

## Reliability of Diatom Test as Indicator of Antemortem Drowning: Study from a Tertiary Care Centre in Haryana

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### Original Research Article

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**Abstract:** Presently, forensic pathologists all over the world are divided over reliability of diatom test as a diagnostic aid. The aim of the present study was to test the reliability of diatom test as indicator of antemortem drowning by comparing the presence of diatoms in dead bodies found in water, in cases where suspected cause was drowning with those cases where another cause of death was established. Specimens were preserved for diatom test at the time of postmortem examination. These specimens were subjected to acid digestion for extraction of bone marrow to conduct diatom test. Water sample was collected from the site of recovery of the bodies. The specimens were subjected to diatom test for detection of diatoms and comparison of types of diatoms found in water & bone sample respectively. Amongst the 41 cases, 28 cases showed positive results and 13 cases showed negative results for diatom tests. Seasonal distribution pattern of cases showed that the diatom positive cases were more in the rainy (13) & summer season (8) as compared to spring (4) and winter (3). The gender distribution clearly deviated towards males with 40 males & 10 females. In 11 cases where other cause of death except drowning was established at the postmortem examination, diatom test were negative in all the cases. In cases where other findings of drowning are lost to decomposition, detection of identical diatoms in body and putative drowning medium should be considered as corner stone for establishing ante-mortem drowning.

**Keywords:** Diatom test, drowning, antemortem.

### INTRODUCTION

Water covers about 71% of our planet and is essential for sustenance of life on earth. This mandates constant interaction of humans with water bodies and consequent accidents in form of drowning.

Drowning is defined as a death due to submersion in a liquid [1]. The main goal of a forensic expert in drowning cases is to differentiate death by submersion from an immersion of body.

Establishment of ante-mortem nature of drowning is a peculiar problem especially in decomposed bodies recovered from water where typical features of ante-mortem drowning disappear very rapidly with commencement of putrefaction. This matter has been raised by experts cautioning that death of a victim found in water should not always be related to drowning [2]. This lead to search for a sensitive, specific and easily applicable test for establishment of ante-mortem drowning and diatom test came into picture. However, every test or methodology has to go through litmus test with passage of time. If proved wrong, it loses its credibility, but if it is found correct

again and again, its importance and application increase over the time [3].

Diatom test gains importance for diagnosis and confirmation of drowning in such cases as due to their hard siliceous skeleton, they can be recovered from putrefied or burnt tissues by either enzymatic or acid digestion [4]. Diatoms are unicellular plant that has most distinctive features of crystalline extracellular coat or frustules composed of silica and having unique pattern of symmetry and microstructure. There are more than 200 genera and 100,000 species of diatoms [5]. The test assumes that when a person drowns in diatom containing water these microscopic algae are inhaled, penetrate the alveolar capillaries and circulate by a still beating heart to distant organs such as brain, kidneys, liver and bone marrow. These organs can be removed at

autopsy, acid digested and examined for presence of diatom[6].

Various other micro organisms have been proposed to be associated with cases of drowning by Abe and Suto *et al.* who proposed the detection of chlorophyll-related genes of *Euglena gracilis* and *Skeletonema costatum* to identify plankton in the victim's tissues [7]. However, these methods give only qualitative results[8] and quantitative results can only be achieved by the diatom test which may also give an indication of the site of drowning. Presently, forensic pathologists all over the world are divided over reliability of diatom test as a diagnostic aid. The aim of the present study was to test the reliability of diatom test as indicator of antemortem drowning by comparing the presence of diatoms in dead bodies found in water, in cases where suspected cause was drowning with those cases where another cause of death was established.

### MATERIALS & METHODS

The present retrospective study was planned and executed in the Department of Forensic Medicine, Postgraduate Institute of Medical Sciences, Rohtak. Cases brought to the mortuary for conducting postmortem examinations formed the study population. Purposive sampling technique was adopted. The study was done on cases examined by the author over a period of two years.

### Inclusion Criteria

Only those cases were included in the study where dead bodies were found in water. Collection of bone marrow specimen: Specimens of long bone (femur/ humerus /sternum) was dissected from the body, cleaned for soft tissue tags, dried & preserved for diatom test at the time of postmortem examination.

Later on these specimens were subjected to acid digestion for extraction of bone marrow to conduct diatom test. A total of 50 such cases brought to the mortuary for postmortem examination were included in the study.

### Collection of water sample

As per written instructions given to the investigating officer, one liter of water sample was collected from the site of recovery of the bodies in clean plastic jars for comparison with diatoms found in bone sample preserved.

The specimens were subjected to diatom test for detection of diatoms and comparison of types of diatoms found in water & bone sample respectively at Forensic Science Laboratory. Only those results were considered positive where diatoms were present in water as well as bone sample and were found of similar type.

