Pathological investigations on sperm whales stranded on the Belgian and Dutch coasts

by T. JAUNIAUX, L. BROSENS, E. JACQUINET, D. LAMBRIGTS & F. COIGNOUL

Abstract

On November 18 1994, four sperm whales were discovered dead on the Belgian coast, and on January 12 1995 three live sperm whales stranded on the Dutch coast. Necropsies were conducted following a standardized procedure and samples were collected. Two Belgian sperm whales had a severe weight deficit and the Dutch sperm whales had reductions in blubber thickness. Agonal lesions such as visceral passive congestion and lung edema were due to the stranding. Significant lesions included acute ulcerations of the skin and acute to subacute ulcerative stomatitis. Severe diffuse subacute to chronic ulcerative external otitis was noted in four animals. Progressive weakness and/or potential alterations of echolocation might have predisposed these sperm whales to visit shallow waters - strong social cohesion and complex coastal topography along the Dutch and Belgian coasts being the final factors leading to the stranding.

Keywords: sperm whale, stranding, pathology, necropsy, stomatitis, otitis, ulceration.

Résumé


Mots-clés: cachalot, échouage, pathologie, autopsie, stomatite, otite, ulceration.

Case history

In Belgium:

Three beached adult sperm whales (Physeter macrocephalus) were discovered on Friday, November 18th, at 6:00 a.m. at Koksijde, a town located along the Belgian coast. Stranding was considered to have occurred earlier the same day. A fourth sperm whale, probably from the same group, was found in shallow water, near the beach of the city of Nieuwpoort, 8 km east of Koksijde. It was observed dead at 2:00 p.m. and was dragged ashore at 6:00 p.m. Necropsies started on Saturday morning at 2:00 a.m. at Koksijde. These were simultaneously performed on the three bodies and followed a procedure derived from the European Cetacean Society protocol for small cetaceans (KUIKEN & GARCIA HARTMANN, 1991).

In the Netherlands:

Three sperm whales were found alive on the beach of Scheveningen (near the Hague) on Thursday, January 12th, 1995 at 7:00 a.m. They died at 11:00 a.m. Help was requested by the National Museum of Natural History of Leiden for necropsies and post mortem investigations. Necropsies were performed on Friday, 13 January and Saturday, 14 January.

Necropsy

Lesions observed on each animal are listed in Table 1.

External examination:

All sperm whales were adult males, about 15 meter long for the six animals stranded at Koksijde and Scheveningen, and 18 meter long for the sperm whale of Nieuwpoort (Table 2). Blubber thickness was 16 to 15 cm on the Belgian sperm whales, 12 to 11.6 cm on the Dutch animals (Table 2).

Similar chronic skin lesions, such as parallel and round scars on the head, round scars on the tail stock, were observed on all animals. Slightly hemorrhagic skin ulcerations were also present on the lower belly and on the tail of the animals of Koksijde and Scheveningen.

Decay was moderate, except for the sperm whale of Nieuwpoort that was severely altered.

Significant lesions on two of the Belgian sperm whales included three to four acute ulcers on the midline of the hard palate. These ulcers were round to oval and 2 to
Table 1 – Lesions observed in sperm whales stranded on the Belgian and Dutch coasts during 1994-1995 winter (after JAUNIAUX et al., in press).

<table>
<thead>
<tr>
<th>Location</th>
<th>Sperm whale #1</th>
<th>Sperm whale #2</th>
<th>Sperm whale #3</th>
<th>Sperm whale #4</th>
<th>Sperm whale A</th>
<th>Sperm whale B</th>
<th>Sperm whale C</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Chronic skin lesions</strong></td>
<td>+</td>
<td>+</td>
<td>-</td>
<td>-</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td><strong>Ventral abrasions</strong></td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td><strong>Acute mouth ulcers</strong></td>
<td>-</td>
<td>-</td>
<td>+</td>
<td>+</td>
<td>-</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td><strong>Acute skin ulcers</strong></td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td><strong>Visceral congestion</strong></td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
</tbody>
</table>

+: lesion observed; -: lesion not observed; ?: organ not examined

10 cm long. Similar lesions up to 30 cm long occurred on the three Dutch animals.

Hemorrhagic acute skin ulcers were also observed dorsally and laterally on the tail stock of one of the Belgian sperm whales. On one Dutch animal, acute skin ulcers were observed on the head. They were round, limited by slightly white, raised and rough edges.

