ORIGINAL RESEARCH

Autopsy Analysis of Drowning-Related Fatalities: A Retrospective Study Conducted on Cases Examined at KMC and MGM Hospital Warangal

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ABSTRACT

Background: Drowning represents a substantial global public health concern. It ranks as the third most common cause of unintentional injury-related fatalities. The post-mortem determination of drowning as the cause of death presents a challenge to forensic experts, as the precise mechanisms underlying drowning-related deaths remain somewhat elusive. Methods: All cases meeting the study criteria were subjected to a comprehensive postmortem examination using the modified Rokitansky method. The investigator documented the macroscopic appearance of submersion and drowning characteristics. The air passages were dissected carefully to prevent the loss, displacement, or dislodging of any foreign objects. The dissection included the pharynx, larynx, trachea, bronchi, and their respective branches. The investigator dissected each level of the airway and extended the examination to the smallest divisions whenever possible to trace any foreign objects. Results: A total of 50 cases of drowning were included in the study. Important external post-mortem findings in drowning cases included Froth around Mouth/Nostrils: 52% of cases (26 cases) had froth around the mouth or nostrils. 28% of cases (14 cases) showed a muddy or sandy body. The important internal post-mortem findings in drowning cases, 68% of cases (34 cases) had voluminous lungs, and 30% of cases (15 cases) had water in the stomach content. 48% of cases (24 cases) had froth in the larynx or trachea, and 66% of cases (33 cases) exhibited mud, sand, or salt in the larynx. Conclusion: Drowning is more prevalent in men than women, except in cases of suicide where the gender difference is slight. Organ weights such as brains and lungs are higher in saltwater drowning cases, although these weights are significantly influenced by variables like BMI and decomposition. Some drowning fatalities exhibit normal organ weights, heavy lungs, and cerebral edema. Keywords: Drowning, Autopsy Findings, Froth, Asphyxia, Suicide, Homicide

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INTRODUCTION

Drowning is defined as a type of asphyxial death that occurs when air is prevented from entering the lungs due to immersion in any fluid medium. It is categorized in Chapter 19, under Schedule T75.1 of the International Classification of Diseases. [1]Water is essential for human survival, and throughout history, many civilizations, including the Egyptian, Mesopotamian, and Indus Valley civilizations, have flourished around water bodies. However, water can be a hostile environment for most air-breathing animals, and even a small amount of water can deprive them of oxygen, just as effectively as the vast Pacific Ocean. Unfortunately, the number of reported drowning cases has been steadily increasing year by year. Globally, drowning is the third leading cause of unintentional injury-related deaths, accounting for approximately 7% of all injury-related fatalities. There are an estimated 2,36000 annual drowning deaths worldwide, although these global estimates may significantly underestimate the true extent of the public health problem associated with drowning. [2, 3]

There is a common belief that nearly all drowning victims aspirate fluid into their lungs, leading to suffocation. However, in about one-quarter of drowning cases, post-mortem examinations reveal no evidence of fluid aspiration into the lungs, and there may be no findings suggesting asphyxiation played a role in the cause of death. [4] The precise mechanism

of death often remains unclear even after meticulous autopsies and thorough laboratory investigations. The examination of bodies recovered from water constitutes a significant portion of medico-legal requests. [5] However, determining whether the victim died from 'true' drowning is frequently challenging. Additionally, diagnosing hydrocution is even more difficult. The diatom test remains the 'gold standard' in such cases. Therefore, there is a need to establish an ideal diagnostic test that definitively proves drowning. [6] Currently, a combination of autopsy findings and the diatom test is a reasonable compromise for reaching a conclusion. Further biochemical and technical methods may also prove valuable. Unfortunately, the cost-benefit analysis of these practices can be challenging to justify. The recovery of bodies from water is a common occurrence in India and around the world, posing significant challenges for legal and medical investigators. Many cases remain undetected due to a lack of evidence or because diagnostic signs are obscured by decomposition. The majority of cases are accidental and are often linked to the widespread presence of rivers, lakes, ponds, and unprotected wells or tanks. India's navigable rivers, which host a significant amount of water traffic, also contribute to the high incidence of drowning.Drowning is not limited to accidents; it is also a common method of suicide in India, with occasional cases of homicide involving drowning. Males and children are disproportionately affected by drowning. Among children aged 5 to 11 years, drowning deaths accounted for 7.2%, 12.5% and 5.8% of all deaths in 1-4, 5-9 and 10-14 years age groups, respectively. [7] The higher risk in males is attributed to greater recreational and occupational exposure to water. Among adults aged 15-44 years, drowning is the tenth leading cause of death.In the United States, alcohol use is involved in approximately 25-50% of adolescent and adult deaths associated with water recreation. [8] The current study tried to examine the external characteristics and identify foreign objects within the airways and lung tissues in drowning cases presented for autopsy at the Department of Forensic Medicine at KMC and MGM hospital Warangal.

