Asphyxia- IV

Body recovered from water

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Objectives

- At the end of this lecture the students should be able to understand
  - Principles of investigation of body recovered from water
  - The signs of immersion
  - The various mechanisms of death in drowning.
  - The autopsy findings in a case of drowning
  - How to conclude the cause of death as drowning.

Body recovered from water

- Many dead bodies are recovered from water.
- Death cannot be attributed to drowning in all
- Pathological proof of drowning is often difficult
- The diagnosis is made by exclusion most of the time.

Bodies recovered from water may be:

- Died from natural disease before falling in to water
- Died from natural disease while already in water
- Died from injury before being thrown into water
- Died from injury while in water
- Died from effects of immersion other than drowning
- Died from drowning

Signs of immersion

- Maceration of the skin
- Starts in areas with an appreciable keratin layer.
- Surface become wrinkled, pale and sodden-the so called ‘washerwoman’s skin’.

Signs of immersion cont…

- Areas protected by clothing get these changes later.
- Time take to develop are variable and depends on the temperature of the water.
- Prolonged immersion can cause detachment of thick keratin of hands and feet (like a glove)

Cutis anserina- or 'goose –flesh'

- This is thought to be due to the rigor mortis of erector pilae muscle attached to the hair follicles.

- Causes generalized dimpling of the skin.

- It is not specific to immersion

Distribution of hypostasis

- May be of any pattern
- Due to constant mobility of the body while in water

Deposits on the body

- Mud, coal-slurry, silt or sand and see weeds, water weed, algae and small aquatic animals

- Mud and sand - on the surface of the body or within the orifices

- Sometimes sand may be found deep in the respiratory passage and in stomach-

Death from natural causes before entering the water

- Uncommon
- Natural catastrophe while in close association with water
- Cardiovascular conditions are common.
- Difficult to differentiate from deaths from natural disease while already in water

Death from natural causes before entering the water cont..

- Eye witnesses account is important
- At autopsy -natural pathological lesion
- Exclude evidence of live entering to water (Eg: cadaveric spasm with weeds)

Death from natural disease while already in water

- Cardiovascular disease are the commonest (IHD, myocarditis)
- A pre existing condition may be exacerbated by physical exertion
- Difficult to differentiate from natural deaths occurring before entering water
- Eye witnesses account is important
- At autopsy -natural pathological lesion

Death from injuries before entering the water

- Disposal of a murdered corpse in to water
- To conceal the murder
  - Prevent discovery of the body
  - Even if discovered often delayed-identification and injury interpretation difficult
- Accidental injuries before entering water
  - Occasional
  - Knocking head while jumping /falling

Death from injuries before entering the water cont…

- Suicidal injuries before entering water
  - Suicidal attempt taken place by the water and fall/ jump into water
  - Electrocution in bathtubs
- Difficult to differentiate from injuries that occur while in water
- If the injuries are clearly distinguishable from those related to water issue is clear
  - Burns
  - Fire arm injuries
  - Explosion


DOCUMENTING REALITY

Death from injury while in water

- Uncommon
- Impossible to differentiate from injuries inflicted before entering the water and postmortem injuries
- Animal attacks, knocking against obstructions or hard bottom of the river, propellers of ships, and boats are known to cause injuries while in water.
- Propeller associated injuries show characteristic parallel wounds set a few centimeters apart.

Death from injury while in water cont…

- Animal attacks, attacks from propellers of ships and injuries from dragging in shallow water are commonly seen post mortem and difficult to distinguish.
- Surface bleeding is washed away- difficult to differentiate from post mortem injury
- Decomposition further complicate differentiation

Propeller injury

Death from immersion other than drowning

- It is known that victims fallen in to water can have an extremely rapid death before drowning occur.
- Need to exclude other pathology.
- They do not show any signs of drowning.
- Mechanism of death is not very clear.
- Thought to be due to reflex cardiac arrest from vagal stimulation:
  - From cold water stimulation of cutaneous nerve endings
  - Sudden entry of cold water in to pharynx and larynx stimulating mucosal nerve endings

Death from drowning

- Drowning is best viewed as a rapid anoxial death due to airway obstruction by water.
- Mechanism of death is complex and not simply asphyxiation
- No autopsy findings pathognomonic of drowning.
- Proof of the victim being alive on entering the water, and excluding other causes of death, are critically important.
- May see intentional injuries some times
  - Stabs, firearms, blunt head trauma etc
  - Enough to incapacitate only
- Some pathological changes are characteristic of drowning, but the diagnosis is largely one of exclusion.

Mechanism of Death

- Originally thought as suffocation due to the mechanical obstruction of the airways.
- In 1947-51, the animal experiments of Swann and his colleagues highlighted the importance of disturbances of blood electrolytes and fluid balance.

