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Case report

Shell fragment aspiration seen at post-mortem computed tomography indicating drowning

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ABSTRACT

The diagnosis of death due to drowning may be difficult, especially in cases of advanced decomposition, as most findings indicative of drowning sought for during post-mortem imaging and autopsy become obscured.

The detection of diatoms within the corpse may still allow for the diagnosis of drowning, even if all other findings have decomposed. Other particles found in natural bodies of water, especially near the shore, are shell fragments. These shell fragments do not decompose either and can therefore also be detected within a badly decomposed body.

We here report the detection of such shell fragments by post-mortem computed tomography in the airways of a body showing signs of decomposition. The presence of fragments in even very peripheral bronchi indicated that large amounts of shell fragment-laden water were aspirated, thus leading to the conclusion that the man died due to drowning.

1. Introduction

Although drowning is, according to the World Health Organisation [1], a frequent cause of death, not every corpse found in a body of water actually drowned, but may have died due to natural causes, injuries or hypothermia, to mention but a few alternatives.

At external inspection, a plume of froth may occasionally be seen emerging from the nostrils and mouth, a finding suggestive of drowning [2] or pulmonary oedema [3]. However, there are cases in which no froth may be present and external inspection may not suffice to clear the cause and manner of death, thus necessitating further examinations such as autopsy.

Autopsy of fresh, i.e. not decomposed corpses may show several findings indicative of drowning; froth in the airways, watery fluid in the paranasal sinuses, diffuse red spots (Paltauf spots) on the pleura and a red discolouration of the great artery walls due to haemolysis, an acute emphysema or pulmonary oedema and watery fluid in the stomach and duodenum which may – ideally in combination with the detection of diatoms in peripheral lung tissue [4] and internal organs – allow for the diagnosis of a death due to drowning.

Several groups have recently shown that signs supporting the hypothesis of a death due to drowning can also be seen by post-mortem computed tomography (PMCT), namely fluid in the airways, paranasal sinuses, stomach, duodenum and a mosaic pattern of the lungs [5–9]. However, fluid in the sinuses is a common finding, not necessarily restricted to drowning [10].

Putrefactive processes obscure the above mentioned findings, thus rendering the diagnosis of drowning at autopsy or PMCT difficult or impossible to make in decomposing bodies. Luckily, diatoms remain present even in severely decomposed corpses. Their detection is at times difficult, and, depending of the season, they may be so scarce in the water, that they may not be found within the corpse at all, even if all other findings clearly indicate that the victim drowned.

2. Method and materials

2.1. Case

A body of a young male clothed with boxer shorts was found drifting on the water surface near the shore of a lake. The corpse showed discoloration and bloating as signs of decomposition (Fig. 1), but no injuries.

By DNA profile comparison, it was possible to determine that the corpse was that of a 23 year-old man who was last seen jumping into the 22 °C warm lake during a city-wide dance party

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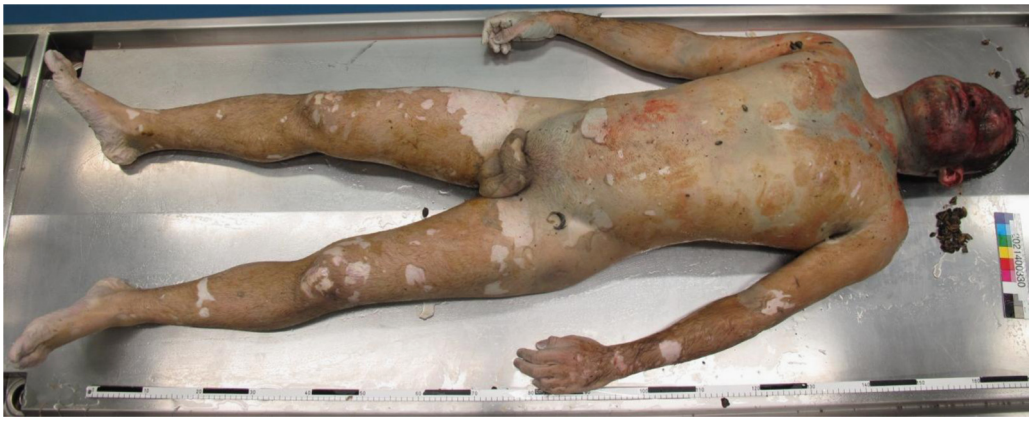

Fig. 1. Overview of the corpse. Note the discolouration and bloating, especially visible in the face.

six days prior to being found. On that day, air had been 25 °C, and the sky was partly sunny, partly cloudy and described as particularly humid. He had been missing ever since.

