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Craniofacial Tumors of the Koala (*Phascolarctos cinereus*)

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Bone tumors of the skull are uncommon in domestic animals and virtually unrecorded in wildlife species. No reports of such tumors in koalas could be found in the literature.

A mature male koala (A) was found in a depressed condition and with a swelling of the right maxillary area. It died shortly after presentation and was examined at necropsy. Tissues for microscopic examination were fixed in 10% phosphate buffered (pH 7.0) formalin, embedded in paraffin by standard methods and stained with hematoxylin and eosin, and toluidine blue. Bone tissue was decalcified in a solution of trisodium citrate and formic acid prior to embedding.

Both kidneys appeared smaller than normal with irregular fibrosis of the cortex. There was a discrete bone-textured mass (3 to 4 cm in diameter) occupying the right nasal passages and frontal sinus and causing compression of the right maxillary sinus and deviation and erosion of the nasal septum (Fig. 1). The right nasopharyngeal meatus was totally occluded in the middle portion and there was some occlusion of the left meatus. The mass was pale, cream-colored with irregular thin soft-textured grey areas throughout, and a white translucent appearance of vari-

able thickness around the periphery. All other organs appeared normal.

Histologically, the kidney showed large areas of segmental interstitial fibrosis, tubular dilation, and glomerular shrinkage. The tubular epithelium was endothelial-like in appearance, with loss of apical cytoplasm, but with retention of nuclei. Approximately 50% of the kidney showed this change with the remaining tissue appearing histologically normal. The bone-textured mass had aggregates of monomorphic undifferentiated sarcomatous cells around its margins (Fig. 2). There were scattered areas of variably mature cartilage throughout the substance of the growth. The chondrocytes appeared hy-

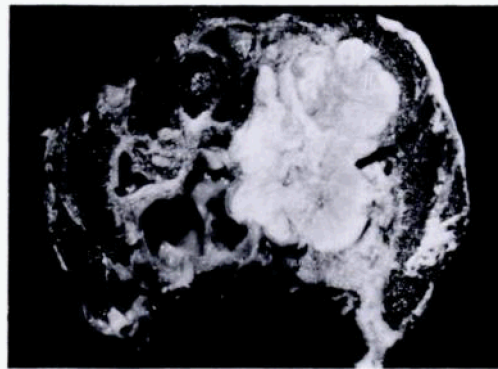


FIGURE 1. Transverse section of the nasal cavity of koala A showing a bony-textured mass occupying the right nasal meatus and frontal sinus. The left meatus is partly occluded.

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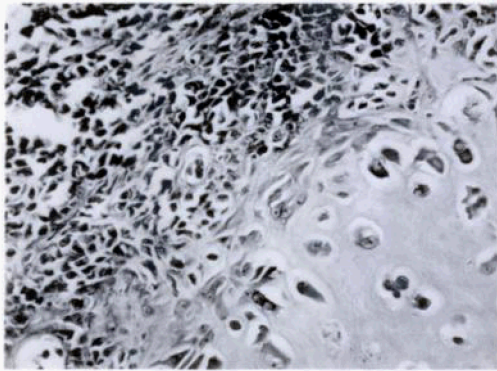


FIGURE 2. Part of the tumor mass from the nasal cavity of koala A near the outer margin showing sarcomatous cells associated with part of the dense bone structure. H&E, $\times 400$.

pertrophied (Fig. 3). Most of the tumor appeared benign and consisted of very dense bony trabeculae with scattered islands of vascular and fibrous tissue (Fig. 3). The sarcoma-like appearance in the marginal area of the mass designated a diagnosis of chondro-osseous osteosarcoma.

The second case (B) was discovered during an investigation into the prevalence of bone tumors in koalas, and consisted of a skull specimen which had been obtained by the Queensland Museum, Brisbane (Museum Ref.: J6789) in 1941. The tumor consisted of two confluent bony

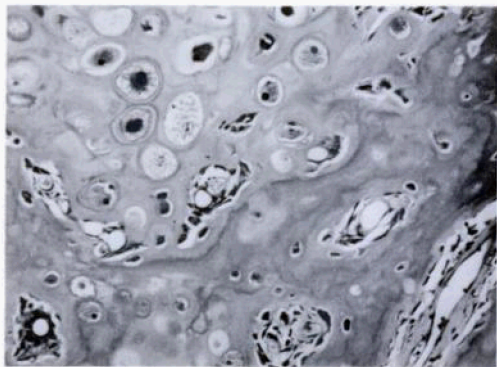


FIGURE 3. Part of the tumor mass from the nasal cavity of koala A showing hypertrophied cartilaginous cells, dense bony trabeculae and islands of vascular spaces and fibrous tissue. H&E, $\times 400$.

