Law

Forensic Science and Forensic Medicine

Asphyxial death: hanging, strangulation, drowning
DESCRIPTION OF MODULE

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<td>Objectives</td>
<td>Learning Outcome:</td>
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<td>To make the learners understand the need of studying asphyxial deaths based on their mechanism.</td>
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<td>To make the learners understand processes to determine the various type of asphyxia operating in different case and manner of death.</td>
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<td>To make the learners understand the mechanism of oxygen supply to the blood and tissues with respect to interference with respiration.</td>
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<td>General understanding of the Obstructions to the air passages due to hanging, strangulation or other asphyxia deaths and occlusion of the air passages within as in drowning or laryngeal spasm.</td>
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**Asphyxia**

Asphyxia is a common term applied to the condition where to a more or less degree interference with the respiratory exchange occurs. It is the condition where oxygen supply to blood and tissue is restricted below the normal level causing any interference with respiratory system. 1,2. It can also be considered as state of hypoxia.
or the lack of oxygen below the required level. Effect of asphyxia can be divided in four stages: 3,4

✓ Stage of inspiratory dyspnoes where deep and forceful respiration occurs, cyanosis lasts for a minute or so.

✓ Stage of expiratory dyspnoea with spasmodic efforts at expiration. At this stage, consciousness is lost, pupils dilated and high blood pressure are the symptoms.

✓ Next is the fall in blood pressure, resulting in increased pulse rate. Sometimes defecation occurs. Erection of penis and ejaculation of semen may also occur.

✓ At last, respiratory movements cease except for terminal irregular occasional respiration. Heart beats for next 10-15 minutes.

**Causes of asphyxia: 2**

✓ Obstruction in air passage due to mechanical asphyxia
✓ Causes blockage of external respiratory orifices, as in smothering.
✓ In case of drowning, occlusion of the air passage
✓ As in case of traumatic asphyxia, pressure on chest.
✓ Inhaling the toxic gases like carbon monoxide.
✓ In case of strychnine poisoning, spasm of the respiratory muscles.
✓ in case of narcotics and anesthesia administered, paralysis of the respiratory centre.

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1 (Premature and Congenitally Diseased Infants, by Julius H. Hess, M.D., Chapter X, Diseases of the Respiratory Tract, parikh).
2 parikh
4 Dixit P.C.; Textbook of Forensic Medicine and Toxicology; Edition 2007; p. 294, 300.)

**Signs of asphyxia: 5,2,6,7,8,9**

1- **Cyanosis: (greek ‘dark blue’)**

✓ The quantity of oxyhaemoglobin and reduced haemoglobin in red blood cells determine the Cyanoses.
When oxygen is lacking, the usual pink colour of well oxygenated blood might get converted to blue-purple.

There should be at least 5gm% of reduced haemoglobin for cyanosis to become evident.

2- **Congestion:**
- Due to susceptibility of capillaries to hypoxia there occurs capillo-venous congestion following visceral congestion resulting in stasis of blood in the dialated capillaries and venules.
- There is redistribution of blood upto certain extrant due to gravity and to some extent by rigor mortis.
- Systemic and pulmonary congestion and dialaltion of right side of heart are the sure sign of asphyaxial death.

3- **Fluidity of blood:**
- It has been established that fibrinolysin are found in cadaver.
- Fluidity depends upon fibrinolysin and amount of fibrinolysin depends upon the rapidity of death rather the cause.

5 sympsom
7 Roughhead W, Burke and Hare, ed 3. Edinburgh, Cited in Poison C, Gee DJ, Knight B: The Essentials of Forensic Medicine, New York, Pergamon Press, 1985.)
8 Knight BH, The significance of the postmortem discovery of gastric contents in the air passages. / Forens Sci 1975; 6:229-234.)

4- **Pulmonary edema:**
- It is of no or less value in diagnosis of death that whether it is due to respiratory failure.
- Lungs should be weighed properly to know the extent of edema.
5- **Pulmonary hemorrhages:**
- Due to trauma of pharynx against the anterior surface of spine, there is large submucosal hemorrhages.
- Rupture of submucous venous plexus at this site is due to serious venous congestion.

6- **Petechial hemorrhages:**
- Petechial hemorrhages or tardieu spots are develop from:
  - Due to increased venous stasis causing congestion which results in increased pressure causing rupture of the vessels.
  - There occurs increased permeability due to hypoxia.
  - Tardieu spots are usually pinhead in appearance, but vary in size and shape.

7- **Stasis hemorrhages:**
- Found in case of homicidal strangulation
- Usually found beneath the mucosa of larynx in the subglottic space.

