



The Challenges of Diagnosing Drowning Death Case

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ABSTRACT

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Background: According to the World Health Organization (WHO), about 0.7% of deaths worldwide, or 500,000 deaths worldwide each year, are caused by drowning. Drowning is the leading cause of death worldwide in boys aged 5-14. In the United States, drowning is the second leading cause of accidental death among children ages 1 to 4 years, with an average death rate of 3 per 1000 people. Based on the latest definition from WHO in 2002, drowning is a process of respiratory distress caused by submersion or immersion in liquid. Most drowning victims who drink only a small amount of water usually get better on their own. Less than 6% of drowning victims require hospital treatment. If the drowning victim is rescued as soon as possible, the subsequent drowning process can be prevented, which means it will not be fatal.

Objective: To determine the challenges of diagnosis of drowning death case at Bhayangkara Pusdik Sabhara Porong Hospital in 2021-2022.

Methods: The study used a retrospective descriptive method. The research sample used was medical record data for drowning victims examined at Bhayangkara Pusdik Sabhara Porong Hospital in 2021-2022.

Results: The study sample consisted of 5 dead bodies. The autopsy findings of drowning victims are cadaveric spasm, the sign of asphyxia, froth in the mouth/nose, abrasion, washerwoman's hands, enlarged lungs, Paltauf's spots, and froth in the airways.

Conclusion: The challenges of diagnosing drowning death case at Bhayangkara Pusdik Sabhara Porong Hospital are mostly the dead bodies found in decomposed stage and unavailability of laboratory data. The diagnosis of drowning based on the results of the examination of signs of asphyxia, cadaveric spasm, and mostly froth was found in the respiratory tract.

Introduction

Drowning is death caused by fluid aspiration into the breath due to the immersion of all or part of the body into the

liquid. In contrast, near drowning is a condition when the physiological disturbance of the body occurs due to drowning but does not cause death. In other

studies, it is also stated that serum electrolyte imbalance affects heart function (cardiac reflex) and can also be caused by laryngospasm due to vagal reflexes (Schilling & Bortolin, 2012).

According to the World Health Organization (WHO), about 0.7% of deaths worldwide, or 500,000 deaths worldwide each year, are caused by drowning. Drowning is the leading cause of death worldwide in boys aged 5-14. In the United States, drowning is the second leading cause of accidental death among children ages 1 to 4 years, with an average death rate of 3 per 1000 people. Based on the latest definition from WHO in 2002, drowning is a process of respiratory distress caused by submersion or immersion in liquid. Most drowning victims who drink only a small amount of water usually get better on their own. Less than 6% of drowning victims require hospital treatment. If the drowning victim is rescued as soon as possible, the subsequent drowning process can be prevented, which means it will not be fatal (Szpilman, 2012).

In general, drowning is an accident, either direct or unintentional, such as drowning in a drunk victim, under the influence of drugs, or in an epileptic patient. In the case of adult homicide, accidental drowning can occur, i.e., the victim was previously abused, and the victim fainted. However, the perpetrator thought the victim

was dead, and to eliminate traces, the victim was thrown into the river, so he died by drowning. Suicide by drowning is also an event that occurs several times (Singh et al., 2015).

Drowning cases have many challenges, when proven by a forensic pathology approach, in determining the cause and manner of death of the corpse. In determining the manner of death, coordinated consideration is required of the circumstances suspected in the death. The available objective medical evidence and some confirmatory data can be sought through external examination, although not specific. Internal examinations and crime scene examinations can help determine how drowning victims' bodies died.

Autopsy Findings

1. External Inspection

- a. There is no pathognomonic sign for drowning; its function is only to strengthen.
- b. Only a few findings confirm the diagnosis of drowning, among others: wet, cold, and pale skin.
- c. Bruises are usually *cyanotic*, except when the water is freezing, the bruising will be pink.
- d. Sometimes, *cutis anserina* (*Goose flesh*) is on the arms, thighs, and shoulders. This is because the cold

water temperature causes contraction of the *m.errector pilorum*.

- e. Fine white froth in the mouth and nose, sticky nature (thick & frothy liquid).
- f. Sometimes, there is a cadaveric spasm in the hands, and dirt can be grasped.
- g. If someone stays in the water for a long time, the skin on the palms of the hands and feet will wrinkle (*Washer women's hands*) and become pale (*bleached*) (Soekry, 2012).

