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REVIEW

Homicide by drowning

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Abstract

In this paper we have reviewed the literature regarding homicidal drowning. Homicide of a child by drowning occurs occasionally, but it is much rarer that an adult is murdered in this way. When the victim is a child, there will often be few or no signs of violence due to the difference in size between the assailant and the victim, unlike the evidence of a struggle that is often found in adult victims of homicidal drowning, unless the victim was incapacitated by alcohol, drugs or physical weakness, or was unexpectedly pushed into or dragged under water. The incidence of cases in which the manner of death is undetermined is high in bodies retrieved from water. Therefore, a thorough investigation of such cases is needed.

Keywords Drowning · Exposure · Homicide · Greenland · Child

Most homicidal drownings reported in the forensic literature involve children drowned by an adult [1]. This may occur in family homicides where a parent, usually the father, kills his children and sometimes the spouse, often followed by his own suicide [2]. An example of such a homicide is described in Example 1. When the victim of homicidal drowning is a child, there may be no or few signs of violence, such as bruising or abrasions, due to the difference in size between the assailant and the victim. Drowning of a child may also be the result of fatal child abuse [3]. Nixon and Pearn [4–6] wrote papers in 1977 describing the characteristics of accidental and non-accidental immersion of children in bath water. Non-accidental immersion occurred at an unusual time of the day with the child alone in the bath. The perpetrators were usually the parents, and a precipitating domestic crisis was usually present. They also found that the victims were older compared to those that had died from accidental immersion (usually 15 to 30 months of age, compared to 9 to 15 months). Additionally, accidental submersion death occurred at the usual bath time. Usually, more than one child were present in the tub, and typically the oldest left the youngest at a time where there was no adequate adult supervision. Birth into a toilet, resulting in drowning of the newborn child, or the drowning of a newborn child in cases of concealed pregnancy, are seen occasionally [3, 7]. These cases necessitate careful investigation of the scene. The position of the infant and placenta must be documented with photography to determine if the position is consistent with delivery into the toilet. A complete history of the circumstances and the medical history of the pregnancy are obviously needed. Autopsy with post-mortem radiology, investigation of the placenta and the umbilical cord, and full microscopy is also important. A sample for paternity testing should be taken. Comparisons of water from the toilet, which sometimes contains chemical additives, with water from the stomach and lungs, are sometimes useful. If the infant was alive when it was delivered, froth may be seen in the water and in the face of the infant. Osculati et al. [8] presented an unusual child homicide performed by placing a seven-month-old baby in a washing machine and turning it on. The perpetrator was the mother who suffered from a serious depressive disorder. Melez et al. [9] reported a case motivated by divorce and struggle over child-custody in which a 30-year-old man and his five-year-old daughter were found drowned in the sea bound together.

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Example 1:

An eight-year-old girl was found dead in her father's house. She lay in supine position in the bathtub dressed in a blouse and underpants. Her clothing and hair were wet. The bathtub contained a small amount of water, and the plug had been removed. There was fixed lividity on the right side of the body that did not correspond to her supine position. There was blood-spattering on the floor and wall that was a result of the father having cut his own wrists.

Autopsy revealed small hemorrhages in the right sternocleidomastoid muscle and in the sternothyroid muscle, and there were many conjunctival petechiae in the conjunctivae, on the eyelids, in the face, and behind the ears. White froth was found in the trachea and mouth and around the nose and mouth, and the lungs were waterlogged; however, there was no fluid in the stomach or in the sinuses. The face was swollen and cyanotic. There was cerebral oedema. Two fresh suggillations were found: on the right thigh and on the left hip.

The cause of death was assumed to be manual strangulation, possibly in connection with drowning.

The perpetrator was an alcoholic and had been physically abusing his wife for many years. He admitted having killed his daughter by applying gaffer tape over her mouth, pulling a plastic bag over her face and manually strangling her. He then held her head under the water in the bathtub to "make sure she was dead". The motive was divorce. His wife had moved to a women's crisis centre.

Homicidal drowning of an adult is much rarer [10–12]. In these cases, signs of violence are often found, unless the victim was incapacitated by alcohol, drugs or physical weakness, or was unexpectedly pushed into or dragged under water [10, 13]. An example from Greenland has been described in Example 2. The general homicide rate in Greenland is high (23/100,000 inhabitants per year, population 2018: 55,577) [14].

