G59 Stab Wounds and Drowning - A Fatal Combination

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After attending this presentation, attendees will: (1) be able to state the percentage of cases in which more than one modality of fatal injury is used to kill; (2) recall the percentage of cases of homicide by stabbing; (3) recall the number of cases of homicide by drowning; (4) be able to quote the literature on the number of reported cases of death by drowning after infliction of stab wounds; (5) appreciate a case of homicidal drowning after the infliction of stab wounds of the chest; (6) review the pathological features of classical drowning; and, (7) review the utility of comparative diatom analysis as an ancillary investigation in cases of drowning and determine its appropriateness as an ancillary investigation.

This presentation will impact the forensic science community by showing how the use of more than one modality of fatal injury in homicides sometimes occurs. It is rare in forensic practice to have death from drowning following multiple stab wounds of the body, especially with penetrating stab wounds of the chest. An interesting case of homicide is presented in which death by drowning in an environmental watercourse occurs after an attack with a knife in which multiple penetrating stab wounds of the chest are sustained. This case is presented due to its rarity and to revisit the utility of the comparative diatom analysis as an appropriate and available ancillary investigation in cases of suspected drowning.

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An interesting case of homicide is presented in which death by drowning in an environmental water course occurred after an attack with a knife in which multiple penetrating stab wounds of the chest are sustained. This case is presented due to its rarity of presentation and to revisit the utility of comparative diatom analysis (Diatom Test) as an appropriate and available ancillary investigation in cases of suspected drowning.

A 17-year-old single mother was missing for two days. Her body was recovered from a canal in a fully clothed state with multiple stab and incised wounds. Investigations revealed that she was lured to the secluded area via text messages and phone calls sent by both her present boyfriend and ex-boyfriend. External examination at postmortem identified multiple stab wounds with four penetrating stab wounds of the chest and multiple defensive stab and incised wounds of the upper limbs. Internal examination revealed pale, hyperinflated lungs that overlapped in the anterior midline with no evidence of collapse from haemo/pneumothorax. There was stab wound injury of the lung and a small volume of residual blood within the right pleural cavity. The cause of death was given as Drowning with Multiple Stab and Incised Wounds. It was evident that the decedent was alive on entry into the water. Comparative Diatom Analysis provided ancillary support for drowning.

Drowning is not necessarily the cause of death when a body is recovered from water. The possible scenarios are:

Death before immersion in water

- natural disease
- injury

Death while in water

- natural disease
- injury
- drowning
- death from effects of immersion other than drowning

The autopsy diagnosis of drowning is a major problem in forensic medicine as the pathological proof is often difficult or impossible to obtain, especially when there is a delay in recovery of the corpse. The diagnosis of drowning can often be easily established in a fresh corpse that has been recovered early. The task becomes more difficult when putrefaction sets in and the signs become obscured!

Modell (1981) defined drowning as *"suffocation by immersion, especially in water."* This is the classic and most widely used definition. The World Congress on Drowning (2002) defined drowning as *"the process of experiencing respiratory impairment from submersion or immersion in a liquid."*

The pathological diagnosis of drowning can be made through identification of the following signs:

- Champignon d'mousse
- Froth in the tracheobronchial tree
- Emphysema aquosum - heavy, waterlogged and hyperinflated lungs – (600-700 g each) that fill the chest cavity, exhibit rib indentations (visible and palpable grooves), overlap/meet in the midline such that they obscure the bare area of heart and obliterate the anterior mediastinum. They are pale and crepitant and do not collapse when placed on the dissection board.

10 - 20% of undoubted drownings are "dry lung" cases with no excess weight (Copeland 1985)*

- Paltauf's hemorrhages
- Pleural effusions
- Water in the stomach*

- Middle ear hemorrhage*
- Low spleen weight*

  * Too inconsistent to be of diagnostic use

Diatoms – Diatoms are microscopic algae that that live in water and range in size from 2µm to 1mm with most being 40-80mm. The smaller species of the order of 2-5mm can easily penetrate tissues. There are about 15 000 species which are almost equally divided between fresh water and brackish/seawater. They are covered by a heat and acid resistant silicaceous exoskeleton (frustule) which are physical properties which are taken advantage of in their laboratory extraction. Diatoms can be demonstrated as a microscopic finding in the tissues in drowning.

Diatom Test – The basis of the diatom test is premised on the aspiration of water into the lungs on entry of a living person into water during drowning such that such that the contained diatoms also enter the lungs. The aspirated diatoms then penetrate the alveolar walls, enter the pulmonary venous circulation and then the systemic circulation such that they are transported and deposited with distant organs and tissues such as the brain, kidney, liver, and bone marrow. Passive entry of diatoms into the lungs can occur in deceased bodies which inadvertently end up in water, through wave action. As there would not have been a functional circulation at the time of entry of these bodies into water, the diatom species of concern will not be present in the distal organs.

The diatom test was first applied by Revenstorf 1904 as an ancillary investigation in possible drowning deaths. It involved the identification and comparison of recovered diatom species to assist in the confirmation of drowning and possibly identify site of drowning. The validity of the test is strongly debated in the medical literature since diatoms can be demonstrated in non-drowning deaths.

The presence of diatoms in non-drowned bodies has been associated with ingestion of seafood, inhalation from the environment and laboratory contamination of glassware and reagents. Despite these, some believe that the diatom test is still the most reliable "drowning test" to date.

Hendey's criteria (1973) set out two (2) criteria for accepting a positive result from a diatom test as evidence of drowning in that:

i. *The species of diatoms recovered from pathological specimens are **all** present in the sample from the site of drowning.*
ii. *species are present in the same order of dominance for the admissible size range and in approximately in the same proportions*

Samples for Comparative Diatom Analysis/Sample preparation – Diatoms must be extracted from the body of water in which the corpse was recovered and compared with those extracted from the tissues. As such, the following samples are needed:

- Water sample from place of recovery of body (at least 500ml)
- Fresh tissues retrieved from the body in a sterile manner
  - lung (one lobe)
  - liver (150g)
  - whole kidney (100-150g)
  - long bone (femoral) marrow

To prevent cross contamination, it is necessary to take each sample *in-situ* with a change gloves and use of sterile instruments and blades when procuring each tissue sample. No co-mingling of the tissues must occur.

The laboratory preparation of the specimens entail:

1. Diatom extraction from tissues

- Acid digestion (HNO_3) *or*
- Water maceration *or*
- Incineration (most useful with fatty tissue eg. bone marrow)

2. Microscopic examination of the residue

3. Comparison of diatom species – The diagnosis of drowning can be made with reasonable degree of certainty from correlation of:

- History/Circumstances of the Death
- Gross lung findings
- Microscopic lung findings
- Diatom examination
- Other ancillary investigations

The Diatom Test should be used as an indicative aid and NOT as legal proof of drowning.

Drowning, Stab Wounds, Comparative Diatom Analysis

