

Case Report

Costal Mesenchymal Chondrosarcoma with Diffuse Pleural and Pericardial Explantation in a Pygmy Goat

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Abstract: A 3 year old intact male pygmy goat developed progressive weakness and eventual recumbancy over the course of 1 week, while maintaining its ability to eat and drink. The animal died and at necropsy, the parietal pleural surfaces and the pericardial surface were noted to be covered with firm, white, variably sized nodules that often formed linear arrays or coalesced into larger clumped aggregates. The visceral pleural surfaces of the ventral lung lobes were also covered with similar nodules. Histopathological and immunohistochemical evaluation of the submitted tissues revealed a diagnosis of mesenchymal chondrosarcoma with extensive seeding throughout the thoracic cavity. (DOI: 10.1293/tox.2013-0040; *J Toxicol Pathol* 2014; 27: 81–85)

Key words: chondrosarcoma, explantation, goat, mesenchymal, pleural

Chondrosarcomas are malignant tumors of mesenchymal origin arising either within bone, and described as either central or medullary, or within the periosteum and termed as peripheral^{1–3}. These tumors are relatively well described in the veterinary literature, having been diagnosed in most domestic species to include a variety of dog breeds^{2,4–8}, cats¹, ferrets⁹, sheep¹⁰, horses¹¹, cows^{9,12,13} as well as single reports in the mandible of a camel¹⁴ and the humerus of a goat¹⁵. In dogs, cats and horses there are occasional reports of extraskeletal chondrosarcomas described as primary to various tissues, including the retroperitoneal space⁶, the pericardium¹⁶, the liver⁴, spleen⁵, mammary gland¹⁷, tongue¹⁸ and subcutaneous tissues^{13,19}. In the majority of reports in domestic species, chondrosarcomas arise with greater frequency in the flat bones as opposed to the long bones. The sternocostal complex appears to be the primary predilection site in sheep while dogs have a statistically significant predominance of tumors arising in the ribs and nasal cavity³. Tumor explantation from a chondrosarcoma into a body cavity has been reported in the medical literature^{4,20,21}, mimicking the macroscopic presentation

of malignant mesothelioma or carcinomatosis secondary to seeding from a distant epithelial tumor, but while widespread chondrosarcoma metastasis to solid organs has been described in the veterinary literature, explantation within the thoracic cavity has only been suggested once in a single animal in combination with widespread metastasis and organ invasion¹².

Mesenchymal chondrosarcomas differ from conventional and myxoid chondrosarcomas in the histopathological appearance of the neoplastic cells and in their growth patterns⁶. This form is typically composed of a predominant population of dense swaths of primitive mesenchymal round cells occasionally centered upon islands of mature neoplastic chondrocytes embedded in chondroid matrix.

This is the first report of mesenchymal chondrosarcoma in a goat and the second description of pleural and pericardial chondrosarcoma explantation in a domestic species.

A 3 year old intact male pygmy goat in good nutritional condition presented dead to the Frederick (Maryland) Animal Health Diagnostic Laboratory in 2011. The animal's antemortem history included weakness and recumbancy with normal appetite. The owner reported the loss of two other animals with similar symptomology. A fecal examination of the animal noted eimerial oocysts and strongyle ova which were too numerous to count. Necropsy of the animal revealed ventral subcutaneous edema concentrated within the axillary and inguinal regions and a small amount of abdominal serous effusion. Upon opening the thoracic cavity, 1.5 liters of clear serous fluid was removed and all of the pa-

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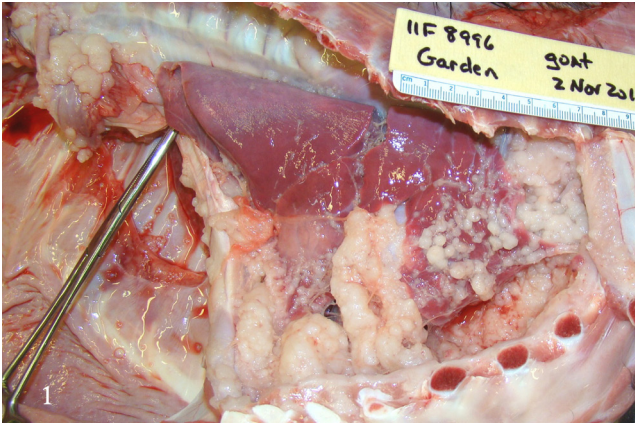


Fig. 1. Pygmy goat, Thoracic cavity: Multifocal to coalescing neoplastic seeding of pleural and pericardial surfaces.