Internal examinations:
Most observations were similar in all animals. In particular, muscle layers of the abdominal wall were evenly dark red to black; the omentum and the serosal surfaces of intestines were severely congested, with prominent blood vessels; livers were entirely dark red, almost black, with round edges. Renal cortices were dark red and the medullae were brick. Gas bubbles were present on mucosal membranes indicating early putrefaction.

Several dozen nematodes were observed in the gastric lumen of five animals.

On two sperm whales, dozens of flat hematomas, 1-2 mm thick, and 3-4 cm in diameter, were spread on various segments of the intestinal serosa, bleeding upon incision. Gastric and intestinal lumens were almost empty.

Chronic external otitis was noted in one Belgian sperm whale and in the three Dutch sperm whales.

Lungs, when observed, were evenly pinkish red without foam, fluid or blood on the cutting edge.

The Belgian sperm whales were weighed (Table 2 and 3). A correction factor was used to compensate for body fluid loss during necropsy and transport (LOCKYER, 1991). The empirically determined formula of LOCKYER (1991) relating normal weight to body length was used to estimate the normal weight of these animals (Table 3).

Complementary investigations

Histopathological investigations:
Microscopic examination of hematoxylin and eosin-stained sections of oral acute ulcerative lesions confirmed the diagnosis of acute to subacute ulcerative stomatitis. This was characterized by severe infiltration by polymorphonuclear neutrophils and by necrosis of epidermal layers. Epidermal cells of adjacent areas were dilated and contained eosinophilic material (ballooning degeneration).

The skin lesion observed on one Belgian animal was ulcerative subacute dermo-epidermitis characterized by lymphocytic infiltration. Along the edges of ulcers, dilated epithelial cells were present.

The skin lesion on one Dutch sperm whale was an acute dermatitis. Dilated epithelial cells containing eosinophilic material, similar to those present in oral ulcers, were also observed in superficial epidermis.

Ear lesions were similar in both group and were diagnosed histopathologically as severe diffuse ulcerative subacute to chronic external otitis. The epithelium lining the ear canal was uneven, with ulcerative areas in some cases. Subepithelial connective tissue was massively infiltrated by inflammatory cells.

Electron microscopy investigations:
Samples were collected from the edges of ulcers found on the hard palate of the Belgian sperm whales. Under the electron microscope, keratinocytes in basal layers of these lesions were severely vacuolated, with large, pale nuclei. In superficial layers, intracellular edema was more prominent. In less affected cells, cytoplasm was rich in polyribosomes. However, no viral particles were found.
Age determination:
Ages were determined by counting the teeth growth layers (Table 2; from Lockyer, pers. comm.). The animal of Nieuwpoort, the largest, was over 29 years old. Some teeth were worn and age was therefore imprecise.

Discussion and conclusions
The four sperm whales stranded in Belgium and the three sperm whales stranded in the Netherlands possibly were members of a single group. For the sake of discussion, one can consider that all animals belonged to one school of bachelor males.

Three groups of lesions were identified. The first seemed to have no relation with the stranding. A second was probably due to the stranding. The last was present before the stranding.

In the first group were various incidental skin lesions. The round scars observed probably resulted from the attachment of squid tentacles (Evans, 1993). The longitudinal parallel scars on the head probably resulted from fights between males (Evans, 1993). Both these lesions had no apparent relation to the stranding.

The second group of lesions included acute erosions observed on the lower bellies and on the flukes. These probably were mechanical abrasions due to the rubbing of animals on the sand during agony. This kind of lesion was not observed on the animal that died at sea. Passive congestion of the liver and kidneys, segmental congestion of the intestines and disseminated hemorrhages of the intestinal serosa, as well as passive vascular congestion even in tissues located in the upper part of dead bodies, confirmed an acute circulatory deficit as the cause of death. The most likely mechanism of death appeared to be cardio-vascular failure leading to shock. The shock process is one of the more frequent consequences of marine mammal’s stranding (Needham, 1993).

