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IMAGES IN FORENSICS

Symmetry: the key to diagnosing propeller strike injuries in sea mammals

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Case report

The fresh carcass of a neonatal Indo-Pacific bottlenose dolphin (*Tursiops aduncus*) was recovered from a suburban beach near Adelaide, South Australia, by officers of the Australian Marine Wildlife Research and Rescue Organisation (AMWRO). The carcass was incomplete with loss of the tail and three deep parallel incised/chop wounds to the torso and tail (Fig. 1).

At necropsy the carcass was that of an otherwise healthy Indo-Pacific bottlenose dolphin neonate of around 1–2 weeks of age. The animal was normally formed and well nourished, with milk in its mouth and stomach indicating that recent breast feeding had occurred. Frothy white foam was present in the upper airway. The most significant findings consisted of a series of four curvilinear parallel incised/chop wounds predominately to the right side of the body (Fig. 2). The most rostral injury was a clean incised wound of the upper back and right side of the chest which shelved into paraspinal muscles (Fig. 3). No major vessels had been damaged and the chest cavity had not been opened. Within the chest cavity, however, the deepest part of the chop wound was associated with fracture-dislocation of the midthoracic spine (Fig. 4) with spinal cord transaction. There were also fractures of the posterior aspects of the first to sixth ribs on the right side with fresh paravertebal soft tissue hemorrhage bilaterally. Thoracic organs and vessels were intact. Fifty-nine centimeters caudal to this was a second incised/chop wound which passed from the right side through the anterior aspect of the dorsal fin (Figs. 1, 2). Although no body cavities or major vessels had been opened the wound shelved caudally with fracturing of the underlying spine and adjacent fresh interstitial hemorrhage. Caudal to this was a deep curved incised wound that also shelved caudally and extended into paravertebral muscles with a chopping injury to the lateral aspect of the vertebral bodies, with underlying fractures. The final injury consisted of amputation of the tail (Fig. 5). There were no congenital defects, underlying organic diseases or parasitic infestations identified that could have caused or contributed to death. Death was, therefore, due to multiple incised/chop wounds typical of boat propeller injuries with subsequent exsanguination. Amputation of the tail and transaction of the mid thoracic spinal cord would have also have prevented the animal from swimming.

Discussion

The analysis of injuries in all situations, whether in humans or animals, requires determination of the chronology, the likely methods of infliction, the degree of survivability and the lethality. In humans, injuries that are symmetrical and parallel tend to be those that are associated with self infliction. Injuries inflicted by another tend not to have this pattern as victims inevitably attempt to move away from the attacker and the impacting object [1, 2]. Patterning of an injury may however enable further clarification of the exact mechanisms that led to the fatal outcome.

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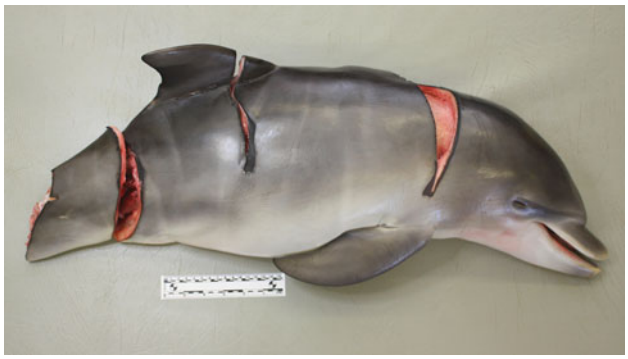

Fig. 1 The carcass of a neonatal Indo-Pacific bottlenose dolphin (*Tursiops aduncus*) showing four incised/chop wounds along the *right side*, with amputation of the tail. These parallel deep injuries are typical of those sustained from contact with rapidly rotating blades of propellers

AMWRRO [3] and The University of Adelaide, South Australia, have been monitoring cases of marine mammal deaths due to propeller strike injuries and in a recent report noted that distinguishing features are the symmetrical and parallel nature of the incised/chop wounds [4, 5]. These characteristic findings occur as propellers that strike sea mammals are usually attached to fast moving boats and have rapidly rotating blades that are able to deliver a rapid series of wounds in quick succession, before the injured animal is able to take evasive action [6]. Thus, multiple closely spaced injuries may occur with only one impact. Certainly in the reported case both the thoracic and tail wounds would have almost instantly incapacitated the animal. Amputations and injuries to major blood vessels with resultant hemorrhage are a frequent occurrence in these types of injuries [7]. The deep vertebral column injuries in the reported animal indicate the significant impact force that may be sustained in propeller injuries.

