

Intestinal adenocarcinomas in two beluga whales (*Delphinapterus leucas*) from the estuary of the St. Lawrence River

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Epithelial cancer of the small intestine (ECSI) is rare in man and in all domestic animals, except sheep and cattle in certain parts of the world. We report 2 cases of ECSI affecting the proximal intestines of 2 beluga whales from a population inhabiting the estuary of the St. Lawrence River. This small, isolated group is estimated at 500 animals and is listed as an endangered population (1).

Case 1 (DL-2-93) was an adult male found stranded at Ruisseau-Castor (lat 49°11'N, long 66°20'W) and brought to the Faculté de médecine vétérinaire, Université de Montréal, for postmortem examination on May 21, 1993. The abdominal cavity contained 20 L of a red-brown aqueous fluid. Seven meters distal to the stomachs, the intestine was constricted by a poorly demarcated multinodular annular mass (40 cm long × 10 cm wide), extending into the thickened mesentery. The lumen of the intestine was decreased from 6 cm to 2 cm. In the strictured segment, the intestinal wall, normally 0.5 cm thick, was 7 cm thick and homogeneously white and very firm. Proximal to the stricture, the intestine was extremely dilated (Figure 1).

Throughout the entire abdominal cavity, numerous small (0.2 to 1 cm in diameter), white, round, firm nodules were scattered on the mesenteric and peritoneal serosae. Microscopic examination revealed that the thickened intestinal wall consisted of small, randomly distributed, poorly formed tubules and acini lined by simple, cuboidal to low columnar epithelium, which was well differentiated and displayed a moderate number of mitoses (2 to 3 per 400× field). The lumen of these glandular structures contained small amounts of mucicarmine-positive material, within which were admixed

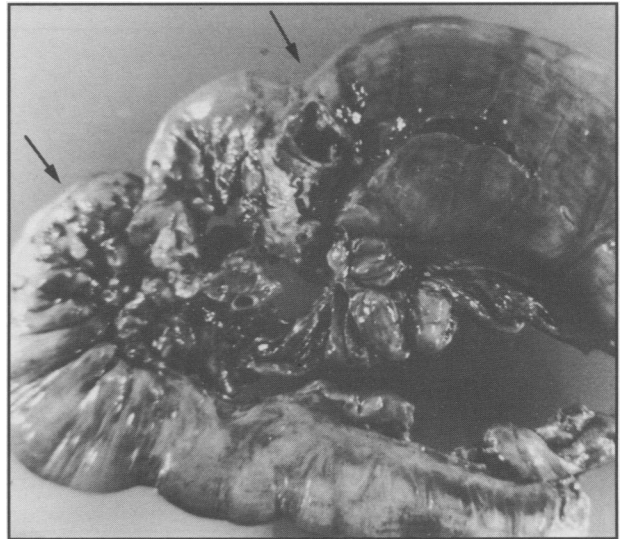


Figure 1. Intestinal adenocarcinoma in a beluga whale. Severe constriction of proximal intestine caused by the tumor is accompanied by marked dilation of the intestinal segment proximal to the constriction. Artefactual postmortem perforations of the intestine are present. The 2 arrows bracket the intestinal segment constricted by the tumor.

several necrotic epithelial cells. Beneath the mucosa, these structures were separated by an abundant fibrous stroma, replaced the normal architecture of the submucosa, and infiltrated the deeper parts of the *tunica muscularis* (Figure 2). The intestinal serosa was markedly edematous. The peritoneal and mesenteric nodules had a composition similar to that of the thickened intestinal wall, except that mucin was less abundant, ill-formed glandular structures were more numerous, and tumor cells were more pleomorphic and often piled up in a disorderly manner. Accordingly, this neoplasm and the accompanying nodules were designated as a scirrhous annular stenosing intestinal adenocarcinoma with peritoneal and mesenteric carcinomatosis.

Case 2 (DL-2-94) was also an adult male. The animal was found stranded at Baie des Sables (lat 48°43'N, long 67°51'W) and was necropsied on May 29, 1994. An intestinal stricture was found about 7.5 m distal to the pylorus. The intestinal lumen was severely reduced to less than 1 cm. The intestinal wall was 3 cm thick and the proximal intestinal segment was moderately dilated. The serosa covering the stricture was haemorrhagic.