Example 2:

On an April morning at 08:00, a man was collecting refund bottles at the back entrance of "Pub Nuam", in a small settlement on the west coast of Greenland, and noticed blood on the snow, a cap and some personal belongings, including a bankcard, lying next to a stack of pallets. He was acquainted with the man whose name appeared on the bankcard, and he called the police. The police officers noticed dragging tracks in the snow leading towards the fiord. They followed the tracks and found traces of blood on an ice slope that led down to the coastline where they discovered a hand sticking up between two ice floes. The ice floes tend to float to the tide. It took the fire brigade several hours to remove the heavy ice floe with a lift, so that the body could be recovered. It was a 55-year-old man who lived in the settlement. A forensic autopsy was carried out days later when the forensic pathologist from Denmark arrived. The autopsy revealed bruising and contusion wounds to the face (Fig. 1), bruising on the left side of the neck, on the upper anterior aspect of the thorax and on the back. More bruising, assumed to be defense lesions, was found on the left underarm and on the back of the left hand. The temporal muscles were infiltrated with blood, but there were no cranial fractures, intracranial bleeding or cerebral contusions. A dissection of the face did not reveal any extracranial fractures. No fractures of the hyoid bone or the laryngeal cartilages and no conjunctival petechiae were found. There was no froth in the mouth or in the airways. The lungs were large, bulky and pale, with a crepitant texture, and the cut surfaces were wet with foamy fluid (weight right/left lung: 745 g/685 g). No Paltauf spots were found. There was 700 ml of straw-coloured fluid in each pleural cavity, but there was no water in the stomach. The paranasal sinuses were not investigated. The skin of the hands was waterlogged (dishpan hands). There were no signs of disease, other than a slight degree of atherosclerosis of the abdominal aorta. The cause of death was assumed to be drowning combined with exposure to cold water. Toxicology showed 1.78 ‰ alcohol in the blood and 2.70 in the urine but no signs of medications or narcotics. Microscopy of the lungs demonstrated acute dilation of the alveoli, with extension, elongation, and thinning of the septa, with compression of the alveolar capillaries and eosinophilic fluid in the alveoli. Heart, liver and kidney tissues were normal.

A video surveillance camera covered the area of the presumed crime scene next to a boathouse behind the pub. The video recording indicated that from 01:48 to 02:35 the same night, a man, later identified as a 35-year-old local man, had mistreated the victim with fist blows and kicks. The victim, who seemed to be severely intoxicated, did not try to escape or call for help. He was eventually dragged away in the direction of the fiord and out of the field of view of the video camera. The perpetrator, who admitted to having been intoxicated at the time of the assault, then went to a party where, according to witness statements, he said that he had been beating a man and then threw him into the sea. Nobody believed him, and therefore, the police were not notified. He was arrested the following day after being recognized from video footage of another video camera that covered the exit door from the pub.

A thorough investigation of a body that is retrieved from water is required to determine the mode of death [1, 15, 16]. Lunetta et al. [11] conducted an investigation in Finland and found a high incidence of an undetermined manner of death at the medicolegal inquest in drowning cases, indicating that homicidal deaths may be underreported [17]. Lucas et al. [18] found that the mode of death was undetermined in approximately one-third of all bodies found dead in the waterways of New York City.

The final conclusion regarding mode of death is usually a result of cooperation between the pathologist, other forensic scientists and the police. The investigation begins at the scene where the deceased was found or where the incident occurred.

