.: Uncertain. F.P.: 12 hours.

Poisoning: (1) To produce artificial bruise. (2) Cattle poison. (3) Criminal abortion. (4) Arrow poison. (5) The root of calotropis procera is highly poisonous to cobras, and other poisonous snakes, which cannot stand even its smell.

CANTHARIDES (Spanish Fly): The active principle is cantharidin, which is readily absorbed from all surfaces including the skin.

Symptoms: (1) Applied to the skin, redness and burning pain are produced followed by vesication. (2) Taken internally, burning sensation in the mouth and throat, pain in the stomach, vomiting, severe thirst, difficulty in swallowing and speech. (3) Later dull pain in the loins, the urine is scanty and bloodstained. (4) Priapism may occur; there is often tenesmus.

F.D.: 15 to 50 mg. of cantharidin; 2 to 3 g. powdered cantharides.

F.P.: 24 to 36 hours.

P.M. Appearances: (1) The kidneys are acutely inflamed and there is haemorrhage in the renal pelvis and bladder. (2) The bladder mucosa is inflamed and ecchymoses may be present. (3) The surface of the heart and endocardium shows haemorrhages.

Poisoning: (1) Aphrodisiac. (2) Criminal abortion.

SNAKES: In India, there are more than 200 species of land snakes. Only five of them are dangerously poisonous to man; king cobra, cobra, common krait, Russell's viper and saw-scaled viper.

The most common poisonous snake is common krait.

Fangs: (1) All the snakes have two fangs. (2) These are curved teeth situated on the maxillary bones and lie along the jaws. (3) When the snake is about to bite, they become erect and point directly forward. (4) They are bigger than the other teeth and are grooved or canalised in poisonous snakes.

Snake Venom: (1) Venom is the saliva of the snake. (2) Cobra venom is faint transparent, yellow and is slightly viscous. (3) Russell's viper venom is white or yellow. (4) Snake venoms are complex mixtures, chiefly proteins, many of which have enzymatic activities, such as proteolytic enzymes, phosphatidase, neurotoxins, hyaluronidase, ophioxidase, lecithinase, proteases, etc. (5) **The colubrine venom is mainly neurotoxic and has a primary toxicity for the respiratory and cardiac centres.** It can produce marked cardiac or vascular changes, or have a direct effect on the blood. (6) **The viperine venom is mainly haemolytic and causes intravascular haemolysis and depression of the coagulation mechanism.** It can also produce changes in the nervous system or in vascular dynamics. (7) As a rule one of the modes of action far exceeds the other. **The sea snake venom is myotoxic.**

Symptoms: (1) **Ophitoxaemia** is poisoning by snake venom. (2) The most common symptom following snake bite (poisonous or non-poisonous) is fright. (3) Due to fright, the victim may become semiconscious with cold clammy skin, feeble pulse and rapid breathing. (4) Sometimes, it produces psychological shock and even death.

Cobra: (1) Within six to eight minutes, a small reddish wheal develops at the site of bite. (2) The bitten area is tender with slight radiating burning pain. (3) Swelling may be minimal or even absent.

(4) Symptoms may appear after about half hour. (5) The patient feels sleepy, slightly intoxicated, weakness of legs, and is unable to stand or move. (6) Weakness of muscles increase, and develops into paralysis of the lower limbs. The paralysis then spreads to the trunk, and affects the head which droops. (7) This is followed by paralysis and swelling of the tongue and the larynx, due to which there is difficulty in speech and swallowing. (8) There may be extra-ocular muscle weakness, ptosis and strabismus. (9) After about two hours, the paralysis is complete. (10) Respirations become slower and the heart rate increases. (11) Though the patient is conscious, he is not able to speak. (12) Coma sets in and finally the respirations stop with or without convulsions.

Krait: Symptoms resemble those of cobra bite, but there is no swelling or burning pain at the site of the bite and the convulsions are milder, while the feeling of drowsiness and intoxication is more intense.

Russle's Viper and Echis Carinate: (1) More than 50% of the victims have minimal or no poisoning, as little or no venom is injected. (2) About 25% will develop serious generalised poisoning but death occurs rarely. (3) When venom is injected, the spot develops a severe pain within eight minutes. (4) The area around the bite is red and painful. (5) The onset of swelling starts within fifteen minutes and there is often bloodstained discharge from the wound. (6) When the venom injected is less, pain and swelling restricted to below the elbow or knee and nausea disappear within one to two days. (7) In moderate poisoning, there is a marked feeling of intense pain, vomiting, giddiness, sweating, abdominal pain, dilation of the pupils, and in about one to two hours, there is marked collapse and often complete loss of consciousness. (8) Tingling and numbness over the tongue and mouth or scalp and paraesthesia around the wound occur. (9) These symptoms usually subside within few hours. (10) There is local extravasation of blood and swelling spreads as far as the trunk in one to two days. (11) In severe cases, the main feature is the persisting shock. (12) A haemorrhagic syndrome with blood-stained sputum, haemorrhages from the gums, rectum, the site of bite, etc. occur due to increased coagulation time. (13) Intravascular haemolysis may lead

to haemoglobinuria and renal failure. (14) Petechial haemorrhages are common. (15) The prothrombin time is markedly increased, blood becomes defibrinated and will not clot. (16) Towards the end, there is an extensive suppuration and sloughing. (17) Paralysis does not occur. (18) Death is usually due to shock and haemorrhage.

Sea Snakes: (1) Bites cause little or no local reaction. (2) After half to one hour, the patient develops pain, stiffness and weakness of the skeletal muscles. (3) Marked polymyositis with a limb-girdle distribution. (4) Later, flaccid paralysis develops, beginning with ptosis. (5) Marked weakness of muscles persists for several months. (6) Myoglobinuria with renal failure may occur. (7) Death may occur due to cardiac arrest or paralysis of respiratory muscles.

F.D.: Cobra: 12 mg; Russel viper: 15 mg; echis: 8 mg; krait: 6 mg; of dried venom. The average yield in one bite in terms of dry weight of lyophilised venom is : cobra 170 to 325 mg; Russell's viper 130 to 250 mg; krait 20 mg; and echis 20 to 35 mg.

Diagnosis: (1) Snake specific venom antigens can be detected in urine. (2) Radio immunoassay (RIA) detects venom. (3) Enzyme immunoassay. (4) ELISA. (5) Injection of extract from the skin into frog.

F.P.: Cobra half to six hours; viper one to four days.

First Aid: (1) Assure the patient. (2) Immediately apply a broad firm bandage around the limb and on the bitten area. In bites on the trunk, head or neck apply firm pressure over the bitten area. (3) Immobilise the limb. (4) Make parallel incisions one cm. long and half cm. deep over each fang mark. Drainage of blood and lymph from the cuts shoud be done by mechanical suction. (5) Do not cauterise the wound. (6) Clean wound with saline.

Treatment: (1) **Polyvalent anti-snake venom** is prepared by hyper-immunising horses against venom of cobra, common krait, Russell's viper and saw-scaled viper, and is available in the form of lyophilised powder in an ampoule. (2) It is useful when given within four hours and is of doutful value after 24 hours. (2) Its half-life is 90 hours. (3) **Dose:** (a) **Minimal symptoms:** Local swelling but no systemic reactions: 5 vials. (b) **Moderate:** Swelling progressing beyond site of bite with systemic reaction: 10 vials. (c) **Severe:** Marked local reaction, severe symptoms: 10 to 15 vials.

(4) The powder is diluted in 500 ml. of distilled water or saline and infused in a period of one hour. (5) In neurotoxic poisoning a second dose of ten vials should be given after one hour. (6) In haemotoxic poisoning the dose is repeated after six hours. (7) If anti-snake venom is not available, 40 ml. of **antivenene** is given i.v. and repeated as required. It is effective for cobra and Russell's viper bites. (8) 1.5 mg. neostigmine, if neuroparalysis occurs. (9) Tetanus antitoxin. (10) Heparin for clotting abnormalities. (11) Sedatives. (12) Haemodialysis or peritoneal dialysis.

P.M. Appearances: (1) Poisonous snakes leave two or occasionally one fang mark. (2) Non-poisonous snakes leave a semicircular set of tooth marks. (3) The punctures are one and one-fourth cm. deep in colubrine and two-and-a-half cm. deep in viperine bites. (4) Sometimes the bite marks may not be visible. (5) Haemorrhages into the bowel, purpuric spots on pericardium and haemorrhages in the lungs and in many tissues may be seen. (6) Internal organs are congested. (7) Washing from the bite may contain cholinesterase or thromboplastin.

Absorption and Excretion: Snake venom is poisonous only when injected, and is harmless when taken by the mouth. It is excreted by kidneys, milk and probably by salivary glands and the mucous membranes.

Poisoning: (1) Poisoning is always accidental. (2) Occasionally, a murder is committed by throwing a poisonous snake on the bed of sleeping person. (3) Cattle are sometimes poisoned by snake venom.

SCORPIONS: The venom is clear, colourless toxalbumen and can be either haemolytic or neurotoxic. Its toxicity is more than that of snakes, but only a small quantity is injected. The mortality, except in children is negligible.

Symptoms: If the scorpion has haemolytic venom, the reaction is mainly local and simulates the viper snake bite, but the scorpion sting will have only one hole in the centre of the reddened area. The symptoms produced by a neurotoxic venom is similar to cobra bite.

Treatment: (1) A tourniquet should be applied above the location of sting. (2) A local anaesthetic is injected at the site to lessen pain. (3) A specific antivenin is available for most species.