Classification of asphyxiation death 2,10
Hanging is a mode of death in which death occurs because of the compression of neck as a result of suspension of body through a ligature. The constricting force results from the weight of the body or a part of body weight acts as a constricting force. Virtually all the suicide cases are suicidal in nature. Diagnosis of antemortem hanging is important to ascertain the death from hanging. There are few features which can ascertain death by hanging: Ligature mark with vital reaction, Saliva dribbling from mouth, Ecchymosis of larynx or epiglottis, Fracture of hyoid cartilage and hyoid bone. 2,5,11

There are chances of complete or incomplete suspension of the body:

**Complete hanging:**
- Here the body is completely suspended in air
- Constricting force is the weight of the body.

**Partial/incomplete hanging:**
- Here the constricting force is weight of the head.
- Lower part of the body like toes, feet, knee and buttocks generate the constricting force.

![Figure: (a) complete hanging (b) partial hanging](image)

2 Parikh’s Text book of medical jurisprudence Forensic Medicine and Toxicology CBS publisher and distributors PVT.LTD.
**Cause of death in hanging:**

Hanging may result in death due to one or combination of the following reasons of immediate death: 12,13,14,5

1- **Asphyxia:**
   - Ligature forces the root of tongue against the pharynx and folds the epiglottis over the entrance of larynx to block the passage of air.
   - A minimum weight of 15 kg is required to complete the trachea.

2- **Injuries to spinal cord:**
   - When hanging is exercised with a long drop
   - Upper cervical cord is stretched
   - Immediate unconsciousness
   - Heart and respiration may continue for up to 10-15 minutes
   - Congestive changes are absent

3- **Vagal inhibition:**
   - By compression of the neck
   - Can be considered as a possible cause where there is no or minimal congestive changes.

4- **Mechanical constrictions of the structures of the neck:**
   - Combined obstructive asphyxia and interfered cerebral circulation is most common cause of death

5- **Cerebral anoxia:**
   - Carotid artery occludes with 4-5 kg tension
   - Vertebral artery with 20 kg tension

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**Reasons for delayed death:**

- Aspiration pneumonia
- Infections
- Hypoxic encephalopathy
- Edema of lungs
- Encephalitis
- Cerebral abscess

**Autopsy findings:** 2,5,15,16

**External:**

- Neck may be stretched or elongated
- Head bend is opposite to the knot
- Face is pale usually
- Face may be swollen but swelling disappears when rope is cut down
- Petechiae present on the skin
- Dribbing of saliva
- Bloody froth may present caused by congestion of lungs
- Pulmonary edema
- In the middle ear hemorrhage may be seen
- Semen drops may come out of penis
- Lower limbs show hypostasis

**Internal:**

- Absence of Petechiae because of complete obstruction in the arterial system
- Saliva run from mouth down the chest
- Fracture of the hyoid bone and thyroid cartilage (considered antemortem)
- Vertebral artery may show rupture
- Thyrohyoid ligament is torn
- Trachea show Petechiae haemorrhages over the epiglottis, trachea and larynx.
- Abdominal organs are congested.


**Strangulation**

Strangulation is another form of asphyxia where death is due to constriction of neck by a ligature or other mean but without suspending the body. Broadly it is of two types (1) ligature strangulation and (2) manual strangulation. There also may be some more type:

- Ligature Strangulation: strangulation is by means of ligature.
- Throttling or manual strangulation: compressing the victim’s neck by the hand
- Mugging: compressing the victim’s neck against the forearm
- Garroting: attacking the victim from behind, grabbing his neck or throwing a ligature over neck and tightening it.
- Bansodala: compressing the neck by means of two sticks.

Areas which are more presumptive of strangulation are head and neck and a thorough examination of these area can be used to ascertain death by strangulation.

**Medico legal importance of strangulation:**

In homicidal cases:

- Single turn of ligature with one or more knot
- Abrasion around the neck due to ligature movement
- Mark of struggle (absent in case of weak or frail individual)

In Accidental cases:

- Children are more prone as they can get entangled in rope while playing.
- Intoxicated person by tie, scarf or collar.
- Umbilicle cord can strangulate the foetus.

In suicide cases:

- Injuries are less marked as less force is applied.
- No sign of struggle
- Ligature is found at scene

Cause of death:
- Asphyxia
- Anoxia
- Congestion
- Vagal inhibition

Autopsy:

External:
- Ligature mark on the middle or lower part of neck
- Depending upon the composition of the ligature it will show regular or irregular pattern around the neck
- Mark is depressed at any level on the neck-usually at the level of thyroid cartilage or below.
- Mark may be found around the neck but is more prominent in front and sides of neck.
- Marks may be interrupted by clothing or victim’s finger or ornaments.
- Mark is usually transverse but sometimes oblique as well.

Internal:
- Laceration of muscles.
- Injuries to blood vessels
- Hyoid bone fracture usually not seen.
- Fracture thyroid is more common.
- Fracture of cricoids is rare, but if pressure is used may be seen.
- Organs are congested.