In the third group, integumental ulcerative lesions were observed. Skin ulcers suggested viral infection (Yager & Scott, 1993; Cheville, 1994), likely candidates being poxviruses (Baker & Martin, 1992; Baker, 1992a; Baker, 1992b). Pox lesions in dolphins are related to stress, poor environment and deficient general health (Geraci et al., 1979). Stomatitides have been described in striped dolphins (Stenella coeruleoalba) with morbillivirus infection (Domingo et al., 1992). For Domingo (1992), lesions were attributable to secondary opportunistic agents or to infections by calicivirus, herpesvirus or picornavirus. Ulcerative subacute to chronic external otitis was observed on Belgian and Dutch sperm whales. The potential extension of such lesions to the middle and inner ear is reported in domestic animals (Wilcock, 1993). Ascension through the eighth cranial nerve is frequent and can lead to encephalitis or meningitis. Unfortunately, there was no possibility to investigate a potential extension of the lesions to the skull of the whales, but on stranded Odontoceti, eighth nerve lesions have been reported as responsible for echolocative and vestibular dysfunctions (Morimitsu et al., 1987; Morimitsu et al., 1986).

Two Belgian animals, whales #3 and #4 had a severe weight deficit (32% and 37%). In addition, the blubber thickness was less than 12 cm in the Dutch animals - thinner than literature descriptions of healthy animals (Lockyer, 1991). Both observations point to a chronic debilitating process.

In conclusion, a hypothesis based on pathology can be drawn to explain the mass strandings that occurred in the winter of 1994 (Figure 1). The weight deficit, the blubber thickness reduction and empty intestines may be explained by a reduction in food intake due to prey shortage and the consequent utilization of body fat deposits. It is

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Table 2 - Body length, blubber thickness, weight and age of the 7 sperm whales stranded along the Belgian and Dutch coasts during the 1994-1995 winter (after Jauniaux et al., in press).

<table>
<thead>
<tr>
<th>Sperm whale</th>
<th>Length</th>
<th>Blubber thickness</th>
<th>Weight</th>
<th>Age</th>
</tr>
</thead>
<tbody>
<tr>
<td>#1</td>
<td>15.4</td>
<td>160</td>
<td>70,000</td>
<td>&gt;24</td>
</tr>
<tr>
<td>#2</td>
<td>14.9</td>
<td>160</td>
<td></td>
<td>&gt;&gt;22</td>
</tr>
<tr>
<td>#3</td>
<td>14.4</td>
<td>150</td>
<td>21,940</td>
<td>28</td>
</tr>
<tr>
<td>#4</td>
<td>18.2</td>
<td>150</td>
<td>38,994</td>
<td>&gt;29</td>
</tr>
</tbody>
</table>

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Table 3 - Body length, actual weight and predicted normal weight of sperm whales stranded on the Belgian coast, Nov. 18, 1994. Predictive formula of normal weight: W = 0.0218 x L^2.74. A correction factor (1.14) was used to compensate for loss of body fluids during dissection and transport (Lockyer, 1991). After Jauniaux et al., in press.

<table>
<thead>
<tr>
<th>Animal #</th>
<th>Length</th>
<th>Weight</th>
<th>Predicted weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 + 2</td>
<td>15.4 and 14.9</td>
<td>70,000</td>
<td>74,800</td>
</tr>
<tr>
<td>3</td>
<td>14.4</td>
<td>21,940</td>
<td>32,500</td>
</tr>
<tr>
<td>4</td>
<td>18.2</td>
<td>38,994</td>
<td>61,800</td>
</tr>
</tbody>
</table>
likely that polychlorinated biphenyls or heavy metals were then mobilized from adipose tissue. These toxic substances are known to induce immunosuppression. Prolonged anorexia and stress may also lead to immune deficiency (ROTE, 1994; MC CANE & SHELBY, 1994). Immunosuppression driven by starvation and the mobilization of toxic contaminants may favor secondary viral diseases, expressed by skin ulcers and stomatitis.

A potential echolocative and vestibular dysfunction following ear lesions, with a debilitating process leading to progressive weakness, may have carried one or some leader sperm whales toward shallow waters (EVANS, 1993). The Dutch and the Belgian coasts particularly are characterized by a complex topography and sand banks. A possible ultimate step leading to several strandings would then be the strong social cohesion of a school trapped in a “cul-de-sac” by a falling tide (NEEDHAM, 1993; RICE, 1989).

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Note added in proof stage

Detailed pathological investigations will be published in volume 34 of the Journal of Wildlife Diseases (see JAUNIAUX et al. in the reference section).

References


JAUNIAUX T., BROSENS L., JACQUINET E., LAMBRIGTS D. and COIGNOUL F.
Department of Veterinary Pathology
University of Liège, Sart Tilman B43
B 4000 Liège, BELGIUM