

Drowning: Autopsy Findings and Medico-Legal Investigation

Exam-oriented forensic medicine notes | formatted for rapid revision

1. Definition of Drowning

Drowning is a form of **violent asphyxial death** caused by **submersion or immersion of mouth and nostrils in water or any liquid medium**, leading to **respiratory impairment** and death.

In the given case, the body is **decomposed** and recovered from a **pond**, so diagnosis of drowning should be made by correlating:

Scene findings + autopsy findings + laboratory tests + exclusion of other causes of death.

2. Classification of Drowning

A. Typical Drowning / Wet Drowning

In **wet drowning**, fluid is **actively inhaled into the lungs**.

Types:

1. **Fresh-water drowning**
2. **Sea-water drowning**

B. Atypical Drowning

In **atypical drowning**, there is **little or no inhalation of water** into the lungs.

Types:

1. **Dry drowning**
2. **Immersion syndrome / hydrocution**
3. **Submersion of unconscious person / shallow water drowning**
4. **Near drowning / post-immersion syndrome**

3. External Postmortem Findings in Drowning

In a **decomposed body**, typical signs like **froth** may be altered or absent. Therefore, findings should be interpreted carefully.

1. Froth at Mouth and Nostrils

There may be **fine, white, copious, tenacious froth** at the mouth and nostrils.

Features:

1. **White or blood-tinged**

2. **Fine and leathery**
3. **Shaving-lather like**
4. Reappears on **pressing the chest**

It is one of the most important signs of **ante-mortem wet drowning**.

But in **decomposed bodies**, froth may be **lost or confused with decomposition fluid**.

2. Cadaveric Spasm

Cadaveric spasm may be seen in the hands.

The victim may firmly clutch:

1. **Weeds**
2. **Grass**
3. **Mud**
4. **Sand**
5. **Gravel**

Significance:

It indicates that the person was **alive at the time of submersion** and made an attempt to save himself.

It is strong evidence of **ante-mortem struggle in water**.

3. Washerwoman's Hands and Feet

There is **wrinkling, bleaching and soddening** of palms and soles due to prolonged contact with water.

Importance:

1. It indicates **immersion in water**
2. It does **not prove drowning**
3. It may occur in **ante-mortem or postmortem immersion**

4. Cutis Anserina

Cutis anserina means **goose-skin appearance**.

It occurs due to contraction of **erector pili muscles**, especially in cold water.

It is a **non-specific sign**.

5. Postmortem Staining

Postmortem staining may be seen over:

1. **Face**
2. **Neck**
3. **Front of chest**
4. **Upper limbs**

This occurs because the body commonly floats in a **face-down position**.

In drowning, postmortem staining may be **bluish-pink**.

6. Changes in Eyes

Eyes may show:

1. **Half-open or closed eyelids**
2. **Congested conjunctiva**
3. **Dilated pupils**
4. **Subconjunctival petechiae**

7. Retraction of Genitals

There may be **retraction of penis and scrotum**, especially in cold water.

8. Clothes and Body Surface

Clothes may be:

1. **Wet**
2. Mixed with **mud, sand, weeds or aquatic vegetation**

Body may show:

1. **Maceration**
2. **Decomposition changes**
3. **Injuries caused by aquatic animals**
4. **Postmortem injuries due to rocks or water current**

9. Decomposition Changes in Water

In decomposed bodies recovered from water, there may be:

1. **Peeling of skin**
2. **Loosening of hair and nails**
3. **Marbling**
4. **Bloating**
5. Dark discoloration of head and neck called **tete de negre**

4. Internal Postmortem Findings in Drowning

1. Respiratory Tract

The larynx, trachea and bronchi may contain:

1. **Fine white froth**
2. **Blood-tinged froth**
3. **Water**

4. **Mud, sand or weeds**

5. **Diatoms**

Froth in the air passages supports **ante-mortem wet drowning**.