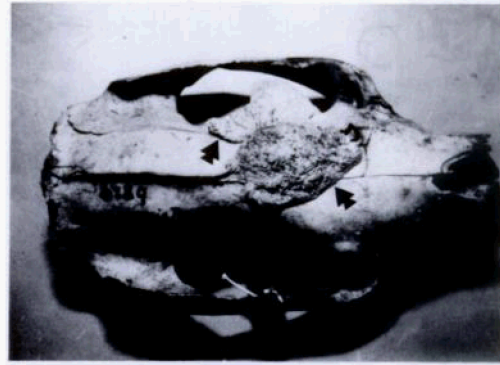


FIGURE 4. Dorsal view of the skull of koala B showing confluent bony masses with a roughened pitted surface on the left dorsal and left lateral surfaces of the cranium (arrows).

masses, mainly on the left side, involving the orbit, frontal and lacrimal bones (Fig. 4) and extending into the nasopharynx. Histological study was not done, but radiographs revealed a dense bony mass with a fine spicular or brush-like border characteristic of osteosarcoma (Fig. 5).

Osteosarcomas have been recorded in both the skull and long bones of wildlife, but they are uncommon. Most cases have been recorded in primates (Kollias, 1979, *In Veterinary Cancer Medicine*, Theilen and Madewell (eds.), Lea and Febiger, Philadelphia, Pennsylvania, pp. 407-423). The tumor in koala A presented diagnostic difficulties in that the bulk of the mass

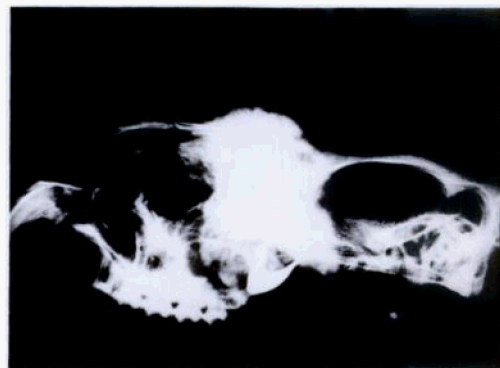


FIGURE 5. Lateral radiographic view of the skull of koala B showing a dense tumorous mass, with a brush-like or fine spicular periphery.

appeared benign and had features consistent with an osteochondroma. In the early forming osteochondroma, a cap of cartilage is distinctive, but in the mature form the cartilage may be discontinuous and be present, as in the mass of koala A, as isolated foci throughout the tumor (Pool, 1979, *In Tumors of Domestic Animals*, 2nd Ed., University of California Press, Berkeley, California, pp. 92–104).

The reasons for the formation of tumors containing both bone and cartilage in bones normally formed by intramembranous ossification are not apparent. In bones of endochondral origin, where cartilage plays a role in the development, alteration in that process with extra proliferation of bone cartilage is feasible (Spjut et al., 1971, *Tumors of Bone and Cartilage*, Armed Forces Institute of Pathology, Washington, D.C., pp. 59–64). In bones of the skull it is possible that a focal disruption of the periosteum has allowed unrestricted bone and cartilage growth at that point. The fact that the sarcomatous activity of the tumor was confined to the margin could suggest that malignant transformation of what had previously been an entirely benign growth had occurred. This has been described in relation to osteomas and chondromas of the canine skull (Pool, 1979, op. cit.).

The clinical effect of the tumor in koala A was difficult to assess. The animal showed no respiratory distress, and it was considered that renal disease played a major role in the depressed state and subsequent death. Estimation of renal function,

based on gross and histological findings is difficult. Full assessment can only be done on detailed clinical and biochemical examination. This was not done, but the gross and histological renal changes, although not involving the entire organs were advanced and extensive.

Differentiation of the tumor in koala A was dependent on the gross and microscopic characteristics (Figs. 1–3). Radiological study was not done, but was the basis along with the gross appearance for the differentiation of the tumor in koala B (Figs. 4, 5). The dense radio-opaque appearance with a brush-like border (Fig. 5) is characteristic of osteosarcomas involving the paranasal sinuses of dogs (Pool, 1979, op. cit.).

The skull with bones of intramembranous formation is not an infrequent site of osteosarcomas in domestic animals (Pool, 1979, op. cit.). However, because of the infrequency of observations of animals such as the koala, it is not possible to compare the likely prevalence of these tumors in wildlife as compared to domestic species.

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