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FORENSIC IDENTIFICATIONS OF DROWNING DEATHBYTHE USE OFDIATOM ANALYSIS

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ABSTRACT

Diatom frustules continue examined commonly during autopsies of deaths due to drowning. Diatoms are unicellular microorganisms which are commonly found in almost all water bodies. Their silica wall plays significant tool in forensic diatomology. Diatom analysis has been suggested to provide supportive evidence of drowning but the consistency and applicability of quantitative and qualitative diatom analysis in the diagnosis of drowning is still tentative in the literature. Diatom test has been extensively applied to detect post mortem or antemortem drowning and comparing the diatoms found in biological sample with those found in water sample indorses that death took place, probably in same water medium. Death by drowning is the result of encumbering of respiration by comprehensive or partial submersion and subsequent entry of water into the air passages. If the person is still alive when entering the water, diatoms will enter the lungs if the person inhales water and drowns. The diatoms are then carried to distant parts of the body such as the brain, kidneys, lungs and bone marrow by circulation. Diatoms found inside the body of a drowned victim may serve as corroborative evidence in the diagnosis of cause of death. The diatom test stands as the only direct screening test for drowning.

INTRODUCTION

Every year in India, along through other cause of death "Drowning" plays a major role; it may be Accidental, Suicidal or Homicidal Drowning. Drowning is a type of asphyxial death in which the respiration is reserved by submersion in a fluid, and it is not compulsory whether the fluid is aspirated into the lungs or not. Since the detection of diatom in lungs in a victim of drowning death by Revenstorf in 1904, diatom test has been considered as an important tool in diagnosis and confirmation of the death due to drowning. Drowning is a form of asphyxia death in which the atmospheric air is prevented from entering the lung by submersion of the body in water or any other fluid medium (Rohn and Frade, 2006). The diagnosis of drowning for bodies freshly retrieved from wateris mainly based on some ''drowning signs'', such as the presence of fine froth at the mouth or nostrils, petechial hemorrhages, impression of ribs on lungs, oedematous lungs and some other histo-pathological findings. For the decomposed corpses and skeletonised body found in water, however, the diagnosis of drowning is rather difficult because those ''drowning signs'' were destroyed.

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Here diatom test stands as the only direct screening test for drowning (He *et al*., 2008). Based on the study of drowning victims, where the diatoms are present in the medium, the penetration of diatoms into the alveolar system and blood stream has been caused by the breathing in of water by the drowning victims and then leads to the penetration of diatoms into other organs and parts of the body, such as bone marrow, thebrain, kidneys and lungs (Krstic, 2002 and Round *et al*., 1990). That diatom test would be of much importance in the diagnosis of drowning cases, origin of diatoms found in bone marrow is known i.e. matching of diatoms from both putative water medium and tissue of drowned body is must requiredfor the success of this test (Holden and Crosfill, 1955). The presence of diatoms can be established and analyzed both quantitatively and qualitatively through a diatom test. This can lead not only to a more direct determination of the cause of death, but also can help to pinpoint thesite of a suspected drowning. The classical view of diatom systematic, inferred mainly from morphological characteristics of their siliceous cell walls, kept species into one of two or three classes: centric diatoms (radial and non-radial) and pennates (araphid or raphid) (Holden and Crosfill, 2005; Simonsen, 1979) Classification is mainly based on the Morphological characteristics and the siliceous cell wall.The structure of the

valve of a centric diatom, and frequently its outline too, is basically radially symmetrical, the frustules often resembling a Petri dish. There are many exceptions, however, that depart from this simple idealized shape. As in pennate diatoms, the shells are ornamented with species-specific patterns and structures. In many centric diatoms the valves contain radical rows of small, more-or-less hexagonal chambers, called 'loculate areolae'. Each chamber (loculus) has an outer wall and an inner wall, and it is usual that one of these is perforated by a large round hole (foremen) while the other contains a delicate porous plate, sometimes called a 'sieve plate' (cribrum). No centric diatom ever has a raphe system (Hoek, 1995). The valve view with the pattern of sculpturing is based on a central point as exemplified by *Coscinodiscusradiatus*. In other genera, however, this "pill box" shape is less apparent; e.g. *Rhizosolenia*, in which the valve is often conical and the girdle length may be up to fifty times the valve diameter, and *Chaetoceros*, in which long spines, called setae, arise from the valves. Many centric diatoms also form chains of cells, in which the cells are joined together by all, or part of their valve surfaces. Three such genera are: *Chaetoceros, Lauderia* and *Eucampia*. In other genera, the cells are linked in chains by spines, e.g. *Skeletonema* or by mucilaginous threads arising from the valve surface, as in *Thalassiosira* (Timperman, 1962).

Forensic biologist studied this microscopic material (diatom) for establishing mode (ante-mortem/post-mortem), probable season of death and putative site of drowning. In case of offering a positive opinion on ante-mortem drowning, the "Criterion of Concordance" was thought to be satisfactory. If the Criterion of Concordance can't be followed then a minimal established limit i.e. 20 diatoms/ 100 µl of pellet (obtained from 10 g of lung samples) and 05 complete diatoms from other body organs should be present. The concordance of the individual diatom distribution from drowned body organs with the diatom species in water samples can also be an exploratory tool in the investigation of suspected drowning site. Diatom test has come up as a direct screening test to diagnose the deaths due to drowning. Diatoms detected in the drowned bodies have been deemed to be the most reliable indicator of drowning particularly in the absence of other evidentiary clues, (Hurlimann *et al*., 200; Kobayashi *et al*., 1993; Ludes *et al*., 1994; Ludes *et al*., 1996; Pollanen, 1996; Peabody, 1977 and 1980; Rohn, 2006; Timperman *et al*., 1962 and Timperman, 1969 and Timperman *et al*., 1972).

