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Case Report

An autopsy case of suction injury

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ABSTRACT

The right upper extremity of a 38-year-old man was entrapped in an underwater intake of a water duct of a dam reservoir, and he died despite being promptly rescued. His right upper extremity was swollen and exhibited purplish-red discolourations. The skin had numerous blisters and increased tension. Severe subcutaneous and muscle bleeding were observed in the right upper extremity. The circumference and volume of the right upper extremity were approximately 1.2 and 1.4 times, respectively, that the circumference and volume of the left upper extremity. The increase in weight of the right extremity was calculated to be approximately 2.1 kg; this finding indicates a severe decrease in the victim's central blood volume. Furthermore, it is possible that much more than 2.1 kg of blood accumulated in the upper extremity upon exposure to vacuum pressure. We conclude that the victim died of circulatory collapse that was attributable to haemorrhage and re-distribution of blood as a result of vacuum pressure on the right upper extremity. Thus, we have examined the cause of death and the effects of vacuum pressure on the human body.

1. Introduction

Suction injuries occur when a part of the body is exposed to negative pressure. Most suction injuries are only slight bruises resulting from the rupture of small superficial vessels; a 'love bite' is probably the most common suction injury [1]. The severity of suction injuries depends on factors such as the magnitude of the negative pressure, the length of exposure, and the area of injury. When a part of the body is exposed to prolonged strong negative pressure, severe suction injury occasionally occurs and often leads to the development of a compartment syndrome. If prompt adequate treatment is not administered to a patient with compartment syndrome, the patient's condition deteriorates and/or after-effects ensue [2–5].

We report an autopsy case of suction injury in a 38-year-old man whose right upper extremity was sucked into the intake of a water duct. His right upper extremity was exposed to vacuum pressure in the duct for approximately 15 min, and he eventually died of the suction injury. To the best of our knowledge, deaths resulting from suction injury alone have not been reported; in addition, the physiological effects of vacuum pressure on the human body have not been investigated. Here, we discuss the cause of death and the effects of vacuum pressure on the victim.

2. Case report

A 38-year-old man, who was employed in the water works industry, was performing maintenance work on a duct for which he had to stop the water flow from the reservoir of a dam. He was unable to turn off a valve on the duct; therefore, he attempted to plug an underwater intake of the duct by using a traffic cone. The duct intake was attached under a plastic float and floated at a depth of 80 cm under water. He inserted the cone into the intake (Fig. 1). Instantaneously, the cone broke, and his right upper extremity was sucked into the duct. Although a co-worker who heard his scream immediately went to his rescue, the right upper extremity could not be released from the duct. The victim became unconscious, and the co-worker kept the nose and mouth of the victim above the surface of the water until an emergency crew cut open the duct. The upper extremity was released approximately 15 min after the accident, but the victim experienced cardiopulmonary arrest. The victim was transported to a hospital, and cardiopulmonary resuscitation was performed on him for approximately 10 min during the transport. However, he was pronounced dead approximately 1 h after arrival at the hospital.

The water from the dam continuously drains through the intake placed in the reservoir to a water plant, which is located at a distance of approximately 1 km. Water drainage to the water plant is facilitated by an approximately 20-m decrease in the height of the water surface from the reservoir to the water plant. The

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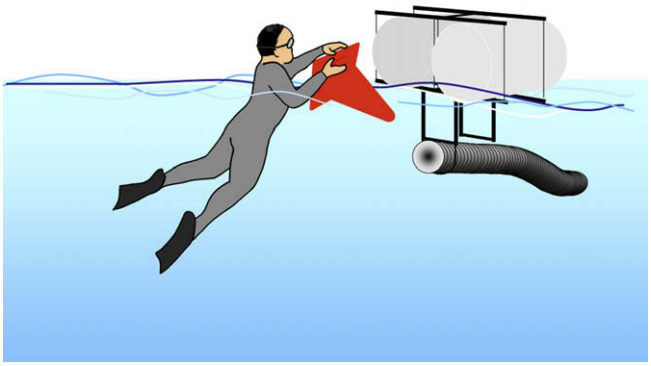

Fig. 1. An illustration of the victim attempting to stopper the underwater intake with a traffic cone before the accident.

amount of water that drains from the dam is approximately 1600×10^3 kg/day. The duct was made of polyvinyl chloride and had concentric patterns on the surface, and its inner diameter was 20 cm. During an investigation after the accident, a man inserted his upper extremity into the duct, and found that his upper extremity tightly fit in this space (Fig. 2).

