



SHORT PAPER

Mast Cell Tumour in a Giant Galapagos Tortoise (*Geochelone nigra vicina*)

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Summary

A well-differentiated cutaneous mast cell tumour was diagnosed in a subadult female giant Galapagos tortoise. The tumour was a pedunculated, verrucose mass located near the base of the neck. The histological features, which were diagnostic for a mast cell tumour, included abundant intracytoplasmic granules that were stained metachromatically with Giemsa and toluidine blue stains. Mast cell tumours are rare in reptiles, and this is the first description of a mast cell tumour in a chelonian.

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The Galapagos Islands host 11 subspecies of the giant tortoise *Geochelone nigra*. All subspecies are considered seriously endangered. *Geochelone nigra vicina* is an endemic subspecies of the southern and middle regions of Albemarle Island (Isabela) (Pritchard, 1996). For the past four decades, the Charles Darwin Scientific Station and the Servicio Parque Nacional Galápagos have maintained a joint captive breeding program based on tortoises captured in the wild.

Many zoological institutions and some private collectors maintain groups of giant Galapagos tortoises, but there are few published reports of disease in this species. To the authors' knowledge there are only two reports of neoplasia in Galapagos tortoises. Thus, Plimmer (1912) mentioned a gastric carcinoma in an elephantine tortoise [presumed by Jacobson (1981) to be *Geochelone elephantopus* = *Geochelone nigra* (see Pritchard, 1996)], and Rideout *et al.* (1993) described alimentary tract lymphomas. Neoplasia in tortoises of all species appears to be less common than in squamates (Jacobson, 1981; Frye, 1994; Garner *et al.*, 2004; Reavill, 2004; Mauldin and Done, 2006). This

report describes the macroscopical and histopathological features of a well-differentiated cutaneous mast cell tumour in a giant Galapagos tortoise.

In October 2005, a single cutaneous mass was discovered at the base of the neck of a subadult female *G. nigra vicina* (curved carapace length, 72 cm) during a standard clinical examination at the Giant Tortoises Breeding Centre (GTBC) of Puerto Villamil (Albemarle Island, Galapagos archipelago, Ecuador). The curator of the GTBC reported that the mass had developed within the previous 8 months of captivity. The tortoise had been captured on the Cerro Paloma (Sierra Negra Vulcan, Albemarle Island) in 1998 and transferred to the GTBC. There it was housed in a large enclosure with tortoises of the same subspecies and size and fed a daily diet of fruits, vegetables and roots.

The mass measured approximately 4 cm in diameter and was pedunculated and verrucose with an ulcerated ventral surface (Fig. 1). The tortoise was actively feeding and appeared to be in good general health. The mass, being superficial, was removed surgically under a permit issued by the Parque Nacional Galapagos. The cut surface was firm and



Fig. 1. Giant Galapagos tortoise (*Geochelone nigra vicina*) showing a mast cell tumour on the ventral surface of the neck.

white, with foci of haemorrhage. The mass was fixed in 10% buffered formalin and embedded in paraffin wax. Sections (5 μm) were cut and stained with haematoxylin and eosin (HE), Giemsa or toluidine blue for histological examination.

Primary differential diagnoses based on the gross appearance included fibropapilloma (including herpesvirus-associated fibropapillomas as seen in sea turtles), various types of cutaneous tumour, and granulomatous dermatitis. Examination of all other tortoises at the GTBC revealed no additional tumours. Fixed samples of the tumour, submitted to the College of Veterinary Medicine, University of Florida, Gainesville, USA for herpesvirus testing with conserved primers (VanDevanter *et al.*, 1996), gave negative results.

Histologically, the dermis was markedly expanded by a mass consisting of dense sheets of neoplastic round cells and subdivided into multiple lobules by thick septa of dermal collagen (Fig. 2). The neoplastic cells, which were consistent with mast cells, were characterized by an increased nuclear to cytoplasmic ratio and contained an abundance of fine amphophilic granules, which were stained metachromatically by Giemsa (Fig. 3) and toluidine blue stains. Nuclei were eccentric and euchromatic, with a single prominent nucleolus. Rare binucleated cells and individual cells undergoing necrosis were present. Mitoses