CHAPTER 28

CNS DEPRESSANTS

ALCOHOL

Absolute alcohol contains 99.95% alcohol; rectified spirit contains 90% alcohol. **Arrack** is liquor distilled from palm, rice, sugar or jaggery, etc.

Absorption: (1) About 20% is absorbed from the stomach and 80% from small intestine. (2) Alcohol can be detected in the blood within 2 or 3 minutes of swallowing. (3) The maximum concentration in blood is reached within 45 to 90 minutes after ingestion.

Metabolism: (1) About 90% of alcohol absorbed is oxidised in the liver, and the remaining 10% is excreted by the kidneys and the lungs. (2) In the liver, alcohol is oxidised to acetaldehyde by alcohol dehydrogenase (ADH) and its coenzyme, nicotinamide adeninedinucleotide (NAD). (3) It disappears from the blood at a fairly uniform rate of about 10 to 15 ml. per hour. This is the equivalent of about 15 mg. % from the blood per hour. (4) Chronic alcoholics are able to metabolise alcohol at a faster rate of 40 to 50 mg. / 100 ml. / hour. (5) During oxidation alcohol is not stored in the tissues. (6) It is poorly soluble in body fat and as such females of the same body weight will have a higher (25% higher) blood alcohol concentration for the same amount of drink. (7) Venous blood alcohol in the absorption phase is about ten percent lower than arterial blood. (8) One hour after drinking, venous blood contains the same concentration of alcohol as arterial blood.

Symptoms: (1) **Stage of Excitement:** There is increased confidence and a lack of self-control, which is constant feature. (2) The person may disclose secrets. (3) Normal good manners are forgotten. (4) When jerking movement is in the direction of the gaze and independent of the position of the head, it is known as **alcohol gaze nystagmus**, and appears at blood levels of 40 to 100 mg% (average. 80 mg. %). (5) Mental concentration is poor and judgement is impaired. (6) These effects are usually seen between 50 to 150 mg./100 ml. of blood alcohol.

(2) **Stage of incoordination** (150 to 250 mg/100ml.): (1) The sense perceptions and skilled movements are affected. (2) He may become carefree, cheerful, ill-tempered, irritable, excitable, quarrelsome, sleepy, and so on. (3) The breath smells of alcohol. (4) The face is flushed and the pulse is increased. (5) The temperature becomes subnormal.

(3) **Stage of coma:** (1) Speech becomes thick and slurring, coordination is markedly affected, causing the patient to become giddy, stagger and possibly to fall. (2) The person passes into a state of coma with stertorous breathing. (3) The pupils are contracted, but stimulation of the person, e.g. pinching or slapping causes them to dilate with slow return (**Mc Ewan sign**). (4) Death occurs from asphyxia due to respiratory paralysis.

F.D.: 150 to 200 ml. of absolute alcohol consumed in one hour.

F.P.: 12 to 24 hours.

Treatment: (1) Hemodialysis or peritoneal dialysis is very useful.

Alcohol addicts are people who cannot stop drinking for long, or who experience withdrawal symptoms if they do. **Chronic alcoholics** are those who have reached a state of irreversible somatic or brain changes caused due to alcohol.

Treatment of chronic alcoholics: (1) Antabuse (disulfiram) is given in a daily dose of three-fourth g. for two days followed by half g. for three to five days. The dosage is gradually reduced. (2) Citrated calcium carbimide (temposil) 50 mg. once a day. (3) Chlorpromazine 20 to 25 mg. every four to six hours.

(4) The conditioned Reflex Treatment: (1) With backdrop of bottles of various alcoholic beverages, the patient is given various types of liquor, together with drugs that will cause immediate acute nausea and vomiting. After five to eight daily treatments, symptoms are brought on simply by the sight of a bottle, and the patient begins mentally to associate his painful sickness with alcohol. (2) Hypnosis and psychotherapy are also useful.

DRUNKENNESS: Drunkenness is a condition produced in a person, who has taken alcohol in a quantity sufficient to cause him to lose control of his faculties to such an extent, that he is unable to execute safely the occupation in which he is engaged at the particular time.

A model scheme of Medical Examination: (1) **Exclusion of injuries and pathological states:** Exclude: (a) Severe head injuries. (b) Metabolic disorders, e.g. hypoglycaemia, diabetic precoma, uraemia, hyperthyroidism. (c) Neurological conditions, e.g. disseminated sclerosis, intracranial tumours, Parkinson's disease, epilepsy. (d) Drugs: Insulin, barbiturates, antihistamines, morphine, atropine. (e) Psychological disorders, e.g., hypomania, general paresis. (f) High fever. (g) Exposure to CO.

(2) History: The history of the relevant events should be obtained.

(3) General behaviour: (a) **General manners and behaviour.** (b) **State of dress:** Presence of slobber on mouth or clothing; presence, character and colour of any vomit, soiling of clothes by excretions. (c) **Speech:** Note the type, e.g., is it thick, slurred or overprecise? Slight blurring of certain consonants is one of the earliest signs of incoordination of the muscles of the tongue and lips. Certain test phrases may be used to bring out this difficulty in speech, such as 'British Constitution', 'West Register Street, Truly Rural, etc. (d) **Self-control:** Whether he is able to control himself.

(4) Memory and mental alertness: Ask suitable questions about his movements during the preceding few hours, and the details of his accident if any. A few very simple sums of addition or subtraction may be asked.

(5) Handwriting: Ask to copy a few lines from a newspaper or book. A note should be made of: (a) The time taken, (b) repetition or omission of words, letters or lines, (c) ability to read his own writing.

(6) Pulse: The pulse is rapid and is usually full and bounding.

(7) Temperature: The surface temperature is usually raised.

(8) Skin: Skin is warm, dry and flushed.

(9) Mouth: (a) Note whether the tongue is dry, furred or bitten,
(b) The smell of the breath should be recorded.

(10) Eyes: (a) **General appearances:** The eyelids are swollen, red, congested. (b) **Visual acuity:** Any gross defect should be noted.

(c) **Intrinsic muscles:** (i) **Pupils:** Usually dilated in early stage, but may be contracted in later stages or coma. (ii) **Reaction to light:** They may become unequal, equalising again in response to light, and dilate again slowly even if the light continues to be directed in the eyes. (d) **Extrinsic muscles:** (i) **Convergence:** Test the degree of ability to follow a finger in all normal directions and to converge the eyes normally on a near object. (ii) **Strabismus:** Note whether it is present. (iii) **Nystagmus:** The presence of fine lateral nystagmus may indicate alcoholic intoxication.

(11) Ears: Examine for gross impairment of hearing.

(12) Gait: Ask to walk across the room and note: (a) **Manner of walking:** Is it straight, irregular, overprecise, unsteady, reeling, or with feet wide apart? (b) **Reaction time to a direction to turn:** Does he turn at once or continue for one or two steps before obeying? (c) **Manner of turning:** Does he keep his balance, lean forward, or swing to one side? Does he correct any mistake in a normal or exaggerated way? It is undesirable to ask him to walk along a straight line.

(13) Stance: Note whether he can stand with his eyes closed and heels together without swaying.

(14) Muscular coordination: Ask him to perform: (a) Placing finger to nose. (b) Placing finger to finger. (c) Unbuttoning and rebuttoning coat.

(15) Reflexes: Knee and ankle reflexes should be tested which are delayed or sluggish. Plantar reflex may be extensor or flexor.

(16) Laboratory Investigations: Blood is the most suitable and the most direct evidence of the concentration of alcohol in the brain.

Collection of Blood: (1) The skin is cleaned with a solution of 1:1000 mercuric chloride or washed with soap and water. (2) Do not use spirit. (3) Blood samples should be preserved by the addition of

100 mg of sodium fluoride and 30 mg. of potassium oxalate for ten ml. (4) A screw-capped glass bottle of "universal" size is suitable.

Widmark formula is $a = prc$, where a, is weight of alcohol (in g.) in the body; p, is the body weight (in kg.); c, is the concentration of alcohol in the blood (in mg. per kg.); and r is a constant (0.6 for men and 0.5 for women). For urine analysis, the formula is $a = \frac{3}{4} prq$. q is the alcohol concentration (in mg. per kg.)

Breath: (1) 60 to 100 ml. of breath is received into a dry balloon and analysed by drunkotester, drunkometer, intoximeter, or breathalyser. (2) **2100 ml. of alveolar air contains the same amount of alcohol as one ml. of blood.** (3) The person is asked to blow into plastic balloon through a glass tube, containing a crystalline bichromate-sulphuric acid mixture. (4) If the blood alcohol is 80 mg% or more, the crystals will become green. (5) Recently developed breath analysers rely on infrared absorption of energy by ethyl alcohol vapour in breath samples. (6) They are a direct method which instantly measures breath alcohol quantitatively.

Diagnosis of Drunkenness: The usual signs of drunkenness are: strong odour of alcohol in breath, loss of self-control and loss of clearness of intellect, unsteady gait, vacant look, congested eyes, sluggish and dilated pupils, dry lips, increased pulse rate, unsteady and thick voice, talks at random and lack of perception of passage of time.

Medical Terminology: "**Under influence**" means that due to drinking alcohol, a person has lost some of the clearness of the mind and self-control that he normally possesses.

Below 10 mg%: Sober.

20 to 70 mg% : Drinking.

80 to 100 mg% : Under the influence.

150 to 300 mg% : Drunk or intoxicated.

400 mg% and above : Coma, and death.

In India the law has made it an offence for a person to drive a motor vehicle above 30 mg%.

Saturday night paralysis occurs in the stage of coma due to pressure on nerve (radial) as when an arm hangs over a chair.