2. Internal Inspections

- a. Airway filled with froth, sometimes found mud, sand, water grass, diatoms, and others.
- b. The pleura may be reddish, and there may be bleeding spots due to compression of the inter-alveolar septum or due to a convulsive phase due to lack of oxygen
- c. The lungs are enlarged, congested, and have a marbled appearance, so the right heart and large veins are dilated. If the lungs are still fresh, sometimes it can be distinguished whether it is submerged in freshwater or saltwater (Soekry, 2012).

3. Laboratory Examination

a. Diatom Examination

Diatoms are single-celled algae (algae) with cell walls made of heat-resistant silicates and strong acids. Diatoms can be found in freshwater, seawater, river water, well water, and air. Diatoms and other plankton enter the respiratory or digestive tract when a drowning person swallows water. Then the diatoms will enter the bloodstream through damaged capillary walls while the victim is still alive and spread throughout the tissues. On the other hand, if a corpse is submerged in water, even though diatoms can enter the lungs passively, no circulating blood flow is possible, so (theoretically) diatoms cannot be found in the larger internal organs. far. Examination of diatoms was carried out on the lung tissue of fresh corpses. When the corpse decomposes, diatoms are examined from kidney tissue, skeletal muscle, or femur bone marrow. Examining diatoms in the liver and spleen is less meaningful because it comes from abnormal absorption from the digestive tract of drinking water or food. Examination of diatoms with the destruction method (acid digestion) in the lungs is carried out by taking 100 grams from the peripheral lung tissue. Then put it in a

Kjeldahl flask, and add concentrated sulfuric acid until the lung tissue is submerged; let it stand for about half a day so that the tissue is destroyed. Then heated in a fume hood while concentrated nitric acid was added until a clear liquid was formed, cooled, and spun in a centrifuge (Nur M, Mayatuti; Ramadhani, Farah Nishfi; Sakarisa, Shanti Andri; W, 2015).

The sediment formed was added with distilled water, re-spun and finally viewed with a microscope. The diatom examination is positive if there are many diatoms found in lung tissue, 4-5/LPB or per 10-20 per one preparation, or only one is found in the bone marrow. In addition, pulmonary sap can be examined by flushing the surface of the lung with clean water, then slicing the periphery. Then take a little juice from the peripheral lung tissue, put it on an object glass, cover it with a cover slip, and look at it with a microscope. Apart from diatoms, algae or other types of plants can also be seen. According to Simpson, the diatom test is sometimes negative, even when submerged in diatom-rich water. There have been many false positives that are said to have occurred for technical reasons;

therefore, the test is so unreliable that this technique should be used. Moreover, the results are interpreted by considering other circumstances (Nur M, Mayatuti; Ramadhani, Farah Nishfi; Sakarisa, Shanti Andri; W, 2015).

4. Electrolyte and Blood Tests

According to Gettler, in cases of drowning in fresh water, serum chloride levels in the blood from the left heart are lower than in the right heart. Meanwhile, drowning in salt water happens the other way around. In addition, another test, the Durlacher test, can also be used to determine the diagnosis in addition to the Gettler test. The Durlacher test determines the difference in plasma specific gravity of the right and left hearts. If on examination, it is found that the specific gravity of the left heart is higher than the right heart, it can be assumed that the victim died from drowning. Differences in electrolyte levels of more than 10% can support the diagnosis, although separately, it is less significant (Nur M, Mayatuti; Ramadhani, Farah Nishfi; Sakarisa, Shanti Andri; W, 2015).

When fresh water enters the lungs, plasma sodium falls and plasma potassium increases, whereas in salt water inhalation, plasma sodium rises

moderately and potassium increases only mildly. Thus, in victims who died in salt water, the serum sodium concentration in the blood from the right ventricle was lower than that of the left ventricle. Meanwhile, in freshwater drowning, the serum sodium concentration in the blood from the left ventricle is lower than that of the right ventricle. However, this figure can vary because when the postmortem begins, the diffusion of fluids can change the actual level of sodium and potassium. Therefore Simpson argues that analysis of the levels of Na, Cl, and Mg has been used, but the results are too diverse to be used in daily practice (Nur M, Mayatuti; Ramadhani, Farah Nishfi; Sakarisa, Shanti Andri; W, 2015).

Methods

The study used a retrospective descriptive method. The research sample used was medical record data for drowning victims examined at the Bhayangkara Pusdik Sabhara Porong Hospital in 2021-2022. The sampling method used is total sampling.