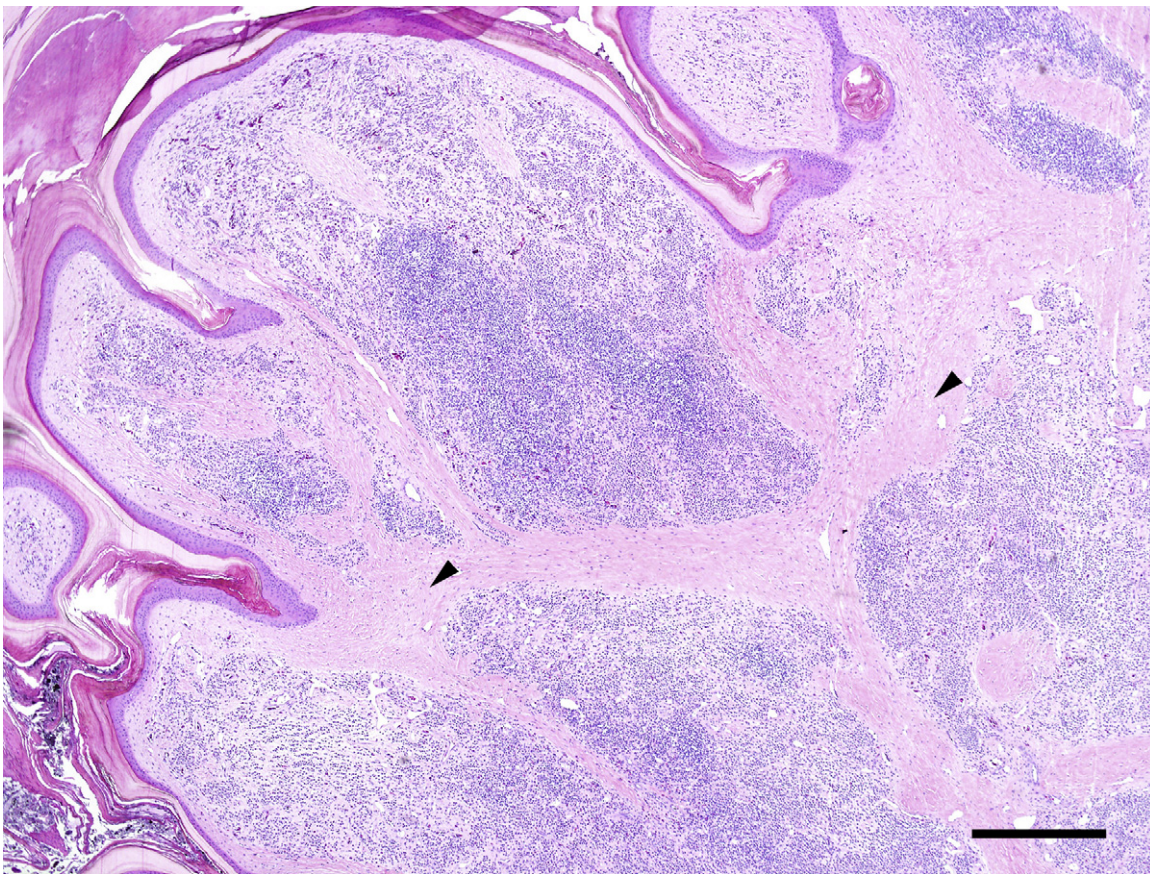


Fig. 2. Skin. A mast cell tumour expands the dermis. Note the prominent septa of dermal collagen (black arrowheads) that subdivide the tumour into lobules. HE. Bar, 500 μm .

