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CASE REPORT

Serious *Physalia* (Portuguese man o'war) stings: implications for scuba‡ divers

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The objective of this study was to describe a serious jellyfish envenomation in a scuba diver by an Atlantic *Physalia physalis*, to review the related literature and to recommend safe diving practices that may reduce the risk of serious jellyfish envenomation in divers. A healthy scuba diving instructor wearing a full wetsuit and gloves but no hood ascended from a night dive and surfaced directly under a large Atlantic *Physalia* jellyfish. He suffered multiple severe stings to the unprotected areas of his face and neck. He developed acute subjective respiratory distress with hyperventilation, muscle pain and spasms, and impaired consciousness en route to hospital, more than 10 min following envenomation. He recovered quickly in hospital with oxygen, aminophylline and intravenous fluid administration. Delayed recovery of the envenomated skin took several weeks and serology was positive for *Physalia* venom antibodies. Full protective clothing (e.g. a full, long sleeved wetsuit, plus gloves and hood when appropriate) should be worn by scuba divers on all dives. Ascent routines in diving should include looking directly upwards at the surface with one wetsuited arm outstretched towards the surface throughout the ascent. Removal of tentacles should not be attempted by the diver until he or she has exited from the water.

Key words: *Physalia*, Portuguese man-o'war, jellyfish, stings

Introduction

It has generally been accepted that there is only one species of stinging *Physalia* (Portuguese man o'war) jellyfish worldwide [1]. This matter is under current re-investigation [2] since documented fatalities have occurred from the Atlantic species [3,4], but death after a Pacific *Physalia* sting is not yet known. A scuba diver was a victim in one of the fatalities [3] when stung by the multi-tentacled Atlantic *Physalia* [5,6]. By contrast, the single-tentacled *Physalia* – typified by the familiar Australian

‡scuba = self-contained underwater breathing apparatus
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Bluebottle – inflicts what may be the world's most common, non-serious jellyfish sting; a painful, 'beaded' urticarial cutaneous eruption (Fig. 1) [7,8].

Some serious effects, probably from Indo-Pacific *Physalia* envenomations [9–11], have occurred upon a scuba diver [10]. We report a serious envenomation in a scuba diver from the Atlantic *Physalia* species, draw correlations between this patient and previous victims, and suggest scuba diving practices which may reduce the risk of serious jellyfish envenomation in divers.

Case report

On December 19 1987 a healthy 45-year-old, 95 kg scuba diving instructor surfaced from a night (19:30) dive without a hand-held light, from a depth of 9 m at Pacific Reef off Miami, Florida. He felt a slight 'mosquito bite-like' sting on his left cheek as his bare head broke the surface. He was handing a lobster from each hand to a boat captain. He then suddenly experienced a series of vicious burning sensations on his body which was not protected by a dive mask, regulator or full-body wetsuit. He had surfaced directly under a large Portuguese man o'war (*Physalia physalis*). He then rolled in the water attempting to avoid the sting, thus 'wheeling' the animal's body onto his head with the bulk of its stinging tentacles wrapped around his neck and head. His immediate response was to remove the animal. He discarded his buoyancy vest and sprang onto the dive platform where he doused himself with approximately 950 ml (1 US quart) of a 50:50 mixture of vinegar (4–6% acetic acid in water) and 70% ethanol. Several minutes later the boat captain doused him with 950 ml of unidentified household 'bleach solution'.

The intense pain increased in severity along the mid-chest, sacral and right deltoid areas. Within the next 5 min he developed strong tonic/clonic spasms of all skeletal

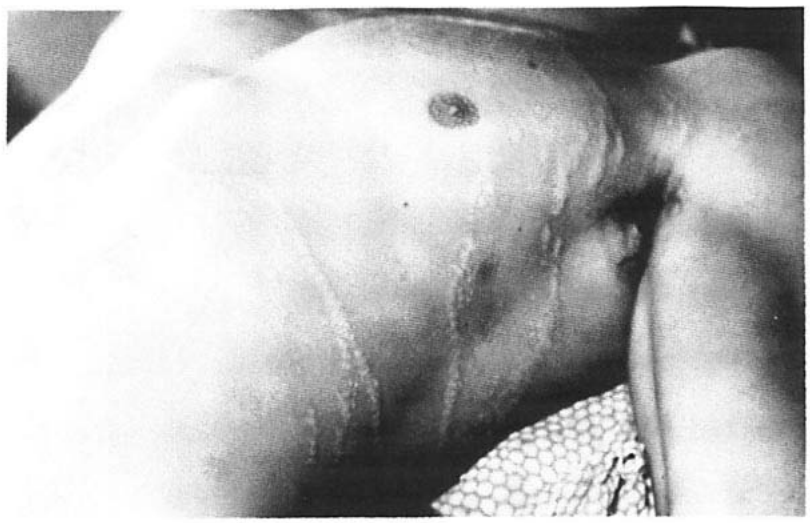

Fig. 1. Multiple stings from several Pacific *Physalia* on a lifesaver who swam through a 'navy' of animals in the surf, photographed some 30 min following tentacle contact. Note the linear, blanched, almost coalescing papules where direct tentacle contact has occurred, and the surrounding angry red flare. Pain was severe.