A full autopsy is important for determining the cause and mode of death, for reconstructing the events that preceded the death and for identifying the victim [1]. In addition, it is clearly important to determine whether the deceased person died from drowning and whether the person was alive before entering the water. It is essential that all body injuries be described. The main positive findings for drowning are froth in the airways and exuding from nostrils and mouth (Fig. 2), water-logged lungs (emphysema aquosum) (Fig. 3), hydrothorax, water in the stomach and nasal sinuses and wrinkling of the skin of hands and feet (dishpan hands) (Fig. 4). These findings are, however, not specific for drowning and can be observed in drugoverdoses and cardiac deaths; the absence of these symptoms cannot exclude the possibility of drowning. Occasionally foreign bodies from the water have been aspirated to the airways (Fig. 5). The diagnosis is especially difficult

Fig. 1 Head of the deceased (Example 2) with a contusion wound in the right eyebrow and suggillations and abrasions on the forehead, cheek, jaw and nose

when there is a delay in recovering the victim. Bodies that are found in the sea will often be decomposed and injured by the action of waves against obstructions or by marine predators (Fig. 6), and blood may be washed out of the wounds. After a few weeks or months, adipocere formation begins. These changes may complicate the evaluation of the case. In Example 2 the body was found quickly, so it was still possible to detect vital lesions. Determining the time of death based on body temperature is difficult if the body has been in water for an unknown period of time. Determining the time in water based on post-mortem changes also difficult. Bodies found in the water are sometimes weighed down or have their hands or feet bound together. Although this can be seen in cases of suicide, it should be considered suspicious. A close investigation of the knots is important to determine whether they could have been tied by the deceased [19]. Pollanen [20] presented six cases of homicidal drownings that were investigated using the diatom test for drowning. The diatoms were extracted from the bone marrow and compared with those obtained from samples of a putative drowning medium. The diatom test gave important information regarding the cause of death and site of drowning in all cases, even when the bodies were recovered on dry land. However, the diatom test is not sensitive, and diatoms can be absent, even in obvious cases of drowning, and the test is sensitive to contamination. Comparison of the content of water from the site of drowning with aspirated material in the bronchi or in the stomach or found on the body or clothing is sometimes useful [3].

Fig. 2 Drowning victim with froth emerging from the nostrils

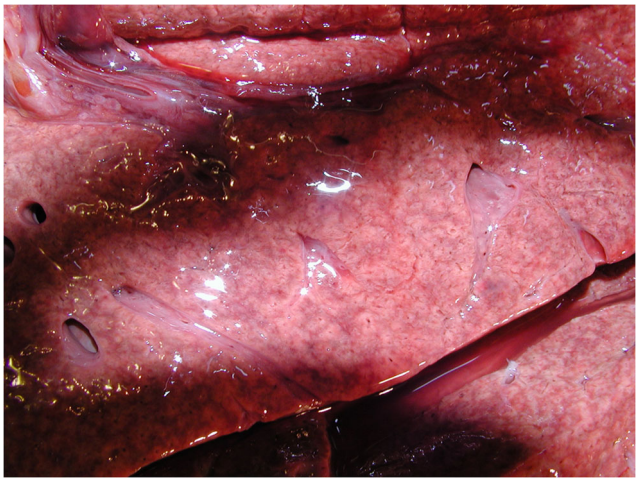

Fig. 3 Lungs from a drowning victim. The lung tissue is pale and oedematous

Presence of alcohol in the blood of both the victim and perpetrator is commonly reported in the literature [21]. Missliwets et al. [22] described a case in which a drunken dispute between two alcoholics led to homicide by drowning in a pond. The perpetrator was a woman who was physically larger than the male victim. Autopsy revealed evidence of a struggle. A full toxicological screening is important to determine whether the deceased was under the influence of alcohol or other drugs at the time of death. Carbon monoxide poisoning should also be considered in cases of death in a bathtub. Seizure disorders such as epilepsy may also result in drowning [23, 24],

People can drown in rivers, lakes or the sea; they can also drown in bathtubs [25], swimming pools or in other bodies of water, such as wells [26].

Several bathtub deaths via homicide have been documented in the literature. The most famous is the so-called "brides in the bath" murders from England, for which the serial killer

Fig. 4 Wrinkling of the skin of the hands in a drowning victim (dishpan hands)