Result and Discussion

From the study sample, which consisted of 5 bodies, the autopsy findings of drowning victims were based on gender, age, cadaveric spasm, signs of asphyxia, froth in the mouth/nose, abrasions, washerwoman's hands, enlarged lungs, Paltauf's spots, and froth in the airways, which can be seen in the following table:

Table 1. Autopsy Findings on Drowning Cases in Bhayangkara
Pusdik Sabhara Porong 2021-2022

No	Examination		Frequency	Percentage
1.	Sex	Male	5	100%
		Female	0	0%
2.	Age	20-40 year old	1	20%
		40-60 year old	3	60%
		>60 year old	1	20%
3.	Dead body condition	Fresh	2	40%
		Decomposed	3	60%
4.	Cadaveric Spasm	Yes	5	100%
		No	0	0%
5.	Asphyxia Sign	Yes	5	100%
		No	0	0%
6.	Froth aorund Nostril and Mouth	Yes	2	40%
		No	3	60%
7.	Froth in upper and lower airways	Yes	4	80%
		No	1	20%
8.	Congestion	Yes	2	40%
		No	3	60%
9.	Washerwoman's Hand	Yes	1	20%
		No	4	80%
10.	Paltauf's Spot	Yes	1	20%
		No	4	80%
11.	Trauma	Yes	1	20%
		No	4	80%

In a study conducted by Wulur, the distribution of drowning cases by sex, it was found that more men died from drowning, as many as 12 cases (80%), compared to women with only 3 cases (20%). These results follow data from the World Health Organization (WHO), the National Safe Kids Campaign (NSKC), and the Centers

for Disease Control and Prevention (CDC), which states that men experience drowning more often than women. The data obtained from the results of the study that the authors obtained from medical records were in accordance with the research conducted by Wulur; as many as 5 (100%) cases recorded were male. This could be because men are

more often exposed to water and risky behaviors such as swimming alone, drinking alcohol before swimming alone, and boating (Wulur, 2013).

From the data on the distribution of drowning cases by age group, Wulur's research found that most cases occurred at the age of 20, around 86.67%. This result is also in accordance with statistical data from the Centers for Disease Control and Prevention (CDC), which states that drowning increases in adulthood. The data obtained from the results of the study that the authors obtained from medical records were in accordance with the research conducted by Wulur; as many as 5 (100%) cases were recorded at the age of 20. This can be because the adult group has a broader scope of activity, in contrast to children and adolescents who are still under supervision and the scope of their activities is still limited. Alcohol is also one of the causes of drowning in adults. About 30-50% of drowning cases in adults are found in a drunken state. Locations on the coast are a risk factor for drowning (Wulur, 2013).

Signs of cadaveric spasms will be difficult to see when the body is in a state of decomposition. The decay process was caused by the old victim's body being found. So that at the time of examination, the corpse was already in a state of decay. A cadaveric spasm is an intravital sign that occurs when the victim tries to save himself

by holding anything, such as grass or other objects in the water, or abrasions on the elbows, fingers, knees, and feet due to friction of objects in the water. Signs of cadaveric spasm were only found in 1 case (6.67%) in the study conducted by Wulur. The data obtained from the study results that the authors obtained from medical records were slightly different from the research conducted by Wulur, namely as many as 5 (100%) cases recorded experiencing Cadaveric spasms. This is a sign that the victim is trying to save himself by holding anything, such as grass, branches, stones, or other objects, in the water (Wulur, 2013).

Asphyxia is generally defined as a lack of oxygen, either partial (hypoxia) or complete (anoxia). In the event of drowning, asphyxia signs were found with a percentage of 100%. Asphyxia is divided into three major classifications: suffocation, strangulation, and chemical asphyxia. In the classification of suffocation, there is environmental suffocation, smothering, choking, drowning, mechanical asphyxia, gagging, and gas suffocation. Meanwhile, there are manual strangulation, ligature strangulation, and hanging in strangulation. The data from the research results that the authors obtained from medical records are similar to the research conducted by Putri, namely 5 (100%) of the 5 cases recorded as having asphyxia (Agung & Anom, n.d.;

Hussein, N. Haidar; Abdulla, 2019). The classic signs are:

1. Tardieu's spot (Petechial Haemorrhages)
2. Congestion and Oedema
 - a. A vascular dam causes the accumulation of blood in the organs.
 - b. Venous dams increase intravascular hydrostatic pressure, which causes the seepage of plasma fluid into the interstitial space, and edema occurs.
3. Cyanosis is when the fingers, nails, and lips appear bluish due to a lack of oxygen in the blood.

In a study conducted in Baghdad, based on an external examination of the corpse, most cases were found with froth in the mouth and airways area, 95%. In Indonesia, the finding of froth was 26.67%. On the body also found the presence of fine white froth coming out of both nostrils and mouth. Froth is produced from air, mucus, and aspirated fluid shaken during vigorous respiratory effort. This signifies that the victim is still alive while in the water.