Alcohol and Traffic Accidents: There is progressive loss of driving ability as blood alcohol concentration rises. 30 to 50 mg%. of blood alcohol affects the driving ability of many persons. All persons with a blood alcohol level of 140 mg% are intoxicated to the point where they cannot deal with unusual, emergency or non-customary problems.

Delirium tremens: (1) It occurs in chronic alcoholics due to (a) temporary excess, (b) sudden withdrawal, (c) shock after receiving an injury, such as fracture of a bone, (d) from an acute infection, such as pneumonia, influenza, erysipelas, etc. (2) It begins 72 to 96 hours after last drink. (3) There is an acute attack of insanity in which the main symptoms are coarse muscular tremors of face, tongue and hands, insomnia, restlessness, loss of memory, uncontrollable fear and tendency to commit suicide, homicide or violent assault. (4) There is disorientation as to time and place and a peculiar kind of delirium of horrors, due to hallucinations of sight and hearing. (5) Patient imagines that insects are crawling under skin or snakes are crawling on his bed. (6) It is considered unsoundness of mind and not intoxication.

MYTHYL ALCOHOL: Pure methyl alcohol (wood alcohol) is colourless, volatile liquid, with an odour similar to ethyl alcohol, and has burning taste.

Symptoms: (1) Methyl alcohol produces symptoms of drunkenness in the same way as ethyl alcohol, but inebriation is not prominent, and the effects are more prolonged. (2) Toxicity can result following absorption through skin or respiratory tract. (3) Symptoms may appear within an hour or after an interval of several hours. (4) They consist of nausea, vomiting, and pain or severe cramps in the abdomen, headache, dizziness, vertigo. (5) There is marked muscular weakness, depressed cardiac action and hypothermia. (6) There may be dyspnoea and cyanosis. (7) The odour is usually present in the breath. (8) The effect on CNS is more intense and persistent than with ethyl alcohol. (9) There may be delirium and coma which may last for two or three days. (10) There is a toxic effect on the liver and kidneys and on highly specialised nerve elements. (11) Urine is

strongly acid and may contain acetone and a trace of albumin. (12)

Severe non-diabetic acidosis in unconscious persons is suggestive of methyl alcohol poisoning. (13) The pupils are dilated and fixed.

Visual disturbances like photophobia and blurred vision, (snowfield vision), seeing spots, central and peripheral scotomata, decreased light perception, concentric diminution of visual fields for colour and form, followed by fairly sudden failure of vision or complete blindness occur due to optic neuritis and atrophy from the effect of formic acid on the optic nerve. (14) Convulsions are usual and death occurs from respiratory failure.

F.D.: Sixty to 200 ml. **F.P.:** 24 to 36 hours.

Absorption: (1) It is rapidly absorbed through the stomach and intestines, and also through the lungs and the skin. (2) Its rate of oxidation and elimination is one-fifth that of ethanol. (3) Formaldehyde (33 times more toxic than methanol) and formic acid are formed during the oxidation of methyl alcohol, which are responsible for metabolic acidosis and retinal toxicity. (4) About 80% is excreted unchanged from the lungs and about 3 to 5% is excreted in urine.

Treatment: (1) Gastric lavage using 5% bicarbonate solution. (2) Activated charcoal reduces the mortality significantly. (3) Ethyl alcohol 50% is given in dosage of one ml/kg. body weight every two hours for five days. The i.v. route is preferred to avoid gastritis. A 5 to 10% concentration should be given slowly. (4) Alternatively 60 ml of ethyl alcohol in 200 ml. fruit juice can be given orally over a period of 30 minutes. Give 50 ml of 50% ethyl alcohol every hour for maintenance. (5) Folic acid 50 to 75 mg. every 4 hours. (6) Keep airway clear. (7) Haemodialysis is the treatment of choice in severe poisoning. It reduces the half-life of methanol from 40 hours to about one hour. (8) Symptomatic.

P.M. Appearances: (1) Cyanosis is marked and there is an absence of postmortem clotting of the blood. (2) The pyridine may give the skin a purple colour. (3) the mucous membrane of the stomach and the duodenum is congested and inflamed with small haemorrhages. (4) The lungs are congested and oedematous. (5) The

brain is oedematous and shows focal haemorrhages. (6) The mucosa of the bladder is often congested. (7) The liver shows fatty change and sometimes early necrosis, and there is tubular degeneration of the kidneys.

OPIUM: (1) Opium (afim) is the dried juice of the poppy (*Papaver somniferum*) which is cultivated in India and other Eastern countries, only under a license. (2) The unripe capsule is incised and the white juice which exudes is collected and allowed to evaporate to obtain opium. (3) Ripe and dry poppy capsules contain a trace of opium and are used for their sedative and narcotic action. (4) Poppy seeds (khaskhas) are white, harmless, demulcent and nutritive and are used as food. (5) The oil from the seeds is used for cooking purposes. (6) Opium occurs in rounded, irregularly formed or flattened masses and has strong characteristic odour and bitter taste. (7) Crude opium occurs in rounded, irregularly formed or flattened masses and has strong characteristic odour and bitter taste. (7) Crude opium contains about 25 alkaloids. These form two chemically different groups: (a) the phenanthrenes: morphine (ten percent), codeine (half percent), and thebaine (0.3%), which are narcotic, and the isoquinoline group: papaverine (one%), and narcotine (six percent), which have mild analgesic but no narcotic properties. Thebaine acts as convulsant. The narcotic symptoms of opium poisoning are practically those of morphine poisoning.

Action: Opiates exert their effects because of their chemical similarity to natural substances called endorphins. The opiate drugs activate receptor sites normally occupied by the natural opiates or endorphins.

F.D.: Opium two g; morphine 0.2 g.; coedine half g.

F.P.: 6 to 12 hours.

Symptoms: (1) **Stage of Excitement:** There is a sense of well-being, increased mental activity, freedom from anxiety, talkativeness, restlessness, or even hallucinations, flushing of face and greatly excited or maniacal condition.

(2) **Stage of Stupor:** (1) The symptoms are headache, nausea, vomiting, incapacity for exertion, a sense of weight in the limbs,

giddiness, drowsiness and stupor. (2) The pupils are contracted, face and lips are cyanosed and an itching sensation is felt all over the skin. (3) Pulse and respiration are normal.

(3) Stage of Coma: (1) The patient passes into deep coma. (2) The muscles become relaxed and all reflexes are abolished. (3) The pupils are contracted to pinpoint size and do not react to light, but in late stage and before death, they may be found dilated. (4) All the body secretions are suspended except sweat. (5) Respiration is very much increased. (6) Temperature is subnormal. (7) Blood pressure is low, breathing is slow and stertorous and may be reduced to three to four per minute. (8) The odour of opium may be present in breath. (9) Pulse slow, irregular and imperceptible, respiration becomes Cheyne-Stokes in type, and death occurs from asphyxia.

Treatment: (1) Wash the stomach frequently, with a solution of 1:5000 potassium permanganate. Gastric lavage should be done even after hypodermic injection of the drug, for the alkaloid is re-excreted into the stomach after absorption. (2) The intestines should be cleared out by enema twice daily for two days to prevent reabsorption. (3) Atropine is not recommended. (4) **Naloxone hydrochloride is a specific opioid antagonist.** It competes with opioids at receptor sites. It can reverse not only the respiratory, depressant, analgesic and euphoric effects of opioids, but also dysphoric, delusional and hallucinatory properties of the synthetic opioids. Two mg., is given and repeated every half to one hour up to a total dose of ten to twenty mg., i.v. It can also be given i.m. or sublingual. (5) **Nalmefene has longer duration of effect than naloxone.** 0.1 mg. is given i.v. followed by one mg. in 2 to 5 minutes. (6) When coma is deep, artificial respiration and oxygen is given by inhalation. **Coma cocktail:** (7) In comatose patients where the identity of poison is not known, 100 ml. 50% glucose, 100 mg. thiamine and 2 mg. naloxone should be given i.v.

P.M. Appearances are those of asphyxia.

Absorption : It is absorbed from mucous membranes, raw surfaces, hypodermic injection and when smoked in cigarettes. It is eliminated mainly as morphine in urine and faeces, and also by stomach, intestines, saliva, bile and milk.

Poisoning: (1) Suicide. (2) To steady the nerves for doing some bold act requiring special courage.

Chronic Poisoning: (Morphinism; morphinomania): Opium addicts can tolerate 3 to 6 g. per day. The habitual use first causes a pleasurable feeling of relief and well-being, but as larger doses are taken, there is disinterest and recurring periods of depression follow. Loss of memory, mental fatigue and gradual intellectual and moral deterioration occur. Constipation, contracted pupils, anorexia, emaciation and weakness and impotence are frequent.

BARBITURATES: They have depressant action on the central nervous system. Large doses directly depress the medullary respiratory centre and cause irreversible brain damage, and yet the patient survives for a sufficiently long period so that they are completely metabolised or excreted before death occurs.

Symptoms: (1) Usually the first symptom is drowsiness. (2) A short period of confusion, excitement, delirium, and hallucinations is common. (3) Ataxia, vertigo, slurred speech, headache, paraesthesiae, and subjective visual disturbances occur. (4) A stupor progressing through deepening coma, with inhibition or loss of superficial and deep reflexes occur. (5) The Babinski toe sign may become positive. (6) Respirations may be rapid and shallow or slow and laboured, but the minute volume is always reduced. (7) There is a fall in cardiac output and an increase in capillary permeability leading to an increase in extracellular fluid. (8) Mild but progressive cardiovascular collapse occurs. (9) The pupils are usually slightly contracted, but react to light; they may dilate during terminal asphyxia. (10) The urine may be scanty or suppressed and may contain sugar, albumen and haematoporphyrin. (11) Incontinence of urine and faeces may occur. (12) The body temperature is usually reduced. (13) Respirations become irregular, sometimes Cheyne-Stokes in character and finally stop. (14) The finding of blisters on the skin, often on areas of erythema, strongly suggests barbiturate poisoning. Blisters contain clear serous fluid. Blisters are commonly found in the sites where pressure has been exerted between two skin surfaces, such as the interdigital clefts and inner aspects of the knees. (15) Death occurs from respiratory failure or ventricular fibrillation.