The study adhered to the tenets of the Declaration of Helsinki for research in humans. All the proforma were manually checked and edited for completeness and consistency and were then coded for computer entry. After compilation of collected data, analysis was done using Statistical Package for Social Sciences (SPSS), version 20 (IBM, Chicago, USA). The results were expressed using appropriate statistical methods.

### RESULTS

A total of 50 drowning cases studied, out of which diatom test could not be done in 9 cases due to technical faults and investigative delays (Lost to follow-up). Amongst the remaining 41 cases, 28 cases showed positive results and 13 cases showed negative results for diatom tests.

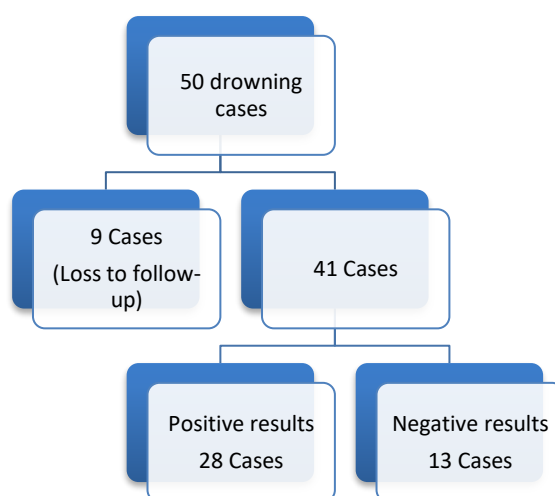


Fig-1: Flow chart describing the Results

Seasonal distribution pattern of cases showed that the diatom positive cases were more in the rainy (13) & summer season (8) as compared to spring (4)

and winter (3). The gender distribution clearly deviated towards males with 40 males & 10 females.

In 11 cases where other cause of death except drowning was established at the postmortem examination, diatom test were negative in all the cases. However, in 2 cases neither the diatom test was positive nor any other cause of death could be established.

## DISCUSSION

Drowning was substantiated as a cause of death when the types of diatoms in human organs matched diatoms present in the putative drowning medium by Pollanen *et al.* [9] similar to the present study. Presence of diatoms in bone marrow and tissues of non-drowned bodies have been reported by Schneider *et al.* [10] but their studies were not based on comparison of types of diatoms found. This claim was further countered by Pollanen *et al.* who stated that presence of diatoms in non-drowned bodies could be due to contamination caused during various processes of autopsy and diatom test.

In the present study the drowning cases were predominantly seen in rainy season. Also, diatom test was negative in cases where other cause of death was established. These findings were similar to that of Anand TP *et al.* [11].

Majority of victims were male in this study, similar to findings of Anand TP *et al.* [11] & Kaushik N *et al.* [12]. Kaushik N *et al.* [12] studied seventeen cases for detection of diatoms, out of which twelve cases were positive (death due to drowning) and 5 were negative (death other than drowning). Similarly, Sithiwong *et al.* [13] used diatom test for detection and identification of diatoms in tissue samples of drowning victims. The diatoms were found in the gastric contents, lungs, duodenum contents, liver, kidney, blood and brain of all twelve of the corpse. Whilst in the tissues of five alternative corpses who died from accidents and diseases studied as control cases, diatoms were absent. These findings were akin to the present study.

The possibility of the presence of diatoms in the tissue of non-drowned people is the root of much of the criticism of the diatom test [14], but this shortcoming can be largely overcome by comparison of diatoms found in putative water sample and bone marrow as done in the present study.

In our results we observed that in two cases neither the diatom test was positive nor any other cause of death could be established, which could be due to difference in species of diatom found at place of recovery of body and actual drowning. This is possible as dead bodies may travel hundreds of kilometers in water channels from one geographical region to another undetected submerged in water. These geographic regions may have different climatic conditions and hence, different species of diatoms. With advent of newer methodology such as Nuclear Magnetic Resonance (NMR) and Inductively Coupled Plasma

Hyphenated Technologies, Atomic Force Microscopy, Fluorimetry, Automatic diatom identification and classification (ADIAC) Diatom test will achieve new heights of reliability in the near future.

## CONCLUSION

In light of above discussion it can be concluded that in cases where other findings of drowning are lost to decomposition, detection of identical diatoms in body and putative drowning medium should be considered as corner stone for establishing ante-mortem drowning. The opinion regarding drowning should be given after having considered all the aspects of medico-legal autopsy i.e. external examination, autopsy findings, histological examination, toxicological analysis and diatom test, keeping in mind that a positive diatoms test is helpful, however, a negative result does not rule out drowning.

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