muscles, accompanied by a decreasing ability to concentrate or to breathe properly. He began to administer oxygen to himself at 6 l min^{-1} continuous flow via a simple Hudson oxygen therapy mask, supplied from a 'Mada' preset oxygen regulator. He switched to nasal cannulae at the same oxygen flow rate, but this produced no subjective improvement.

Breathing became exhausting; respiratory muscle activity was limited to the upper intercostal muscles because of the abdominal spasms. He assumed a semi-Fowler's position as the rescue boat approached shore. Intravenous (IV) access en route was not possible due to intense peripheral venoconstriction. The patient's conscious state deteriorated during the helicopter ride inland from the boat dock to the emergency room – a period of at least 10 min. On arrival in the emergency room he was unconscious, his respiratory rate was 38 breaths per min, and his blood pressure 160/100 mm Hg. Intravenous therapy with Hartmann's solution was commenced, IV meperidine 100 mg was administered and a urethral catheter inserted. An electrocardiograph monitor at 19:50 h showed sinus tachycardia of 120 min^{-1} with unifocal premature ventricular contractions. The patient was 'shaking'. No airway obstruction was recorded. Arterial blood gasses on an inspired oxygen concentration (FIO_2) of approximately 60% were recorded as P_aO_2 125 mm Hg, P_aCO_2 13 mm Hg, pH 7.65, HCO_3 (calculated) 14 mM l^{-1} (NR for laboratory 22–25 mM l^{-1}). His white cell count was 29100 with 61% polymorphonuclear leukocytes, 20% lymphocytes, 5% monocytes and 14% banded forms; serum sodium, potassium and creatinine were normal.

He remained obtunded for 'several hours'. While in the hospital, he also received 0.5 mg of adrenalin subcutaneously, IV aminophylline (dose unknown), and 10 mg of diazepam and 25 mg diphenhydramine intramuscularly. After 7–8 h under close observation and having received 4 l IV fluids during that time, he had improved sufficiently to be discharged from the hospital. One oral dose of hydrocortisone was taken before discharge (amount unknown).

Two days later the patient had violaceous, urticarial lesions on hands, face and neck. The latter two areas were still edematous and by then pruritic. Generalized fatigue persisted for at least 10 days and local hyperpigmentation for many weeks. Slight edema and hypesthesia of the left face was present for 3 weeks. Examination of the patient's serum 5 years following this episode revealed positive *Physalia* venom antibody IgG titres to a dilution of 1:450 (normal; 1:50 or less) [12].

Discussion

Physalia ('Portuguese man o'war', 'Bluebottle') jellyfish are usually blue–purple floaters which may be identified from below by divers looking upwards towards the surface during a controlled ascent (Fig. 2). Adherence to a standard diving axiom (Look up, reach up, come up) might have changed the outcome for the better in our victim's case. The patient, who was carrying a lobster in each hand, was stung on the highly vascular areas of the face and neck which broke the surface first. Had he ascended with a light, an arm extended and looking upwards, he might have seen and deflected the jellyfish so that the tentacles would have wrapped harmlessly around his wetsuited, elevated arm. These precautions apply equally to breath-hold divers [5,6].

Wearing correct diving clothing was probably life-saving in this case. Unfortunately an earlier diver, a 30-year-old male wearing only the bottom half of a wetsuit, succumbed to

