

A review on diagnosis of death by drowning

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Abstract-

Diatom analysis is a very important tool in diagnosis and confirmation of death due to drowning. Diatoms have number of characteristics as their widespread presence in water, high diversity in species and habitat specificity. The basic principle of diatom test in drowning is based on the inference that the diatoms are present in medium where drowning took place and the inhaled water enter the alveolar spaces of lungs and penetrates from the alveoli into the blood circulation. The diatoms found inside the body of drown victim may be conclusive evidence to support the diagnosis of death, it can be ascertained whether the death is ante-mortem or post mortem. The presence of diatoms in body tissues liver, kidney, brain and bone marrow is the confirmation of the death due to drowning.

Keywords- Drowning deaths, Diatoms, Acid digestion method, ante-mortem and post-mortem drowning.

I- Introduction-

Diatoms are photosynthesizing algae contains chlorophyll A & C. Diatoms as unicellular eukaryotic algae characterize an organism group which have a number of prominent distinctive features: (i) high diversity both locally and regionally accounting for much of the freshwater biodiversity especially in streams, (ii) relatively strict preferences for various environmental factors reflected as a tight coupling between community and environment, and obviously, (iii) siliceous cell wall for which diatoms are widely acknowledged (1). They are characterized by their highly ornamented siliceous cell walls their silica-based skeletons do not readily decay and they can sometimes be detected even in heavily decomposed bodies. Found in almost all moist conditions like river, pond, soil and in marine waters. The name diatom is derived from the Greek word diatoms meaning "cut in half, which refers to the two valves of the diatoms. All diatoms are enclosed by a frustule that is made up of two valves fitted together by a connective zone called a girdle. They are nonmotile, or capable of only limited movement along a substrate by secretion of mucilaginous material along a slit-like groove or channel called a raphe. The expedition in the field of taxonomy was apparently started with its 1st recorded in 1703 by a fellow of the Royal society and was penned by Antonie van Leeuwenhoek, who appears to have recorded the existence of diatoms much earlier, during the invent of microscope itself.

The history of diatom can be roughly classified into 3 eras.

1. Era of exploration (1844-1900)- During this time most research focused on diatoms as objects of study and more attention was given to the discovery of new taxa, their life cycle and basic physiological aspects.

2. Era of systematization (1900-1970)- During this period, the most of the efforts were attempted to reduce the rich mosaic of information and inference concerning diatoms to more manageable dimensions. The origin of conveying information to managers and public were developed in this era.

3. Era of objectification (Stoermer and Smol.1999)- Computational tools and multivariate statistics, which make it possible to determine the variables that affect diatom occurrence and growth, and more importantly, they are quantified, reproduced and measured with precision. which strengthen diatom ecology. There are two principal habitats for diatoms: moist or submerged surface (Benthic) and open water (Planktonic). (Wikipedia)

Diagnosis of drowning deaths is one of the most difficult tasks. Diatom test has emerged as one of the most important tests in forensic science by detection of diatoms in tissues samples [2]. Diatom analysis can further used in forensic science by identifying the individuals, clothing or belongings from the sites of investigation [3]. The two factors for the diatoms test are the concentration of diatoms in the lungs and the development of a river monitoring programme in the district of the study [4]. Continuous monitoring of fresh water sites and comprehensive species level inventories of diatom flora at these sites may be useful in the medico legal investigation of drowning deaths [5]. Increase in the number of diatoms in the internal organs was thought to confirm that the body had drowned and, if a sample of the water was also taken at the presumed site of drowning, the similarity of different species of diatoms in the water and the body could be determined. On the other hand, if a dead body was dropped into water, although diatoms could reach the lung by passive percolation, no circulatory transfer could occur and so (theoretically) no diatoms would be present in the distant organs.(6) The advantages claimed for this technique include the fact that it could be used even in the presence of putrefaction, if protected tissue such as bone marrow was examined. Unfortunately, diatom test is often negative, even in undoubted cases of drowning in waterways full of diatoms, and there have been numerous false positive results that are said to have occurred for a variety of technical reasons.(7) Some important characteristics of diatoms help them to prove their evidentiary value. Firstly, they are too numerous and more importantly these are the only microorganisms with acid resistant frustules, making them easier to extract from post-mortem tissues.(8) They are too small to penetrate various distant organs of the body. They can be easily classified and identified. Analyses of the concentration of sodium, chloride and magnesium have been used, but the results are too variable (due to the rapid postmortem diffusion of electrolytes throughout the body after death.(9,10).