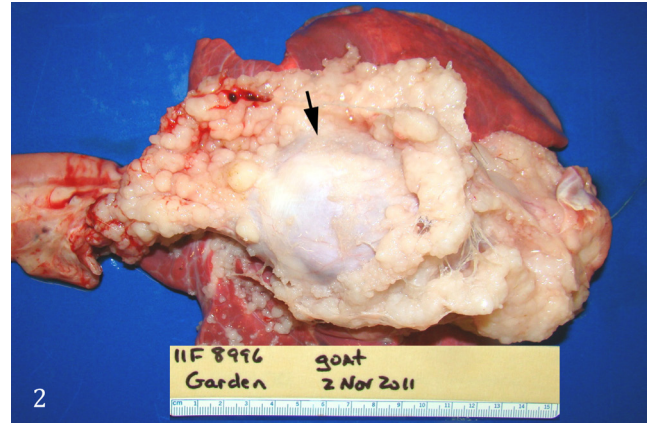


Fig. 2. Pygmy goat, Heart and lungs: Completely obscuring the pericardium (arrow) and the ventral surface of the lungs are innumerable coalescing nodules of chondrosarcoma having seeded from the point of origin in a rib.

rietal pleural surfaces as well as the pericardium were covered by firm, white coalescing nodules, ranging from 1 to 10 mm in diameter (Figs. 1, and 2). These frequently formed either linear arrays or larger clumped aggregates. While the visceral pleural surfaces of the ventral lung lobes were covered in these nodules, there was no macroscopic evidence of parenchymal invasion. Based on the gross necropsy, and the presentation of a diffuse thoracic neoplastic process, a primary differential diagnosis of malignant mesothelioma was proffered without noting a site of origin. All tissues were submitted for microscopic examination.

While the macroscopic evaluation did not reveal the tissue initially transformed, histopathological examination of all submitted tissues noted neoplastic invasion and effacement of a rib, strongly suggesting a probable point of origin (Fig. 3). The neoplasm markedly expanded, replaced and effaced the pleural surfaces of the intercostal musculature, the diaphragm, the pericardium, all mediastinal components and obscured the ventral aspects of the lungs (Fig. 4). Microscopically, the tumor was characterized by coalescing islands and larger swaths of pleomorphic cells (Fig. 5), ranging in shape from individualized round cells to streams of spindle cells (Fig. 6). These cells frequently bounded the islands and formed coalescing zones of both gradual and abrupt transition to maturation into large polygonal cells reminiscent of chondrocytes. Neoplastic cells had distinct cell borders and were separated by variably abundant amorphous amphophilic to lightly basophilic matrix. The subpopulation of spindle cells had a small amount of fibrillar cytoplasm, while the round and larger polygonal cells had abundant flocculent cytoplasm. The phenotype of the nuclei was variable based on the shape of the neoplastic cells but typically had roughly stippled chromatin and 1 to 3 distinct nucleoli. There was significant anisocytosis and anisokaryosis associated with the pleomorphism of the various phenotypes described. The mitotic rate was approximately 2 per high powered field among the subpopulations of round and spindle cells, however no mitoses were observed within the differentiated neoplastic chondrocytes. No endochondral

ossification was noted in multiple samples taken throughout the thoracic cavity. Additional histopathological findings in the examined tissues included a pyogranulomatous and eosinophilic bronchopneumonia with rare intrabronchiolar nematodes interpreted to be metastrongyles.

In order to confirm the histopathological diagnosis of chondrosarcoma, samples of the neoplasm were stained with Alcian blue (pH 2.5) and mucicarmine, while sections were also evaluated immunohistochemically for reaction to S-100 protein and vimentin. Diffusely the intracellular neoplastic matrix stained with Alcian blue as well as mucicarmine. Additionally, there was strong nuclear immunohistochemical reactivity for S-100 protein (Fig. 7) and strong cytoplasmic immunoreactivity to vimentin (Fig. 8).

While malignant mesotheliomas have been reported to display both osseous and chondrous differentiation²², these tumors typically are negative to S-100 protein²³. Additionally, while the biphasic mesotheliomas described in the literature often contain islands of cartilagenous metaplasia, they also typically involve zones comprised of proliferative infiltrative papillary projections, with the neoplastic cells supported by thin fibrous connective tissue^{22,24}. Typical, myxoid and mesenchymal chondrosarcomas are not reported to form this papillary pattern.

Based on the histopathological findings of a metastatic tumor composed of alternating regions of primarily poorly differentiated sheets of round cells and the more typical chondrous maturation described in chondrosarcomas, combined with the successful application of special stains demonstrating the chondrous matrix and finally the immunohistochemical findings of neoplastic reactivity to both S-100 and vimentin, a definitive diagnosis of mesenchymal chondrosarcoma was proffered.

