Death and Postmortem changes

Dr. S. K. Pandey

Forensic Medicine

Thanatology- is the branch of science that studies death in all its aspect

Forensic Thanatology- is study of death from a medicolegal angle.

Definition of death

1.**As per Black's law dictionary-** Death is uniformly defined as cessation of life or ceasing to exist(Legal definition).

2.**Australian law** defines death as irreversible cessation of circulation of blood in the body of person or irreversible cessation of all the function of the brain of the person. This applies to all parts of Australia except western Australia.

3.**Age long physician's conception of death** is Total stoppage of circulation with consequent cessation of animal and its vital function.

4.**Medicolegal definition-** Death is permanent and irreversible cessation of function of the three interlinked vital systems of the body(tripod of life) nervous, circulatory and respiratory systems.

Stages of Death

Somatic Death(Clinical death, Legal death, Systemic death)- is permanent, irreversible death of individual as a whole. Concept of when somatic death occurs has kept changing. Initially the concept was that it occurs when there is irreversible cessation of heart, lung and brain(Bichat's Criteria as in Medicolegal definition).Concept was gradually changed to brain death and finally to brain stem death. Now the somatic death coincides with death of brain stem, meaning by complete and irreversible stoppage of vital brain stem functions. Several cells of the body keep functioning after somatic death till the onset of molecular death.

Molecular death- is death of all individual cells with the body.All the biochemical(molecular) activity within the cells comes to stop, it takes 2-3 hours after somatic death.

- **The moment of death-** Moment of death refers to exact moment, when the person dies.

A.Classical criteria of death- Criteria of death refers to criteria and tests which confirms death.1.**Bichat's Criteria**- before the era of heart transplantation was in use.

2. **Atria mortis-**(Latin, Gateway of death or death's portal of entry) since death could enter only by stoppage of these organs(brain, heart and lung) each was called atrium mortis.

In old days tests were developed to determine death of each organ.

Tests for circulation- Stethoscope was invented in 1819.It was **Bochet** in 1846 suggested cardiac auscultation for 2-3 minute to diagnose death but in suspended animation heart sound could not be detected and missed.

a. **Magnus test(Ligature Test)-** Suggested by Italian Hugo Magnus in 1872. Tying a string around one of the finger with a pressure just above venous pressure and below pressure in arteries. If the circulation is maintained finger distal to ligature would swell.

b.**Icard test-** by Severin Icard in 1895 it consists of subcutaneous injection of a compound(fluorescin with sodium bicarbonate).Fluorescin is colourless substance, on oxidation by haeme produces fluorescein which is colourful substance and give yellow colour to body when circulation is present.

c. Diaphanous test(transillumination test)- strong source of light is held against hand with finger closed.it appears red and translucent during life and opaque and yellow after death.

Finger nail test-pressure applied to nail bed, during life it is red on pressure turns pale and release of pressure red again.

Other tests-1. cutting of small arteries. 2. Heat test- Application of heat produces blisters during life.

Tests for respiration-

a. Winslow test- Suggested by Danish physician Jacques Benigne Winslow-Small pot containing water, milk or Mercury placed just below xiphisternum slightest movement of chest wall indicated by ripple formation on the surface

b.Mirror test- Mirror held in front of mouth and nostril become hazy due to water vapor in breath.

c.Feather test- Feather placed in front of mouth and nostril, movement during life.

3. Tests for Brain-1.Blowing strong stimulant into nose.2 Inserting sharp instrument under nail.3.Scalding with hot water or oil.4.Trumpeting or loud sound.

4.Ripault sign-External pressure to eye causes permanent distortion of roundness of pupil.

B. Brain death- With advent of heart transplant in 1967 definition of death needed to be revised and made more logical because transplant surgeons needed a live and beating heart from a dead donor(Beating heart donor).Retrieval of organ for transplantation was not possible with old definition.