F.D.: Short-acting: One to two g.; Medium-acting: Two to three g.; Long-acting: 3 to 5 g. **F.P.:** One to two days.

Treatment: (1) Gastric lavage. (2) **There is no specific antidote.**

Analeptics: (a) Amphetamine. (b) Cardiazol. (3) **Scandinavian method**, uses antishock measures, maintenance of airway, and adequate respiratory support. CNS stimulants have been totally eliminated. Fluid replacement therapy should be used and not vasopressors. If shock persists dopamine should be given. (4) **Haemodialysis and exchange transfusion are sometimes life-saving.** (5) Forced alkaline diuresis is most useful in poisoning by barbiturates which are not protein-bound like phenobarbitone, allobarbitone and barbitone.

P.M. Appearances are mainly of asphyxia.

METHAQUOLONE: Some persons are extremely sensitive to this drug and may become unconscious even after one tablet. The patient may feel dizzy, sweat and a syndrome similar to hypoglycaemia is produced. Addiction may occur and some degree of tolerance is seen after prolonged use.

CHLORAL HYDRATE: It depresses the CNS. It is absorbed rapidly from the stomach and small intestine and also from the rectum.

Signs and Symptoms resemble those of barbiturates. Death usually occurs from paralysis of the respiratory centre.

F.D.: 5 to 10 gm. **F.P.:** Eight to twelve hours.

Poisoning: (1) It is given in food or drink to render a person suddenly helpless for the purpose of robbery or rape. **Its action is so rapid that it has been given the name of “knockout drops”.** A combination of alcohol and chloral is commonly known as **“Mickey Finn”**. (2) It is often added to liquor to increase its potency.

BROMIDES: The bromides displace chlorides from plasma and cells, and may cause fatal depression of the nervous system. Excessive consumption may lead to clinical picture resembling intoxication.

F.D.: 30 to 45 g. **F.P.:** 6 to 18 hours.

CHAPTER 29

MISCELLANEOUS POISONS

HYDROCARBONS: Most of the hydrocarbons are derivatives of petroleum distillates. The toxic substances like gasoline, **kerosene**, naphtha, mineral spirit, light gas oil, and mineral sea oil are poorly absorbed from the G.I. tract.

Signs and Symptoms: (1) Acute or chronic contact with hydrocarbons causes chronic eczematoid dermatitis, with redness, itching and inflammation. (2) Cutaneous exposure to gasoline and other hydrocarbons can cause second degree burns, and systemic manifestations. (3) When ingested symptoms are: nausea, vomiting, abdominal pain and diarrhoea with risk of aspiration pneumonitis. (4) The breath, vomit and urine have the peculiar smell. (5) Aspiration produces coughing, choking, gasping, bronchospasm, hypoxia and CNS depression.

F.D.: 15 to 50 ml. of kerosene. **F.P.:** Within one day.

P.M.Appearances are those of asphyxia.

Poisoning: Poisoning is usually accidental, especially among children. In the siphoning of gasoline from a tank, the mobile liquid can easily be aspirated in the lungs and cause death.

Symptoms: (1) Burning pain in the throat and mouth, anorexia, apathy, lassitude, nausea, vomiting and thirst are the early symptoms. (2) The respiration is at first fast and deep, and later laboured and dyspnoeic. (3) Vertigo, ringing in the ears, deafness and impaired vision are common. (4) In severe poisoning a primary respiratory alkalosis with marked hyperapnoea and loss of CO₂ is caused. (5)

Later, metabolic acidosis supervenes. (6) The urine is strongly acid. (7) The skin is flushed and moist, pupils dilated, pulse is rapid and irregular. (8) There may be platelet dysfunction and prolonged clotting time. (9) Death occurs from acidosis and uraemia with peripheral failure due to shock. (10) Idiosyncrasy is seen in 0.2% cases.

PARACETAMOL (Acetaminophen): F.D.: 10 to 20 g.

F.P.: 2 to 4 hours.

Symptoms: (1) Anorexia, nausea, vomiting, diaphoresis, hypotension, tachycardia and dyspnoea. (2) In two to three days, there is pain in the right upper quadrant due to hepatic damage. (3) In 3 to 5 days, jaundice and renal failure.

Treatment: (1) **N-acetylcysteine (NAC) is a specific antidote.** (2) Haemodialysis.

P.M.Appearances: They include acute centrilobular hepatic necrosis, acute tubular necrosis in the kidney, myocardial necrosis and cerebral oedema.

CHAPTER 30

STIMULANTS

AMPHETAMINE: (1) The common preparations are: **amphetamine** (benzedrine), dexamphetamine sulphate (dexedrine), methylphenidate (ritalin), lithium carbonate and caffeine. (2) They give a feeling of confidence and mental alertness. (3) They produce a false sense of euphoria which may be followed by severe depression. (4) The onset of fatigue is delayed and tasks are more easily completed, but there is loss of judgement and accuracy. (5) Symptoms begin to appear within an hour after ingestion. They are: increased awareness and activity, lessening of fatigue, liveliness, talkativeness, insomnia, tremors, anorexia, dry mouth, nausea, vomiting, sweating, tachycardia, arrhythmias, palpitation, anxiety, headache, dilated pupils, confusion, hallucinations, delirium, convulsions, coma and death. (6) Fatal dose is about 200 mg. and fatal period about five days. (7) Dangers of misuse are: (1) Overactivity or aggressive behaviour. (2) Paranoid psychosis. (3) Shock and collapse. (4) Risk of suicide during the withdrawal.

CAFFEINE: (1) Large doses can stimulate directly the myocardium to produce tachycardia, arrhythmias and extrasystoles. (2) It increase cardiac output and stroke volume. (3) It decreases fatigue. (4) Adrenaline and noradrenaline secretion is increased. (5) It can increase the basal metabolic rate by about ten percent. (6) It also increases oxygen consumption. (7) It acts as diuretic. (8) Significant amounts of caffeine are present in tea, cola beverages and chocolates.

CHAPTER 31

DELIRIANT POISONS

DATURA FASTUOSA: Datura alba is a white flowered plant, and datura niger, a deep-purple flowered plant. All parts of these plants are poisonous, especially the seeds and the fruit. **They contain 0.2 to 1.4% of hyoscine (scopolamine), hyoscyamine and traces of atropine.**

Action: The alkaloids first stimulate the higher centres of brain, then the motor centres and finally cause depression and paralysis.

Symptoms: (1) Contact with leaves or flowers causes dermatitis in sensitive persons. (2) A bitter taste, dryness of mouth and throat, with difficulty in talking, dysphagia, and vomiting are first noticed. (3) The face becomes flushed, conjunctivae congested, pupils widely dilated with diplopia. (4) Mental changes include restlessness and agitation, and patient cannot recognise relatives or friends. (5) The patient becomes confused, giddy, staggers as if drunk. (6) The skin is dry and hot, the pulse rapid 120 to 140 per minute, full and bounding, respirations are increased. (7) The temperature may be raised by 2 to 3°C . (8) Muscle tone and deep reflexes are increased. (9) A scarlatinal rash or exfoliation of the skin may be seen over most of the body. (9) **Delirium** is restless and purposeless; in its earlier stages it is indicated by excitement, talkativeness and unintelligent speech. The patient may be silent but usually he is noisy, tries to run away from his bed, picks at the bed clothes, tries to pull imaginary threads from the tips of his fingers, threads imaginary needles. (11) Hallucinations of sight and hearing and delusions occur. (12) This excitement passes off in one to two hours and the patient passes into deep sleep or coma

which may end rarely in death from respiratory paralysis. (13) The patient may remain in this condition for two to three days, but usually distinct improvement occurs in 24 hours.

8D's : Dryness of mouth, dysphagia, dilated pupils, dry hot skin, drunken gait, delirium, drowsiness, death due to respiratory failure.

F.D.: One g. (100 to 125 seeds); Atropine 120 mg.

F.P.: One day.

Treatment : (1) **Physostigmine** half mg. i.v or i.m. In many cases a single dose is sufficient. (2) **Pilocarpine nitrate** 5 mg s.c

P.M appearances are those of asphyxia

Poisoning : (1) Curshed or powdered seeds or an extract is used by criminals for stupefying a victim prior to robbery, rape or kidnapping. It is usually given in food or drink, e.g chapatis, curry, tea, liquor, etc. to travellers in railway stations, choultries, etc. (3) Sometimes, the seeds are mixed with incense wood, and the victim is exposed to the fumes which produce lethargy. The victim soon falls into a deep sleep and later wakes up to find his belongings lost. (4) Abortifacient. (5) Aphrodisiac. (6) Added to liquor or toddy to increase the intoxication. (7) Love philter.

CANNABIS SATIVA OR INDICA : (1) It is also known as Indian hemp, hashish or marihuana. (2) The plant grows all over India, but its cultivation is restricted by law. (3) The active principle tetrahydrocannabinols (THC) are contained in its resin. (4) All parts of the plant, male or female, contain the active material. It is a CNS stimulant. It is used in the following forms.

