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What is This?
Keratinizing ameloblastoma in a 9-month-old llama (*Lama glama*)

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Abstract. A 9-month-old male llama (*Lama glama*) was presented because of a rapidly growing mass on the right side of the face. Radiographs revealed a marked expansion of the right caudal face region with bone lysis involving the maxilla and the nasal, lacrimal, zygomatic, and palatine bones. Cytologically, the mass consisted of atypical round to polygonal cells with round nuclei and basophilic cytoplasms that formed acini and rows. Histologically, the mass consisted of anastomosing cords and sheets of neoplastic odontogenic epithelial cells embedded in a loose fibrovascular connective tissue. Single layers of peripheral, polarized, palisading, columnar epithelial cells were seen at the edges of some cords. Within the centers of the cords, epithelial cells showed rapid progression to keratin production. The histologic diagnosis was keratinizing ameloblastoma. Ameloblastomas are neoplasms of odontogenic epithelium that tend to be locally aggressive and can cause substantial destruction of bony structures. Because ameloblastomas do not tend to metastasize, they can be successfully treated by complete surgical excision, performed before extensive bony destruction occurs. Ameloblastoma, although expected to be rare, should be on the list of differential diagnoses for facial swelling in llamas.

A 9-month-old male llama weighing 78 kg (171 lb) was admitted to the Oregon State University Veterinary Teaching Hospital, Corvallis, Oregon, because of a rapidly enlarging mass on the right side of the face. The llama had been acquired 3 months earlier, and the owner had noticed the mass shortly after acquisition. Previous treatment consisted of lancing the swelling on the assumption that it was an abscess, which resulted in a bloody discharge and a nonhealing wound. The mass did not interfere with mastication and did not appear to be painful.

Except for the large mass on the right side of the face, no abnormalities were identified on physical examination. A firm, centrally ulcerated, 10-cm-diameter, irregular, protruding mass covered the entire right maxilla and extended to the rostral and ventral borders of the orbit. Radiographs (Fig. 1) showed marked expansion of the right facial region, extending from the base of the orbit through the lacrimal region with lysis of the right maxilla and the nasal, lacrimal, zygomatic, and palatine bones. Fine-needle aspirate and core biopsy specimens were obtained. Aspirated blood-colored fluid and biopsied tissue samples were cultured. No aerobic or anaerobic organisms were grown.

The cytologic smear from the aspirate contained thick clusters of rounded cells (Fig. 2). Thinner areas had round to polygonal cells with eccentric, round nuclei and dark blue cytoplasm. These cells also formed acini and rows. Cell borders were often indistinct. Anisokaryosis and anisocytosis were minimal to moderate. Some cells had perinuclear clearing. Scattered keratinocytes undergoing keratinization were

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Figure 1. Dorsoventral radiograph of the skull demonstrating marked expansion, distortion, and destruction of the right caudal face extending from the base of the orbit through the lacrimal region (arrows). Specific bones involved include the maxillary, nasal, lacrimal, zygomatic, and palatine bones. A small focus of soft-tissue mineralization also is present (asterisk). Normal structures labeled on the left side of the skull: Z = zygomatic arch; O = orbit; M = mandible.

Figure 2. Cytology of an aspirate of the facial mass showing atypical cells with eccentric nuclei suggestive of neoplasia of epithelial origin. Anisokaryosis and anisocytosis are minimal, and cells have indistinct cell borders. Wrights-Giemsa stain. Bar = 5 μm.

Figure 3. Histologic section from the soft-tissue regions of the facial mass. A single layer of palisading cuboidal to low columnar cells borders the mass (arrows). Squamous differentiation is prominent (asterisk). Hematoxylin and eosin stain. Bar = 50 μm.

noted. Inflammatory cells were minimal in number, consistent with peripheral blood. The cells were atypical, suggestive of neoplasia, and were considered most compatible with epithelial cells, possibly squamous or odontogenic epithelium.

Histologic sections from the soft-tissue and bony regions of the mass consisted of anastomosing cords and sheets of neoplastic odontogenic epithelial cells embedded in loose fibrovascular connective tissue (Fig. 3). Single layers of polarized, palisading columnar epithelial cells lined the periphery of some of the cords. The epithelial cells, which lay within the center of the cords, exhibited rapid maturation toward keratin-producing cells. Histological evidence of bone resorption was not seen. The histologic diagnosis, based on the peripheral palisading of columnar basal cells around the islands of squamous cells, was keratinizing ameloblastoma.

The llama was sent home with the owner pending test results and with the understanding that successful treatment was unlikely. The llama was euthanized by the referring veterinarian after the histologic diagnosis was determined. The animal was not returned for a postmortem examination.