On internal examination, the upper airways filled with fine white froth until the airways branched (carina) and came out of both lungs without pressure. The froth that comes out in the form of lung edema fluid contains exudate, protein, and surfactant mixed with water from the media where the victim drowned. Usually white, sometimes red or pink, because it mixes with blood due to intrapulmonary bleeding. Froth is

scattered from the trachea, main bronchi, and smaller airways. The data obtained from the study results that the authors obtained from medical records differed slightly from the research conducted by Putri; namely, only 2 (40%) of the 5 cases had froth. This can occur in dry drowning, where the amount of water that enters is minimal, or the victim dies shortly after entering the water.

In Hussein's study, 54 (90%) of the 60 drowning cases could be found Washerwoman's hands. The data obtained from the research results that the authors obtained from medical records are slightly different from the research conducted by Hussein, in which is only 1 (20%) of the 5 cases recorded as having Washerwoman's hands (Hussein & Abdulla, 2019).

Another study conducted by Wulur, in line with the results found in the study, found that 2 (13.3%) of 15 cases experienced Washerwoman's hands. This may be because signs such as Washerwoman's hands are difficult to evaluate if the body is in a decomposed state. The decay process was caused because the old victim's body was found, so at the time of examination, the corpse was already in a state of decay (Wulur, 2013). In addition, according to Hussein, some of the bodies did not show these signs because they were pulled out of the water immediately after drowning or because of

the low temperature of the water. This is because Washerwoman's hands are a sign of prolonged immersion often observed in women who use water for a long time in the kitchen or bathroom (Hussein & Abdulla, 2019).

In accordance with research conducted in Belgium, a study by Hussein found emphysema, edema, increased lung weight, and pleural effusion in drowning cases as much as 100%. Enlarged lungs in drowning bodies are caused by edema and lung congestion. The data obtained from the study results that the authors obtained from medical records differed slightly from the research conducted by Hussein; namely, only 2 (40%) of the 5 cases recorded had enlarged lungs. This is because the possibility of enlarged lung data is not recorded in the victim's medical record (Putra, 2012; Hussein & Abdulla, 2019).

According to research conducted in Baghdad, the most drowned bodies found paltauf spots by 100% on internal examination. These patches, known as Paltauf's spots, are bleeding spots that result from increased pressure leading to rupture of the alveolar walls. It is often found on the anterior surface and border of the lung but can also be found in the subpleural space if there has been further perforation or rupture. The data obtained from the study results that the authors obtained from medical records differed slightly from the

research conducted by Putri; namely, only 1 (20%) of the 5 cases recorded had a paltauf spot. This is due to the possibility of spot paltauf data not being recorded in the victim's medical record (Putra, 2012; Putri, 2021).

In a study conducted in Baghdad, based on external examination of the bodies, most cases were found with froth in the mouth and respiratory tract area. In contrast, in Manado, Indonesia, drowning bodies found froth only at 26.67%. Froth formation is due to fluid entry into the respiratory tract, stimulating mucus formation. When mixed with water and surfactant from the lungs, this substance is shaken due to intense breathing effort. This indicates that the victim is still alive when in the water. The data obtained from the results of the study that the authors obtained from medical records were in accordance with the research conducted by Putri, in which 4 (80%) of the 5 cases recorded that there was froth in the respiratory tract (Putri, 2021; Wulur, 2013).

Signs of violence can occur when the victim tries to save himself by holding anything, such as grass or other objects, in the water, while abrasions can occur on the elbows, fingers, knees, and feet due to friction of objects in the water. The percentage of abrasions in drowning victims is 86.67%, based on research conducted by Wulur. The data obtained

from the study results that the authors obtained from medical records differed slightly from the research conducted by Wulur; only 1 (20%) of the 5 cases recorded had injuries. This is because the possibility of data on the occurrence of injuries is not recorded in the victim's medical record (Wulur, 2013).

Conclusion

Drowning is a form of suffocation in which the victim is immersed in water/liquid, and the object is sucked into the airway to the alveoli and lungs. When drowning occurs, the whole body does not always go into the water, but if the nostrils and mouth are below the surface, it is sufficient to meet the criteria as a drowning event. The challenges of diagnosing drowning death case at Bhayangkara Pusdik Sabhara Porong Hospital are mostly the dead bodies found in decomposed stage and unavailability of laboratory data. The diagnosis of drowning based on the results of the examination of signs of asphyxia, cadaveric spasm, and mostly froth was found in the respiratory tract.

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