(1) Bhang (*Siddhi, sabji*) : (a) It is prepared from the dried leaves and fruit shoots. (b) It is used as we use tea to prepare a decoction. (c) It is the mildest and contains 15% of active principle. **(2) Majoon :** It is sweet prepared with bhang. **(3) Ganja :** (a) It is prepared from the flower tops of the female plant. (b) It has a rusty-green colour and a characteristic odour. (c) It is mixed and smoked with tobacco in a pipe or hukka. (d) It contains 15 to 25% of the active principle. (e) Ganja (pot or grass) also known as marihuana, is used for smoking in cigarettes, which contain 0.3 to 0.6 g. cannabis and are known as **reefer**. **(4) Charas or hashish:** (a) It is the resin (dope or shit) exuding from the leaves and stems of the plant, and it contains 25 to

40% of the active principle. (b) It is darkgreen or brown in colour. (c) It is mixed and smoked with tobacco in a pipe.

Symptoms : (1) They appear soon after smoking and last for one to two hours, and within half hour after swallowing and last for two to three hours. (2) Taken in small dose the effects are very slight, which usually include euphoria, passivity, heightening of subjective experiences, and disorientation. (3) With moderate doses these effects are intensified by impaired immediate memory function, disturbed, thought patterns, lapses of attention, and subjective feeling of unfamiliarity.

Intoxication : (a) Psychiatric : (1) Feelings of detachment, disinhibition, depersonalisation, euphoria, elation, relaxation, well-being, dreaminess, sleepiness, self-confidence, jocularity, laughing, silliness, rapidly changing emotions. (2) Thought process: irrelevant, decreased concentration and attention span, altered sense of identity, disorientation. (3) Sensory novelty and increased awareness of stimuli: vivid images, illusions and hallucinations. (4) Feeling of precordial distress and tightness in chest; fear of dying. (5) Altered concepts of time and space, change in body image, altered sexual feelings. (6) Impaired judgement, failure to meet responsibilities. (7) Talkative, flighty, poor immediate memory.

(b) Physical : Increased appetite and thirst, nausea, heaviness in the head, dizziness, dysesthesias, somnolence, paraesthesia, restlessness, ataxia, tremors, dry mouth, tachycardia, urinary frequency, congested conjunctivae.

F.D.: Chars two g.: ganja eight g.: bhang ten g./kilo body weight

F.P.: Several days.

Treatment: (1) Stomach wash, (2) Diazepam, (3) Antipsychotic drugs.

Chronic Poisoning : (1) The use of the drug in small quantities even for long periods is not harmful. (2) Used in excess, it causes degeneration of the CNS and insanity. (3) There is loss of appetite, weakness, wasting, tremors, vacant look, red eyes, impotence and moral and mental deterioration. (4) Rarely they become insane, and may suffer from hallucinations and delusions of persecution. The person may **run amok**, i.e., he develops a psychic disturbance marked by period of depression, followed by violent attempts to kill people

(impulse to kill). He first kills a person against whom he may have real or imaginary enmity and then kills anyone that comes in his way until the homicidal tendency lasts. Then he may commit suicide or may surrender himself.

Poisoning : (1) To stupefy persons to facilitate robbery. (2) Taken by criminal before committing a criminal act, to strengthen the nerves. (3) Aphrodisiac.

COCAINE : (1) It is obtained from the leaves of Erythroxylum coca. (2) The usual routes of intake are by application to the nasal mucous membrane (snorting) and by the i.v route (skin popping). It is also smoked.

Symptoms : (1) Stage of Excitement : (1) Dryness in the mouth, dysphagia, feeling of well-being and loss of depression and fatigue. (2) The patient may be excited, restless and talkative, but this passes into a calm, dull condition. (3) The pulse is rapid, blood pressure falls, respirations rapid and deep, pupils dilated, headache, pallor of the skin, cyanosis, sweating and the temperature is raised. (4) The reflexes are exaggerated and there may be tremors or convulsions. (2) **Stage of Depression:** (1) Within an hour or even less, respirations become feeble, profuse perspiration, collapse, convulsions and death.

F.D.: One to one -and-half g. orally. **F.P.:** Few minutes to few hours.

Treatment: (1) Gastric lavage. (2) If applied to the nose or throat, wash out the mucous membrane with water. (3) If injected, apply a ligature above the part. (4) **Amyl nitrite is antidote and is given by inhalation.**

P.M appearances are those of asphyxia

Cocaine habit : (1) It is also known as cocaineism, cocainophagia or cocaineomania. (2) It causes anorexia, salivation and emaciation. (3) The face is pale, sunken, pupils dilated and the gaze 'shifty'. (4) The tongue and teeth are black. (5) The sniffing habit leads to ulceration of the nasal septum. (6) Degeneration of CNS occurs, and the patient may suffer from hallucinations, convulsions, delirium and insanity.

Magnan's symptom or cocaine bugs is seen in chronic cocaine habit, in which there is feeling as if grains of sand are lying under the skin, or some small insects are creeping on the skin, giving rise to itching sensation (**tactile hallucinations**).

CHAPTER 32

DRUG DEPENDENCE

(1) **Drug addiction** is a state of periodic or chronic intoxication, produced by the repeated consumption of a drug and is harmful to the individual and the society. The most important drugs of addiction are opium and its derivatives, pethidine, heroin, alcohol, barbiturates, cocaine, cannabis, LSD and amphetamine. Other drugs are chloral hydrate and bromides. Heroin is the most dangerous. (2) **Drug habituation** (habit) is a condition resulting from the repeated consumption of a drug, in which there is a psychological or emotional dependence on the drug. Caffeine and nicotine are habit forming drugs. **Drug dependence** includes both the terms ‘addiction’ and habituation’. (3) **Drug abuse (substance abuse)**: Improper or excessive use of therapeutic drugs may be termed abuse, even in the absence of addiction. The use of medically not useful or illegal drugs is usually called drug abuse, even when the use is moderate and leads to no harm. (4) **Addiction consists of physical dependence and psychological dependence.** (5) **Physical dependence** is a biological phenomenon, which depends on the type, dose and duration of drug use irrespective of personality factors. If the drug is abruptly withdrawn, a withdrawal syndrome will occur in a physically dependent person. (6) **Psychological dependence** is a compulsive need for a drug in order to maintain a state of well-being, and it can occur in the absence of physical dependence. (7) Indiscriminate use of any of these drugs produces a gradual mental, physical and moral worsening of the individual and sometimes sexual

perversions or crime. (8) The majority of drug victims are neurotic individuals who are mentally unbalanced. (9) Hereditary factors, abnormal mental conditions, frustrations in life, anxiety, chronic tensions, physical inability to do a job, curiosity, etc, are some of the causes.

Symptoms of Drug Dependency : Loss of appetite and weight, clumsy movements, unsteady gait, tremors, reddening or puffiness of eyes, unclear vision, slurring of speech, loss of interest, sleeplessness, lethargy and passivity, acute anxiety, depression, profuse sweating, mood changes, temper tantrums, depersonalisation and emotional detachment, impaired memory and concentration, preference for solitude, especially spending long hours in the toilet.

Trait	Drug addiction	Drug habituation
(1) Dependence:	Psychological and physical.	Psychological only.
(2) Compulsion :	Present.	Desire but not compulsion
(3) Dose :	Tendency to increase.	No tendency to increase.
(4) Withdrawal symptoms.	Characteristic symptoms.	None or mild.
(5) Harm :	Both to the individual and society.	If any, primarily to the individual.

Withdrawal symptoms : (1) They may begin within 6 to 8 hours following stoppage of the drug or they may be delayed for 24 to 48 hours, depending upon the particular drug being used. (2) The length of period of withdrawal symptoms also varies and can last up to ten days. (3) The intensity of the symptoms depends on the dose and type of the drug used, the duration of addiction, and the suddenness of withdrawal of the drug. (4) Early symptoms are chilliness, sensation of cold, uneasiness, yawning and rhinorrhoea. (5) Later, respirations become laboured, and very rapid. (6) Goose skin, lachrimation, gross tremors and dilated pupils are seen. (7) Anorexia is present in all the stages. (8) The third stage is one of sleep lasting from 8 to 16 hours. (9) Upon awakening all the previous symptoms become intense. (10) In addition, there is tachyapnoea, fever, hypertension, pain and cramps in the legs and abdomen, perspiration, vomiting and diarrhoea.

Treatment : (1) The person should be removed to an institution, so as to remove him from the association with which the addiction started. (2) Constant supervision to prevent addict from obtaining secret supplies of the drug. (3) Detoxification : This consists of reduction in dosage of drug over a period of one to three weeks. (4) Sedatives, benzedrine, hyoscine. (5) Diverting the mind by engaging him physically and mentally in some occupation. (6) Psychotherapy (group, family or individual). (7) Improving general health. (8) Symptomatic. (9) The treatment is successful only in 10 to 25 percent of cases.

Narcotic addicts may be murdered by a 'hot shot'. This is a dose of narcotic with poison, such as strychnine in it. In such cases, only signs of anoxia and cerebral depression are present. Another method of accidental or homicidal death is by the use of purer drug than the addict has been using.

Heroin (brown sugar) : (1) Street heroin is known as "smack, junk, or dope". (2) Heroin is the most dangerous among all drugs of addiction. (3) It can be smoked or injected or used as snuff. (4) It is more analgesic and euphorogenic than opium. (5) Tolerance to heroin occurs very rapidly (within days) and can be increased to more than hundred times the initial dose. (6) The effects last for 3 to 6 hours. (7) Fatal dose 50 mg.