MATERIAL AND METHODS

This retrospective study was conducted in the Department of Forensic Medicine and Toxicology, Kakatiya Medical College and MGM Hospital, Warangal. Institutional Ethical approval was obtained for the study.

Inclusion Criteria

1. Cases with a confirmed history of drowning.

Exclusion criteria

1. Cases with a doubtful history and those cases where cause of death is drowning combination with others.

All cases meeting the study criteria and undergoing postmortem examinations in the forensic medicine department were subjected to a comprehensive postmortem examination using the modified Rokitansky method. During this examination, the documented investigator meticulously the macroscopic appearance indicative of submersion and drowning characteristics. The examination of the air passages involved a careful dissection process, with utmost precautions taken to prevent the loss, displacement, or dislodging of any foreign objects. This dissection encompassed the pharynx, larynx, trachea, bronchi, and their respective branches. The investigator diligently dissected each level of the airway as mentioned, extending the examination to the smallest divisions whenever possible to trace any foreign objects. After dissection at each level, the airway's lumen was gently wiped with a moist cotton pad to highlight any minute particles against a white background. Any foreign objects adhering to the air passages were collected using this method and transferred to a cotton swab. The analysis focused on including demographic various aspects, characteristics, submersion medium, observed froth characteristics in the mouth, nostrils, and air passages, patterns of postmortem staining, the presence of edema and emphysema aquosum, the presence of fluid in the supra sella turcica area, and the occurrence of middle ear hemorrhages.

Statistical analysis

The data collected in this study was recorded in MS Excel and subjected to further analysis using SPSS version 21.0 software. The continuous variables were represented as mean, standard deviation, and percentages. Categorical variables were represented by p values(p < 0.05) were considered significant.

RESULTS

A total of 50 cases of drowning brought to KMC and MGM were included in the study. The age distribution of males was from 8 years to 62 years and the mean age of the victims was 28.5 years. In females the age ranges of victims were from 9 years to 53 years and the mean age was 22.5 years. Table 1 presents the distribution of drowning cases based on the location of occurrence and gender. In total, there were 33(66%) of victims were male and 17 (34%) of victims were female drowning cases, making up the 50 cases in the study.60% of the cases of drowning occurred in Lakes / Rivers, 12% of the cases occurred in Wells. 26% of the cases occurred in House Tanks, and 4% of the cases occurred in Swimming Pools.

Table 1: Study distribution of cases of drowning

Places of occurrence	Male	Female	Total (%)
Lakes / Rivers	20	10	30(60)
Wells	5	1	6(12)
House Tanks	7	5	13(26)
Swimming pools	1	1	2(4)
Total	33	17	50(100)

Table 2 presents the external post-mortem findings in drowning cases, categorized by specific findings, gender distribution, and respective percentages.Froth around Mouth/Nostrils: 52% of cases (26 cases) had froth around the mouth or nostrils.28% of cases (14 cases) showed a muddy or sandy body,10% of cases (5 cases) exhibited mud or sandy nails,40% of cases (20 cases) displayed signs of asphyxia,52% of cases (26 cases) showed signs of injury. Note that many cases had more than one external findings in the study.

Table 2: Study of external post-mortem findings in drowning cases

External Findings	Male	Female	Total (%)
Froth around mouth/Nostrils	14	12	26(52)
Mud/Sandy Body	11	3	14(28)
Mud/sandy Nails	1	4	5(10)
Sign of asphyxia	18	2	20(40)
Sign of injury	24	2	26(52)

Table 3 provides an overview of the internal postmortem findings in drowning cases, categorized by specific internal findings, sex distribution, and respective percentages. 68% of cases (34 cases) had voluminous lungs, and 30% of cases (15 cases) had water in the stomach content. 28% of cases (14 cases) displayed food in the stomach content, 48% of cases (24 cases) had froth in the larynx or trachea, and 66% of cases (33 cases) exhibited mud, sand, or salt in the larynx.

 Table 3: The Study of Internal post-mortem findings in drowning cases

Internal Findings	Male	Female	Total (%)
Froth Larynx / trachea	16	8	24(48)
Mud / Sand / salt etc in larynx	27	6	33(66)
Lungs voluminous	30	4	34(68)
Stomach content water	10	5	15(30)
Stomach content Food	12	2	14(28)
Injury	5	1	6(12)
Total	33	17	50(100)

