Case Report

Diatoms: Role in Drowning

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Abstract
Drowning is a form of asphyxia due to aspiration of fluid into air passages caused by submersion in water or other fluid and is mostly accidental. The main question in case of a body recovered from water is whether the individual was alive at the time he entered water. If a body is found in water is does not necessarily mean, that this person has drowned. Deaths by drowning are difficult to determine and are often diagnosed by eliminating all other potential causes of death. Diatoms found inside the body of a drowned victim may serve as corroborative evidence in the diagnosis of cause of death. It can be ascertained whether the drowning is ante-mortem or post-mortem. The diatom test stands as the only direct screening test for drowning. The present case is one such example wherein the presence of diatoms has helped in arriving at a decision of ante mortem drowning, thereby emphasising its significance.

Key Words: Drowning, Death, Diatoms, Bone Marrow

Introduction:
Drowning is a form of asphyxia due to aspiration of fluid into air passages caused by submersion in water or other fluid and is mostly accidental. The main question in case of a body recovered from water is whether the individual was alive at the time he entered water.

Circumstantial evidences, external appearances like cutis anserina, washerwoman feet and internal findings like emphysema aqueosum and froth in airways up to the terminal bronchioles give substantial amount of evidence for the diagnosis of ante mortem drowning. The discovery of diatoms and its application in diagnosis of drowning has increased the corroborative evidences for drowning. The present case is one such example wherein the presence of diatoms has helped in arriving at a decision of ante mortem drowning, thereby emphasising its significance.

Case history:
Police authorities brought the dead body of a 21 year old male to the mortuary of SMS Hospital Jaipur for autopsy. On eliciting history, it was found that the person had gone to attend a pool side party at a farm house in the outskirts in Jaipur. There was provision of alcoholic beverages in the party.

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He was swimming and taking drinks in between. At one point he dived into the pool and did not resurge in the usual time. It is when his friends panicked and jumped in to rescue him from the pool. Immediately they brought him to the Emergency of SMS Hospital and informed relatives on the way. The person was declared dead in the Emergency and dead body was shifted to mortuary.

On arrival, the immediate relatives suspected foul play as the deceased was a swimmer and there were meagre chances of him drowning in the pool. Also there was an abrasion on the forehead thereby raising the possibility of assault and submersion in water. They expressed their concern to the police authorities who requested the Department of Forensic Medicine to conduct the autopsy by a panel doctors. After routine inquest procedures, a Board constituting of Forensic Personnel including the author, and a surgeon was constituted.

External examination:
The subject was a moderately built and nourished 21 year old adult male. Rigor mortis was present all over the body and post-mortem staining was present over back. Eyes and mouth were partially open and nails and lips were bluish in colour. An abrasion of size 1 X 1 cm
was present over left side forehead which was red in colour.

**Internal examination:**

All internal organs were grossly intact and congested. The larynx and trachea on opening showed scanty frothy fluid mixed with brownish colour particles and brownish semi liquid material. Both lungs were edematous with blood stained froth exuding on squeezing the lungs. Mucous membrane of stomach was congested and contained about 50ml of brownish semi liquid material. Viscera for routine chemical analysis were preserved along with Gall bladder as a whole for narcotic drug analysis. Blood sample for chemical analysis of common poisons was preserved. A separate sample with Sodium fluoride preservative was also preserved for qualitative and quantitative estimation of alcohol. A piece of sternum was preserved for diatom examination.

On receiving the final reports, the Histopathological examinations of the viscera were unremarkable other than congestion. Chemical examiner’s report revealed the presence of Morphine in viscera along with Ethyl alcohol in a concentration of 103.5mg/100ml. diatoms were detected in the piece of sternum and the control sample of water taken from the site of recovery of the deceased body. Diatoms were found in good numbers in the bone marrow and water sample forwarded to the Forensic lab.

In viscera as well as control water, the nature of diatoms was found almost similar. The final opinion regarding cause of death was given as due to ‘asphyxia’ as a result of drowning with cumulative effect of aspiration of gastric contents and effect of alcohol and morphine.