PETHIDINE (MEPERIDINE) : (1) It acts on cerebrum and produces analgesia and sedation. (2) Two grams is fatal. (3) Death in 24 hours.

Symptoms : (1) Effects are similar to morphine. (2) It causes more dizziness, greater elation, and impairment of ability to work is more than with morphine. (3) Addicts may have twitchings, tremors, dry mouth. (4) Abstinence syndrome resembles that of morphine withdrawal and symptoms appear in 3 to 4 hours and are maximum in 8 to 12 hours and disappear in 4 to 5 days. (5) Treatment is same as for opium.

Hallucinogenic Drugs : LSD, mescaline, dimethyl tryptamine (DMT), psilocybin, psilocin, peyote and phencyclidine (PCP) are important.

Symptoms : (1) Both sympathetic and parasympathetic symptoms are produced. (2) During hallucinations sensory perceptions are

intensified, colours seem brighter and more clear, sounds seem excessively loud with an exaggeration of detail. (3) The individual feels a sense of depersonalisation and separation from the environment. (4) The person may perceive that he is observing an event as opposed to being involved in one. (5) The person's body image may become distorted, so also the boundaries of objects in the environment. (6) Alternatively, synesthesia or sensory misperceptions occur such as hearing colour or seeing sounds.

LSD (Lysergic acid diethylamide) : (1) It is a colourless, tasteless, odourless, semi-synthetic compound. (2) The dose required to produce psychotropic effects (take a trip) is 100 to 200 micrograms. (3) Tolerance develops rapidly. (4) It is commonly taken as : (a) liquid on sugar, (b) saturated sugar cube, (c) soaked into blotting paper, (d) capsule, and (e) blue pills.

Fatal Dose : About fourteen mg.

(1) The after-effects may persist for days or weeks. (2) At the height of the effects of the drug on the mind, individual may commit a crime of violence or personal injury. (3) The feeling of being able to fly under the influence of LSD can lead users to jump out of windows. (4) Biological half-life of LSD in man is three hours. (5) Tolerance develops fast and also disappears quickly.

Flashback Phenomenon : This may occur days, weeks or even months after the ingestion of a dose, and the person experiences a recurrence of the emotional and psychological aspects of the previous 'LSD trip'. These delayed recurring symptoms may lead to eccentric behaviour, suicide or even homicide.

SOLVENT (volatile substance) ABUSE : (1) It involves the deliberate inhaling of a variety of substances, such as toluene (glue-sniffing), gasoline (petrol), xylene, benzene, methylene, ethylene chloride, fluorocarbons, carbon tetrachloride, butane, propane, etc., for their psychotropic and hallucinogenic properties. (2) **Huffing** refers to inhaling vapours from a cloth that is saturated with the volatile substance and held over or near to the nose and mouth. (3) **Bagging** refers to inhaling and exhaling into a bag that has been filled with a small amount of a volatile substance. (4) The effects vary from a condition resembling alcoholic intoxication, and distortion

of perception to actual hallucinations. (5) The person feels powerful dreams, heightened sensation and detachment from reality. (6) The sufferer often behaves totally irrationally and may injure or even kill himself. (7) Later, the abuser will often have complete amnesia for the period of intoxication. (8) Major cause of death is due to sudden cardiac arrest. (9) Other causes of death are hypoxia and hypercapnoea, plastic bag asphyxia, aspiration of vomit and accidents.

Body packer and body stuffer syndromes : (1) The act of swallowing containers, condoms, balloons, plastic bags of packages filled with illegal drugs for the purpose of smuggling has been termed “**body-packing**”. (2) On arrival at his destination, the courier takes a laxative, retrieves the packets and passes them on to the “pusher” who distributes the drugs. (3) Sometimes, packets become unsealed or burst in the small intestine, especially cocaine filled containers, allowing massive absorption and cause the courier’s death from poisoning. (4) Even if the packets do not rupture, osmotic seepage across the latex wrapping allows small amounts of drug to appear in the circulation and urine. (5) Drugs may be concealed in the ears, mouth, nose, vagina or rectum. (6) Most body packers may be diagnosed by X-ray of the abdomen as the packages are often radio-opaque. (7) Arrested persons swallows illegal drugs for concealing the evidence from authorities. This is termed “**body stuffer**”.

CHAPTER 33

SPINAL POISONS

STRYCHNOS NUX VOMICA : (1) Strychnine (kuchila) is an alkaloid obtained from the seeds of strychnos nux vomica and other species of strychnos, which are found in the jungles in India. (2) The **seeds of nux vomica contained in the ripe fruit are poisonous.** (3) The seeds contain strychnine and brucine up to one-and-half percent each. (4) All parts of the tree are toxic. (5) Strychnine is 10 to 20 times more poisonous than brucine. (6) The bark, wood and leaves contain brucine but no strychnine.

Absorption and Excretion : (1) All mucous membranes absorb strychnine. (2) Much is taken up by the liver and muscles to be either released again to blood stream or to be destroyed. (3) About 80% is oxidised mainly in the liver. (4) It may be found in the cadaver up to four years.

Action : (1) It depresses the inhibitory post-synaptic potentials in the spinal cord and prevents the effects of glycine. (2) Widespread inhibition in the spinal cord results in ‘release’ excitation. (3) The action is particularly noted in the anterior horn cells. (4) It stimulates the cerebral cortex.

Symptoms : (1) If swallowed uncrushed, the seeds of nux vomica have no poisonous action, as they are not dissolved in the G.I tract, and are passed entire in faeces. (2) Bitter taste in the mouth, sense of uneasiness and restlessness, feeling of suffocation and great fear and difficulty in swallowing occur. (3) The convulsions are preceded by such prodromal symptoms as increased acuity of

Trait	Strychnine	Tetanus
(1) History :	No history of injury.	History of injury present
(2) Onset :	Sudden.	Gradual.
(3) Convulsions :	All muscles of the body are affected at a time.	All the muscles are not affected at a time.
(4) Lower jaw :	Does not start in, nor especially affect the jaw.	Usually starts in and especially affects lower jaw.
(5) Muscular condition:	Between fits muscles are completely relaxed.	Between fits muscles are slightly rigid.
(6) Fatal period :	One to two hours.	More than 24 hours.

perception, increased rigidity of muscles, and muscular twitchings. (4) Convulsions are at first clonic, but eventually become tonic. (5) Risus sardonicus results. (6) The convulsions are most marked in anti-gravity muscles, so that the body typically arches in hyperextension (**opisthotonus**). (7) In supine position the body is supported by the heels and head in a bow-like form. (8) Sometimes, the spasm of the abdominal muscles may bend the body forward (**emprosthotonus**), or to the side (**pleurosthotonus**). (9) Consciousness is not lost and the mind remains clear till death. (10) The duration of convulsion varies from half to two minutes. (11) In between the convulsions, the muscles are completely relaxed and the patient looks well and the breathing is resumed. (12) After 5 to 15 minutes or on slightest impulse, another convulsion occurs. (13) **Death usually occurs after 4 to 5 convulsions.** (14) Hypoxia causes medullary paralysis and death.

FD.: 15 to 50 mg : one crushed seed. **F.P.:** One to two hours.

Treatment : (1) The patient should be kept in the bed in a dark room, free from noise and disturbance. (2) Convulsions may be controlled initially with **diazepam**. (a) Between convulsions ether may be administered to the point of unconsciousness. (3) **Short-acting barbiturates** like pentobarbital sodium or sodium amyital are antidotes to strychnine and should be given in a dose of 0.3 to 0.6 g.i.v (4) Stomach wash with potassium permanganate. (5) Activated charcoal to adsorb strychnine.

CHAPTER 34

CARDIAC POISONS

NERIUM ODORUM : (White oleander) : All parts of th plant are poisonous, containing several cardiac glycosides, primarily oleandroside (**oleandrin**), and nerioside (**nerin**), which resemble digitalis in action.

Symptoms : Difficulty in swallowing and articulation, abdominal pain, vomiting, salivation, diarrhoea. Pulse is first slow and later rapid and weak, respirations are increased, muscular twitchings, tetanic spasms, lockjaw, drowsiness, coma, respiratory paralysis and death.

F.D.: Fifteen to 20 g. of the root. **F.P.:** 24 to 36 hours.

Poisoning : (1) Suicide (2) Abortifacient. (3) Cattle poison.

CERBERA THEVETIA : (Yellow oleander) : All parts are poisonous. The seeds contain cardiac glycoside **thevetin**, and **thevetoxin**, similar to digitalis in action; **nerifolin**, **peruvocide**, **ruvocide** and **cerberin**.

Symptoms: Burning pain in the mouth, dryness of throat, tingling and numbness of tongue, vomiting, diarrhoea, headache, giddiness, loss of muscular power and fainting. Pulse is rapid, weak and irregular, blood pressure is low. Heart block, collaps and death from peripheral circulatory failure.

F.D.: Eight to ten seeds, 15 to 20 g. root; 5 to 10 leaves.

F.P.: 2 to 3 hours.

CERBERA ODALLAM (*pilikirbir*) : The active principles are **cerberin**, **cerberoside**, **odollin**, **odollotoxin**, **thevetin** and **cerapain**.

F.D.: Kernal of one fruit **F.P.:** One to two days or more

ACONITE : All varieties and all parts of the plant are poisonous. The root is most potent, contains **aconitine**, and ten or more other alkaloids, such as **pseudoaconitine**, **indaconitine**, **bikhaconitine**, **picraconitine**, **aconine**. Aconitine stimulates and then depresses CNS.

