



## Case report

## A rare case of a scuba diver's death due to propeller injuries of a desalination pump

G. Perilli <sup>a</sup>, B. Di Battista <sup>a</sup>, A. Montana <sup>c</sup>, J. Pavia <sup>b</sup>, S. Cauchi <sup>b</sup>, N.M. Zerafa <sup>b</sup>, C. Pomara <sup>a, b, \*</sup><sup>a</sup> Department of Forensic Pathology, University of Foggia, Ospedale Colonnello d'Avanzo, Viale degli Aviatori 1, 71100 Foggia, Italy<sup>b</sup> Department of Anatomy, University of Malta, Msida, Malta<sup>c</sup> Department of Forensic Toxicology "G.F. Ingrassia", University of Catania, via S. Sofia 87, Comparto 10, 95123, Catania, Italy

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## ABSTRACT

Water skiing, boat racing, skin and scuba diving, as well as pleasure boat cruising are becoming increasingly popular hobbies. As a result, the incidence of injuries secondary to motor propellers is becoming more frequent. Injuries by propellers, amputation, death by drowning, and bleeding are rare reported events in forensic literature. The most common circumstances surrounding boat-propeller-related injuries are concerned with getting into or out of the boat, personal watercraft use or water skiing, and falling or being thrown from the boat. A case of a scuba diver's death that occurred during an illegal scuba fishing trip around a desalination plant is presented. A complete autopsy and histological study of all organs and surfaces of dismembered cadaveric sections, performed in order to determine the phases of death, are reported. An underwater scene investigation was conducted by an engineering team studying the mouth of the pump and the dynamic characteristic of rotating propeller blades.

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## 1. Introduction

Water skiing, boat racing, skin and scuba diving, and pleasure boat cruising are hobbies whose popularity is on the increase. As a result, the incidence of injuries secondary to motor propellers is becoming more frequent.<sup>1,2</sup>

According to previous reports, the frequency of propeller accidents is greater than 1 in every 20 boating accidents, with a fatality rate of 15–23%. 75% of the victims are male.<sup>3,4</sup>

The sharp blades of propellers rotating at high speeds cause multiple serious injuries such as bruises, contusions, deep lacerations, chop wounds, open wounds, musculoskeletal and vascular injuries, bone fractures, traumatic mutilation of extremities, and death.<sup>5,6</sup>

## 2. Case report

A 56-year-old man was at a scuba diving fishing trip at around 6:30 am with two other scuba divers. The men were fishing at

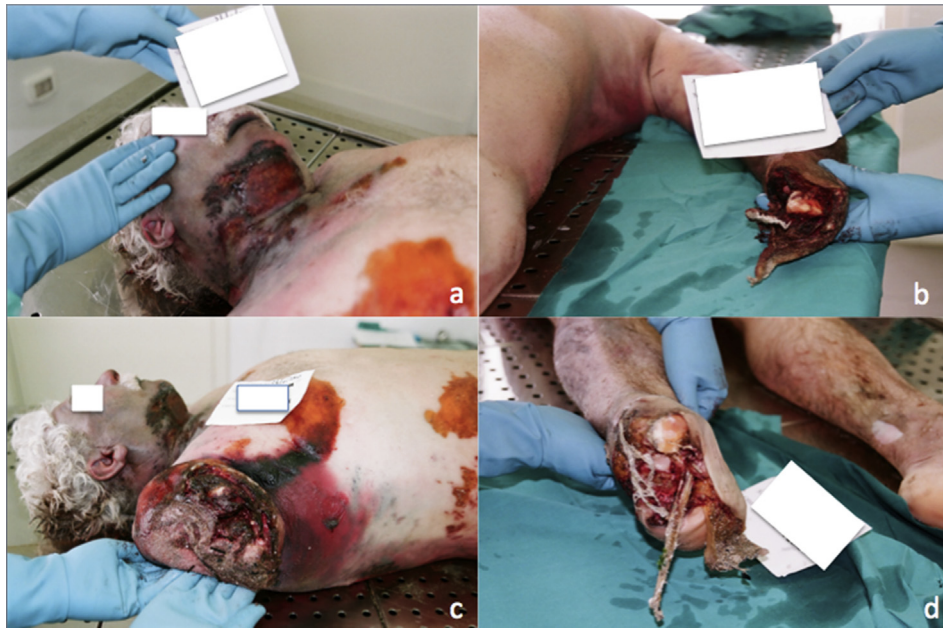
3–4 m depth, about 30 m away from the beach. It was decided that fishing will occur close to a disused desalination plant, as the enormous quantity of "big mussels" attached onto the surface of the underwater part of the desalination pump probably served as an element of attraction. A large, bloody patch in the water surrounding a lifeless corpse of one of the crew member attracted the attention of the crew shortly after an unexpected burst of activity of the desalination pump. The corpse was rescued to shore and the local authorities were alerted.