2. Lungs - Emphysema Aquosum

Lungs are typically:

1. **Voluminous**
2. **Ballooned**
3. **Heavy**
4. **Oedematous**
5. **Boggy and doughy**
6. May overlap and cover the **heart**
7. Show **rib impressions** on the surface

On cut section:

1. Copious **frothy fluid** exudes
2. Fluid may be **blood-stained**
3. Lungs are waterlogged

This condition is called **emphysema aquosum**.

3. Paltauf's Haemorrhages

Paltauf's haemorrhages are:

1. **Large**
2. **Pale bluish-red**
3. **Subpleural haemorrhages**
4. Commonly seen over **anterior surface and lower lobes of lungs**

Cause:

They occur due to **rupture of alveolar walls and capillaries** from violent respiratory efforts and overdistension of lungs during drowning.

4. Stomach and Intestines

The stomach may contain:

1. **Water**
2. **Mud**
3. **Sand**
4. **Weeds**
5. **Diatoms**

Presence of drowning medium in stomach suggests **swallowing during life**.

If water reaches the **small intestine**, it is more suggestive of **ante-mortem drowning**, because passage into intestine requires survival for some time.

5. Wydler's Sign

In **Wydler's sign**, stomach contents settle into **three layers** in a beaker:

1. Upper layer - **froth**
2. Middle layer - **water**
3. Lower layer - **mud, sand and solid particles**

It supports swallowing of drowning medium.

6. Seht's Sign

Seht's sign refers to **tears or micro-ruptures of gastric mucosa** due to overdistension of stomach by swallowed water.

7. Heart and Blood

Common findings:

1. Right side of heart may be **full of dark fluid blood**
2. Left side may be **less filled or empty**
3. Blood may be **diluted** in fresh-water drowning
4. Blood may be **concentrated** in sea-water drowning

8. Middle Ear and Sinuses

1. **Ueno's sign** - haemorrhage or water in **middle ear / petrous temporal bone**
2. **Sveshnikov's sign** - water in **sphenoid sinus**

These findings support drowning but are not absolutely diagnostic alone.

9. Spleen

Sabinsky's spleen:

1. Spleen is **small**
2. **Contracted**
3. **Anaemic**

10. Other Viscera

Other organs may show general signs of asphyxia:

1. **Congestion of brain**
 2. **Cerebral oedema**
 3. **Congestion of liver, kidneys and other viscera**
 4. **Pulmonary oedema**
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5. Causes / Mechanisms of Death in Drowning

1. Asphyxia

This is the most important mechanism.

Water enters the air passages and causes:

1. **Obstruction of air entry**
2. **Hypoxia**
3. **Loss of consciousness**
4. **Death**

2. Laryngeal Spasm

Few drops of water entering the larynx may cause severe **laryngeal spasm**.

This causes **dry drowning**, where little or no water enters the lungs.

3. Ventricular Fibrillation

Classically seen in **fresh-water drowning**.

Fresh water causes:

1. **Haemodilution**
2. **Haemolysis**
3. **Hyperkalaemia**
4. **Ventricular fibrillation**

4. Circulatory Shock and Cardiac Failure

Classically seen in **sea-water drowning**.

Sea water causes:

1. **Haemoconcentration**
2. **Hypovolaemia**
3. Massive **pulmonary oedema**
4. **Cardiac failure / asystole**

5. Vagal Inhibition

Sudden entry into cold water may cause **reflex cardiac arrest**.

This is called:

Immersion syndrome / hydrocution / cold-water drowning.

6. Secondary Complications

In near drowning, death may occur later due to:

1. ARDS
2. Pneumonia
3. Pulmonary oedema
4. Septicemia
5. Hypoxic encephalopathy

6. Laboratory Investigations in Drowning

In a **decomposed body**, laboratory investigations are important because classical autopsy signs may be absent.

A. Diatom Test

Principle

Diatoms are microscopic unicellular algae with **siliceous cell walls**.