Symptoms : There is a burning sensation from the mouth to the stomach and tingling and numbness in the mouth, tongue and pharynx, followed by salivation, nausea, vomiting and diarrhoea. (2) Later the mouth is dry, thirst and dysphagia. (3) Tingling and numbness are then felt all over the body. (4) The limbs become weak and the patient is unable to walk or stand. (5) There may be twitching of the muscles with darting pains, and cramps and convulsions may occur. (6) **The pupils alternately contract and dilate (hippus)**, but remain dilated in the later stages. The vision becomes dim and there may be diplopia. (7) The pulse is slow, feeble and irregular, blood pressure low, the breathing laboured. (8) Death occurs from paralysis of heart or respiratory centres or both.

F.D.: One to 2 g. root : 2 to 5 mg. of aconitine.

F.P.: One to 8 hours.

Poisoning: (1) Added to liquor to increase intoxication. (2) It is given with betel leaf to disguise its taste for homicide. (3) Abortifacient. (4) Cattle poison. (5) Arrow poison.

CHAPTER 35

ASPHYXIANTS

CARBON MONOXIDE : Action : (1) CO has 200 to 300 times greater affinity for haemoglobin than that of oxygen, and 40 times more to myoglobin. (2) It displaces oxygen from its combination with haemoglobin and forms a relatively stable compound known as carboxyhaemoglobin. (3) It acts as chemical asphyxiant and produces death due to anaemic anoxia. (4) The blood under the skin and in the tissues will be cherry-red in 15 to 20% cases. (5) It inhibits the electron transport by blocking cytochrome oxidase.

Sources : The common sources of CO include : coal gas, smoke from fire and the fumes from defective heating appliances, e.g., furnace stove, waterheater, burning oil lamps, fumes of coke kilns, lime kilns, explosion in mines, detonation of explosives, and the exhaust fumes of internal combustion engines.

Symptoms: (1) **The effects of CO are simply those of suboxia.** (2) Damage to the CNS may produce monoplegia or hemiplegia. (3) Impairment of higher intellectual functions, personality changes, cerebellar damage, and severe Parkinsonism may occur and may be delayed by several weeks after apparent recovery. (4) Bullae tend to be separate and isolated lesions. These bullae are localised by external pressure. They are caused due to skin hypoxia. They rarely involve fingers and toes. (5) There is tendency of the dying victim to wild, swinging, erratic movements inside the room disturbing clothing and furniture, which gives an impression of violent struggle. (6) **Death usually occurs when 80% of haemoglobin is saturated with CO.**

(7) CO can pass from the maternal to the foetal blood, and can produce intrauterine death, even though the mother survives.

Delayed Deaths: Coma is accompanied by degenerative changes in brain and capillaries. A wide variety of neurological symptoms ranging from blindness to decerebrate rigidity occur.

The Effects of Different Air Concentrations of CO: (1) The upper limit of safety is 0.01% CO in air. (2) If a person breathes CO in low concentration for a considerable length of time, especially during sleep, he will be poisoned just as effectively as though he were exposed to high concentrations for a short period. (3) Exposure to atmosphere containing 0.2% of gas will cause death in about four hours, 0.4% in one hour, and 10% in half hour.

Treatment : (1) Remove the patient to fresh air. Between 40 to 50 percent of CO is eliminated by the blood during first half an hour. (2) With higher degrees of gassing, artificial respiration must be started and pure oxygen given. (3) A whole blood transfusion is useful. (4) Complete rest for 48 hours.

CoHb %	Symptoms
0 to 10%	No appreciable symptoms.
10 to 20%	Breathlessness on moderate exertion, mild headache.
20 to 30%	Headache, irritability, emotional instability, disturbed judgement, defective memory and rapid fatigue.
30 to 40 %	Severe headache, nausea, vomiting, dimness of vision, confusion, cherry-red discolouration of skin.
40 to 50 %	Increasing confusion, sometimes hallucinations, severe ataxia, rapid respirations and collapse with attempts at exertion. Symptoms resemble alcoholic intoxication.
50 to 60%	Syncope or coma with intermittent convulsions, rapid respirations, tachycardia with weak pulse.
60 to 70%	Increasing depth of coma with incontinence of urine and faeces.
70 to 80%	Deep coma with depressed or absent reflexes, a weak thready pulse, shallow and irregular respirations.
Above 80%	Rapid death from respiratory arrest.

Autopsy : (1) A cherry-red colouration of the skin, mucous membranes, areas of hypostasis, **blood, tissues and internal organs,**

seen in 15 to 20% cases. (2) The cherry-red discolouration changes to dark-green, then to brown with the onset of decomposition. (3) Fine froth may be seen at mouth and nose. (4) Muscle necrosis and **skin blebs are common.** (5) Pulmonary congestion and oedema. (6) The blood is fluid, hyperaemia is general and serous effusions are common. (7) Necrobiosis of the heart muscle and pleural and pericardial anoxic haemorrhages are common. (8) Bilateral symmetrical necrosis of the basal ganglia in the brain, especially the putamen and globus pallidus and punctiform haemorrhages in the white matter of the brain with widespread oedema are common. (9) **CO persists for many weeks after death, and may be detected even after putrefaction or embalming and prolonged burial.** (10) CO-blood has very little tendency to clot.

HYDROGEN SULPHIDE : It is colourless gas with a smell of rotten eggs. It is often found in large quantities in sewers (**sewer gas**), cess pools, privy vaults and tannery vats.

Symptoms : (1) In great dilution, there is feeling of dullness and sleepiness, and **death may occur during sleep without the victim regaining consciousness.** (2) In weak concentration there is cough, giddiness, nausea and feeling of oppression. (3) The breathing is laboured and heart irregular, cyanosis of the face, inflammation of the conjunctivae, lachrymation and photophobia, muscular weakness and prostration. (4) There may be delirium, convulsions or coma and death occurs from asphyxia. (5) **If breathed in a concentrated form, death occurs immediately from paralysis of respiratory centre.** (6) Its toxicity and rapidity of action are comparable to HCN. (7) The colour of blood and viscera is greenish-purple.

Treatment : (1) Remove patient to fresh air. (2) Amyl nitrite inhalation and sodium nitrite infusion will form sulphmethaemoglobin.

HYDROCYANIC ACID : It is also called prussic acid or cyanogen; odour of bitter almonds. All persons cannot smell the gas.

Action : Cyanide inhibits the action of cytochrome oxidase and carbonic anhydrase. It kills by creating histotoxic or cytotoxic anoxia, although the blood may contain a normal oxygen content.

Absorption: Cyanide gas is absorbed rapidly from the respiratory system, and the acid and cyanide salts from the stomach. The acid is also absorbed through the skin. Alkaline cyanides when ingested are converted by hydrochloric acid in the gastric juice into chlorides, and hydrocyanic acid is liberated.

Symptoms : (1) **This is most rapid of all poisons.** (2) When inhaled as a gas, its action is instantaneous. (3) If a large dose is taken, symptoms usually occur at once, but in some cases symptoms appear after about one minute. (4) **CNS :** Headache, vertigo, faintness, perspiration, anxiety, excitement, confusion, drowsiness, prostration, opisthotonus and trismus, hyperthermia, convulsions, paralysis, stupor, coma. (5) **G.I.T.:** Bitter, acid burning taste, constriction or numbness of throat, salivation, nausea. (6) **R.S.:** Odour of bitter almonds in breath. (7) Initially tachyapnoea and dyspnoea. Later rapid slowing of respiratory rate with severe respiratory depression and cyanosis. (8) **C.V.S.:** Initially hypertension with reflex bradycardia, sinus arrhythmia. Later tachycardia with hypotension and cardiovascular collapse. (9) **Skin :** Perspiration, bullae. **Eyes :** Glassy and prominent, pupils dilated, unreactive. (10) **Renal :** Acidosis. (11) Death occurs from respiratory failure.

(1) In poisoning by cyanides the symptoms may not occur for 10 to 20 minutes because of the delay in the decomposition of the salt by gastric juice, and the liberation and absorption of hydrocyanic acid. (2) Cyanide salts have a corrosive effect on the mouth, throat and stomach and cause epigastric pain and vomiting. (3) Other symptoms are similar to hydrocyanic acid.

F.D.: Fifty to sixty mg. of pure acid; 200 to 300 mg. of sodium or potassium cyanide.

F.P.: Two to ten minutes. Potassium or sodium cyanide half hour.

Treatment : (1) Break 0.2 ml. ampoule of **amyl nitrite** in a handkerchief and hold over the patient's nose for 15 to 30 seconds of every minute. (2) 0.3 g. of **sodium nitrite** in 10 ml. of sterile water is given i.v. slowly over a period of one to three minutes. Sodium nitrite forms methaemoglobin. (3) Through the same needle infuse 25 g. **sodium thiosulphate** in 50% solution i.v. over a period of ten minutes. It converts cyanide to non-toxic thiocyanate. Repeat

the nitrite-thiosulphate injection after an hour if recovery has not occurred. (4) **Hydroxocobalamine** 4 to 5 g. i.v as infusion is given. It forms non-toxic cyanocobalamine. (5) **Dicobalt EDTA** acts by chelating cyanide. 600 mg. i.v. slowly followed by 300 mg. if recovery does not occur. Cobalt EDTA and aminophenols are more rapid in action, efficacious and less toxic than nitrates. (6) Gastric lavage is then performed using activated charcoal, or 10% sodium thiosulphate or potassium permanganate. (7) Ventilate with 100% oxygen. (8) Methaemoglobin of more than 50% is an indication for exchange transfusion.

