Morphological and chemical findings in drowning: analysis of 10 cases

Background and aims

The determination of chemical substances present in the drowning medium could be a complementary tool in the forensic investigation. Referring to this, both strontium (Sr) and silicon (Si) have proven to be interesting in the diagnosis of drowning (D), in addition to the histological and SEM plankton research in lower airways (Figures 1 & Figure 2).

Spectrum processing: No peaks omitted
Processing option: Oxygen by stoichiometry (Normalized) Number of iterations=6

Standard;
C CaCO₃ 1-Jun-1999 12:00AM
Na Albite 1-Jun-1999 12:00AM Al₂O₃ 1-Jun-1999 12:00AM Si SiO₂ 1-Jun-1999 12:00AM
S FeS₂ 1-Jun-1999 12:00AM
Ca Wollastonite 1-Jun-1999 12:00 AM Fe Fe 1-Jun-1999 12:00AM

Figures 1 Plankton bolus in the alveolar duct (drowning in freshwater), ordinary (Figure A) and polarized light (Figure B) (EE, 480X).

Figure 2 In the upper right, endoalveolar foreign body observed by SEM (case of drowning in freshwater). In the image below, elemental analysis with EDX: more evidence of Si; other organic and inorganic elements.

Table 1 Chemical findings

<table>
<thead>
<tr>
<th>Element</th>
<th>Weight%</th>
<th>Atomic%</th>
<th>Compd%</th>
<th>Formula</th>
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<td>CO₂</td>
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Volume 6 Issue 1 - 2018

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Received: November 27, 2017 | Published: January 25, 2018

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Materials and methods

We selected 10 suspected drowning cases, in particular 5 bodies recovered from seawater (Sw) and 5 recovered from freshwater (Fw). In all cases, the investigation included an anamnestic and circumstantial study, an autopsy and histology, with particular attention to the polarization and fluorescent examination. Within the 5 bodies recovered from the Sw, oligoelements, in particular Sr and Si were studied; only Si was studied in Fw suspected drowning. This was performed separately for the left (l) and the right (r) ventricles, with special regard to the difference of the concentration of each single oligoelement in both the l and r ventricular blood ($\Delta_{l-r}$). Aquatic samples were analyzed in all cases.

Results

Autopsy: Classic pictures of D. in 9 cases. In 4 cases (Sw), the presence of pleural effusion, as well. Histology: Acute emphysema was the prominent observation; edema and hemorrhages were also present. In 9 cases (Figure 3, Figure 4, Figure 5 & Figure 6), exogenous material in the airways, comprehensive of planktonic boli in the lower branches, clearly demonstrable at polarization microscope (and possibly confirmable at SEM’s elemental analysis with EXD). Zooplankton and phytoplankton have been better identified in the UV microscope. It is mandatory to differentiate the planktonic material from gastric content, regurgitated and aspirated (Figure 7 & Figure 8).

Chemical findings: 5 bodies from the Sw have been investigated. In 4 cases ($\Delta_{l-r}$) was significantly positive for Sr and Si. The only negative for Sr and Si was a 37 years old subaqueous swimmer and the death was recorded by a camera (Figure 9): histologically, the lungs tested were negative for plankton; disseminated

Figure 3 & Figure 4 Drowning in seawater. Images of endoalveolar zooplankton (protoconch of crustacean) (EE, 480 X, polarized light).

Figure 5 Drowning in freshwater; recovery corpse after 20 days. Endoalveolar phyto- and geoplankton (EE, 240X, polarized light).

Figure 6 Drowning in freshwater; recovery corpse after few hours. Geo- and phytoplankton in a lower bronchus (EE, 120X, polarized light).

Figure 7 Same case of Figure 7. Fragments of food (cooked meat and tuber cells) in the main stem bronchus (EE, 240X).

Figure 8 Same case of Figure 7. Plant material identified in the esophageal mucosal laceration (EE, 480X, UV).

myocardiosclerosis was microscopically identified (sudden death). In $F_w$, Si ($\Delta_{Fw}$) was positive in 4/5 cases.  

**Conflict of interest**

The author declares no conflict of interest.

**References**


