

# FORENSIC & TOXICOLOGY SUMMARY

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## Drowning

- ❖ The dominant manner of death is accidental.
- ❖ **Water composition (less important than the quantity):**
  - ✓ Temperature — cold water causes ventricular dysrhythmia.
  - ✓ Tonicity — if hypertonic (sea water) or hypotonic (fresh water) which results in cardiac arrest.
    - Possibly the cardiac arrest happens earlier in fresh water drowning.
  - ✓ Contamination — high load of pathogens increase the risk of infection & sepsis.
- ❖ Aspiration of 1 to 3 mL/kg of liquid compromises the function of surfactant and leads to respiratory compromise and hypoxemia.

### ❖ Classification:

#### ○ Typical:

1. **Fresh water drowning** (fatal period is 4-5 min)
2. **Salt water (sea water) drowning** (fatal period is 8-12 min)

#### ○ Atypical:

##### 1. **Dry drowning:**

- Water does not enter the lungs due to **laryngospasm** (blocks air entry).
- Cardiac arrest induced by small amounts of water entering the larynx.
- Negative autopsy findings & dry lungs.

##### 2. **Immersion syndrome/cold water drowning:**

- Vasovagal reflex that leads to cardiac arrest due to sudden immersion in cold water (less than body temperature by 5 degree).
- The resultant **loss of consciousness leading to secondary drowning**.
- Common among middle-aged alcoholic men.

##### 3. **Near drowning (post-immersion syndrome):**

- The patient died beyond 24h due to **complication** (ARDI, DIC, hypoxemia induced encephalopathy).

##### 4. **Shallow water drowning:**

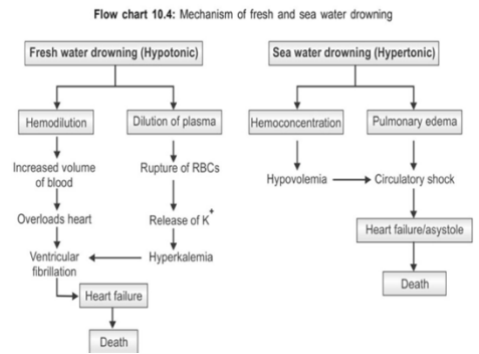
- Submersion of the **unconscious** (alcoholics, drugged, epileptic) in shallow water.

### ❖ Phases of drowning:

1. Breath holding >> hypercapnia >> breath center activation.
2. Water swallowing >> space of air remaining in the lungs replaced by water.
3. Profound unconsciousness >> gasping >> respiratory standstill >> heart failure >> irreversible changes in the brain >> death.

### ❖ Causes of death:

1. **Asphyxia — the most common cause.**
2. Ventricular fibrillation — in fresh water drowning.
3. Cardiac arrest/asystole — in sea water drowning & immersion syndrome.
4. Laryngospasm — in dry drowning.
5. Vagal inhibition.
6. Concussion and head injury.



7. Apoplexy – SAH from the rupture of berry aneurysm or cerebral hemorrhage by the rupture of cerebral vessels.
8. Secondary causes – septic aspiration pneumonia & sudden bursting of aneurysm.

#### ❖ Fatal period & treatment:

- ✓ Symptoms: mental confusion, auditory & visual hallucinations, tinnitus, vertigo / chest pain (in dry drowning).
- ✓ Treatment: artificial respiration with closed chest cardiac massage, defibrillator when there is ventricular fibrillation.
- ✓ Fetal period: 4-5 min in fresh water drowning, <sup>8-12 min</sup>~~8-12h~~ in sea water drowning.

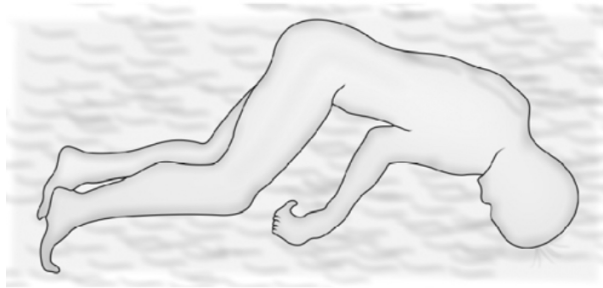
#### ❖ Postmortem findings (external):