1. Harvard criteria of brain death(1968). This laid stress on determining the activity of whole brain to determine death. Criteria of moment of death- A. Unreceptivity and unresponsivity- Pt. is totally unaware of externally applied stimuli. Even the most intensely painful stimuli evoke no vocal or other response. B. No movement or breathing- There should be no spontaneous muscular movement or any breathing movement for at least one continuous hour, breathing movements are observed by turning off the ventilator for 3 minute. C. No Reflexes- Pupil should be fixed and dilated and unresponsive to bright light. Occular movement to head turning and irrigation of ears with warm and ice cold water should be absent. Corneal and pharyngeal reflexes are absent. Spinal reflexes are also absent.

d. **Flat EEG-** is of great confirmatory value.

e. **Repetition of tests-** above tests should be repeated again after 24 hours with no change. Respirator must be put back on between two tests.

- C. Brain stem death(Modern criteria of moment of death)-In 1971 Mohandas and Chou neurosurgeons from Minnesota suggested that even within the brain most important part was Brin stem reason is 1. **Resistance to anoxia-** medullary neurons are most resistant to anoxia.2.**Vital centers**-Brain stem is responsible for all vital functions of the body.

3. **Gateways**- all cortical pathways passes through the brain stem. Thus if brain stem was dead all pathways would be dead. Criteria for brain stem death now popularly known as **Minnesota criteria** as follows-

1. No spontaneous movement 2. No spontaneous respiration when tested for a period of 4 minute. 3 Absence of 5 major brain stem reflexes(No pupillary light response, No blinking- Absent corneal reflex, No grimacing- Absent ciliospinal reflex, Absent vestibulo-ocular reflex to caloric stimulation of ears, Absent gag reflex or pharyngeal reflex on stimulation of posterior pharyngeal wall.) 4. EEG not mandatory. All the above finding must remain unchanged for at least 12 hours.

Who can declare Pt. dead whose brain stem is dead- not mentioned in the above these criteria but in Indian law on brain stem death- such death is certified by board of medical experts consists of I)Registered medical practitioner (RMP) in charge of hospital in which brain stem death has occurred. II)an independent specialist nominated by doctor specified in clause I of Transplantation of Human Organ and Tissue act 1994.III) a neurologist or neurosurgeon nominated by the RMP specified in clause(i) and V) RMP treating the Pt. whose brain stem death has occurred.

Modes of Death- is an old concept of death based on **Bichat's criteria of tripod of life.** This concept was based on which organ died first and initiated the process of death in two other system. This concept is no more used today.

Death occurs first in	Mode of death	Typical P.M. finding
Brain	Coma	Injury to head, disease of brain, congestion of brain and meninges
Lung	Asphyxia	Cyanosis, Oedema, engorgement of Rt side heart, tardieu's spot, congestion
Heart	Syncope(Fainting)	Anaemia, excessive haermorrage, heart contracted, chambers empty, viscera pale

- **Gordon' classification of Death-** Old classification, concept of tissue anoxia based classification of death was first given in 1920 by Joseph Barcroft, he mentioned only 3 types namely Anoxic type, anaemic type and stagnant type. It was Isidor Gordon university of Cape town in 1944 added the 4th type Histotoxic anoxia.

Natural Death- Means death occurring due to natural disease or pathological condition, old age, debility or devitalisation in which death is not intended or attempted and also does not occur accidentlly.

Sudden death- is death which is not known to have been caused by any trauma, poisoning or violent asphyxia and where death occurs all on a sudden or within 24 hours of the onset of the terminal symptoms. This period is highly variable some take this as 1 hour and other as 6 hours.

By definition sudden deaths are mostly natural deaths where deaths occur immediately or within 24 hours of the onset of terminal symptom which my be totally different from the symptoms which the Pt. having for long. If the cause is diagnosed or known to be unnatural one it can't be termed as sudden death.

Incidents of sudden death is about 10% of all cases of death. Of these again most of the deaths are due to cardiovascular or circulatory causes next in frequency are respiratory causes.