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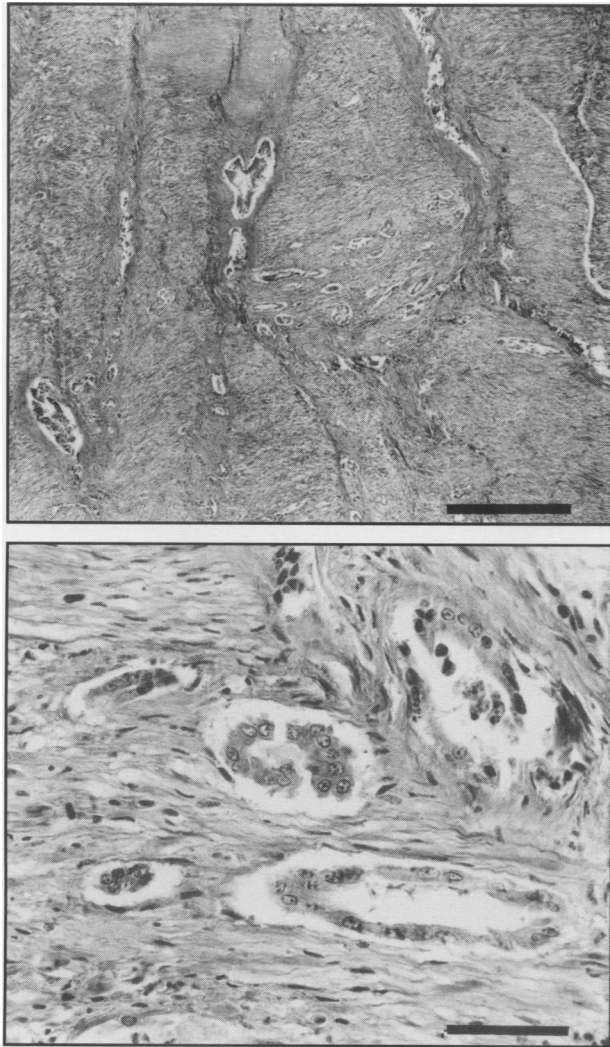


Figure 2. a) Intestinal adenocarcinoma in a beluga whale. Cystic cavities lined by a simple columnar epithelium are scattered between intact muscle bundles of the *tunica muscularis* layer. Bar = 500 μ m. HPS. b) Higher magnification. Bar = 50 μ m. HPS.

Histological features of the tumor were similar to those of DL-2-93.

Complete postmortem examination of both animals did not reveal any other significant lesions. Paraffin embedded tissues and histological sections of both animals have been deposited in the Registry of Comparative Pathology, Armed Forces Institute of Pathology, Washington, DC, USA; the accession numbers are 2464200 (DL-2-93) and 2464226 (DL-2-94).

The condition index, defined as the percentage of total body weight accounted for by the combined weights of the skin and blubber, was 46.2% for DL-2-93 and 45.2% for DL-2-94. These measurements were slightly greater than the mean, 42.6%, calculated for the 24 other beluga whales examined in our laboratory between 1988 and 1990 (2). Thus, these 2 animals were not emaciated. Muscular mass and tissue lipids may have been depleted, however, but these parameters were not determined.

To our knowledge, only 2 intestinal epithelial cancers, both found in beluga whales from the St. Lawrence

Table 1. Frequency of intestinal cancer of epithelial origin in stranded beluga whales from the estuary of the St. Lawrence River (1983–1993) compared with that in man and domestic animals

Species ^a	CAR ^c of intestinal epithelial cancers	
	Small	Large
Beluga (3 cases)	55	ND
Beluga (4 cases)	73	ND
Man	0.8	28.5
Cattle	1.85 (2.78 ^b)	0
Dog	2.67 (6.87 ^b)	5.7
Cat	10.8 (26 ^b)	3.17
Horse	0	1.28
Sheep	up to 2000	ND

^aman (6), cattle, dog, cat, horse (7), sheep (8)

^bsum of epithelial cancers listed under "Intestine—NOS (not otherwise specified)" and those listed under "Small Intestine" (7)

^cCAR: crude annual rate per 100 000 animals

e.g.,

$$\text{Car} = \frac{3/4 \text{ animals with ECSI} \times 100\,000 \text{ animals}}{11 \text{ years} \times 500 \text{ animals}} = 55/73 \text{ animals}$$