**Discussion:**

Drowning is a form of asphyxia due to aspiration of fluid into air passages caused by submersion in water of other fluid. Complete submersion is not necessary for drowning to take place. [1]

The post-mortem examination of drowning, is one of the most difficult problems in forensic. Although there are some typical signs of drowning known, it is still difficult to determine a death by drowning. [4] Therefore one has to come up with these questions:

- Drowned the person by conscious (e.g. non swimmer, suicide)
- Drowned by unconsciousness (e.g. beaten, surfing accident)
- Sudden Death (e.g. heart stroke)
- Already Dead (e.g. get rid of a body) [3]

Deaths by drowning are difficult to determine and are often diagnosed by eliminating all other potential causes of death. The diatom test stands as the only direct screening test for drowning. However, the field of forensic limnology has stagnated in the literature, at least in terms of the emergence of new and more accurate collection, testing, and confirmation modalities.

Diatoms are a major group of algae, and are one of the most common types of phytoplankton. Most diatoms are unicellular, although they can exist as colonies in the shape of filaments or ribbons. A characteristic feature of diatom cells is that they are encased within a unique cell wall made of silica (hydrated silicon dioxide) called a frustule. These frustules show a wide diversity in form, but usually consist of two asymmetrical sides with a split between them, hence the group name. Fossil evidence suggests that they originated during, or before, the early Jurassic Period. Diatom communities are a popular tool for monitoring environmental conditions, past and present, and are commonly used in studies of water quality. There are more than 200 genera of living diatoms, and it is estimated that there are approximately 100,000 extant species. Diatoms are a widespread group and can be found in the oceans, in freshwater, in soils and on damp surfaces. Diatoms generally range in size from ca. 2-200µm, and are composed of a cell wall comprising silica. This siliceous wall can be highly patterned with a variety of pores, ribs, minute spines, marginal ridges and elevations; all of which can be utilised to delineate genera and species. The cell itself consists of two halves, each containing an essentially flat plate, or valve and marginal connecting, or girdle band. [3]

Diatoms found inside the body of a drowned victim may serve as corroborative evidence in the diagnosis of cause of death. It can be ascertained whether the drowning is ante-mortem or post-mortem. Diatoms are not always there in all of the drowning cases but if present and present in distant organs in abundance they definitely provide a positive evidence in favour of ante-mortem drowning. There is a lot of controversy about the reliability of diatom tests. Many authors do not consider this as a valuable and a fool proof method. The fact which supports their opinion is that diatoms are not only inhaled through water, they can also be inhaled through air as they can also be found in the air and from there they can gain entry by the respiratory system. But the older studies form a view that diatom test is very reliable in ascertaining ante-mortem or post-mortem drowning by taking each and every aspect with great care and keen observation. A definite
conclusion can be drawn if proper care is taken to avoid every sort of contamination and by knowing all necessary specification of the diatom test, it can provide a great assistance in the investigation of drowning cases. [2]

According to this criterion, the diatoms found in the blood and organs of the victim (such as femur), must be the same. This is to refute the objections of many pathologists who assert that diatoms are ubiquitous in human tissues. Researchers have found diatom like particles in hepato-portal circulation indicating thereby that they might have entered through ingested food or water. It is implied that they would then get distributed among the tissues of the body during the life of the person. [2]

A number of methods are described for the digestion of the tissue for the isolation of diatoms by doing minimum damage to the frustules. The samples if seen under Scanning Electron Microscope probably give the best results. No doubt diatom test has been an excellent remark in the diagnosis of drowning cases but somehow it can also be used more potentially in those cases where recovered body is under suspicion for drowning site or where drowned body is found on land. A fresh outlook is necessary to use of this important application for medico legal investigations.

References:
1. Dixit P.C: Textbook of Forensic Medicine & Toxicology, Pee-Pee Publishers and Distributors, New Delhi, 307-316.