The autopsy was performed 24 h after death. The external examination of the body showed an abrasion of the neck of a length of 12.5 cm and a width of 11 cm (Fig. 1a). A large bluish/red abrasion/contusion of the right thoracic wall extending to the superior part of the ipsilateral abdominal wall was also noticed. Multiple amputations of the arm and leg were observed, particularly left hand amputation that showed the distal epiphysis of the radius and ulna (Fig. 1b); right upper limb amputation in which the proximal portion of the humeral epiphysis was recognizable (Fig. 1c); and right foot amputation in which the heel, the distal epiphysis of the tibia and fibula were identified (Fig. 1d). Multiple abrasions of the right lower limb were observed. Portions of the right hand and a part of the right foot were found near the propeller.

Autopsy confirmed the complete sectioning of the right arm, the left forearm and both ankles and corresponding great vessels (both

\* Corresponding author. Department of Forensic Pathology, University of Foggia, Ospedale Colonnello d'Avanzo, Viale degli Aviatori 1, 71100 Foggia, Italy, Tel.: +39 3332466148 (mobile), fax: +39 0881736903.

E-mail address: [crisforpomara@hotmail.com](mailto:crisforpomara@hotmail.com) (C. Pomara).



**Fig. 1.** a) Excoriations and contusions of the neck; b) Mutilated left hand; c) Mutilated right upper limb; d) Mutilated right foot.

the axillary, the cephalic and basilic veins). A contusion of the thoracic soft tissue with multiple fractures (the left sixth rib from the fifth to the eighth right rib) were also described. Examination of all other organs was unremarkable, except for pulmonary and cerebral oedema. The autopsy findings of lungs showed oedema and were increased in volume and size, with few sub-pleural haemorrhagic spots.

Vessels were completely free of blood.

Histological examination with standard H&E staining showed mild cerebral oedema with focal subcortical haemorrhagic spots and focal pulmonary oedema associated with extended areas of atelectasia, acute emphysema (Fig. 2a), and “ballonee” cells inside the alveolar spaces (Fig. 2b).

The skin revealed the presence of red blood cell infiltration into derma (Fig. 2c,d) of all dismembered surfaces.

The toxicological analysis did not reveal the presence of drugs or alcohol. An underwater scene investigation was conducted by an engineering team, studying the mouth of the pump and the dynamic characteristic of rotating propeller blades.

The prosecutor's office immediately verified and confirmed that the desalination plant was in action only for a few minutes (approximately 5 min) due to exceptional technical servicing.

Consistent with the data obtained and with the dynamics of the fatal event, the cause of death resulted by drowning and massive haemorrhage due to propeller injuries.

### 3. Discussion

Propeller injuries are rare events and are thus seldom reported in literature. According to previous reports, the fatality rate in propeller accidents is 15–23%, with an incidence of propeller accidents being greater than one in every 20 boating accidents.<sup>1,4,7,8</sup>

Most propeller injuries occur at water recreational facilities such as those equipped for water skiing, boat racing, and skin and scuba diving.<sup>7,9</sup>

Due to an increase in the popularity of such activities, the number of boat propeller accidents are on the rise.<sup>1,2</sup> Injuries

caused by the propeller can be very serious; they typically cause multiple, deep, parallel lacerations that can result in permanent scarring, substantial blood loss, traumatic or surgical amputation, or death.<sup>3,9</sup>

Death can often result due to the physical trauma sustained from the propeller blades, such as severe chop wounds on the head or thorax, with head injury being the commonest cause of death in such accidents. If the wounds sustained are not immediately fatal, massive haemorrhaging from the propeller wounds could ensue, which could itself be the primary cause of death.

In addition to the wounds sustained by the propellers, the victims are at risk of drowning; a factor that increases the risk of mortality in such accidents.<sup>10</sup>

To the best of our knowledge there have been no reported injuries or deaths related to propellers from a desalination plant prior to this case. This case shows the severity of injuries and their sequelae, until the death caused by high-speed propellers of the desalination pump. Theoretically, it has been shown that a typical three-blade propeller rotating at 3200 rpm and with a blade length of 33.2 cm can cut an average person from head to toe in less than one tenth of a second.<sup>3,8</sup>

In this case the engineering findings showed that the man, while fishing, was aspirated from the terminal part of the desalination pump (Fig. 3 a, b, c). It is possible that the man had approached the final stretch of the desalination pump when it was turned off. The sudden turning on of the desalination pump with the current of the intake flow and the rapid rotation of the desalination pump propellers violently sucked the man towards the rapidly rotating blades, slicing the entire right arm, left hand, and right foot.

An opinion is held that in the type of accident that has just been described, autopsy remains the only option to elucidate both the manner and the cause of death. The histological study of all organs, in particular the skin surfaces of the dismembered sites, is essential to determine the vitality of injuries, whilst that of the lungs is essential to establish drowning diagnosis and qualifying the phases of death.

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