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Source: Journal of Zoo and Wildlife Medicine, 48(3):902-905.

Published By: American Association of Zoo Veterinarians

<https://doi.org/10.1638/2016-0154.1>

URL: <http://www.bioone.org/doi/full/10.1638/2016-0154.1>

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SQUAMOUS CELL CARCINOMA OF THE ROSTRAL MAXILLA IN AN ADULT CAPTIVE WHITESPOTTED BAMBOO SHARK (*CHILOSCYLLIUM PLAGIOSUM*)

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Abstract: An approximately 10-yr-old adult female whitespotted bamboo shark (*Chiloscyllium plagiosum*) presented with a smooth, white, irregular, ulcerated, and expansile lesion on the left lateral aspect of the maxillary rostrum. The lesion had short periods of abrupt and rapid proliferation and then remained static for several months. Cytology and culture were nonspecific and did not reveal any discernible etiologic agents or cellular atypia. The lesion was nonresponsive to parenteral antibiotics. One year after the initial onset of the lesion, the ulcer was 10 cm in diameter, a percentage increase in size of 455%. Due to a protracted clinical course and lack of response to medication and supportive care, coupled with an acute onset of neurologic signs and self-inflicted trauma, the shark was euthanized. Histopathology of the mass disclosed a locally invasive squamous cell carcinoma with no evidence of metastasis.

Key words: *Chiloscyllium plagiosum*, elasmobranch, neoplasia, skin, squamous cell carcinoma, whitespotted bamboo shark.

BRIEF COMMUNICATION

Elasmobranchs are popular display animals in public aquaria and zoologic institutions. While there are few reports of neoplastic diseases in sharks, mesenchymal tumors have been more frequently reported than those of epithelial origin.^{13,15} Reports of cutaneous involvement have been limited to invasive and malignant melanomas in two thornback rays (*Raja clavata*)^{6,7} and two common skates (*Raja batis*),⁷ and an osteoma in the skin of a tawny nurse shark (*Nebrius ferrugineus*).¹⁰ A repository for information on neoplasia in vertebrates and cold-blooded vertebrate animals,⁴ the Registry of Tumors in Lower Animals (RTLTA) collected, archived, reviewed, and classified neoplastic specimens⁵ in an effort to gain fundamental understanding of neoplastic processes until funding was discontinued. The following skin tumors were documented by the RTLTA in elasmobranchs: a fibroma in a bull shark (*Carcharhinus leucas*),⁵ a fibrosarcoma in a blacktip shark (*Carcharhinus limbatus*),¹² an epidermal papilloma

in a dusky smooth-hound (*Mustelus canis*),¹⁵ and a chondroma in a leopard shark (*Stegostoma fasciatum*) (Wolf, pers. comm.). Additional reports of cutaneous neoplasias include a melanoma in a 27-yr-old nurse shark (*Ginglymostoma cirratum*),¹² and a dermal lymphosarcoma which was treated in a bonnethead shark (*Sphyrna tiburo*).⁸ There is one published report of a squamous cell carcinoma in a female cat shark (*Scyliorhinus catulus*) of the Carcharhiniformes order.¹¹ This report describes a cutaneous squamous cell carcinoma in an elasmobranch and is the first report in the Orectolobiformes “carpet shark” order.

In July 2012, an adult, female, captive-bred whitespotted bamboo shark, *Chiloscyllium plagiosum*, presented with a smooth, white, irregular, approximately 1.8-cm-diameter ulcer on the left maxillary rostrum. The shark, estimated to be 10 yr of age, resided at the Vancouver Aquarium for the duration of its life. The animal was kept in a 272,550-L multispecies tank housing four other whitespotted bamboo sharks (*C. plagiosum*), five blacktip reef sharks (*Carcharhinus melanopterus*), two southern stingrays (*Dasyatis americana*), a zebra shark (*Stegostoma fasciatum*), two reticulated whiptail rays (*Himantura uarnak*), a green sea turtle (*Chelonia mydas*), and a large variety of tropical marine teleosts. Three months after the initial observation, the lesion increased in size, reaching approximately 2.5 cm in diameter, spanning the rostrum, and extending caudally along the snout. No further changes were observed in the following months and no intervention for

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further diagnostic procedures or treatments was elected due to the difficulty of catching the shark in the display tank.

After 11 mo of no apparent change in demeanor and no indication of repetitive injury resulting in chronic irritation, the lesion ulcerated, exposing irregular, pink-white subcutaneous tissue with proliferative margins. Despite a normal appetite the shark's body condition declined from a score of 3/5 to 1/5. The shark was moved off exhibit to a side pool on the same water system as the main habitat.