1. Face: Pale, cyanosed, bloated.
2. Eyes: half closed half open.
3. Tongue: swollen, may be protruded.
4. Froth: white & odorless, mixture of air, water & mucus due to forcible respiration.
5. PM staining: in the dependent areas (face, neck, front of upper part of chest, upper and lower limbs as the body usually floats face down) with light pink color.
6. **Rigor mortis: appear early.**
7. **Cadaveric spasm:** with mud, sand, grass, gravel, ... (vital proof of antemortem drowning).
8. Injuries.
9. Goosebumps: skin appears granular with hair standing on the end; due to spasm of erector pili muscles.
10. Washerwomen hand: wrinkling, thickening of the skin & white in color.
11. Degloving – 2 weeks.



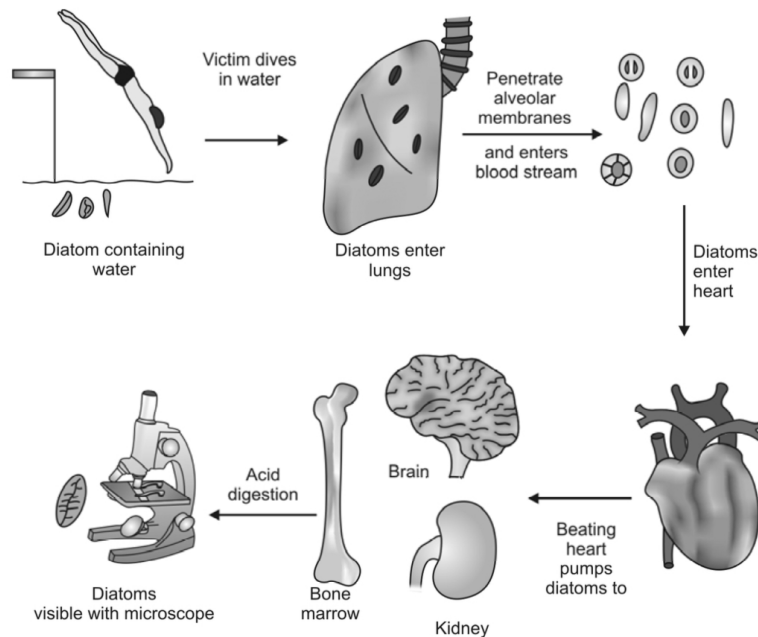
#### ❖ Postmortem findings (internal):

1. lungs are voluminous, distended and show ballooning.
2. Rib imprints may be present on the surface of lungs.
3. Paltauf's hemorrhage: mottled areas of red and gray distended alveoli (reflects intra-alveolar hemorrhages).
4. Heart and blood vessels: Like in other forms of asphyxia, left side of heart will be usually empty; the right heart will be full with the venous system engorged with dark blood.
5. Gettler test: Normally, the **chloride** content of the right and left side of heart is nearly same. If difference is 25 % or more, it is suggestive of antemortem drowning.
6. Stomach filled with water in 70%.
7. Hemorrhage in the middle ear and mastoid air cells.
8. The presence of **diatoms** in the lung substance, bloodstream, brain, liver, kidneys, bone marrow of femur (best site for analysis) or humerus or in the skeletal muscle has been claimed to be suggestive proof of antemortem drowning.



**Fig. 10.16:** Position of a submerged dead body

Differentiation 10.4: Antemortem drowning and postmortem submersion <sup>36</sup>		
S.No. Feature	Antemortem drowning	Postmortem submersion
1. Froth over mouth and nostrils	Fine, lathery froth, appears spontaneously	Absent, even if present, it is coarse, not spontaneous
2. Cadaveric spasm in hands	Aquatic vegetations, mud may be present	Not observed
3. Trachea and bronchioles	Presence of algae, mud along with frothy mucus	Absent
4. Lungs	Ballooned up, bulky, edematous, bear indentations of ribs	Collapsed, decomposed
5. Mud and algae in stomach and small intestine	May be present	Absent
6. Diatom and Gettler tests	Positive	Negative
7. Injuries	If present, need to be consistent with drowning	Injuries inconsistent with drowning
8. Other suggestive signs	Water in middle ear, retracted genitals, cutis anserina, washer-woman's hands, wet clothing, mud and sand	Water is never present in middle ear; others are not valuable and corroborative findings



**Fig. 10.18:** Principle of diatom test