P.M.Appearances : (1) Eyes are glistening and prominent with dilated pupils. (2) The jaws are firmly closed and there is froth at the mouth. (3) The colour of the cheeks and postmortem staining may be cherry-red or brick-red. (4) **The blood is bright cherry-red in about half the cases.** (5) **All the vessels of the body including the veins contain oxygenated blood.** (6) The odour of hydrocyanic acid may be noticed on opening the body. (7) There is congestion of viscera and oedema of the lungs. (8) Potassium or sodium cyanide produce slight corrosion of mouth.

JUDICIAL EXECUTION : (1) In some countries, hydrocyanic acid gas is used for legal execution. (2) The condemned person is strapped in a chair and several cyanide "eggs" are dropped into a pan of strong acid, which produces large quantities of the poison gas immediately. (3) Unconsciousness occurs very rapidly, although the heart continues to beat for ten to twenty minutes.

WAR GASES : The term "war gases" includes any chemical (gaseous, liquid or solid), which are used to produce destruction mostly in times of war.

(1) Vesicant or Blistering gases : These are mainly mustard gas and lewisite. Mustard gas causes irritation of the eyes, nose, throat, and respiratory passages, nausea, vomiting and abdominal pain. It passes through the clothes into the skin and produces intense itching, redness, vesication, and ulceration, especially of the moist areas.

(2) Asphyxiants or Lung Irritants : These are chlorine, phosgene. Chloropicrin and diphosgene are liquids, which are used in gas shells. Their action is mainly on pulmonary alveoli.

(3) Lachrymators or Tear Gases : These are mainly chloracetophenone (C.A.P) and ethyliodoacetate (K.S.K), and bromobenzyl cyanide (B.B.C). The vapours cause intense irritation of the eyes with a copious flow of tears, spasm of the eyelids and temporary blindness.

(4) Sternutators or nasal Irritants : These are solid, organic compounds of arsenic. They are diphenylchlorarsine (D.A), diphenylamine-chlorarsine (D.M), and diphenylcyanarsine (C.D). The vapours cause intense pain and irritation in the nose and sinuses, sneezing, headache, salivation, nausea, vomiting, tightness in the chest and prostration.

The above are used to control riots. Only two are being used now. (1) Orthochlorobenzylidene malanonitrile (CS) by police and the military. (2) CN (Mace) available in devices used for self-protection. They are solids dispersed in an aerosol of either powder or liquid. Effects begin within seconds after exposure and usually last in 10 to 15 minutes. Improvement is usually rapid.

The nerve agents are esters of phosphoric acid (liquid) and are identical in their biological activity to organophosphates. (2) The major agents are G.A (tabun) GB (soman) and VX. (3) The vapours are heavier than air so they tend to sink into valleys, trenches and basements. (4) They are compounds related to phosphate esters in action and toxicity. (5) These are colourless and odourless volatile liquids. (6) They are absorbed from the lungs, G.I.T, skin and conjunctivae. (7) They inhibit acetylcholine esterase. (8) Exposure to a large amount of vapour will cause loss of consciousness within seconds followed by convulsions. (9) Muscles become flaccid and breathing stops. (10) Treatment is similar to organophosphates.

CHAPTER 36

FOOD POISONING

The term food poisoning in its wider sense includes all illnesses which result from ingestion of foods containing non-bacterial products. But the term is usually restricted to acute gastroenteritis due to the bacterial infection of food or drink.

Causes : (I) Poisoning due to bacteria and toxins. (II) Poisons of **vegetable origin** (natural food poisons) : (1) Lathyrus sativus. (2) Poisonous mushrooms. (3) Rye, oats, barley, etc. (4) Poisonous berries, such as atropa belladonna. (5) Lolium temulentum. (6) Paspalum scrobiculatum. (7) Argemone mexicana. (8) Cotton seeds. (9) Groundnuts. (10) Vicia faba. (11) Cabbage. (12) Solanine. (13) Soyabean. (14) Sweet clover. (III) **Chemical :** (1) Intentionally added, such as flavouring agents in processed food, colouring agents, preservatives, extraction of fat by solvents like hydrocarbons. (2) Accidentally added, such as pesticides and insecticides. (3) Products of foods. (4) Radionucleides.

Bacterial Food Poisoning : Bacterial food poisoning is divided into two groups. (1) Infection type, which follows the multiplication within body of pathogenic organisms, contained in the foods. (2) The ‘toxin’ type, which follows the ingestion of food in which poisonous substances have been formed due to bacterial proliferation. In **the infection type**, organisms belong mainly to the *Salmonella* group, e.g. *S. enteritidis* of Gaertner, *S. typhimurium*, *S. cholerasuis* and less commonly the paratyphoid bacilli. Bacterial food poisoning results from the ingestion of contaminated food, uncooked food

or imperfectly cooked food. The **toxic type** is due to ingestion of preformed toxin in prepared food, such as canned or preserved food. Exotoxin, e.g. enterotoxin of staphylococci and the botulinum toxin produce intoxication. The materials usually affected are meat, milk, fish or egg. Less frequently, vegetables and cereals and very rarely fruit are affected.

Food poisoning is common in summer, because the temperature favours multiplication of microorganisms. It may occur as isolated cases or small outbreaks. The main diseases spread by infected food are : (1) The enteric group. (2) Cholera. (3) Bacillary dysentery. (4) Staphylococcal and other bacterial infection. (5) Amoebic dysentery and other portozoal infections. (6) Acute infective hepatitis. (7) Brucellosis. (8) Various worm infestations. (9) Schistosomiasis. (10) Traveller's diarrhoea (due to pathogenic E.coli).

Diagnosis : This is made from : (1) History. (2) Clinical features. (3) Isolation of the organism from the remnants of suspected food and from vomit, faeces, blood, etc., from sick person. (4) The injection of the portion of the left off food into mice or guinea pigs should be performed. If the animal gets sick, attempt should be made to isolate organism from them.

Botulism : (1) *Clostridium botulinum* does not grow in body, but produces a potent neurotoxin. (2) It is normally present in the soil and by soil contamination, food may become infected especially, fruits and vegetables. (3) The toxin is destroyed by heat at 80°C. (4) Botulism is an intoxication, not an infection. (5) *C. botulinum* multiplies in the food, e.g. tinned meat, fish, fruits, etc., before it is consumed, and produces a powerful exotoxin. (6) The fatal dose for an adult is 0.01 mg. or even less. (7) The toxin paralyses the nerve endings, by blocking the nerve impulses at the myoneural junctions.

Symptoms : (1) Symptoms are : dry or sore mouth or throat, dysphagia, difficulty with visual accommodation, dysphonia, diplopia, descending bilaterally symmetrical motor paralysis, constipation, respiratory insufficiency, and urinary retention. (2) Death may occur within 24 hours from the onset of symptoms, but may be delayed for a week. (3) Mortality varies from 25 to 100%.

Ptomaines : (1) These are alkaloidal bodies which are formed as a result of bacterial decomposition of protein. (2) When they are formed in the dead tissues, they are known as **cadaveric alkaloids**. (3) Alkaloids secreted by living cells during metabolism are called **leucomaines**, which are slightly toxic when injected to an animal, but have no action when ingested. (4) They are not bacterial poisons. They are found only when the food becomes too disagreeable to be eaten. (5) The symptoms resemble those of atropine. **Ptomaines are not the causative agents of food poisoning.**

LATHYRUS SATIVUS (Kesari dhal) : (1) Consumption of **L. Sativus seeds in quantities exceeding 30% of the total diet for more than six months have been known to causes paralysis.** (2) The active neurotoxic principle is B (N) oxalyl aminoalanine (BOAA). **L. sativus produces neurolathyrism**, which is characterised by progressive spastic paraplegia with preservation of sphincters, sensation and mental activity. (4) There may be pain in the back or weakness of legs, and difficulty in sitting down and getting up. (5) Later the patient is unable to walk without the aid of a stick; spastic gait occurs. (6) Later complete paraplegia occurs.

MUSHROOMS : (1) Amanita phalloides and Amanita muscaria are the common varieties of poisonous fungi. (2) A. muscaria contains an alkaloid muscarine, the action of which resembles stimulation of parasympathetic post-ganglionic nerves. (3) A. Phalloides contains phalloidin, phallon, and B amanitin, which are cyclopeptides. (4) They are cytotoxic.

Symptoms : In some cases irritant symptoms may be present, and in others neurotic or a combination of both.

Fatal dose : 2 to 3 mushrooms . **Fatal Period :** 24 hours.

Treatment : (1) Atropine sulphate. (2) Antiphalloidien serum. (3) Haemodialysis.

ARGEMONE MEXICANA : (1) The plant contains two alkaloids berberine and protopine. (2) The oil contains two alkaloids, sanguinarine and dihydrosanguinarine. (3) All parts of the plant are poisonous. (4) **The oil causes epidemic dropsy.**

Symptoms: (1) Marked oedema of the legs, sometimes generalised anasarca. (2) In severe cases, myocardial damage and dilatation of the heart is seen. Liver may be enlarged and tender. (4) Patient becomes breathless. (5) Tingling and hyperaesthesia of skin and tenderness of the calf muscles may be seen. (6) Bluish mottling of the skin is seen due to dilation of the peripheral vessels. (7) Death occurs from severe damage to the heart.

FISH AND MARINE ANIMALS : (1) A primary toxicity is caused by the presence in certain fishes of a neurotoxin. (2) 90% of cases of fish poisoning are **ichtyosarcotoxic** (involving toxin from muscles, viscera, skin, gonads, and mucous surfaces). (3) Rarely, toxicity involves the fish blood or skeleton, characterised by various gastrointestinal and neurological disturbances.

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