

DROWNING

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DROWNING

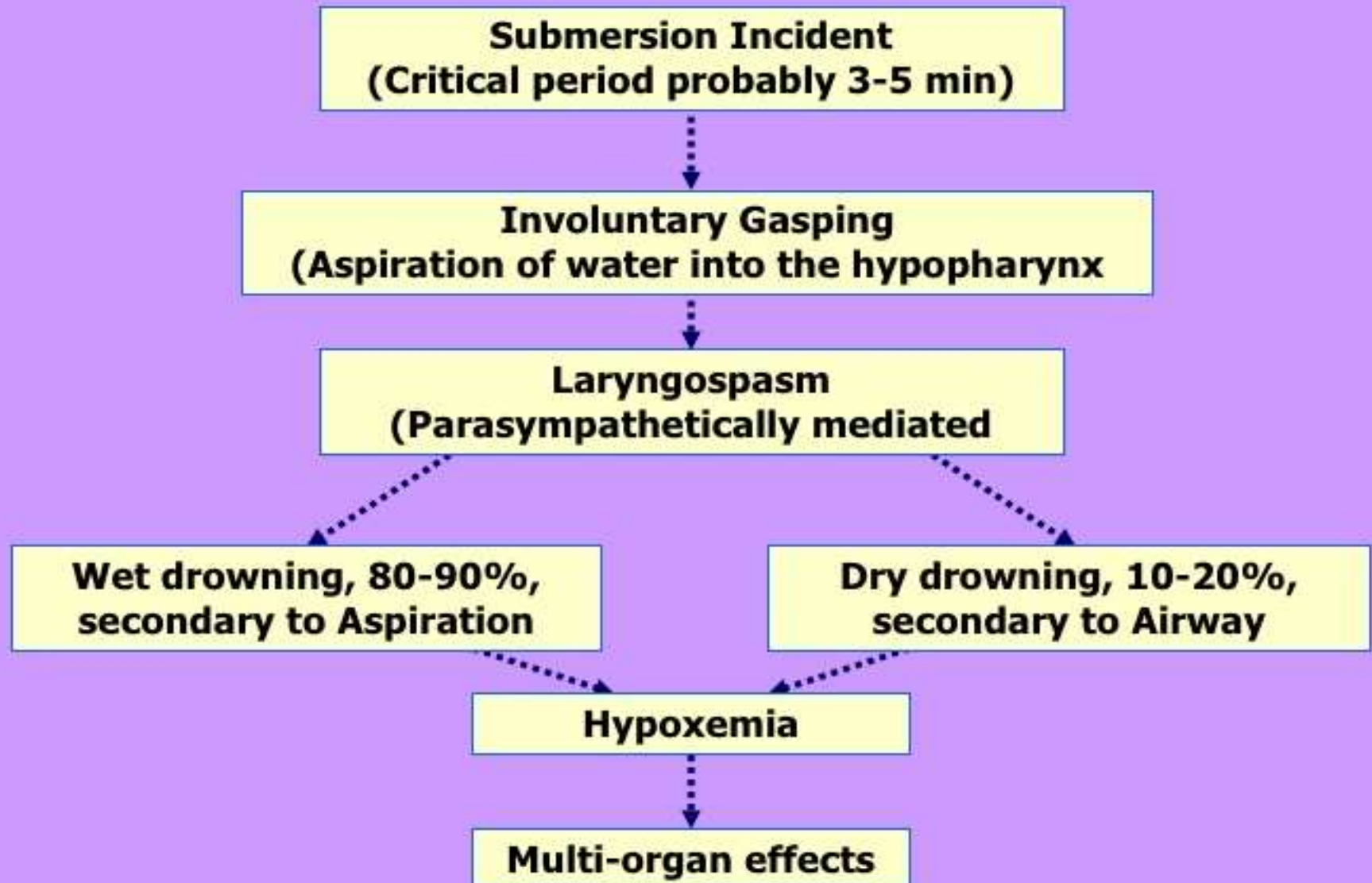
Definition

Drowning is a form of violent asphyxia caused by aspiration of fluid into air-passage, caused by complete or partial submersion in water or other fluid.

