

Spontaneous Cutaneous Squamous Cell Carcinoma in a Sooty Mangabey (*Cercocebus atys*): A Case Report

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An adult sooty mangabey (*Cercocebus atys*) with a solid mass arising from the skin of the dorsolateral cervical area was presented to the veterinary clinical staff. Grossly, the mass was firm, elongated, ulcerated at the tip, and measured $2.7 \times 2.0 \times 2.3$ cm. It was surgically excised and then submitted for histopathologic evaluation. On histopathology, this tumor was composed of irregular masses and cords of neoplastic squamous epithelial cells that invaded the dermis and subcutis, often undergoing keratinization and forming numerous keratin pearls. On the basis of these histologic findings, the mass was diagnosed as a squamous cell carcinoma. Additional tests, including hematologic evaluations and radiographic views of the abdominal, thoracic, and cervical areas, were normal. Sections of the tumor were analyzed by electron microscopy and showed no evidence of viral particles. To the authors' knowledge, this is the first reported case of a spontaneous cutaneous squamous cell carcinoma in a sooty mangabey.

Abbreviation: SCC, squamous cell carcinoma

Spontaneous malignant tumors in nonhuman primates are relatively rare. The most frequently reported neoplasms in these species are carcinomas, with the digestive system being the most commonly affected organ system. Squamous cell carcinomas (SCCs) are malignant neoplasms that usually arise from the skin and stratified squamous epithelial cells of all body openings, and SCCs have been recognized frequently in most of the domestic animal species. In nonhuman primates SCCs in the oral cavity,^{13,18,19,29,31,34,37} stomach,³⁶ esophagus,^{2,44} lung,^{4,8,15,26} cervix,^{11,12,38} skin,²³ vagina, and penis^{26,32,41} of various species of macaques (*Macaca* spp.) have been reported, with most of these lesions originating in areas of mucocutaneous junctions. Reported sites of SCCs in nonhuman primates other than macaques include the perineal skin of hamadryas baboons (*Papio hamadryas*),¹⁷ the stomach of an orangutan (*Pongo pygmaeus*),³⁰ a bronchogenic carcinoma in a Sykes monkey (*Cercopithecus mitis*),³⁹ the face of an African green monkey (*Cercopithecus pygerythrus*),⁹ the epidermis of a white-lipped tamarin (*Saguinus fuscicollis*),³³ the oral and nasopharyngeal areas of a marmoset (*Callithrix* spp.),^{3,21} and the oral cavities of squirrel monkeys (*Saimiri sciurus*),^{25,27,35} a capuchin monkey (*Cebus apella*),¹⁰ and a black-faced spider monkey (*Ateles chamek*).⁷ In the present report we describe a spontaneous squamous cell carcinoma originating from the skin on the dorsolateral aspect of the neck of a sooty mangabey (*Cercocebus atys*).

Case Report

History. The subject of this case report was born in April 1993 at the Lawrenceville, GA, field station of the Yerkes National Primate Research Center, a facility accredited by the Association for the Assessment and Accreditation of Laboratory Animal Care,

International, and had been maintained in an indoor-outdoor compound since birth. It was fed a commercial primate diet (Monkey Chow/Purina No. 5, Ralston Purina, St Louis, MO), supplemented with fresh fruits and water ad libitum, and was assigned to an AIDS core study at the Primate Center. All uses and procedures were approved and in accordance with the Institutional Animal Care and Use Committee (IACUC) of Emory University. On 17 February 2004, this 11-y-old, 8.4-kg, castrated male mangabey was presented to the veterinary clinical staff for the main complaint of a growth and some blood staining around the neck (Figure 1).

During physical examination, this animal appeared completely normal except for a mass arising from the skin on the left dorsolateral cervical area. Grossly, the mass was firm, elongated, ulcerated at the tip and measuring $2.7 \times 2.0 \times 2.3$ cm (Figure 2). Blood samples were obtained for hematologic evaluations including complete blood counts, serum chemistries, and bacterial culture; all these results were unremarkable. Lateral and ventrodorsal radiographic views of the abdominal, thoracic, and cervical areas were taken and showed no evidence of metastasis to any internal organs. The mass was surgically removed by wide excisional biopsy, in accordance with routine surgical procedures. These included aseptic technique, induction of anesthesia with an intramuscular dose of tiletamine-zolazepam (4 mg/kg) followed by endotracheal intubation, and maintenance within an appropriate anesthetic plane by using inhaled isoflurane (1%). After removal, the mass was placed in 10% neutral buffered formalin and sent to the Department of Pathology at the Yerkes Main Center (Atlanta, GA). Recovery of the animal after surgery was uneventful. Postoperative treatment buprenorphine (0.01 mg/kg 3 times daily) for 24 h and ceftriaxone (25 mg/kg once daily) for 7 d.