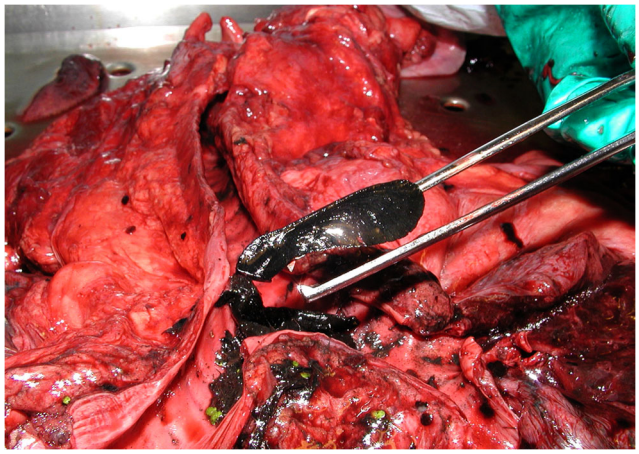

Fig. 5 A drowning victim who has aspirated foreign material to the airways

and bigamist, George Joseph Smith, was executed in 1915 [27]. He murdered three wives, two of them during their honeymoon, by dragging them underwater by the ankles while they were taking a bath. The mechanism of death was probably reflex asphyxia (vagal inhibition) caused by a sudden influx of water through the mouth and nose. No lesions were found due to the element of surprise; the deaths were initially judged to be natural deaths or accidents. Reconstruction of the events with the original bathtub and a figurant can be of importance in such cases [28]. Another famous bathtub homicide from Yorkshire, England, in 1957 was considered the first

Fig. 6 A drowning victim with lesions caused by marine predators

proven murder by insulin and was an example of a combined poisoning and drowning [29]. Kenneth Barlow, a 38-year-old male nurse, reported that he had found his 32-year-old wife dead in the bath. An autopsy revealed signs of drowning and an 8-week pregnancy. On thorough re-examination, two hypodermic injection sites were identified on each buttock. Tissue samples taken from the injection sites were shown to contain insulin. The amount of insulin injected was sufficient to render her unconscious and was potentially lethal. Kenneth Barlow was found to be guilty and sentenced to life imprisonment. Fanton et al. [30] reported a case from France in which a woman was found dead in the bathtub. Autopsy confirmed drowning, but the diatom test showed the presence of two taxons of diatoms (*Cocconeis scutellum* and euglipta) that are found in marine and fresh or brackish water, respectively. The husband later admitted that he had drowned his wife in a marshland in Brittany, transported her body to their home in Paris and arranged the scene in the bathroom. Pfeiffer et al. [31] reported a case where a husband was sentenced for killing his wife by drowning in a bathtub and electrocution. Because of the high heat capacity of water, an electrical burn is rarely found in such cases [32, 33]. According to Bonte et al. [33], electrocution in the bath seems to cause the margin of hypostasis to correspond with the horizontal line of the water level. Electrocution death in the bath is now very rare due to the widespread use of fault detecting relays.

There can be many different reasons for using drowning as a method of homicide. Many homes have a bathtub, and drowning may be perceived as an easily accessible method. A few planned cases of homicidal drowning involved luring the victim out for a walk and pushing them into the water [13]. Drowning may also be the conclusion to a primarily differently executed assault (often strangulation) [34], as in the case presented in Example 2. These cases are sometimes called secondary homicidal drownings. The victim may also be dumped in water to camouflage the death as an accident. In Greenland, the water is so cold that a body will rarely resurface, and it was quite lucky that the body was found so quickly after the event. Missliwets et al. [22] described a case of a 23-year-old man found in a river; the lesion pattern and the findings of fat embolism and car paint in an abrasion suggested that the victim had been hit by a car and then thrown into the river while still alive. The disposal of a murdered body in water is well known, but is not within the scope of this paper.

Key points

1. Homicide by drowning of a child occurs occasionally but is rare in adults.
2. Homicide by drowning of children is mostly seen in family homicides, fatal child abuse and in cases of concealed pregnancy.
3. Homicide by drowning of an adult is seen in drunken disputes, as planned homicides or to camouflage the death as an accident.
4. Drowning may be the conclusion to a primarily differently executed assault (secondary homicidal drowning).
5. If a dead body is found in water, the case must be thoroughly investigated to determine the mode of death.
6. Evidence of a struggle will often be found at autopsy in adult victims, but is not always present if the victim is a child.
7. Many adult victims of homicidal drowning are intoxicated by alcohol.

Compliance with ethical standards

Conflict of interest The authors declare that there is no conflict of interest.

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