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Intestinal Volvulus in a Bowhead Whale, *Balaena mysticetus*

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ABSTRACT: An adult female bowhead whale, *Balaena mysticetus*, from the Beaufort Sea, Alaska (USA), had necrosis of a well-demarcated portion of the mid-jejunum and adjacent mesentery, accompanied by fibrinous peritonitis. The veins within the mesentery adjacent to the affected intestine were severely dilated and hyperemic. There were no perforations of the gastrointestinal tract, nor any thromboses within the mesenteric veins. Death appeared due to the sequelae of intestinal volvulus and infarction; reduction of the displacement presumably occurred during handling of the animal.

Key words: volvulus, intestine, peritonitis, bowhead whale, cetacean, *Balaena mysticetus*.

The bowhead whale, *Balaena mysticetus*, a large cetacean of Arctic waters, is hunted by native Alaskan whalers under strict international regulations. Killed animals are not only of economic and cultural importance to these people, but also are a source of material for scientific study. Tissues provided by the whalers have been the basis for studies of the skin (Haldiman et al., 1985), stomach (Tarpley et al., 1987), reniculus (Abdelbaki et al., 1984), and respiratory system (Henry et al., 1983) of these large whales.

An 8.2 meter female bowhead whale was found dead and floating in the Beaufort Sea (70°10'N, 143°21'W) approximately 10 km east of Kaktovik, Alaska (USA), by a group of whalers on 2 October 1991. The animal was towed to Kaktovik for butchering. The animal appeared to have died recently, based upon the condition of the skin and the modest amount of damage caused by scavenging birds. Harpoon wounds were not found. The skin, blubber, baleen, flippers, and flukes were removed by the whalers, and personnel from the Department of Wildlife Management, North Slope Borough, Barrow,

Alaska, conducted a necropsy of the carcass.

There were approximately 40 l of serosanguinous, foul smelling fluid within the abdominal cavity. Fibrin was loosely attached to the serosal surfaces of abdominal viscera. A large, gelatinous, fibrin clot engulfed the coiled intestinal loops. No foreign material or ingesta were found within the abdominal cavity. The omentum was not adherent to any of the viscera or the abdominal wall. The small and large intestine were moderately distended with gas.

Seven meters of the mid-jejunum were necrotic, being friable and discolored a dark purple to black (Fig. 1). This discoloration extended from the serosa to the mucosa. There was prominent thickening of the wall of the affected portion of intestine. The adjacent mesentery was similarly discolored and markedly thickened. Multiple nodular thickenings of the mesentery, ≤ 10 cm in diameter, were found adjacent to the affected intestine. No perforations of the gastrointestinal tract or mesentery, or displacements of the intestine, were observed at necropsy. The remainder of the abdominal and thoracic viscera lacked significant gross lesions.

Portions of normal and affected small intestine, as well as the adjacent mesentery were fixed in 10% phosphate-buffered formalin and transported to the Veterinary Diagnostic Laboratory, Oregon State University, Corvallis, Oregon (USA) for further dissection and histologic examination. Five micrometer sections of paraffin-embedded tissues were stained with hematoxylin and eosin, and Perls modified Prussian blue (Thompson and Hunt, 1966).

The prominent thickening and discol-

oration of all layers of the affected intestine could be attributed to severe passive congestion, edema, and hemorrhage. Although autolysis was severe, vasculature was discernable within histologic sections; the vessels were engorged with blood within all layers of the intestine. Hemosiderin pigment was prominent within the edematous serosa and lamina propria. Normal intestine was thin-walled and light tan, and lacked the hyperemic vasculature and prominent hemosiderin accumulations observed in the affected intestine.

The mesentery adjacent to the discolored intestine was diffusely hyperemic. Severely dilated mesenteric veins, ≤ 4 cm in diameter, were filled with blood; similar veins within the non-affected mesentery were ≤ 1 cm in diameter. Intense vascular congestion and subsequent enlargement of mesenteric lymph nodes may have caused the nodularity observed within the mesentery.

Although no displacements of the intestine were identified during the post mortem examination, the observed gross and histologic lesions were consistent with an intestinal volvulus. Aside from the sharp demarcation of the necrotic intestine and mesentery from viable tissue, the other major evidence for a volvulus included the marked dilation and passive hyperemia of the veins within the affected portion of mesentery; the hyperemia, edema, hemorrhage, and hemosiderin accumulation within the intestinal wall; and the fibrinous peritonitis and fluid accumulation within the abdominal cavity in the absence of perforation of the gastrointestinal tract or abdominal wall.

We propose that an intestinal volvulus occurred, precipitating the death of the animal, and that the volvulus was reduced either near the time of death, or during post mortem handling of the animal. It is likely that rolling of the animal while in the water, or when beached and pulled up onto shore, resulted in reduction of the volvulus, as rotation of an animal around its intestine and supporting mesentery has



FIGURE 1. Intestinal volvulus in a *Balaena mysticetus*. Note junction (arrows) between well-demarcated portion of necrotic intestine and mesentery and normal tissue. Necrotic tissue is darkened. Bar = 20 cm.

been implicated in the pathogenesis of intestinal volvulus (Page and Amstutz, 1972). The absence of anchoring adhesions between the affected intestine and surrounding structures also would have facilitated spontaneous reduction.

Obstruction of venous outflow of the intestine and mesentery by a strangulating displacement of these structures, in the face of continual arterial input of blood, would not only have led to ischemic necrosis within the affected tissues, but also overfilling and distension of the veins, massive local edema, and hemorrhage due to anoxic damage to endothelial cells. While similar events and lesions could accompany venous thrombosis, no thrombi were found within the mesenteric veins.

The pathological and physiological bases for the death of an animal with an intestinal volvulus is complex (Blood and Radostits, 1989). Aside from acute shock due to cardiovascular reflex action, occlusion of the mesenteric veins results in loss of fluid from the vasculature due to increased arterial pressure. This fluid accumulates within the mesentery, intestine, and abdominal cavity, and leads to dehydration and loss of electrolytes. In severe cases in which infarction of the intestine occurs,

intestinal bacteria gain access to all layers of the intestine (Barker et al., 1993). This not only results in bacteremia and endotoxemia, but also peritonitis as bacteria leak from the necrotic intestine into the abdominal cavity. Any or all of these conditions may have contributed to the death of this animal.

Rarely is the cause of natural death in large Cetacea accurately determined. Surveys of natural disease processes in killed large whales have been conducted. Severe perirenal vascular lesions were described within fin whales, *Balaenoptera physalus* (Lambertsen, 1986). A variety of gastrointestinal abnormalities and substantial skin lesions were documented in a killed sperm whale, *Physeter macrocephalus* (=catoon) by Lambertsen and Kohn (1987). Serum chemistry was used to identify renal failure in a fin whale (Lambertsen et al., 1986). As the whales in these reports had been killed, the relevance of the lesions to mortality in great whales is uncertain. Lesions in large whales that died of natural causes have been reported. Pyothorax and fibrinous pleuritis and pericarditis, as well as trauma, have been observed in stranded gray whales (Stroud and Roffe, 1979). In this report we have described an apparent volvulus of the small intestine as the cause of death in a bowhead whale, adding to the limited amount of information detailing natural death in large whales.

All tissues from this whale were collected and transported under authority of Permit #519 issued by the National Marine Fisheries Service to Dr. Thomas Albert.

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