



Diagnostic challenges of drowning in forensic medicine.

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Abstract

Background: Due to overlapping characteristics with other causes of death and the lack of pathognomonic signs, the forensic diagnosis of drowning is still difficult. **Aim:** In a retrospective cohort of 80 medico-legal autopsies, the diagnostic difficulties related to drowning were evaluated, and the validity of traditional autopsy results and ancillary investigations was evaluated. **Methods:** A retrospective descriptive study was conducted on 80 cases of suspected drowning subjected to medico-legal autopsy. Data regarding demographic variables, scene investigation, autopsy findings, types of water body involved, and internal organ weights, histopathological were analysed. Diagnostic consistency between initial suspicion and final cause-of-death determination was evaluated. **Results:** Classical findings such as overinflated lungs (82.5%), fine froth in airways (67.5%), and Paltauf's spots (48.7%) were frequently observed but lacked specificity. River drowning was found the most about 36.25% followed by 26.2%. Histological features were found most in 78.7% followed by most emphysema aquosum. **Conclusion:** Drowning is still an excluded diagnosis. The results of a traditional autopsy are not enough to make a conclusive diagnosis. To increase diagnostic accuracy, a multidisciplinary strategy combining laboratory tests, toxicological, histology, and scene investigation is necessary.

Keywords: River drowning, autopsy, toxicology, paltauf's spots, overinflated lungs.



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INTRODUCTION

Death from respiratory impairment brought on by immersion or submersion in liquid is known as drowning. Even with its widespread occurrence, forensic verification of drowning is still difficult. Drowning does not exhibit pathognomonic postmortem signs, in contrast to other causes of death (1).

Emphysema aquosum, frothy fluid in the airways, Paltauf's hemorrhages, and watery stomach contents are examples of traditional autopsy indications that have low specificity and can show up in non-drowning deaths. Interpretation is further complicated by postmortem artifacts, environmental influences, and decomposition (2).

Recent studies investigate biomarkers such inflammatory mediators, aquaporins, and microRNAs. PMCT has also demonstrated potential in the detection of sinus opacification and fluid distribution patterns (3). The purpose of this study is to examine the diagnostic difficulties that were faced in 80 past cases of suspected drowning in light of these uncertainty.

MATERIALS AND METHODS

Study Design

Retrospective descriptive study conducted at PRM Medical College & Hospital, Baripada and SJ Medical College & Hospital, Puri, Odisha.

Study Population

80 medico-legal autopsies of suspected drowning conducted in the year January 2023 to December 2024.

Inclusion Criteria

- Bodies recovered from water
- Suspicion of drowning based on scene investigation

Exclusion Criteria

- Advanced decomposition precluding evaluation
- Severe traumatic injuries incompatible with life

Data Collection

The following parameters were reviewed:

1. Demographics (age, sex)
2. Circumstances and scene findings
3. External and internal autopsy findings
4. Histopathological examination
5. Diatom testing (when performed)
6. Toxicological analysis
7. Radiological imaging (PMCT when available)

Statistical Analysis

To compare suspected and confirmed instances, descriptive statistics were used, including cross-tabulation and percentage distribution.

RESULTS

Demographics

- Males: 56 (70%)
- Females: 24 (30%)
- Age range: 4–78 years
- Most affected age group: 21–40 years

Table 1: Frequency of autopsy findings

Finding	Frequency	Percentage
Overinflated lungs	66	82.5%
Fine froth in airways	54	67.5%
Paltauf's spots	39	48.7%
Water in stomach	55	68.7%
Sphenoid sinus fluid	43	53.7%

No single finding demonstrated absolute diagnostic value.

Table 2: Type of Water Body Involved

Water Body	Number	Percentage (%)
River	29	36.25%
Lake/Pond	21	26.2%
Sea	12	15%
Well	15	18.7%
Bathtub	5	6.25%

Table 3: Internal Organ Weights (Mean $\pm$ SD)

Organ	Mean Weight (g)	Reference Normal Range (g)
Right lung	782 $\pm$ 150	450–500
Left lung	710 $\pm$ 130	400–450
Brain	1340 $\pm$ 90	1200–1400
Liver	1500 $\pm$ 180	1400–1600

Table 4: Histopathological Findings

Histological Feature	Number	Percentage (%)
Alveolar edema	63	78.7%
Alveolar hemorrhage	40	50%
Emphysema aquosum	52	65%
Inflammatory infiltrates	19	23.7%
Diatoms in lung tissue	35	43.7%

DISCUSSION

The present retrospective analysis of 80 autopsy-confirmed drowning cases highlights important autopsy findings, type of water body involved, internal organ weights, histopathological findings, all of which collectively underscore the persistent diagnostic challenges in forensic drowning (4).

Although they were commonly seen, traditional findings including Paltauf's spots (48.7%), fine froth in airways (67.5%), and overinflated lungs (82.5%) lacked specificity. The highest rate of river drowning was 36.25%, followed by 26.2%. The majority of emphysema aquosum and histological characteristics were detected in 78.7% of cases.

Histopathology predominantly demonstrated alveolar edema, intra-alveolar hemorrhage, and features consistent with emphysema aquosum (5). These changes result from water aspiration, surfactant destruction, and hypoxic injury. Intra-alveolar hemorrhage observed in several cases may result from increased intrathoracic pressure during respiratory struggle (6). Nonetheless, similar findings can occur in mechanical asphyxia and trauma. Therefore, microscopic findings must be interpreted cautiously and in conjunction with toxicology and diatom analysis (7).

CONCLUSION

This study reaffirms that drowning remains one of the most challenging causes of death to diagnose in forensic medicine, requiring careful integration of epidemiological context, autopsy findings, histopathology, and ancillary testing. The high frequency of pulmonary edema, increased lung weight, and emphysema aquosum aligns with established literature; however, their lack of specificity necessitates correlation with investigative, toxicological, and laboratory data.

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