Types of drowning

- Depending on different circumstances, effects and factors, we get the following types of drowning –
 1. Dry drowning
 2. Wet drowning
 - (a). Fresh water drowning
 - (b). Salt water drowning
 3. Shallow water drowning
 4. Immersion syndrome
 5. Secondary drowning

Pathophysiology



1. Dry drowning

- ❖ In about 10% to 20% of deaths due to drowning no water is found in the lungs during the postmortem examination.
- ❖ These are the circumstances where death actually occurs due to submersion or drowning, yet the lungs remain dry or water-free.

Dry drowning may occur in two ways

- (1) During first inhalation of water, there is severe laryngeal spasm which does not allow any water to enter the lungs though death occurs due to asphyxia due to laryngeal spasm in a circumstance of drowning.
- (2) When death occurs due to vagal inhibition of heart before complete submersion of the body under the water, as it happens in case of immersion syndrome

Wet drowning

- Classical & Primary
- In this variety, the water enters the lungs. The effects of water entering the lungs depend on, whether submersion has occurred in
 1. freshwater
 2. salt water.

Wet drowning: Water enter the lungs

- Fresh water(Type-IIA):Due to less salinity

Rapid absorption of water through alveolar membrane
(**Hemodilution**)

Overload to heart

Ventricular fibrillation

Heart failure

Osmotic pressure effects

Dilution of plasma

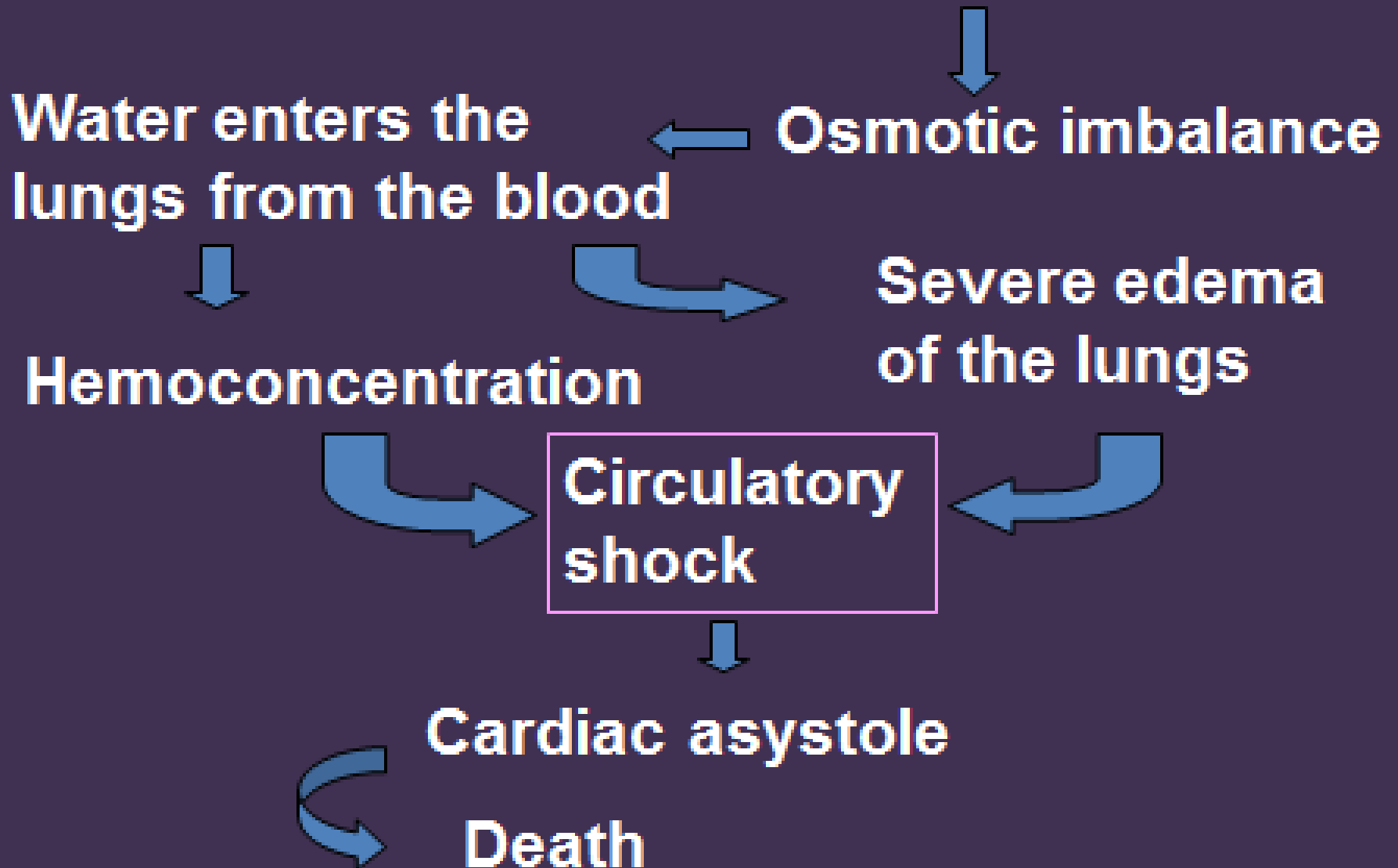
Rupture of RBCs

Release of K⁺ -
Hyperkalemia

Death(in 4-5 mins)



- Salt water drowning: High salinity



3. Shallow water drowning

- Alcoholics, epileptics, infants and children and unconscious persons may die due to drowning in shallow water, in a shallow pit or a drain.
- In shallow water drowning, the whole body need not be submerged.
- Submersion of face alone is sufficient to cause drowning if the mouth and the nose remains under the water.

4. Immersion syndrome

- Hydrocution , Submersion inhibition
- This is a condition which is found in temperate and cold zones.