In fresh water drowning

- *Water is rapidly absorbed into the circulation producing an expansion of blood volume, haemodilution and haemolysis.*
- *Results in*
  - *Circulatory overload,*
  - *hyponatraemia and sodium/potassium imbalance*
  - *myocardial hypoxia.*

In salt water drowning

- *The aspiration of water results in withdrawal of water from the pulmonary circulation into the alveolar spaces while at the same time electrolytes (sodium, chloride, magnesium) pass into the blood.*
- *There is haemo-concentration but not haemolysis*
- *little change in the sodium/potassium balance.*

Accepted Mechanism today

- Later found,
- inconsistencies between animal and human responses.
  - *The animals were always completely submerged*
  - *The main intracellular action in the dog erythrocyte is not potassium but sodium.*
  - *The biochemical findings in humans surviving drowning are less distinct.*
- As a result hypoxiaemia was emphasized once again as a mechanism of death in drowning.

Autopsy findings

- Autopsy findings vary depending the period of delay for recovery of the body as well as for the autopsy.
- Positive signs of drowning fade away with the period of delay.

Froth in the air passage

- Most useful positive sign
- A fine, white, froth or foam in the airways and exuding from the mouth and nostrils.
- This is due to pulmonary oedema.
- Seen in both fresh water and salt water drowning terminally
- In both, there is concurrent transfer of water in both directions.

Froth in the air passage cont…

- Thus, pulmonary oedema develops simultaneously with the diffusion process
- Indicates that the victim was alive at the time of submersion
- However the finding is not specific for drowning
- On the other hand, the absence does not exclude drowning :
  - With the increased postmortem interval the feature may be absent
  - So called ‘dry lung drowning’ is not uncommon.

Froth in the air passage

Over inflation of the lungs

- The lungs are characteristically over-inflated filling the thoracic cavity.
- Heart may be completely covered; lungs are meeting at the midline.
- Texture is pale and crepitant, like in asthma, older name emphysema aquosum.
- The reason is blockage of the bronchi by the oedema fluid, preventing passive collapse of alveoli.

Over inflation of the lungs

- In addition there is an valvular action also taking place in bronchi.
- Lateral surfaces of the lungs show rib indentations (Visible and palpable grooves).
- areas of intrapulmonary haemorrhage giving a red tinge to the oedema fluid.
- Features are again not specific to drowning.
- On the other hand the absence does not exclude drowning.

Emphysema aquosum

- Submersion in conscious state
- Violent respiratory effort
- Increased pressure due to forced expiration
- Since the airways blocked with a column of froth
- Air trapped within alveoli – ballooning of alveoli

Oedema aquosum

- Submerged in unconscious state
- No violent effort for respiration
- Water passively enters alveoli
- Passive oedema
- No column of froth

Cadaveric spasm

- Also known as **instantaneous rigor**, **cataleptic rigidity**, or **instantaneous rigidity**
- A rare form of muscular stiffening that occurs at the moment of death
- Often crystallizes the last activity
- Usually associated with violent deaths
- Typically groups such as the forearms, or hands
- When seen in cases of drowning victims where weeds are clutched proof of life at the time of entry into the water.
- This strongly suggest cause of death as drowning or immersion


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cm
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Other findings

- No other reliable autopsy changes in drowning.
- It is doubtful whether the foreign matter found in the airways constitutes proof of immersion during life
- The presence of large quantities of water and debris in the stomach strongly suggests immersion during life
- however passive entry is possible depending on the tone of the oesophagus.

Other findings cont..

- Conversely, the absence of water in the stomach suggests either rapid death by drowning, or death prior to submersion.
- Foreign material in trachea again is not reliable.
- Haemorrhages into the middle ear-totally unreliable
- Dilated and engorged right heart- subjective and nonspecific
- Haemodilution in fresh water; fluid blood- subjective and not reliable.

Laboratory tests for drowning

- **Chemical analysis**
  - No universally acccepted diagnostic laboratory tests for drowning.
  - Theoretically with the haemodilution, chemical analysis of plasma can give good evidence in drowning.
  - However due to postmortem biochemical changes these are not practical.

The diatom test

- Diatom test may provide corroborative evidence of death by drowning.
- Diatoms are microscopic algae found in water with silicaceous exoskeleton.
- When a live person is drowned in water containing diatoms, many diatoms will penetrate the alveolar wall, and be carried to distant organs.
- Strong acids are used to digest the organs leaving diatoms.

diatom test cont…

- Indicates live entry into water
- May say the place of drowning based on type of diatom.
- To get reliable results, technique should be such that there is no contamination

Drawbacks are:

- Diatoms are present commonly in environment, and also in food-thus, it is expected to find diatoms in human organs
- They can enter the blood stream through intestinal lining-so when a man is used to drink water from a place he drowned similar type of diatoms are expected in him anyway.
- On the other hand, absence cannot exclude drowning.

Histopathology

- Changes are inconsistent and unreliable.

Summary

- Manner of death in a body recovered from water could be natural, accidental, suicidal or homicidal.
- Presence of signs of immersion does not confirm drowning as a cause of death.
- Hypoxemia is one of the mechanisms of death in drowning
- Autopsy findings of drowning are nonspecific and could vary with the period of delay for recovery.
- Drowning is essentially a diagnosis by exclusion.


Thank you!