

ASPHYXIA & RELATED DEATHS

1. Definition & classification of Asphyxia
2. Anatomy of Asphyxia
3. Biochemistry of Asphyxia
4. Pathology of Asphyxia
5. Types of Mechanical Asphyxia & their medico-legal aspects

ASPHYXIA

Asphyxia (Greek) literally means “absence of pulse”. But in broader sense, it refers to a state in which body becomes deprived of oxygen.

Asphyxia can be defined as “a method of rendering the tissue hypoxic”.

Asphyxia is also defined as ‘state of impaired transfer of oxygen to the lungs’.

ROUTE OF OXYGEN

ATMOSPHERE



LUNGS → CIRCULATION → TISSUE

HYPOXIA

- **Hypoxia** is defined as “State of reduced oxygen supply to the tissues”.

Types Of Hypoxia

1. Hypoxic Hypoxia
2. Anaemic Hypoxia
3. Stagnant or Ischaemic Hypoxia
4. Histotoxic Hypoxia

CLASSIFICATION OF ASPHYXIA

Basically there are two types:

1. Mechanical:

Flow of oxygen into the body is interfered through some physical impediments.

Examples:

- a) Suffocation
- b) Choking
- c) Hanging
- d) Garotting
- e) Throttling
- f) Traumatic asphyxia

2. Non-mechanical:

Supply of oxygen to the body is interfered through some physiological/chemical interference or disease process.

Examples:

- a) Environmental Asphyxia
- b) Toxicological Asphyxia
- c) Pathological Asphyxia
- d) Iatrogenic Asphyxia

ANATOMY OF ASPHYXIA

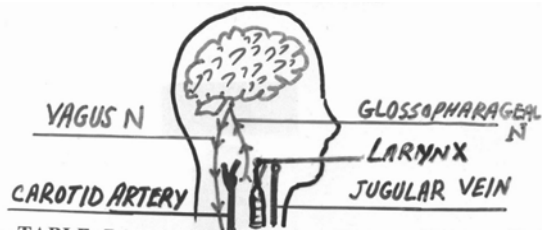


Table: Rope Tension Required to Occlude Tubular Structures in the Neck

| Structure | Tension (kg) | Tension (Lb) |
|--|--------------|--------------|
| Jugular veins | 2 | 4.4 |
| Carotid arteries | 5 | 11 |
| Trachea | 15 | 33 |
| Vertebral arteries | 30 | 66 |
| Least Tension needed to occlude all the neck structures | 5-10 | 11-22 |
| Greatest Tension needed to occlude all the neck structures | 20-40 | 44-88 |

POSSIBLE MECHANISMS OF DEATH IN ASPHYXIA

- Cerebral Anoxia/Hypoxia.
- Hypoxic Hypoxia/Anoxic Anoxia.
- Cardiac Arrhythmia.

CEREBRAL ANOXIA / HYPOXIA

- Most common mechanism.
- Occurs due to compression of jugular veins, with or without that of the carotid arteries.
- Death occurs within few minutes.

HYPOXIC HYPOXIA/ANOXIC ANOXIA

It is contributory factor in some hangings where the Hyoid bone and tongue are pushed upwards and backward against the Laryngo – Pharynx producing air hunger.

CARDIAC ARRHYTHMIA

- Pressure over the carotid sinus provokes “Vagal Reflex” causing bradycardia and cardiac arrest (Vagal inhibition of heart).
- It occurs particularly in the elderly or those with underlying cardiac disease.
- Petechiae or congestion are usually not present in these cases.

PHYSIOLOGY OF ASPHYXIA

1. Struggle - forceful breathing.
2. Quiescence - unconscious, lifeless.
3. Convulsions - disturbs scene, incontinence.
4. Apnea - lifeless, weak pulse.

BIOCHEMISTRY OF ASPHYXIA

Agonal changes in biochemistry of blood during mechanical interference with respiration are:

- ↘ O₂
- ↗ CO₂
- ↘ PH
- ↗ Blood Sugar

Different studies have revealed that these changes has no value in differentiation asphyxial death from other forms of

PATHALOGY OF ASPHYXIA

- 1) Non-specific general pathological changes.
- 2) Specific pathological changes.