Historical Overview-

Historical outlook of this method reveals extensive literature. However, the methodology has remained largely unchanged since its improvement in the early 1960s. In 1861, a man got an idea that water along with some mud and other debris fragments channels to the various body organs when drowning takes place.(11) While Brouardel conducted series of experiment on dogs and found that a quantity of water equal to a third or quarter of the subject's blood volume enters the circulation when submersion takes place for about 20 minutes or more. But seventy years later Swann reported that only after 3 minutes of submersion the original blood volume could be diluted by same volume of water.(12) First discovery of diatoms in lungs was made by Hofmann but a successful attempt was made by Revenstorf who correlated this presence of diatoms in lung in solving the drowning mystery.(13) This method was improved by digesting lung tissue with acid for the extraction of diatoms. Detection of diatoms in blood and parenchymatous organs was successfully made by Incze. This work was further carried out by Tamasaka but this time source of diatoms was bone marrow. His studies helped to reach a conclusion that presence of diatoms in bone marrow indicates death by drowning but negative results of diatom studies carried out with this sample may therefore contradict drowning.(14)

A series of experiments on rats were carried out by Mueller and Gorgs who reported that diatoms could easily be found in lungs but to a lesser extent in liver, kidney, brain and left side of the heart, and diatoms about the size of 30μ diameter could move into heart. Mueller could not find any diatoms in the livers, kidneys and lungs of 30 non-drowned bodies and opined that diatoms can pass from air to other organs.(15) Fluid from sinus of the basal bone was also only once recommended by Sveshnikov in the history of literature. The fact that a great majority of diatoms are found in the digestate of peripheral tissue in cases of drowning, but that negative diatom findings do not rule out drowning was explained by Naeve. (16)

Classification-

Investigations of homicidal drowning can benefit from the diatom test in two important ways: (17) the confirmation of a diagnosis of drowning made at postmortem examination and the detection of drowning in cases of homicidal deaths involving extensive decomposition or postmortem burning of the body. It is particularly helpful in cases where the body is transported from the putative drowning medium to a dry site on land (18).The occurrence of diatoms in the bone marrow is a proof that the individual was alive when entered the water. This means that the cause of death was due to the drowning but absence of diatoms does not immediately rule out drowning.(19) Forensic limnology is in critical corporation, and the diatom test is among those modalities that need to remain at center stage. Presence of diatoms in bone marrow, lungs, liver, spleen, kidney, and brain tissue led to the development of the diatom test.(20) This test became a direct screening test for the diagnosis of drowning. The presence of aquatic diatoms in a cadaver has long been held by many workers to be a clear

indicator of death by drowning. 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 the site of a suspected drowning. (21).

II- Methodology-

Diatoms can be collected not only from natural surface (Sedimentation, stones and vegetation) but also from other substrate or surface type in an aquatic environment. The living component can also be collected in a controlled fashion using the sample expedient of artificial substrate (Gold et.al.,2002). They collectively show a broad range of tolerance along the gradient of aquatic productivity, with individual species having specific water chemistry requirements. They respond directly and rapidly to many environmental parameters such as a geology (Stevenson, 1997; and Pan et.al., 2000), current velocity (Peterson and Stevenson, 1990), and nutrients (Potapova and Charles, 2007). These might vary according to species physiology and the species- specific sensitivity to parameters, which leads to a large panel of assemblage composition according to the river ecology conditions.

Examination of diatoms- In 1942 Inched 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 diatom as a diagnostic test for drowning is based upon the hypothesis that diatoms will not enter the systemic circulation and be deposited in such organ 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, sands, mud or other material likely to interfere with microscope examination.

Internal Organs used for Diatom Test-

When an individual gets submerged in water containing diatoms then because of aspiration of water they get enter into the lungs because of forceful inspiration and expiration microscopic tears got developed in alveolar wall, they get entered into the blood stream and acquire lodged into the inner organs of submerged victims many studies conducted throughout the planet showed that completely different internal organs is used for the detection of diatoms.[22] showed that left chamber blood is used for alga take a look at whereas Pachar and Cameron [23] showed that liver, urinary organ and brain may be used Matsumoto and Fukui [24] showed that lungs may be used for the detection of diatoms in a very study created by Nadia Fucci [25] respiratory organ, liver, urinary organ and brain were used for the detection of diatoms in ten cases of drowning deaths. Bone marrow is taken into account to be the simplest because it proves the hypothesis of ante mortem drowning additionally because it is least plagued by contamination throughout post-mortem submersion [16,26]. Anand and Unmesh [27] used bone marrow, paranasal sinus aspirate and respiratory organ bits for the detection of diatoms from fifty dead bodies in drowning cases and Pathak and

Mangal [28] used os bone for the detection of diatoms in eighty six cases associated with drowning deaths.

III- Conclusion-

Death of a victim found in water will not always be drowning. 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 laboratory tests show diatoms in the corpse that are of the same species found in the water where the body was recovered, then it may be good evidence of drowning as the cause of death. Bone marrow is described as a sanctuary organ and if diatoms reach this tissue, the diagnostic of drowning could be assessed. Death of a victim found in water should not always be related to drowning. 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 laboratory tests show diatoms in the corpse that are of the same species found in the water where the body was recovered, then it may be good evidence of drowning as the cause of death. Bone marrow is described as a sanctuary organ and if diatoms reach this tissue, the diagnostic of drowning could be assessed.

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