At that time, the shark was restrained by tonic immobility for physical examination and sample collection. The ulcerated lesion was 3 cm in diameter, spanned the width of the rostrum, and extended dorsocaudally a short distance along the snout. The exposed dermis was irregular, frayed to smooth, and white with a centrally depressed hemorrhagic core. A skin scrape was collected along the margin and central regions of the lesion for cytologic evaluation and bacterial culture (IDEXX Laboratories, Delta, British Columbia V3M 6M2, Canada). Cytology was consistent with septic inflammation and hemorrhage with no cellular atypia or dysplasia noted. Bacterial culture yielded moderate growth of *Sphingobacterium thalophilum*, an environmental nonpathogenic gram-negative bacterium that was sensitive to ceftazidime.

Therapy was initiated and included ceftazidime (20 mg/kg i.m. every 72 hr for five treatments; Pfizer Animal Health, New York, New York 10017, USA) and meloxicam (0.2 mg/kg im every 72 hr for five treatments; Metacam injectable, Boehringer Ingelheim Vetmedica, St. Joseph, Missouri 64506-2002, USA). Using tonic immobilization, all injections were administered intramuscularly in the lateral peduncle, dorsal to the lateral line.

Following the first treatment, the lesion appeared smoother with minimal necrosis or inflammation. The second through fifth treatments were completed and the lesion remained unchanged in color, size, and texture, with no hemorrhage. A blood sample was collected from the caudal tail vein and submitted for hematology and plasma biochemistry evaluation, as well as for aerobic and anaerobic culture. The blood was evaluated using nonpublished hematologic/serum chemistry values for male and female white-spotted bamboo sharks from the John G. Shedd Aquarium (Chicago, Illinois 60605, USA). Retrospectively, the blood was evaluated using species and sex-specific hematologic values published by

Alexander et al.¹ Hematologic abnormalities of the shark included a moderate to marked anemia with a packed cell volume of 0.09 L/L, lower than Alexander et al. reported for healthy females (0.18–0.20 L/L)¹ and Shedd Aquarium collection values (0.18–0.58 L/L). Alexander et al. reported white-spotted bamboo sharks are capable of mounting an inflammatory hemic response¹ and in this case, a moderate heterophilia of $8.036 \times 10^9/L$ (Shedd reference range $0.000\text{--}3.128 \times 10^9/L$, Alexander et al. reference range $2.482\text{--}4.732 \times 10^9/L$)¹ was present despite a normal to mild leukopenia of $9.8 \times 10^9/L$ (Shedd reference range $3.000\text{--}16.30 \times 10^9/L$, Alexander et al. reference range $11.9319.75 \times 10^9/L$).¹ The plasma biochemistry profile showed a mild hypophosphatemia (0.60 mmol/L; reference range 1.0336–2.003 mmol/L) and mild decrease in alkaline phosphatase (10 IU/L; reference range 13.00–100.00 IU/L). Alexander et al. reported no serum chemistries for comparison.¹ Aerobic and anaerobic cultures of the blood yielded no growth (IDEXX Laboratories, Delta, British Columbia V3M 6M2, Canada).

Approximately 14.5 mo after initial presentation of the lesion being smooth, ulcerated, white, and irregular, it had become raised and pink, and cartilage protruded through a portion of the defect (Fig. 1A). At that time, the shark was swimming upside down in the tank sustaining trauma on the rostrum from swimming into the tank walls.

Humane euthanasia was elected due to the extent of the rostral lesion, lack of response to medical treatment, and deteriorating body condition of the animal. At gross necropsy the shark was emaciated (weight: 0.943 kg). The animal was 76.2 cm long with a 17.1-cm axillary girth. No internal metazoan or external protozoal parasites were noted on gross examination. The abraded rostral lesion measured 8×4 cm, and on transverse section of the snout, nodular proliferations extended into the nasal pit (Fig. 1B). Tissues from all major organ systems were collected and fixed in 10% neutral-buffered formalin for histopathology.