The follow-up plan for this animal includes an annual physical examination (at the same time for routine surveys), complete blood counts, serum chemistries, and radiographs of the affected area, chest, and abdomen. The most recent evaluation (Febru-

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Figure 1. Photograph showing the ulcerated mass, localized at the dorsolateral neck area.

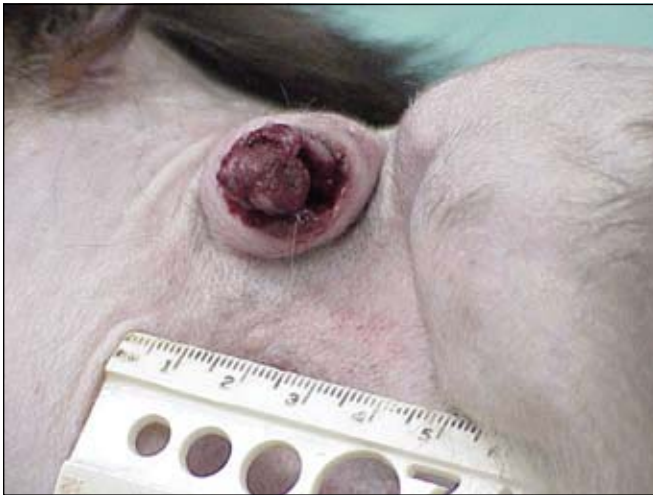


Figure 2. A closer photograph of the mass measuring 2.7 × 2.0 × 2.3 cm prior surgical removal.

ary 2005) revealed no physical signs of tumor local recurrence, with radiographic views and blood results remaining essentially unremarkable.

Pathologic findings. Fixed tissues were trimmed, routinely processed, embedded in paraffin, sectioned at 5 μm, and stained with hematoxylin and eosin for histopathologic evaluation. Histologic evaluation of the mass revealed irregular cords and masses of epithelial cells that proliferated and invaded the dermis and occasionally the subcutis (Figure 3). These neoplastic cells were round to oval and had centrally located vesicular, round nuclei with abundant eosinophilic cytoplasm (Figure 3, insert). The neoplastic cells often underwent keratinization forming keratin 'horn pearls.' In addition there were variable numbers of intercellular bridges (prickle cells or desmosomes). The presence of these keratin pearls and intercellular bridges are characteristic histopathologic findings in well-differentiated SCCs. Mitotic figures for this tumor were infrequent: 0 to 2 per high-power field. Evidence of invasion to the blood vessels was not noted; however, the neoplastic cells extended to 2 of the surgical margins. On the basis of these histologic findings, the mass was diagnosed as a cutaneous SCC. In addition, sections of this tumor were examined by electron microscopy, but no viruses, viral particles, or noteworthy findings were present.

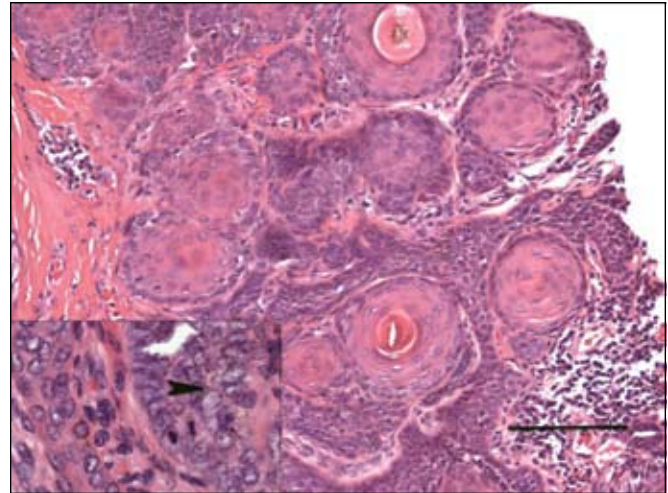


Figure 3. High magnification of the mass. Note the severe acanthosis of the epidermis with endophytic proliferation of island and cords of neoplastic squamous cells. Also note the dermis containing keratin pearls (arrows). Hematoxylin and eosin; scale bar, 100 μm.