Non-specific general pathological changes:

Nervous tissue & small blood vessels i.e. venules & capillaries are extremely sensitive to O₂ lack. Reduced oxygen supply can lead to following changes:

- Cyanosis.
- Congestion.
- Generalized edema (Lungs, Brain).
- Petechial Hemorrhages (Tardieu spots).
- Fluidity of blood.
- Engorgement of right side of heart.

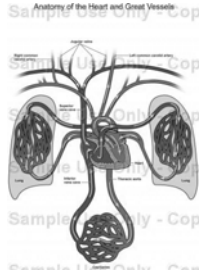
CYANOSIS

The word is derived from Greek meaning "dark blue". It is the colour imparted to the tissues by the presence of an excess of deoxygenated blood. It is easily visible in the skin & in mucus membrane. Development of cyanosis requires minimum concentration of 5g/100ml of reduced Hb.

It is significant as an evidence of death associated with generalized hypoxia. So cyanosis is present in bodies died of Asphyxia.

It is also present in many natural deaths especially death from Coronary insufficiency.

CONGESTION



CONGESTION

Reduction in oxygen tension produces dilatation of capillaries & venules.

It is a general pathological change in all forms of rapid hypoxic/anoxic deaths as well as deaths from shock & from many other natural causes.

Intensity of congestion depends largely on the amount of blood & its distribution in organs & tissues at the time of death.

CONGESTION

(Continue)

If death occurs instantly, the amount of blood in various parts of the body will be the amount in the organs & tissues at the moment of death.

If death occurs relatively slowly, then because the failing heart is unable to pump the blood effectively around the circulation, there is a damming back of blood into the organs & tissues.

CONGESTION

(Continue)

In this ways, organs such as the liver & the lungs may become distended with the blood dammed back in their capillaries, producing an enlargement of the organ as well as a congestion of the parts with blood. This congestion is due to the distension or over distension of the capillaries with blood.

CONGESTION

(Continue)

Reduced oxygenation of the tissues

↓
Capillary dilatation

↓
Stasis of blood

↓
Reduced venous return to heart

↓
Reduced pulmonary blood flow

↓
Deficient oxygenation

GENERALIZED EDEMA

May be produced as a result of:

- 1) Increased hydrostatic pressure due to venous congestion.
- 2) Increased vascular permeability due to hypoxia.

It may be responsible for congestive facial swelling, bulging of the tongue & pulmonary edema. It is more prominent if the agonal period is prolonged.

PETECHIAE (Tardieu Spots)

Petechiae also called “Tardieu Spots” after the name of French police surgeon who described them in 1866. They are small venular hemorrhages (characteristically pinhead size) formed as a result of hypoxia or increased intra-capillary pressure. They may be present anywhere but are most easily seen on the skin, serous surfaces e.g. pericardium, pleura or conjunctiva.

PETECHIAE (Continue)

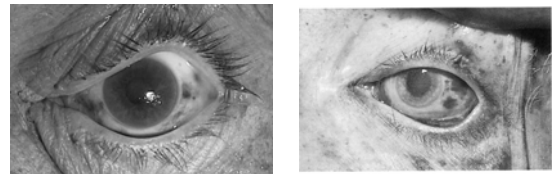
Petechiae are most characteristic of local hypoxia and venous congestion. Petechiae are most commonly visible in:

- The skin around the eyes in the “butterfly” or “mask” distribution.
- The conjunctivae.
- The skin behind the ears.

PETECHIAE (Continue)

- The face and neck.
- The buccal mucosa.
- The epiglottis.
- The visceral pleurae.
- The epicardium.
- The serosa of the bowel.
- The thymus gland.

Subconjunctival Petechiae



FLUIDITY OF BLOOD

- Frequently seen in asphyxial deaths.
- It is result of fibrinolytic activity of the enzyme fibrinolysin.
- It is so non-specific that no longer regarded as asphyxial sign.