ECSI: epithelial cancer of the small intestine

ND: not determined

estuary population (2), have been reported in cetaceans. One (DL-7-89) was located close to the stomachs, and the second (DL-8-89) was 5.5 m from the anus. Thus, all but 1 intestinal cancer have been observed close to the stomachs. In cetaceans, there is no grossly detectable demarcation between the small and large intestine (3). Kleinenberg *et al* (3) state that the large intestine forms "about one-third of the intestines," using rather vague criteria. Simpson *et al* (4) reported that the colons of some odontocetes that they had studied were 30 cm long. Thus, we conclude that 3 and possibly 4 epithelial intestinal cancers reported in the beluga whale population in the St. Lawrence River affected the small intestine.

With this report, a total of 77 tumors have been reported in cetaceans worldwide. Of these, 30 cases (39%) come from the beluga whale population in the St. Lawrence River (2).

We compared the estimated rate of ECSI seen in that population with that seen in other animals and in man, using the crude annual rate (CAR) for cancer per 100 000 animals as described elsewhere (5) (Table 1). Stranded carcasses are rarely reported in winter (January to March) because of the ice cover and the harsh climatic conditions, thus the estimated CAR is a minimum figure. The resulting CAR is 2 orders of magnitude higher than that of man and much higher than that of domestic animals examined at veterinary colleges (Table 1). The prevalence of cancer among domestic animals is probably overestimated, because 1) it includes a higher number of sick animals and 2) it consists of animals that generally live longer than wild animals (9).

The precise etiology for ECSI has not been determined in either man or animals. A viral etiology cannot be ruled out, but it is unlikely, since viruses have not been incriminated in the etiology of intestinal adenocarcinomas.

Various forms of cancers are inherited (10). Since a recent study suggests that beluga whales in the St. Lawrence River have a reduced genetic variability, when compared with that of whales from the delta of the Mackenzie River (11), genetic susceptibility to cancer might play a role in carcinogenesis. It appears unlikely that intestinal cancer is a feature of beluga whales, since cancers have not been reported in other populations of this species.

Old age could be another cause of a high cancer rate. However, beluga whales in the St. Lawrence River appear to be younger than Alaskan beluga whales (12) (unpublished observations). In contrast to its rarity in other animals, ECSI is common in sheep from New Zealand, where it is believed to be caused by chemical contaminants (8). A high prevalence of ECSI, associated with ingestion of bracken fern and infection with papillomaviruses, has also been observed in cattle from northern England and Scotland (13). Since beluga whales in the St. Lawrence River are exposed to environmental carcinogens and immunosuppressive compounds (14), environmental contamination may have contributed, with or without other factors, to the etiology of the 4 intestinal cancers reported in this population over the last 11 y. CVJ

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Answers to Quiz Corner/Les réponses du Test Éclair

- | | |
|---|--|
| <ol style="list-style-type: none"> 1. d 2. c — Using a lesser volume of fixative may result in insufficient tissue fixation and consequent sample decomposition.
c — L'emploi d'un volume plus faible de produit fixateur peut résulter en une fixation insuffisante des tissus et par conséquent causer la décomposition de l'échantillon. 3. c — The bursa has no role in red blood cell production.
c — La bourse n'a aucun rôle dans la production de globules rouges. 4. d 5. b — Necrotic laryngitis is the most common upper airway disease of calves in this age range.
b — La laryngite nécrotique est l'affection des voies respiratoires supérieures la plus fréquente chez les veaux de ce groupe d'âge. | <ol style="list-style-type: none"> 6. d — The Ehmer sling prevents weight bearing and produces medial rotation of the femoral head into the acetabulum.
d — Le bandage d'Ehmer empêche de supporter le poids du corps et permet la rotation médiale de la tête du fémur dans l'acétabulum. 7. b 8. a — Only the first choice is a true statement.
a — Seul le premier choix est un énoncé vrai. 9. d 10. c — Mares should be at 330 days of gestation and have cervical relaxation and some waxing of the teats before parturition can be induced with a good success rate.
c — Chez la jument, une gestation de 330 jours, la relaxation du col utérin et la présence de «cire aux trayons» sont nécessaires pour induire la parturition avec un bon taux de succès. |
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