Among **cardiac causes** most frequent are- i) Coronary artery disease ii) Bridging iii) Aortic Dissection iv) Cardiomyopathies v) Coronary artery spasm vi) Conducting system disorder vii) Acute endocarditis viii) Hypertensive cardiovascular disease ix) Myocarditis x)Acute pericarditis xi) Valvular disease. Incidence of cardiovascular causes are 45-50%.

Among the **Respiratory cause-i**) Acute oedema of glottis ii) Acute oedema of lung iii) Air embolism iv) Bronchial asthma v) Bronchitis vi) Bronchopneumonia vii) Diphtheria, influenza, pneumonia and other acute infective conditions viii) Epiglottitis ix) Lung abscess x) Lung Neoplasm xi) Pleural effusion xii) Pneumothorax xiii) Pulmonary embolism xiv) Massive lung collapse. Incidence of respiratory causes are about 15-25% of all sudden death.

Most common CNS Causes- i) Epilepsy ii) Meningitis iii) Intracranial Haemorrhages iv) Brain tumours v) Encephalitis. CNS responsible for about 10-20% of sudden death.

Most common **GIT Causes-i**) Acute haemorrhagic pancreatitis ii) Appendicitis iii) Cancer of Oesophagus iv)Enlarge spleen v) Oesophageal varices vi) Haemorrhage into GIT from ulcers vii) Intestinal Obstruction viii) Liver abscess ix) Strangulation oh hernia x) Intussusception xi) Paralytic ileus. These are causes for 6-8% of sudden death.

Most common **Genitourinary causes-** i) Chronic nephritis ii) Ectopic pregnancy rupture iii) Nephrolithiasis iv) Obstructive hydronephrosis and pyonephrosis v) Toxaemia of pregnancy vi) Twisting of ovary vii) Uterine haemorrhage viii) Tumors of kidney and bladder ix) Tuberculosis of kidney. Genitourinary causes responsible for 3-5% of sudden death.

Miscellaneus causes- i) Anaphylaxis to drugs ii) Blood dyacrasias iii) Cerebral malaria iv) Diabetes mellitus v) Mismatched blood transfusion vi) Reflex vagal inhibition vii) status thymo-lymphaticus

Post mortem changes- These are i) Immediate changes ii) Early changes iii) late changes

Immediate changes- Cessation of CNS,respiratory and heart function

- Early Changes-

A. Changes in skin- Skin becomes ashy white pale and loses elasticity.Lips are dry brownish and hard due to drying.

B.Changes in Eye-

1.Loss of corneal reflex-

2. Opacity of cornea- Cornea becomes opaque about 6 hrs after death(this is the time period upto which cornea can be transplanted). Classically grey,black and cloudy cornea considered a sign of death- Larcher's sign.

If the eye ball remain open after death dessication and drying of sclera occurs giving rise to somewhat triangular shaped discoloured area- Taches noire de la sclerotique or simply Taches noire. These are yellowish in colour initially but as dust settles become dark red and ultimately black.

3. Flaccidity of eyeball-eyeball looks sunken and softer after death due to fall of intraocular pressure.

4. Pupils- Normal pupil size during life is between1-8mm.If pressure is applied by fingers on two or more sides of eye ball the pupil may become oval, triangular.

5. Retinal vessels- segmentation of the retinal blood columns occurs immediately after death. On ophthalmoscopic examination- the continuous blood column in the retinal blood vessels breaks up into small segment which then collide with each other.This is just like rail roading, trucking or cattle trucking on the high way. This phenomenon is known since 1904 and popularized by Kevorkian in 1961 and referred to as Kevorkian sign. Colour of Retina- becomes pale after death and becomes more and more pale as the time of death increases.

Biochemical changes-During life potassium concentration is low in vitreous humor but much higher in peripheral tissues such as retina after death potassium from retinal tissue starts diffusing in the vitreous raising its concentration.