ENGORGEMENT OF RIGHT SIDE OF HEART

Non-specific sign. Present not only in asphyxia but may also be seen in other congestive deaths as a part of generalized rise in venous pressure.

COMMON MECHANISMS OF MECHANICAL ASPHYXIA

A. Obstruction Of External Respiratory Passages (Nose, Mouth):

Suffocation:

- I. Smothering.
- II. Gagging.
- III. Overlaying.

B. Obstruction Of Internal Respiratory Passage (Larynx, Trachea, Bronchi):

Choking:

- I. Foreign Body Obstruction.
- II. Laryngeal Edema.
- III. Laryngospasm.

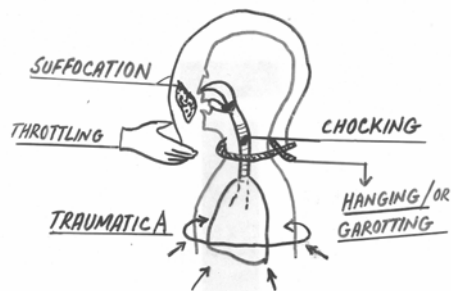
C. Neck Compression:

- I. Manual Strangulation (Throttling).
- II. Ligature Strangulation (Garotting).
- III. Hanging (Suspension).

D. Chest Compression:

- I. Traumatic Asphyxia.

Levels Of Interference To The Supply Of Oxygen To Lungs



SUFFOCATION

Definition:

Obstruction to the passage of air into the respiratory track, caused by closing of external respiratory orifices i.e. nose & mouth. (It is the purest form of asphyxial death).

Types:

- 1) Smothering.
- 2) Gagging.
- 3) Overlaying.

Mechanism of Death:

Anoxic Anoxia / Hypoxic Hypoxia.

Autopsy Findings:

- 1) Non-specific Pathological findings.
- 2) Specific findings.

Specific Findings at the Locus

(Mouth, Nose):

- a) Bruise (mouth, nose, cheeks, lips & mucosal surfaces).
- b) Distribution of Lividity.

Medicolegal Aspects

Accidental Group:

1) Infants

- a. Prone position improbable due to reflex movement.
- b. Overlaying by elders.
- c. Woman while feeding asleep.

2) Children

“Space man” game-Helmet of polythene bag gets firmly molded to the shape of face.

3) Adults

- a. Plastic bags (sexual asphyxia).
- b. Old/Infirm/intoxicated fall in prone position

Homicidal Group:

1) Infants

- a. Smothering is the commonest method of infant killing (palm/soft pillow).
- b. Gagging less than smothering.

2) Adults

Physical health & age are important factors – victim generally weak/old/ill who is unable to offer resistance – adhesive taps may be used to prevent the victim's calls for help especially in sexual adventures.

Suicide:

Not possible.

STRANGULATION

(Circumferential Squeezing of Neck)

Types:

- 1) Throttling
- 2) Garroting
- 3) Hanging (Suspension)

THROTTLING: (Manual Strangulation)

Constriction of the neck of a person by pressure from hands/forearm of

MECHANISM / MODE OF DEATH

- 1) Cerebral Hypoxia.
- 2) Anoxic Anoxia.
- 3) Reflex Cardiac Inhibition.

AUTOPSY FINDINGS:

General Asphyxial Findings:

More the agonal period more prominent are the finding. In complete obstruction, time is less – so less prominent Asphyxial findings. In partial obstruction, time is more – so more prominent findings like cyanosis, congestion, petechiae.

Specific Findings:

- Disc-like fingertip bruises.
- Nail Marks (abrasions from assailant or victim).
- Bruising of neck, soft tissue e.g., strap muscles.
- Fracture of Hyoid bone or Thyroid cartilage are common.