Histologic examination of the rostral lesion revealed an ulcerated squamous cell carcinoma with multifocal invasion deep into the subcutaneous tissue. The tumor was composed of polygonal cells arranged as cords, broad fronds, trabeculae, and tightly packed pearls with moderate amounts of intervening stroma (Fig. 2). Tumor cells contained 0–3 mitotic figures per $\times 40$ objective lens field and no cytoplasmic or intranuclear inclusions were apparent. There was no evidence

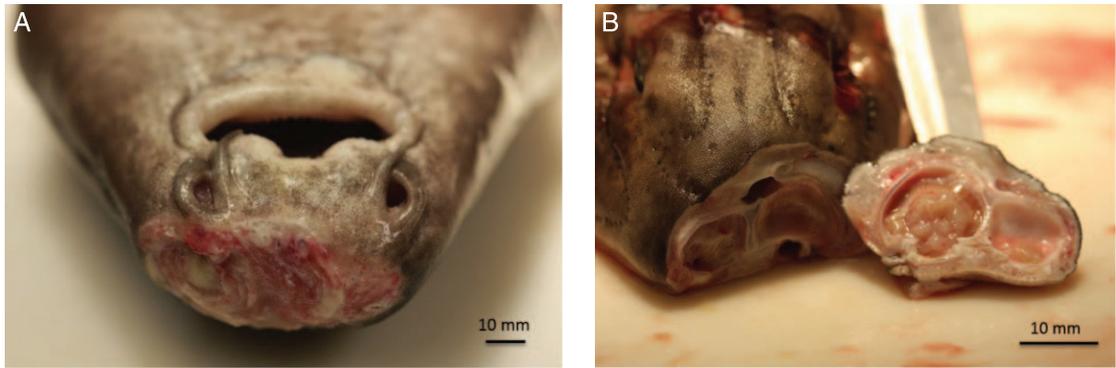


Figure 1. Adult female whitespotted bamboo shark (*C. plagiosum*) postmortem. **A.** Ventral view of rostrum with exposed cartilage and visible neoplasia within the left naris resulting in possible tumor pressure on the olfactory nerve. **B.** Cross-section of locally invasive squamous cell carcinoma within the rostrum.

of metastasis. Considered an incidental finding, culture of the lesion yielded heavy growth of *Vibrio alginolyticus* (IDEXX Laboratories, Delta, British Columbia, V3M 6M2, Canada). Additional postmortem findings included oophoritis and follicular atresia. The macrophages surrounding the area of atresia contained no bacteria or parasites. Foci of mineral were also detected in the rectal gland. However, the foci were not associated with inflammation nor were they believed to have adversely affected the health of the shark. It is hypothesized the inverted swimming pattern and erratic swimming into tank walls exhibited by this bamboo shark prior to euthanasia may have resulted from a reaction to the necrotic tissue, to the pressure of the tumor cells on the olfactory nerve, or to osmotic imbalances related to the breach in the skin.

In the cat shark (*Scyliorhinus catulus*) report, the lesion was initially identified as cutaneous epithelioma¹¹ and subsequently diagnosed as a squamous cell carcinoma.^{2,9} The lesion was described as a large, smooth, red fleshy mass, broadly sessile, and located on the lower jaw oral mucosa caudal to the oral commissure.¹¹ Histologically, flattened tumor cells invaded underlying muscle and infiltrated the connective tissue, cartilage, bone of the visceral skeleton, and skin.¹¹ Similar to the shark presented here, the lesion was fast growing, locally invasive, and lacked metastasis. In contrast, this shark's lesion initially presented smooth and white, later developing a depressed hemorrhagic core.

The present case of squamous cell carcinoma in a female whitespotted bamboo shark (*C. plagiosum*) is believed to be the second report of squamous cell carcinoma in elasmobranchs. In terrestrial animals excessive ultraviolet exposure

has been implicated in cutaneous squamous cell carcinoma;¹⁴ however, based on the tank design and lack of solar elastosis, this pathogenesis was unlikely. Additional carcinogens may include coal tar or arsenic³ as well as papillomavirus infections (Bowen-like disease).^{3,14} Basosquamous carcinoma and papilloma were prime clinical and pathologic differentials in this case.