- Usually the young swimmers are the victim. When they drive in very cold water, they may suffer from vagal inhibition of the heart and die sudden death in water, even though they may be good swimmers.

5. Secondary drowning

This is not drowning in the truest sense but a complication or sequelae of drowning. After a few days of recovery from drowning the victim may suffer from pulmonary infection and edema.

Ultimately the person may die due to asphyxia of pulmonary origin. Due to its etiological background, such a development is termed as secondary drowning

Causes of death

- Asphyxia
- Ventricular fibrillation
- Laryngeal spasm
- Vagal inhibition
- Exhaustion
- Injuries: head injuries
- Secondary causes

Death occurs in 4-8 mins in complete submersion

⚠ WARNING



Children can fall into bucket and drown.

Keep children away from bucket with even a small amount of liquid.

Signs of submersion in a dead body removed from water

External signs

1. When freshly removed from water, the body and the clothes will be wet. Irrespective of the time passed after recovery of the body from the water there will be sand and mud stain on the body, hair and clothes.

This finding is not specific of ante mortem drowning or death due to drowning

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Signs of submersion in a dead body removed from water

External signs

2. Development of cutis anserine (goose skin like appearance of the surface of the body) is another non-specific finding which also does not tell about the ante mortem or post-mortem nature of drowning.

It also occurs in all dead bodies during the state of rigor mortis of the muscle of the skin. Cutis anserina is not appreciable when decomposition of the dead body starts.

3. Retraction of the scrotum and penis in males is another non-specific finding which occurs due to submersion whether before or after death.

Cutis Anserina



- **Cutis Anserina** : 'Goose Skin' or 'Goose Flesh'

Puckerred or granular appearance of the skin

Contraction of erector pilorum muscles.

Can be both ante mortem or postmortem.

- **Washerwomen's hand** : Wrinkled, soddened & bleached appearance of the palms & soles – 24 hours.