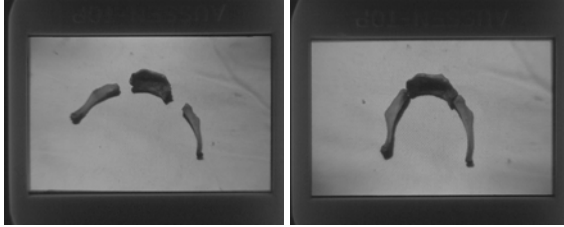
MEDICOLEGAL ASPECTS

- Almost always homicidal.
- Suicidal not possible because constricting pressure on the neck is released at the time of loss of consciousness.

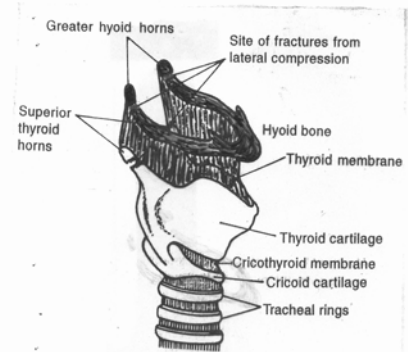
MECHANISM OF FRACTURE OF HYOID BONE

- a). By direct pressure.
- b). By indirect pressure through thyrohyoid ligament.
Breakage of hyoid bone shows amount of pressure but age is also an important factor. Fracture is more common after age of 40 due to ossification of fibrous joints between body and greater horn.

Hyoid Bone



ANATOMY OF HYOID BONE



AUTOPSY ADVICE

Open the Cranial cavity and chest cavity before neck to avoid simulated bruising during handling.

After the drainage of blood bruise becomes more prominent.

GAROTTING (Ligature Strangulation)

Constriction of the neck by a Ligature the constricting force being applied directly to the ligature.

Mechanism Of Death:

1. Cerebral Hypoxia.
2. Hypoxic Hypoxia.
3. Reflex Cardiac Inhibition.

AUTOPSY FINDINGS:

• Non-Specific Findings:

Usually gross congestion, cyanosis and petechiae in the face.

2) Specific Findings:

1. Ligature mark is generally in the midline of the neck and is continuous all around the neck horizontally. Soft Ligature e.g., Dupatta leaves a diffuse mark while hard Ligature e.g., wire or rope leave a more defined, deeper mark.

2. Finger mark abrasions in attempt to relieve the constriction.
3. Bruising of the soft tissue.
4. Fracture of Hyoid bone may occur damage to thyroid cartilage less common.

MEDICOLEGAL ASPECTS

- **HOMICIDAL** – Common.
- **SUICIDAL** – Possibility cannot be ruled out with help of device or knotting.
- **ACCIDENTAL** – Rare e.g., in sexual Asphyxia or in infants umbilical cord around neck.

HANGING (Suspension)

Constriction of the neck by a ligature, the constricting force being applied indirectly to the Ligature through the weight of the body.

Types:

A. COMPLETE HANGING:

Weight of the whole body acts as constricting force body is wholly suspended with the feet above the ground.

TYPICAL:

Knot on occipital region.

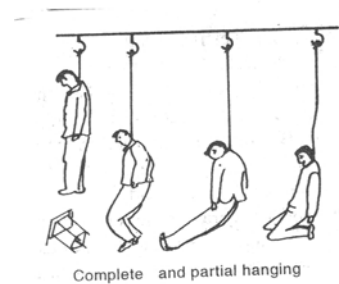
ATYPICAL:

Any variation of this standard position.

B. INCOMPLETE HANGING:

Body is in position of partial suspension. In suicidal cases when space is less to hang and suspension point is at low level e.g., a door knob – usually wt. of the head acts as constricting force.

Partial & Complete Hanging



Typical & Atypical Hanging



MECHANISM OF DEATH

- 1) Anoxic Anoxia.
- 2) Reflex Cardiac Arrest.
- 3) Fracture dislocation of cervical vertebrae (compression of floor of 4th ventricle).

Autopsy Findings:

A. Non-specific Findings:

May or may not be present depending upon the type of hanging i.e., partial or complete.