Historical background of this test reveals extensive literature. However, the methodology has remained largely unchanged since its improvement in the early 1960s (Holfmann, 1896) Was first to discovered diatoms in lungs but their use in solving drowning mysteries was successfully approved by (Revenstorf, 1904) (Revenstorf, 1904). A diatom has been considered as one of the important forensic evidences in solving drowning cases (Peabody, 1977). He reported that presence of diatoms in bone marrow was a sure sign of drowning and type of diatoms in bone marrow could also provide information about the type of water where death had occurred i.e. fresh or salt water (Peabody, 1977). Critically reviewed role of diatoms in drowning cases and detailed the most outstanding. The common of the autopsy findings are related to asphyxia and have no specific link to drowning. The signs of drowning depend on the delay in improving the body and on the development of the putrefaction phenomenon which alter the positive signs of drowning. One of the signs of drowning would be large amounts of froth present around nostrils and mouth in freshly drowned bodies. This froth is also present in the upper and lower airways. Froth can also be observed in cases of edema of left ventricular failure but in drowning cases the volume of froth is generally much more abundant than in other origins. And appreciable format of diatom research conducted in the last century. It is admitted that lung weights are higher in drowning cases but it was shown that normal weights are possible in the drowning cases after cardiac arrest reflex or vaso vagal reflex. After water inhalation, the lungs may be over inflated, filling the thoracic cavity, generally water logged referred to as "emphysema aquosum". So the surfaces of lungs have a marbled appearance with dark red areas linked with collapsed alveoli, interspersed with more aerated tissues areas. The fluid is trapped in the lower airways and blocks the passive collapse of the bronchi that normally occurs after death. Subpleural bullae of emphysema, sometimes hemorrhagic may be found and are related to the rupture of the alveolar walls (Pounder, 2005). Even if these signs are mostly evocating of drowning, none of them is pathognomonic of water inhalation. In 1942 Incze demonstrated that, during drowning, diatoms could enter the systemic circulation via the lungs. Their presence can be demonstrated in such tissues as liver, brain and bone marrow following acid digestion of the tissue. The use of diatoms as a diagnostic test for drowning is based upon the hypothesis that diatoms will not enter the systemic circulation and be deposited in such organs as the bone marrow unless the circulation is still functioning thus implying that the decedent was alive in the water. Before diatoms can be examined, they have to be cleaned. This involves the removal of cell contents, pigments, sand, mud or other material likely to interfere with microscope examination

DISCUSSION

Diatoms are abundant and diverse in aquatic habitats. This uniqueness makes them of forensic value in cases of suspected drowning. Laboratory tests may reveal the presence of diatoms in the body. Diatoms are microscopic algae found in both seawater and fresh water. Their silica-based skeletons do not readily decay and they can sometimes be detected even in heavily decomposed bodies. If the person is dead when entering the water, then there is no circulation and the transport of diatom cells to various organs is prevented because of a lack of circulation and diatoms cannot enter the body. When a body is recovered from water, there is usually a suspicion whether it was a case of ante-mortem or post-mortem drowning i.e. whether the body was drowned before or after death. In these medico legal cases, presence of diatoms in the body tissues is very useful evidence. In drowning related death cases, a correlation between the diatoms extracted from bone marrow and liver/lungs) samples and the samples obtained from drowning medium have to be established for the successful determination of drowning site in Forensic laboratories. The systematic sampling of locations where submerged remains are frequently encountered allows for the creation of a predictive diatom database. Such a database is suitable for comparison with recovered tissues. Comparison

between the diatoms found in the tissues and the algae of the water site also allowed us to exclude the possibility of air inhalated diatoms before death. The network established for water monitoring of diatoms must be extended to other rivers and streams to complete the network of the French water agencies in order to provide more extensive reference data bases for use in cases of drowning.

Conclusion

Quantitative and qualitative diatom analysis in victims found in the water can give strong evidence of death due to aspiration of water. Diatoms detection in both drowning and non-drowning cases do not show a definitive relation with time since death. The diatom test, while extremely specific, is of immense value considering the limited objective tests available for drowning diagnoses. If the person is still alive when entering the water, diatoms will enter the lungs if the person inhales water and drowns. The diatoms are then carried to distant parts of the body such as the brain, kidneys, and bone marrow by circulation. If the person is dead when entering the water, then there is no circulation and diatoms cannot enter the body. Diatoms do not occur naturally in the body. If the diatom profiles of the tissues match those of the water, diatom analyses will be very useful for the forensic pathologist to state about the cause of death, such as drowning. The determination of the dominant taxa may also indicate the site of drowning. It has been suggested that marrow of the sternum may be as good of a source of diatoms as femoral tissue. Death of a victim found in water should not always be related to drowning.

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