An important role in the forensic assessment of sea mammal injuries is to determine whether human or animal intervention was likely, whether these occurred ante- or post-mortem, and whether these had been intentional or not. The injuries in the reported animal were clearly antemortem given the degree of paraspinal hemorrhage around the vertebral and rib fracture sites. They were also quite distinct from those that may have been sustained during a shark attack [8] given the repetitive pattern, with shelving, and deep chop wounds through vertebral bodies. Determining whether the injuries were deliberately inflicted or not is a more difficult exercise. Anecdotally, reports occur of boats and surf skis being deliberately driven towards dolphins, and a local newspaper in Tasmania recently reported that "jet skiers have ploughed through a dolphin pod that included baby dolphins". Video footage with the story on the internet provided verification [9]. Deliberate killing of marine mammals is also well reported

Fig. 2 The dorsal aspect of the dolphin demonstrating more clearly the parallel nature of the curvilinear incised wounds

[10]. However, given the natural curiosity that dolphins show towards humans and boats, accidental strike is an alternative possibility that cannot be excluded in this case.

One of the difficulties in assessing the extent of the problem of propeller strikes for marine animals is that animals may recover from less severe injuries, and carcasses of those that die may not always be found. It is, however, recognized amongst humans that a high boating density is associated with increasing episodes of trauma [7]. Although not immediately lethal, propeller strikes may also interfere with foraging behavior and lead to death from malnutrition, or may result in infection with significant debilitation.

Given that this case involves a very young dolphin and that three of the last four propeller strike deaths that have

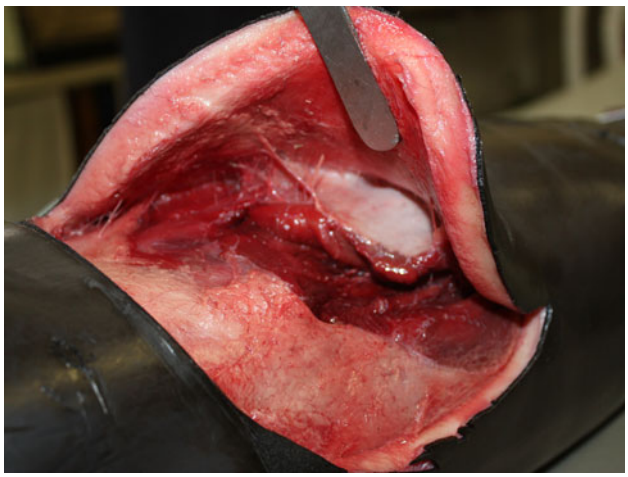

Fig. 3 Lifting of the skin and blubber in the most rostal injury demonstrating cleanly incised wound edges with shelving of the wound caudally into skeletal muscle tissue

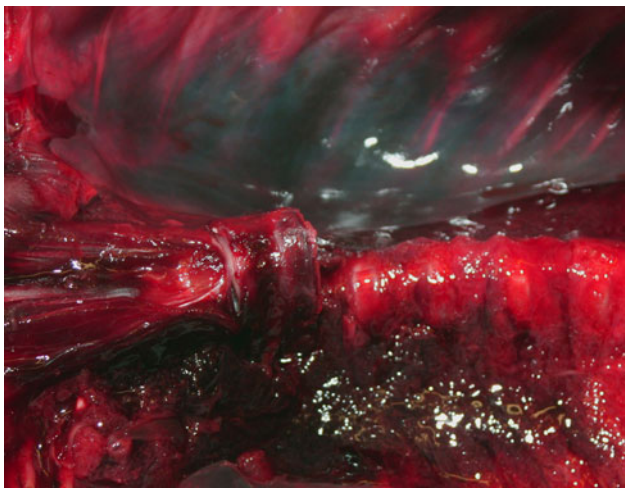

Fig. 4 The posterior aspect of the thoracic cavity underlying the injury shown in Fig. 3 demonstrating fracture-dislocation of the vertebral column with adjacent recent interstitial hemorrhage

been investigated in South Australia involved immature animals, it appears that the very young are the most vulnerable. Presumably this is because they have not yet developed an awareness of the significant dangers posed by recreational and commercial fishing and pleasure craft.

Causing the death of a sea mammal in a number of jurisdictions is a serious criminal act. Accurate evaluation of injuries such as propeller strikes is therefore an important part of forensic wildlife pathology so that the nature of injuries can be clearly documented. This may assist in the prosecution of those involved in deliberate acts that injure animals, and also form the basis for public awareness campaigns if the injuries have not been intentional. Boat owners should be encouraged to slow their engine speeds in areas know to be frequented by dolphins, particularly if there are juveniles in the pods.

Fig. 5 Amputation of the tail with severing of major vessels

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