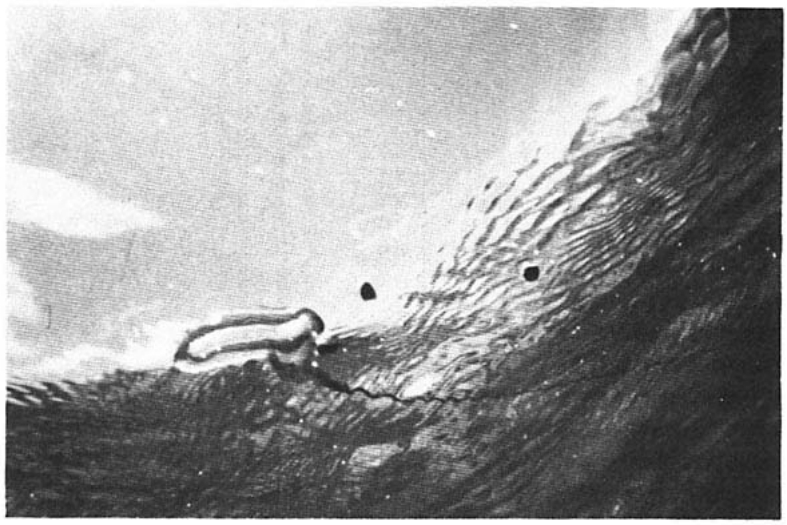

Fig. 2. A Pacific single-main-long-tentacled *Physalia utriculus*, photographed from below the surface, as may be seen by an ascending diver. This animal was in a gentle sea current; hence the main tentacle is seen streaming down-current rather than (as so often pictured) hanging vertically in the water below the floating body.

an Atlantic *Physalia* sting delivered over the exposed upper body as he ascended during a daytime dive into the floating medusa [3]. On another occasion a bare-chested skindiver survived but was seriously envenomated by *Physalia physalis* [5].

Our case also reinforces the necessity for close and sustained observation of jellyfish-envenomated patients. While the cause of our subject's impaired conscious state remains debatable (e.g. a contribution from hyperventilation or possible prolongation by meperidine), it did not occur until 10–30 min after his sting. This is similar to one other non-fatal report [9]. Another documented serious *Physalia*-envenomation victim lost consciousness much sooner [5]. This suggests that the time interval between the sting and the onset of impaired consciousness does not necessarily correlate with the gravity of the situation, and that medical attention must be sustained during early post-sting hours.

Other features emerge from a review of the documented cases. One scenario in particular appears repeatedly: a diver ascends blindly into the medusa [3,5] or is stung while finning along underwater [10], panics [5,6], and may swim upwards into the jellyfish [3,6]. Most jellyfish tentacles tend to adhere to a victim's skin, allowing the jellyfish to move or be pulled closer and become entangled on the victim [4,5]. Therefore, divers might be advised to respond to a sudden pain or sting by resisting the (natural) tendency for rapid or jerking withdrawal movements [6]. Following such controlled evasive movement, ascent should be conducted as best possible with appropriate buddy communication. Uncontrolled or panicked ascent (a dangerous event for any scuba diver) [13] should not occur. Slower, rational maneuvers, if possible combined with visual detection of the animal and/or its tentacles (requiring an underwater light for night diving), are more likely to avoid further contact with other tentacles or the floating

body of the jellyfish. As already indicated, prior to actual ascent, the diver (and his ascending buddy) should look up, reach up and then come up. Night dive ascents without lighting are clearly unsafe. If jellyfish parts (or any other hazard [14]) are still directly above, visibility permitting, avoidance is thus possible.

Additionally, divers should be cautioned not to attempt removal of adherent tentacle material in the water; such manipulation usually results in increased stinging. Tentacle removal should occur after the patient is out of the water and his/her condition is stabilized. Unlike chirodropid (multi-tentacled box jellyfish) envenomations [15], the area of skin visibly affected by many jellyfish stings does not directly correlate with a potentially serious outcome. Life-threatening *Physalia* envenomations may result from stings producing relatively small cutaneous reactions [9] (this includes the uncommon but confirmed possibility of anaphylaxis [16]). In addition, two of the serious cases [9,10] but none of the lethal stings [3,4] involved only the lower extremities. *Physalia* stings on the legs can present with systemic symptoms [10] as well as a severe swimming problem because of cramping in the large muscle groups of the legs, arms and chest.

Muscle cramps after a jellyfish sting also may affect a swimmer's or diver's breathing. This phenomenon has been observed repeatedly [5,6,17]. Respiratory muscle efficiency may be compromised by pain and muscle spasm. In our case there was actual hyperventilation with significant hypocarbia combined with intra-pulmonary shunting, despite the clear subjective sensations of being unable to breathe adequately. Actual respiratory depression did not seem to feature in our case. This is in contrast to a similar patient in a previous report in whom both hypercarbia and desaturation on air, with intra-pulmonary shunting were initially present (age 21 years; FIO_2 0.2; pO_2 71 mm Hg; O_2 saturation 92%; pCO_2 53 mm HG; Ph 7.35; HCO_3 27 mM l^{-1}) [17]. That patient required 4 h to respond to treatment.

Reference has been made previously to the diagnostic confusion with decompression illness that may result from severe muscle pains occurring in a diver soon after ascent [10,18,19]. This is more likely when neither evidence of a sting nor an animal is observed (a surprisingly common event in jellyfish stings [18]).

Physicians [20] and divers should realize that some jellyfish (including *Physalia*) stings can be dangerous, and that a full length wetsuit and correct ascent procedure for scuba and breath-hold diving offer the best protection.

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