Neoplasia in camelids has been reported infrequently. Of the camelid species, llamas are most commonly reported to have neoplasms, but this may be due to their higher numbers and their longer time under herd management conditions in North America. The most common neoplasms reported in South American camelids are lymphosarcomas followed by carcinomas. A variety of other neoplasms also have been reported in camelids, but only 2 neoplasms of the head, a malignant teratoid medulloepithelioma in the eye and an anaplastic sarcoma of the mandible, have been reported. Although the majority of neoplasms are seen in adults, many neoplasms also have been reported in neonatal and juvenile camelids. To the authors’ knowledge, this is the first ameloblastoma reported in a camelid.

Epithelial odontogenic neoplasms are rare; however, ameloblastoma is the most common odontogenic neoplasm reported in animals and occurs more commonly in the mandible than in the maxilla. Ameloblastomas, lymphosarcomas, and carcinomas are the most common neoplasms reported in camelids.
toma has been reported at all ages but in some species is found primarily in young animals (e.g., cattle), whereas in other species ameloblastoma is more common in middle age (e.g., in dogs) and in older animals (e.g., horses).\textsuperscript{1,12} In addition to humans,\textsuperscript{8,12} ameloblastoma has been identified in horses,\textsuperscript{1,12} cattle,\textsuperscript{1,12} sheep,\textsuperscript{10} water buffalos,\textsuperscript{7} rodents,\textsuperscript{6} dogs,\textsuperscript{1,22} cats,\textsuperscript{1,12} and monkeys\textsuperscript{23} but is more common in dogs and cattle.\textsuperscript{1}

Ameloblastoma is a nonencapsulated, well-demarcated, noninductive epithelial neoplasm of odontogenic origin. As was seen in this case, ameloblastomas are composed of odontogenic epithelium within a mature, often edematous, fibrous connective tissue stroma. Epithelial cells can be seen as irregular masses and interdigiting cords or discrete islands of tall, columnar, palisading epithelial cells with apical nuclei (reverse polarization).\textsuperscript{5,8,12} Fully differentiated ameloblasts may also exhibit Tomes processes, which are located at the distal ends of the cells in the region where enamel matrix is secreted,\textsuperscript{8} but these secretory processes were not seen in this case. Central cells may form a loose network similar to the stellate reticulum of the developing tooth, and stromal degeneration may lead to cyst formation in the epithelial cords.\textsuperscript{5,12} These features are not required for diagnosis of an ameloblastoma and were not noted in this neoplasm.\textsuperscript{1,8} Squamous metaplasia, however, is commonly seen in ameloblastomas,\textsuperscript{5,12} and when prominent, as in this tumor, the term keratinizing ameloblastoma is more appropriate.\textsuperscript{5}

These neoplasms, often termed intraosseous or central, tend to be locally aggressive and involve substantial destruction of bony structures.\textsuperscript{1,5,12} Ameloblastomas can extend into sinuses, as in this case, or the oral cavity,\textsuperscript{1} which was not noted on physical examination of this llama. Despite the locally aggressive nature, these neoplasms rarely metastasize.\textsuperscript{1,5,8,12,22} Because a postmortem examination was not performed, confirmation of the lack of metastases in this animal was not possible, but clinical signs of metastasis were not identified on clinical examination. Ameloblastomas warrant a good prognosis for survival and function if excised before extensive bone destruction; however, neoplasms may recur with incomplete excision.\textsuperscript{22} Surgical removal was not attempted in the llama because the extensive bony involvement made complete excision impossible.

Other possible causes for the facial swelling include tooth root abscess, actinomycosis, osteomyelitis, soft-tissue infection, or abscess.\textsuperscript{3} These differentials were initially ruled out on clinical examination, by radiographs, and later by negative bacterial culture. The history of rapid growth and a nonhealing skin incision were more characteristic of neoplasia than other causes of facial swelling, despite the rare occurrence of facial neoplasms in llamas. The young age of the animal would generally make neoplasia less likely, but odontogenic neoplasms do occur more commonly in young animals in some species (e.g., cattle).\textsuperscript{12} The radiographic appearance of this mass was characteristic of neoplasia based on the extent of bony distortion and destruction accompanied by extensive soft-tissue changes. The lack of inflammatory cells and bacteria on cytological examination was helpful in ruling out infection. Additionally, the presence of atypical cells identified on cytology as possible squamous epithelium or odontogenic epithelium supported the diagnosis of neoplasia. The diagnosis of ameloblastoma was confirmed by histopathology.

In many species epithelial odontogenic neoplasms account for <1\% of oral neoplasms,\textsuperscript{22} and because so few neoplasms have been reported in camelids, ameloblastomas and other epithelial odontogenic tumors are expected to be rare. However, ameloblastoma should be included in the list of rule-outs for facial swelling in camels because early diagnosis and surgical excision before bony destruction occurs could be curative.

References