DISCUSSION

The present study focuses on the post-mortem findings in fatalities resulting from drowning incidents in KMC Warangal. The drowning occurrences were distributed as follows: 60% cases in lakes/rivers, 12% in wells, 26% in house tanks, and 4% in swimming pools (Table-1). External postmortem observations revealed that out of the total cases, 52% exhibited froth around the mouth/nostrils, 4% had muscle spasms, 28% had mud/sand on their bodies, 5% had mud in their nails, 40% displayed signs of asphyxia, and 52% showed signs of injury (Table-2). In the internal post-mortem analysis, it was found that 48% cases had froth in the larvnx/trachea, 66% had mud/sand/salt in the larvnx, 68% cases had voluminous lungs, 30% had water in their stomach contents, 28% had food in their stomach contents, and 12% showed internal injuries (Table-3). These findings were generally consistent with earlier studies. [8-10]

It has been documented that, in addition to the effects of resulting hypoxia on tissues, various potential mechanisms may underlie cardiovascular alterations in drowning cases. These include electrolyte shifts, potential variations with between hypotonic freshwater and hypertonic saltwater immersion. Furthermore, the impact of cold water on hypothermic cardiovascular effects has been acknowledged. [11] In a small percentage of drowning cases, it has been noted that some individuals succumb to drowning without apparent inhalation of water. [12] A higher incidence of male deaths has been reported compared to females, likely due to a higher number of suicide cases among males. Suicide and homicidal drownings constitute a significant proportion of drowning fatalities. Although suicidal drownings are relatively uncommon, their occurrence may vary depending on geographic location and accessibility to bodies of water like lakes and rivers. Cases involving wells as the site of drowning are also noteworthy.

Additionally, a history of psychiatric illness and the post-mortem detection of varying levels of psychiatric medications and ethanol have been documented. [13] Furthermore, homicidal asphyxia, including cases of strangulation, emerged as a significant contributor to drowning-related fatalities. Drowning predominantly leads to asphyxial deaths, affecting multiple organ systems, particularly the respiratory system and lungs. Respiration, an involuntary process governed by the central nervous system, responds to variations in blood and tissue oxygen, carbon dioxide levels, and blood pH.The rate of putrefaction in any death primarily hinges on time and temperature. In comparison to air, water tends to slow down the decomposition process. The timing is contingent on the promptness of body recovery. Given that most bodies tend to sink, recovery may experience delays. In cases where a person's submersion is unwitnessed or the submerged body is not visible, discovery might only occur many days later, as putrefaction triggers gas formation within the body due to the proliferation of microorganisms. This gas increases buoyancy, causing the body to float to the surface, making it more likely to be found.

CONCLUSION

Drowning is more prevalent in men than women, except in cases of suicide where the gender difference is slight. Organ weights such as brains and lungs are higher in saltwater drowning cases, although these weights are significantly influenced by variables like BMI and decomposition. Some drowning fatalities exhibit normal organ weights, heavy lungs, and cerebral edema. It's essential to interpret these anatomical findings within the broader context of the overall case investigation. This study can aid medicolegal experts in diagnosing drowning and identifying risk factors to prevent drowning deaths.

REFERENCES

- 1. International classification of diseases, chapter 19 schedule T75.1 ed.10, 2010.
- 2. World Health Organization. Geneva: World Health Organization. Drowning fact sheet; 2023. Available from: <u>https://www.who.int/news-room/fact-</u><u>sheets/detail/drowning</u>Accessed on 10 Aug 2023]
- Armstrong EJ, Erskine KL. Investigation of Drowning Deaths: A Practical Review. Acad Forensic Pathol. 2018 Mar;8(1):8-43.
- Armstrong E.J. Water-related death investigation: practical methods and forensic applications. 1st ed. Boca Raton: CRC Press; c2011. Chapter 1, Introduction; p. 1–26.
- Kotabagi RB, Charati SC, Jayachandar D. Clinical Autopsy vs Medicolegal Autopsy. Med J Armed Forces India. 2005 Jul;61(3):258-63.
- 6. Piette MH, De Letter EA. Drowning: still a difficult autopsy diagnosis. Forensic Sci Int. 2006 Nov 10;163(1-2):1-9.
- Dandona R, Kumar GA, George S, et al. Risk profile for drowning deaths in children in the Indian state of Bihar: results from a population-based study. Injury Prevention 2019;25:364-371.
- 8. Sugantha M, Parwathi K. Analysis of deaths due to drowning A retrospective study. Int J contemp Med Res 2019; 6: 15-19.
- 9. Copeland AR. Homicidal drowning. Forensic Sci Int 1986; 31(4): 247-52.
- Pean J. Pathophysiology of drowning. Med J Anat1985; 142 (1): 586-58.
- 11. WR Keathinge, MG Hayward. Sudden death in cold water and ventricular arrthymia J. Forensic science 1981; 26 (1): 459-461.
- JH Modeel, M Bellefleur Drowning without aspiration; Is this an appropriate diagnose? J Forensic Sci 1999; 44: 1119-21.
- Wirthwein DP, Barnard JJ, Prahlow JA. Suicide by drowning: a 20-year review. J Forensic Sci. 2002 Jan;47(1):131-36.