Drowning
Drowning is a form of asphyxial death due to aspiration of fluid into the air passages by submersion of the body in water or some other liquid medium. Complete submersion not necessary, submersion of nose and mouth of a living person under water is enough. Types of drowning:

Drowning is mainly of four types:

1- Wet drowning: when more water goes to lungs.
2- Dry drowning: no water goes to lungs, death is due to laryngeal spasm.
3- Secondary drowning: Survival beyond 24 hours, victim may survive or die later
   - Injury to CNS is reported
   - Hypothermia and low oxygen delivery to vital tissues are the main factors towards morbidity and mortality.
4- Immersion drowning: Death is due to vagal inhibition following cardiac arrest. In drowning this may be brought about by
   - A sudden water entry to larynx.
   - Falling in water in a way such that it strikes the abdomen suddenly, especially the epigastric region.
   - Sudden entry of cold water into the ears.

Medico legal importance of drowning:

- Sure signs of drowning,
- Could still be identified in putrefied bodies,
- Could give an evidence of the site of drowning (fresh or salt water species).
- Whether the death was due to drowning or other cause?
- Length of time the body was in water.
- Whether it was accidental/suicidal/homicide


The change occur in body simply tells about the duration of submersion of body in water. Changes are result of imbibition of water in outer layer of body. Changes start to develop first in finger tips (3-4 hours) later spreading to entire hand (24 hours). By careful examination of these changes duration of submersion can be determined.

- In a couple of hours only, skin starts developing wrinkles
- In about 12 hours of submersion, cuticle becomes bleached.
- In 24 hours saddening of skin can be seen.
In about 48 hours of submersion, cuticle of skin starts separating from palm and foot and can be peeled off by 3-4 days.

Usually body starts to float in about 24 hours of submersion in summer in 2-3 days in winter.

Autopsy/diagnosis of death by drowning can be ascertained by (a) External sign (b) internal sign (c) biochemical test and (d) analysis through diatoms. 22,23,24,25

External sign:
- Clothing and skin is wet, cold and pale
- Hypostasis is pink in color due to oxygenation or may be cyanotic
- Upper parts of body show postmortem staining
- Petechial haemorrhage may be present
- Pupil dilated
- Cyanosis may be present
- Rigor mortis takes place early
- White and leathery froth sometimes with blood is present over the mouth and nostril. When chest is pressed more froth comes out.
- Cutis anserine (Due to spasm of the erector pilae muscles and due to exposure to cold water at the time of death) or goose skin is present
- Cadaveris spasm: presence of weeds in grass in hands.
- Washerwomen’s hand: saddening of the skin due to absorption of water.


Internal signs:

Paltauff’s haemorrhages:
- Present in the lower lobes of lungs
- Red or grey patchy appearance
- This condition of lung is also known as emphysema aquosum and trokenes oedema.

Microscopic findings of drowning lungs:
Following stages are encountered
 Thickness of the alveolar wall is reduced to capillary width
 Alveolar are more distended and capillaries lie separately.
 Capillaries appearance is thread like, lumina is observed occasionally.
 Involve only scattered alveoli.

 Water in stomach and duodenum:
 When water is taken in excess, it passes to the duodenum.

 Froth in air passage:
 In case of fresh drowned bodies, froth comes out from mouth and nostril.
 Froth is odema fluid from lungs
 Froth consist of proteinaceous exudates and surfactant mixed with the drowning medium water.

 Over-inflation of lungs:
 Lungs may be over-inflated filling the thoracic cavity.

 Biochemical tests:
 Many workers have worked on the biochemical and biophysical tests on drowning related cases including calcium, magnesium or specific gravity of plasma but the results are not rewarding. The rapid onset of post mortem changes in case of drowning may be considered as one of the reason which is obscuring the reliability of biochemical tests. 26

 Diatoms (bacillariophyceae) is a photosynthetic unicellular algae with siliceous exoskeleton is found in water.
 There are nearly 15,000 species of diatom found in fresh and sea water.
 A broad classification of diatom can be (1) oligohalophilic: live in fresh water (2) mesohalophilic: in sea water with salinity more than 0.05%.

Different types of diatoms

When a person drowns in water containing diatoms, many diatoms reach the pulmonary parenchyma. From there they enter into the bloodstream through the alveolar walls during forceful inspiratory or expiratory efforts. Once they enter in blood, they are distributed in the whole body through the bloodstream. This presence of diatoms makes the basis of diatom test in drowned individuals.

When a person is not drowned or a body is thrown in water after death, diatoms are though able to reach lungs by passive perlocation but cannot reach to distant organs.

Hence organs examined routinely for the presence of diatoms are lung, liver, brain and bone marrow.

There may be cases where the person was not drowned but diatoms were present or may be absent when person was drowned. Such conditions can arise due to:

- Seasonal variation
- Due to having raw fruits or vegetables which have been in contact of soil diatoms
- Having their ubiquitous nature, they are present in soil, water and in air.
- Sometimes they can penetrate the intestinal lining and can directly get in the blood stream.
- Certain food like selfish contain diatoms.

In such conditions, following are the requirements which should be fulfilled:

- Diatoms species recovered from body organs and from water of submersion should be same.
- They must be present in approximate same proportion. 29, 30,31