In **ante-mortem drowning**, water containing diatoms enters the lungs. Due to violent respiratory efforts, diatoms may pass through the alveoli into the blood and reach distant organs through circulation.

Therefore, finding diatoms in **bone marrow or internal organs** supports **ante-mortem drowning**.

Specimens Collected

Best specimen:

1. Bone marrow from intact femur

Other specimens:

1. Sternum
2. Lung
3. Liver
4. Kidney
5. Brain
6. Drowning medium water sample from the pond

Method

The specimen is digested using **acid digestion technique**, commonly with **concentrated nitric acid**.

The residue is examined microscopically for **diatoms**.

Interpretation

The diatom test is useful when:

1. Body is **decomposed**
2. Body is recovered from water
3. Classical signs of drowning are absent
4. Drowning is alleged but doubtful

Medico-legal importance:

1. It is a **corroborative test** for **ante-mortem drowning**
2. Diatoms in **bone marrow** are more significant than diatoms only in lungs
3. Diatoms found in organs should be compared with diatoms in the **suspected drowning medium**
4. It is not absolute proof, because **contamination and false positives** may occur

B. Gettler's Test

Gettler's test compares **chloride content** of blood from right and left sides of heart.

Classically:

1. Normal chloride level is about **600 mg/100 mL**
2. Difference of more than **25 mg/100 mL** between two sides suggests drowning

In fresh-water drowning:

Left heart chloride < Right heart chloride

Reason: **haemodilution** of blood in left side of heart.

In sea-water drowning:

Left heart chloride > Right heart chloride

Reason: **haemoconcentration** due to hypertonic sea water.

Importance:

It is a **classical test**, but it is less reliable in **decomposed bodies**.

C. Chemical / Biochemical Tests

Useful tests include:

1. **Magnesium**
2. **Strontium**
3. **Chloride**
4. Other electrolytes

In **sea-water drowning**, increased **magnesium and strontium** in left heart blood may support diagnosis.

D. Histopathology

Microscopy of lungs may show:

1. **Alveolar overdistension**
2. **Rupture of alveolar septa**
3. **Pulmonary oedema**
4. **Foreign material / diatoms**
5. **Haemorrhages**

E. Toxicology

Toxicology should be done to rule out:

1. **Alcohol intoxication**
2. **Poisoning**
3. **Drug intoxication**
4. Incapacitation before drowning

7. Medico-Legal Investigation in a Decomposed Body Recovered from Pond

The main medico-legal questions are:

1. **Identity of the deceased**
2. Whether the person was **alive or dead before entering water**
3. Whether death was due to **drowning or other cause**
4. Whether manner of death is **accidental, suicidal or homicidal**
5. Whether there are **ante-mortem injuries**
6. Whether there is evidence of **poisoning or intoxication**

Important Steps

1. Examine the **scene of recovery**
2. Note depth of water, accessibility and possibility of accidental fall
3. Look for signs of **struggle near pond**
4. Preserve **water sample** from the site for diatom comparison
5. Record condition of **clothes and belongings**
6. Look for **injuries** on the body
7. Differentiate **ante-mortem injuries** from postmortem aquatic injuries
8. Conduct **bloodless and careful dissection** if neck injury is suspected
9. Collect viscera for **chemical analysis**
10. Collect femur/bone marrow and organs for **diatom test**
11. Establish identity by:
 - **Clothes and belongings**
 - **Dental examination**
 - **Fingerprints**, if possible
 - **DNA profiling**, if required

8. Short Notes

A. Cadaveric Spasm

Cadaveric spasm is instantaneous stiffening of muscles at the moment of death without passing through primary flaccidity.