Discussion

SCCs have been recognized in and considered the most common form of carcinoma in several species of domestic animals.^{1,14,22} As with most neoplasms, the etiology of these tumors is undefined; although most arise without antecedent cause, prolonged exposure to sunlight is considered a major predisposing factor for their origin in many species. Humans and white cats show a strong correlation existing between the development of SCC and chronic exposure to ultraviolet light;²⁸ SCCs develop about 13 times more frequently in white cats than in other cats and usually arise from the pinnae and frontal ridges and on eyelids. In dogs, those with autoimmune disorders or nasal depigmentation and breeds with lightly pigmented skin and short coats appear to be more predisposed to develop this type of tumor in association with prolonged solar injury. In humans, when this type of tumor originates from the epidermis, the term 'epidermoid carcinoma' is commonly used, and the name 'Bowen disease' is used in human dermatopathology to describe patients with one or more SCCs in situ.²⁴ Solar induction is the most common predisposing cause for this condition, but viral induction, especially by papillomaviruses, also is important.²⁰

A retrospective study in dogs demonstrated papillomavirus structural antigens in 5 of 9 canine SCCs,⁴⁰ suggesting this virus has an etiologic component in the origin of these neoplasms for this species as well. In addition, SCCs occurred at the injection site of a live canine oral papilloma virus vaccine in some dogs.⁵ Many cats with Bowen disease have been recognized; affected cats were old, did not have lightly pigmented skin or coats, and presented with multiple, variable pigmented hyperkeratotic plaques, especially on the head, neck, shoulder area, and forelimbs. In large animals such as cattle and horses, 'solar keratosis,' which consists of focal processes of lichenification, hyperkeratosis, and erythema, often precedes the development of SCCs. For both bovines and equines, breeds with white hair and poorly pigmented skin are commonly affected by these carcinomas, with occurrence anywhere on the body but usually around nonpigmented, poorly haired areas near mucocutaneous junctions, particularly in the eyelids, lips, nose, and external genitalia.¹

Spontaneous tumors in nonhuman primates other than macaques are infrequently reported, possibly due to the relatively

short lifespan of monkeys maintained in primate facilities. Only a few cases of SCC originating from the skin have been reported,^{17,23,33} and only 1 of these showed a possible correlation between the development of the tumor and exposure to sunlight.³² Papillomaviruses have been associated with these carcinomas in nonhuman primates because these viruses were isolated and characterized from a lymph node metastasis of a primary penile SCC found in a rhesus macaque.^{16,17} Along with solar exposure, nonhealing fight wounds and the use of chemical disinfectants have previously been suspected as predisposing factors in a case report involving 2 hamadryas baboons housed in a captive troop.¹⁷ Chemicals such as *n*-methyl-*N*-nitrosourea have been implicated in nonhuman primates as a potential carcinogen, persistently producing SCCs in the digestive tract, mostly of the esophagus.⁴²

In mangabeys, only 2 isolated cases of neoplasms have been reported in the past, a hepatoma in a sooty mangabey⁶ and a uterine myosarcoma in a black mangabey (*Cercocebus atterimus*).⁴³ Here we report the 1st case of a spontaneous squamous cell carcinoma in the skin of a sooty mangabey. Possible etiologies that we considered for this particular case include viruses (specifically papillomaviruses) and some environmental events or factors that can act as preneoplastic or neoplastic conditioners. Potential environmental factors include direct contact of cleaning chemical disinfectants with the affected area, chronic irritation due to nonhealing skin wounds from fighting with other animals in the compound, and especially exposure to solar or ultraviolet light, based on the fact that these animals spend most of the day in the outside area of these compounds. Electron microscopy was performed to identify a possible viral association, but no viruses or viral particles were found. This animal did not have any previous events of trauma from fighting wounds, according to his clinical history and experimental records; however, small unreported injuries in the past cannot be completely omitted or ruled out. In addition, it has long been assumed that stages of initiation, promotion, and progression of SCC in humans and domestic animals are influenced by 1 or more genetic factors. The confirmed appearance of this type of carcinoma in a sooty mangabey elucidates the need to identify all possible causes and initiating factors, circumstances that may act as intensifying factors, and, finally, viable treatment options.

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