Signs of submersion in a dead body removed from water

External signs

4. Changes in the skin of the palm and sole, like that which occurs in a washer-women is yet another non-specific sign of submersion of a body under water for some hours which has no relationship specifically with ante mortem or postmortem drowning.

The skin of the palms and soles are leached, corrugated and thickened.



Signs of submersion in a dead body removed from water

External signs

5. Presence of mud, sand, gravel and weed in the hand, in a state of cadaveric spasm is one of the confirmatory signs of death due to drowning, because the cadaveric spasm of the hands indicate the last work of the person which he performed during the process of his death.

Presence of sand, weed etc. in the hand in that state, indicates that, just before death he tried to grab the soil at the bottom of the water. This means that at the time of death he was submerged under the water

Signs of submersion in a dead body removed from water

External signs

6. *Presence of copious fine white and lathery froth near the mouth and the nasal opening is vital finding in a case of death due to drowning.*

It occurs due to the churning effect of the air in the alveoli the water inhaled and the mucus secretion from the respiratory tract wall. The churning effect results from the violent effort for respiration.

Surest Ante mortem finding of drowning

Signs of submersion in a dead body removed from water

External signs

7. Suffused and congested conjunctiva is another external finding of ante mortem drowning which also carry reasonable weight towards ante mortem phenomenon of the drowning.
8. Distribution of postmortem staining in a body removed from water is somewhat different than in other dead bodies and is usually found over the head, face and neck.
10. Sand and mud may be present inside the mouth cavity and the nose.
11. A dead body recovered from a pond or river may bear post mortem injury due to eating by fish or other aquatic animals or due to impact with some projecting substances.

Signs of submersion in a dead body removed from water

Internal signs

1. The mouth cavity will show presence of sand, mud etc. which are not of much significance.
2. Sand, mud or weed may be present in the esophagus which is also not very much significant in support of death due to drowning.
3. The lumen of the larynx, trachea, bronchus and bronchioles show presence of fine forth mixed with sand and mud.

This is a very important sign of death due to drowning. Presence of sand and mud in the lower respiratory tract is more important than their presence in the upper respiratory tract.

Signs of submersion in a dead body removed from water

Internal signs

4. The lungs are voluminous, edematous have balloon like appearance with marks of indentation over the surface by ribs. The lungs pit on pressure. When incised, the cut surfaces ooze frothy thin fluid blood.
5. The stomach may show presence of water, sand mud and weed.
6. Presence of water, sand etc. in the upper part of the intestine is diagnostic of death due to drowning, because passing of these substances through the pylorus needs antemortem process of peristaltic movement and opening of the pyloric sphincter

Lung in drowning



https://link.springer.com/chapter/10.1007/978-3-319-67175-8_1

Signs of submersion in a dead body removed from water

Internal signs

7. The blood is thick in case of death due to drowning in salt water and is thin due to haemolysis in case of drowning in fresh water.
8. Detection of diatoms in some remote organs and tissues including brain and bone marrow. This is one of the most dependable signs of death

8. Laboratory findings

Blood chemistry:

- According to Gettler in case of **fresh water** drowning haemodilution occurs in the right side chambers of the heart early and for this the chloride value of the blood on the right side chambers may come down to the 50% of the normal value.
- Conversely, in **salt water** drowning, there is Haemoconcentration which affects the left side chambers of the heart first and as a result there is increase in the level of chloride in the blood of the left side chambers of the heart by 30% to 40%

DIATOMS

- These are unicellular algae which have inert silicon coating around them.
- These are present in all natural water sources more abundantly in pond water or in a lagoon or where the water is stagnant.
- They are less frequent in streams or in rivers where the water is frequently polluted by chemicals and industrial refuse.
- When a drowning person inhales water and when the alveoli get distended with water and air the alveolar walls may get ruptured exposing the capillaries which are also ruptured along with. The water from the alveolar sacs along with diatoms it contains, enters the circulation and are carried to distant organs and tissues.