B. Specific Findings:

1) **LIGATURE MARK** is in upper part of the neck – usually depressed below the skin surface – usually running obliquely upwards towards the point of suspension and may be missing near the peak. However, if a running knot is used, the ligature mark may be horizontal all around the neck and can be confused with that of Garotting – usually no evidence of injury surrounding the Ligature mark is present - Patches of Lividity may

- 2) Soft tissue injuries may be present.
- 3) Fracture of hyoid bone and thyroid cartilage are uncommon.
- 4) Distribution of Post Mortem staining may be characteristic (Stocking & Glove distribution).

Medicolegal Aspects:

- **SUICIDAL** – Common.
- **HOMICIDAL** – Rare.
- **ACCIDENTAL** – Uncommon.

TRAUMATIC ASPHYXIA

Traumatic immobilization of the chest with stoppage of respiratory function. Commonly seen in compression of chest due to building collapse after mass disasters, collapse of trenches and by weight of grains or soil etc.

MECHANISM OF DEATH:

Anoxic Anoxia.

AUTOPSY FINDINGS:

Non-specific:

- Cyanosis, intense congestion of face and upper chest and petechiae are present.

Specific:

- No external injury may be visible. However, bruises on the chest may be present.
- Soft tissue damage (respiratory muscles).
- Rib fractures.

MEDICOLEGAL ASPECTS:

- Almost always accidental.
- Homicidal – rare, in sedative sexual

DROWNING/IMMERSION

IMMERSION:

State of being in a liquid medium – may or may not be fatal.

DROWNING:

A form of death resultant from defective oxygenation of the blood in lungs due to presence of fluid in air passages after entering through nose and mouth.

TYPES OF DROWNING

a. ATYPICAL DROWNING:

Also called “Dry Drowning”.

Fluid not aspirated into Lower respiratory tract - may be due to

- Vagal Inhibition of the heart.
- Laryngeal spasm.

b. TYPICAL DROWNING:

Also called “Wet Drowning”.

Aspiration of the drowning fluid into respiratory passages – It may be

- Fresh water drowning.
- Sea- water drowning.

FRESH WATER DROWNING

Fresh water of rivers, Canals, swimming pools is Hypotonic to Plasma.

- ↓ It enters circulation.
- ↓ Haemodilution.
- ↓ R.B.C. Lysis.
- ↓ Release of K⁺.
- ↓ Sensitization of heart muscles.
- ↓ Ventricular fibrillation.

SALT WATER DROWNING

Sea water is Hypertonic to plasma.

- ↓ Extraction of water from the blood into alveoli.
- ↓ Haemoconcentration.
- ↓ Lung becomes water logged & soggy.
- ↓ Hypoxic Hypoxia.
- ↓ Death.

MODES OF DEATH

- 1) Vagal inhibition of heart.
- 2) Anoxic Anoxia.
- 3) Ventricular Fibrillation of heart.

AUTOPSY FINDINGS:

Are based on three factors:

- 1) Submersion of body in water.
- 2) Mode of dying.
- 3) Entry of drowning media in the body.

SUMMARY – AUTOPSY FINDINGS

1) Changes in the skin:

- Wrinkling of skin.
- Cutis Anserina.
- Specific Hypostasis distribution.

2) Changes in Respiratory tract:

- Foaming of nose and mouth.
- Weeds, sand, fluid in respiratory passages.
- Changes in the lungs, dry/wet.

SUMMARY – AUTOPSY FINDINGS

(Continue)

- 3) Foreign Material in G.I.T.
- 4) Foreign Material in the Hands.
- 5) Shoulder, Girdle Bruises.

DROWNING TESTS

1. Diatoms in Bone Marrow:

(Diatoms are unicellular Algae found in fresh water and soil – having silicon cell wall.) – Different types.

2. Plasma Chloride (Gettler Test).
3. Plasma Magnesium.
4. Specific Gravity of Blood.

MEDICOLEGAL ASPECTS

- 1) Suicidal (common in Eastern countries).
- 2) Accidental (common).
- 3) Homicidal (in adults rare, infants – not uncommon).