The victim, though slightly overweight, was otherwise healthy and did not have any other relevant personal medical history.

3. Autopsy findings

An autopsy was performed 22 h after death. The length and weight of the body were 168 cm and 86 kg, respectively. Slight post-mortem hypostasis was observed on the back; no petechiae were observed in the palpebral conjunctivae. The entire right upper extremity was swollen and exhibited purplish-red discolourations (Fig. 3), increased skin tension, and numerous blisters (Fig. 4). A continuous linear abrasion from around the shoulder to the axilla was noted; this abrasion sharply demarcated the injured area from the normal area. Concentric band-like bruises were observed at regular intervals on the skin between the shoulder and upper arm; the pattern of these bruises resembled that of the surface of the duct. The right hand showed gross swelling and was considerably larger than the left hand (Fig. 5). The circumferences

Fig. 2. An on-scene investigation. The entire upper extremity of an adult male was trapped so tightly in the duct that it could not be pulled out.

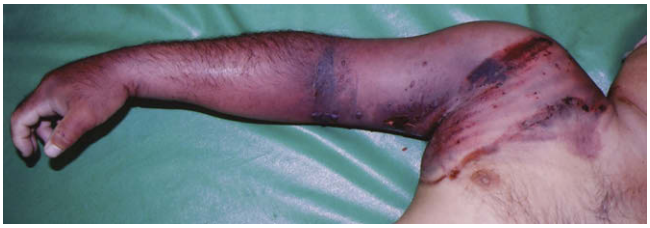

Fig. 3. The right upper extremity showed severe swelling and purplish-red skin. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

Fig. 4. Concentric band-like bruises were arranged at regular intervals on the shoulder and axilla. There were numerous blisters on the upper arm.

of both the upper extremities were measured at different points (Table 1). Severe haemorrhage was observed in the subcutaneous region and skeletal muscles of the upper extremity (Figs. 6 and 7), and a large amount of bloody fluid oozed from the incision site. The subcutaneous haemorrhage extended to the right side of the neck with bleeding from the sternocleidomastoid and platysma muscles, but injury of the carotid artery or the internal and external jugular veins was not observed. The aorta and the superior and inferior vena cava were not damaged; moreover, haemorrhage in the mediastinal area was not observed. The major arteries located between the brachiocephalic and brachial arteries, and the right subclavian and axillary veins were not damaged. The heart weighed 430 g and did not exhibit any abnormalities, but it was

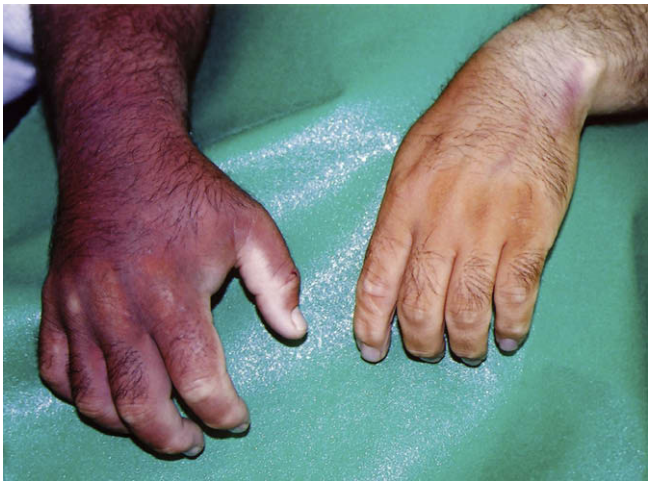

Fig. 5. Both hands of the victim. The right hand is much more enlarged than the left.