DIATOMS

- Hence in a body removed from water, if diatoms can be demonstrated in the tissues of some distant organs (distant from the lungs and the body surface, to exclude the chance of contamination of the tissue by surface diatoms) then it goes strongly in support of death due to drowning.
- There are of course certain fallacies of the presence of diatoms in the tissue

Test for presence of diatoms

1. By histological examination diatoms can be demonstrated in the lungs or rarely in some other tissue provide that plenty of diatoms were present in the submerging water and a good number of them entered in the circulation.
2. Diatoms can be demonstrated, alternatively and comparatively more easily by acid digestion of the bone marrow, brain or tissue from other organs.

Value and fallacy of diatom test

- Along with test of tissue for diatoms, a sample of the water from which the body has been recovered, should be subjected to control test.
- If similar type of diatoms are **not** available in both the test sample of the tissue and the sample of water for control test or if diatom is only present in the tissue then it can be conclude that diatom entered the body tissue of the victim during the usual process of drinking water which contained diatoms.
- On the other hand, diatoms may not be observed in the tissue, even if drowning was ante mortem and the water contained diatom.

Value and fallacy of diatom test

- If diatoms are present in **both test** sample of tissue and control sample of water then it is strongly presumed that drowning was ante mortem in nature and occurred in that water. *But still it not conclusive in all cases.*
- Even if the drowning was not ante mortem in nature similar diatom may be present in both the test sample and the control sample if the victim was habituated to drink water from the same source during his/her life.
- This is because when a person drinks water a little of the water may trickle down the larynx and trachea etc. and may reach the lungs bed and enter the circulation through some weak point of the alveolar walls.

Value and fallacy of diatom test

- In spite of chances of fallacy, if similar diatoms are Available, both in the tissue and the water then, that acts as a strong evidence of death due to drowning.

Medico legal aspects of drowning

1. Whether drowning was ante mortem or postmortem.
2. If drowning was ante mortem what was the precise cause of death?
3. What was the nature of drowning, suicidal, homicidal or accidental?
4. What is the time of death and when did the submersion occur?
5. Was any other offence involved in the case?
6. If the body is unidentified then establishment of the identity becomes an important step of investigation?
7. If the body has been recovered from a river, then it is necessary to know the actual place of drowning?

DROWNING

1. Whether drowning was ante mortem or postmortem

Of all the postmortem findings available in a dead body recovered from water, only some external and internal finding and some laboratory findings focus light on whether drowning was antemortemor postmortem. These are-

ANTE MORTEM FINDINGS

EXTERNAL FINDINGS

- (a) Cadaveric spasm of the hands with presence of sand, mud, weed etc. in the grip.**
- (B) Copious, white fine froth through the nose and mouth.**
- (c) Presence of similar froth along with sand, mud etc., in the lumen of the whole of the respiratory tract**

ANTE MORTEM FINDINGS

INTERNAL FINDINGS

- (d) Voluminous lungs, like balloons, with indentation or presence of marks of ribs on the surface; discharge of copious frothy fluid blood from the cut surface; emphysema aquosum change; presence of thin haemolysed fluid blood in the spaces at the undersurface of the pleura on the lower lobes and at the interfaces of the lobes and absence of Tardieu's spots are the important feature of ante mortem drowning deaths.**
- (e) Presence of water, sand, mud and weed in the stomach and the upper part of the small intestine.**
- (f) Presence of diatoms in the distant organs or tissue, similar to those present in the water where the body of the victim was submerged.**
- g) Difference in the chloride levels in the blood of both side chambers of the heart**

ANTE MORTEM FINDINGS

INTERNAL FINDINGS

Changes in the blood in addition to the above, like haemoconcentration, increased plasma magnesium level, relative increase in the R.B.C. count, about 40% decrease in the blood volume, crenated appearance of the R.B.C.s under the microscope in case of salt water drowning.

- Increase blood volume (even up to 70%) due to haemodilution, haemolysis with absolute and relative decrease in R.B.C. count, increase potassium level in plasma in case of fresh water drowning.