In drowning, the hands may firmly hold:

1. **Grass**
2. **Weeds**
3. **Mud**
4. **Sand**
5. **Stones**

Importance:

1. Indicates the person was **alive at the time of submersion**
2. Indicates **struggle for survival**
3. Helps identify the **place of drowning**
4. Cannot be easily simulated after death

B. Wreden-Wendt Test

Wreden-Wendt test is mainly a test related to **live birth**, not a standard test for drowning.

It is based on presence of **air in the middle ear cavity** of a newborn who has breathed after birth.

In drowning, the relevant middle ear finding is **Ueno's sign**, not Wreden-Wendt test.

C. Paltauf's Haemorrhage

Paltauf's haemorrhages are large, pale, bluish-red **subpleural haemorrhages** seen in drowning.

They are commonly present on:

1. **Anterior surface of lungs**
2. **Margins of lower lobes**

Cause:

They occur due to **rupture of alveolar capillaries** from violent respiratory efforts and overdistension during **wet drowning**.

D. Dry Drowning

Dry drowning is an atypical drowning in which little or no water enters the lungs.

Mechanism:

1. Water touches larynx
2. Causes severe **laryngeal spasm**
3. Air entry is blocked
4. Death occurs due to **asphyxia**

Findings:

1. Lungs may be relatively **dry**
2. Froth may be absent
3. Water in stomach may be absent or minimal

E. Wet Drowning

Wet drowning is typical drowning where water is **actively inhaled into lungs**.

Findings:

1. **Froth** at mouth and nostrils
2. Froth in air passages
3. **Emphysema aquosum**
4. Water in stomach
5. **Paltauf's haemorrhages**
6. Diatoms may be present in organs

F. Fresh-Water Drowning

Fresh water is **hypotonic** compared to blood.

Mechanism:

1. Water passes from alveoli into blood
2. Causes **haemodilution**
3. Causes **haemolysis**
4. Leads to **hyperkalaemia**
5. Death may occur due to **ventricular fibrillation**

Features:

1. Blood becomes **diluted**
2. Lungs may be **ballooned and pale**
3. Left heart chloride is **less than right heart chloride** in Gettler's test

G. Sea-Water Drowning

Sea water is **hypertonic** compared to blood.

Mechanism:

1. Fluid is drawn from blood into alveoli
2. Causes severe **pulmonary oedema**
3. Causes **haemoconcentration**
4. Causes **hypovolaemia**
5. Death may occur due to **circulatory shock and cardiac failure**

Features:

1. Lungs are **heavy, waterlogged and congested**
2. Blood becomes **concentrated**
3. Left heart chloride is **more than right heart chloride** in Gettler's test

9. Opinion in the Given Case

Since the body is **decomposed** and recovered from a **pond**, diagnosis of drowning cannot be made from one sign alone.

Findings favouring ante-mortem drowning are:

1. **Fine tenacious froth** at mouth, nostrils or air passages
2. **Emphysema aquosum**
3. **Water, mud or weeds in stomach**
4. Water in **small intestine**
5. **Paltauf's haemorrhages**
6. **Cadaveric spasm** with weeds or mud in hands
7. **Diatoms in bone marrow/internal organs**
8. Same diatoms in body tissues and **pond water**
9. No evidence of fatal injury or poisoning before immersion

Therefore, final opinion should be given after correlation of:

Autopsy findings + diatom test + toxicology + scene investigation + circumstantial evidence.

Exam Recall Box

Drowning = respiratory impairment due to submersion/immersion in liquid.

Wet drowning: water enters lungs -> **froth + emphysema aquosum + Paltauf haemorrhage**.

Dry drowning: **laryngeal spasm**, little/no water in lungs.

Cadaveric spasm: weeds/mud in hand -> **alive during submersion**.

Diatom test: best sample = **femur bone marrow**, only **corroborative**.

Fresh water: **haemodilution + haemolysis + hyperkalaemia + VF**.

Sea water: **haemoconcentration + pulmonary oedema + shock**.

Decomposed body: diagnosis by **autopsy + diatom + toxicology + scene evidence**.