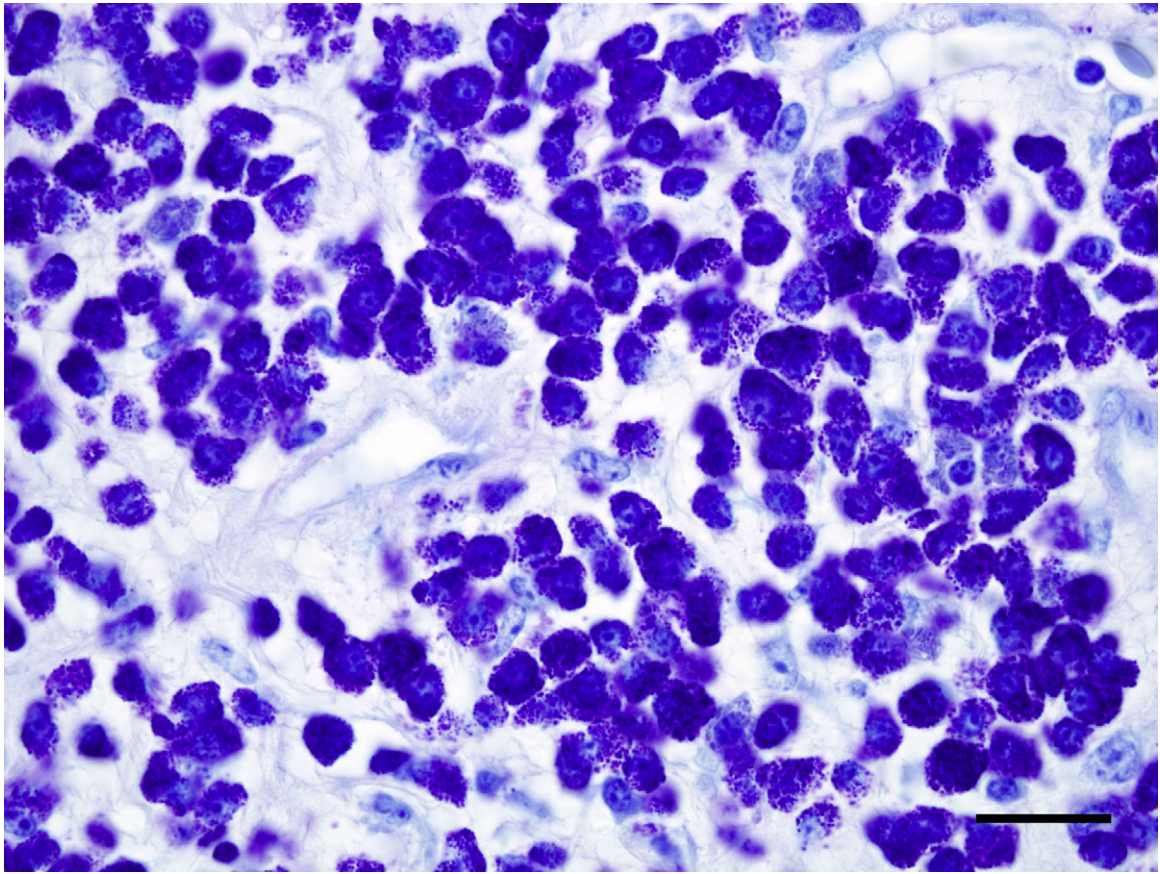


Fig. 3. Skin, mast cell tumour. Neoplastic mast cells are well-differentiated and contain typical metachromatic granules. Giemsa stain. Bar, 20 μ m.

were also rare (less than one per 10 high power fields). Neoplastic mast cells extended to all surgical margins. Small numbers of acidophilic granulocytes, including heterophils and granulocytes with round granules (probable eosinophils), were interspersed between the neoplastic cells, as also were multiple small dense aggregates of lymphocytes. The overlying hyperkeratotic epidermis was thrown into prominent folds and ridges and was covered by a thick crust composed of layers of keratin, degenerate granulocytes, bacterial colonies and pigmented debris. The histological and staining features were consistent with those of a well-differentiated mast cell tumour.

Haematological examination was not carried out at the time of diagnosis. However, a complete blood cell count carried out later (August 2006) revealed no abnormalities. The tortoise was in apparent good health 11 months after excision of the tumour.

Mast cell tumours are common in domestic animals and one of the most common cutaneous tumours in dogs (Pulley and Stannard, 1990; Goldschmidt and Hendrick, 2002). Across species, these tumours exhibit wide variation in biological behaviour. They may be focal or multicentric in the skin, and may also affect

internal viscera such as the spleen, liver and intestine. Prognostically significant grading schemes, which have been developed for dogs, are based on cellular differentiation, cytological atypia, proliferation, and tissue invasion (Patnaik *et al.*, 1984; Goldschmidt and Hendrick, 2002). In other species, mast cell tumours range from typically benign in horses to commonly malignant in cattle (Goldschmidt and Hendrick, 2002). Because reports in non-domestic species are rare, the biological behaviour and prognostic indices for such animals are unknown.

Within the class Reptilia, neoplasms of skin and mesenchymal tissues have been reported in crocodilians, lizards, snakes and chelonians (Jacobson, 1981; Frye, 1994; Reavill, 2004; Mauldin and Done, 2006). In a recent review of submissions to a large diagnostic service for non-domestic animals, cases of neoplasia in reptiles occurred most commonly in snakes, followed by lizards, chelonians and crocodilians (Garner *et al.*, 2004). To our knowledge, only four cases of mast cell tumour have been reported in reptiles. Schumacher *et al.* (1998) described an undifferentiated mast cell tumour in a 16-year-old captive-bred male eastern king snake (*Lampropeltis*

getulus getulus). The tumour was observed to be an ovoid mass (2 × 2 × 5 cm) which was raised above the ventral scales, its location being ventral to the liver region. It was firmly attached to the fascia of the skin and the underlying skeletal musculature. The tumour recurred at the original site 6 months after excision and the animal died 3 months after the initiation of radiation therapy. Necropsy revealed multiple metastases in the liver, lung, spleen, endocardium, kidney and fat body. Reavill *et al.* (2000) described a well-differentiated, multicentric cutaneous mast cell tumour and mastocytosis of the peripheral blood in a captive common iguana (*Iguana iguana*). The animal, which was an adult female, showed a small swelling in the mouth and several subcutaneous masses. After euthanasia due to poor prognosis, no metastases were observed at necropsy. Frye (1994) recorded a mast cell tumour in a desert tortoise (*Xerobates agassizii*) and a malignant mastocytoma in a boa (*Boa constrictor constrictor*) among tumours diagnosed in reptiles during a 27-year period. In the National Cancer Institute's Registry of Tumours in Lower Animals (RTLA), mast cell tumour submissions are limited to caudate amphibians (23 cases), including the axolotl (*Ambystoma mexicanum*), the barred tiger salamander (*Ambystoma mavortium*) and a single case in an eastern newt (*Notophthalmus viridescens*).

The causes of mast cell tumours are unknown but may include viral infection, genetic predisposition and environmental stimuli (Pulley and Stannard, 1990; Goldschmidt and Hendrick, 2002). An environmental carcinogen was suspected in one report of mast cell tumours in *Ambystoma mavortium* (originally reported as *A. tigrinum*), in which affected animals originated from a polluted sewage pond with a high prevalence of cutaneous neoplasia in the resident salamanders (Rose, 1976). This is the second report of a mast cell tumour in a chelonian and the first in a Galapagos tortoise.

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