A forensic PMCT and autopsy was commissioned by the responsible district attorney in order to clear the cause and manner of death.

2.2. PMCT

PMCT was performed on a 128-slice dual source CT scanner (Flash Definition, Siemens, Forchheim, Germany). PM scanning was performed and the images reconstructed following a standard protocol [11].

3. Results

3.1. PMCT

There was gaseous distension of organs and symmetrically and evenly of fat and muscle tissue. Due to their distribution and in absence of haemorrhage or fractures, this emphysema was taken as a sign of decomposition. No vital injuries were discerned.

Radiopaque fragments, occasionally triangular in shape, their size varying from 1 mm to almost 5 mm, were found in the pharynx, trachea, oesophagus, and in the central and peripheral bronchi (Figs. 2 and 3). These fragments displayed Hounsfield Unit values of 480–1148.

The lungs were contained in gas-containing pleural cavities. There was bilateral mosaic pattern throughout the lungs (Fig. 4).

The mastoid cells were filled with radioopaque material, most likely fluid, to an extent covering at least 2/3 of them (Fig. 5). Conversely, the frontal, maxillary and ethmoid sinuses were almost entirely gas-filled, with only little fluid. The tympanic membranes appeared to be intact on both sides, middle ear cavities were gas filled and no indication of fluid.

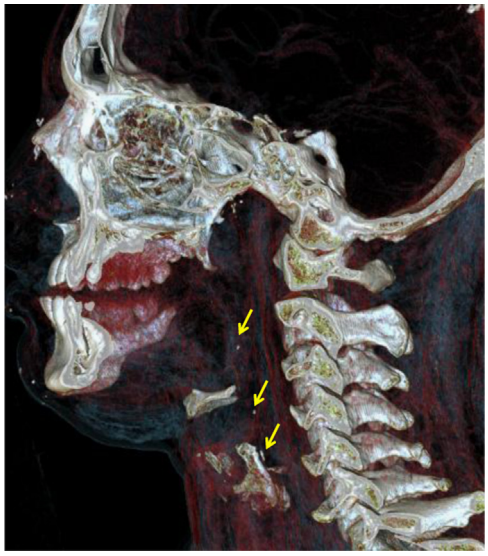

Fig. 2. 3D CT reconstruction showing tiny radiopaque structures within the pharynx (arrows).

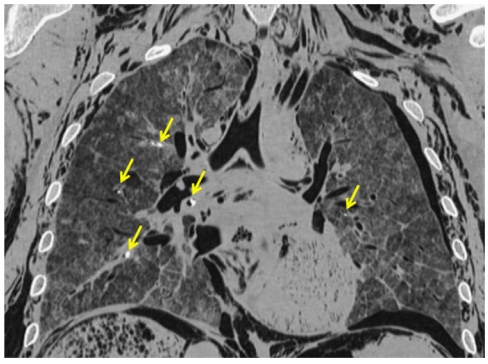

Fig. 3. CT reconstruction. Besides the gas accumulation in the soft tissues and inner organs due to putrefaction, radiopaque structures are seen in the lungs (arrows).

3.2. Autopsy and toxicology

The body showed red and green discoloration of the head, neck and upper chest as well as of the palms of the hands. The skin of the trunk was of normal to slightly green discoloration, whereas the extremities displayed a mostly normal skin colour. The skin exhibited softening on its outer layers in all body regions, with non-vital pale patchy defects. There appeared to be brownish algae on the remaining outer skin layers. At autopsy, as correlate for radioopaque fragments identified at PMCT, fragments of varying size of mussel shells (Zebra mussel shells, *Dreissena polymorpha*, Pallas 1771) were found in the oesophagus and in the central and peripheral bronchi (Fig. 6). These particular shells are abundant in our rivers and lakes, in particular also in the very lake where the body was retrieved [12]. Apart from these shell fragments, no other foreign matter, such as mud or sand, was detected in the airways or oesophagus. The rather scarce stomach contents (only 50 ml) displayed an indistinguishable sediment, probably silt, topped by an aqueous fluid with froth on top. Neck dissection exhibited well delineated skeletal muscle without signs of injury. Subcutaneous fat and muscle tissue of the whole body