Although this case of squamous cell carcinoma was identified postmortem and no etiologic agent was identified, an antemortem biopsy of the nonhealing lesion would have likely resulted in an earlier diagnosis. Ideally, early aggressive treatment would have included excisional biopsy with histologically clear margins. Continued reporting of neoplastic diseases in elasmobranchs is recommended in an effort to determine possible

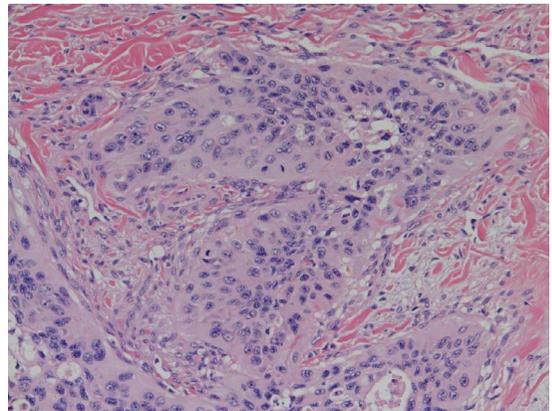


Figure 2. Anastomosing cords of neoplastic cells with multifocal crowding and piling. There are variably distinct intercellular bridges with abundant fibrillar to homogenous eosinophilic cytoplasm. Hematoxylin and eosin, $\times 200$.

etiologic agents, improve early diagnosis, predict tumor behavior and response to medical therapies, and ultimately determine prognosis.

Acknowledgments: The authors thank G.D. Marty for providing the initial morphologic diagnosis; Ann Dreolini, Ann Viera, Dr. Juergen Schumacher, and Dr. Ed Ramsay for their technical assistance; and the Vancouver Aquarium veterinary staff, in particular technician Kate Cooper and aquarists Joelle Prevost and Darin Smy for the care and documentation of the case presented in this report. The authors also thank Dr. Caryn Poll of the Shedd Aquarium for hematologic information.

LITERATURE CITED

1. Alexander AB, Parkinson LA, Grant KR, Carlson E, Campbell TW. The hemic response of white-spotted bamboo sharks (*Chiloscyllium plagiosum*) with inflammatory disease. *Zoo Biol.* 2016;35:251–259.
2. Borucinska JD, Harshbarger JC, Reimschuessel R, Bogicevic T. Gingival neoplasms in a captive sand tiger shark, *Carcharias taurus*, (Rafinesque), and a wild-caught blue shark, *Prionace glauca* (L.). *J Fish Dis.* 2004;27:185–191.
3. Gurudutt VV, Genden EM. Cutaneous squamous cell carcinoma of the head and neck. *J Skin Cancer* [Internet]. 2011 [Cited 2016 Nov 12]; 2011:502723. Available from <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3064996>
4. Harshbarger JC. Role of the Registry of Tumors in Lower Animals in the study of environmental carcinogenesis in aquatic animals. *Pathol Vet.* 1966;3: 280–288.
5. Harshbarger JC. Work of the Registry of Tumors in Lower Animals with emphasis on fish neoplasms. *Symp Zool Soc Lond.* 1972;30:285–303.
6. Johnstone J. Internal parasites and diseased conditions of fishes. *Proc Trans Liverpool Biol Soc.* 1910–1911;25:113–122.
7. Johnstone J. Internal parasites and diseased conditions of fishes. *Proc Trans Liverpool Biol Soc.* 1911–1912;26:118–124.
8. Manire CA, Clarke AC, Wert D, Landolfi J. Lymphosarcoma in captive bonnethead shark, *Sphyrna tiburo* (L.). *J Fish Dis.* 2013;36:437–440.
9. Ostrander GK, Cheng KC, Wolfe JC, Wolfe MJ. Shark cartilage, cancer and the growing threat of pseudoscience. *Cancer Res.* 2004;64:8485–8491.
10. Pereira N, Peleterior M. Osteoma in the skin of a tawny nurse shark, *Nebrius ferrugineus* (Lesson). *J Fish Dis.* 2002;25:565–567.
11. Stolk A. Tumours of fishes. Epithelioma of the oral mucosa in the scylliid *Scylliorhinus catulus* (L.). *Proc K Ned Akad Wet Ser C Biol Med Sci.* 1956;59(Pt. IXA, IXB):196–210.
12. Waldoch JA, Burke SS, Ramer JC, Garner MM. Melanoma in the skin of a nurse shark (*Ginglymostoma cirratum*). *J Zoo Wildl Med.* 2010;41:729–731.
13. Wellings SR. Neoplasia and primitive vertebrate phylogeny: echinoderms, prevertebrates, and fishes: a review. *Nat Cancer Inst Monogr.* 1969;31:59–128.
14. Withrow SJ, Vail DM, Page RL. *Withrow and MacEwen's Small Animal Clinical Oncology.* 5th ed. St. Louis (MO): Saunders Elsevier; 2013. 768 p.
15. Wolke RE, Murchelano RA. A case report of an epidermal papilloma in *Mustelus canis*. *J Wildl Dis.* 1976;12:167–171.

Accepted for publication 6 April 2017