Mesenchymal chondrosarcomas are very rarely reported soft tissue neoplasms of domestic species and account for approximately 2% of all chondrosarcomas in humans. In the medical literature, 50% of mesenchymal chondrosarcomas

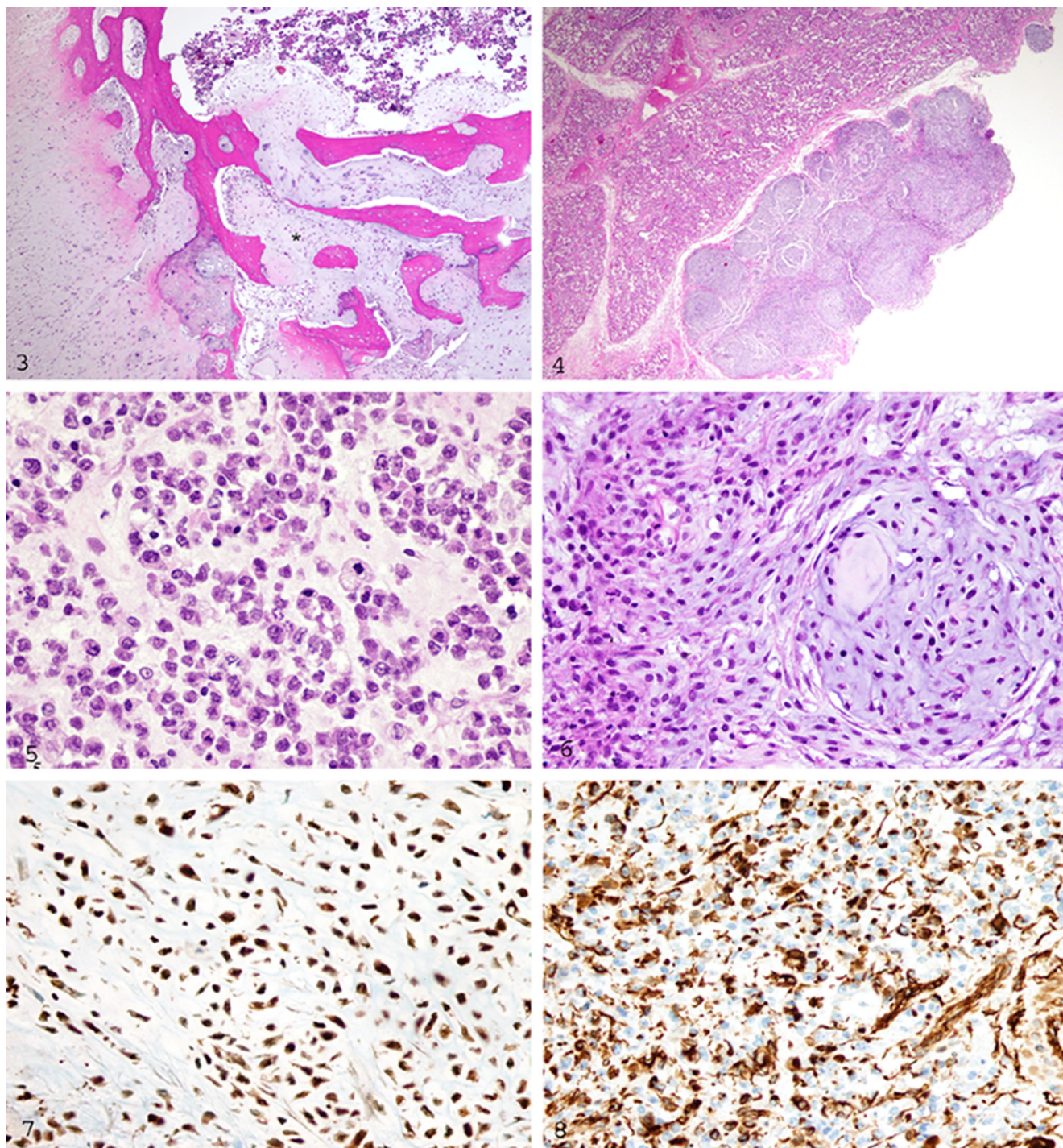


Fig. 3. Pygmy goat: Rib: Effacing the cortical bone of the rib are coalescing islands of neoplastic chondrocytes surrounded by abundant amphophilic matrix (asterix). Hematoxylin and eosin. 200 \times .

Fig. 4. Pygmy goat, lung, pleura surface: Expanding and replacing the pleural surface of the lung are coalescing islands of neoplastic cells (asterix). Hematoxylin and eosin. 40 \times .

Fig. 5. Pygmy goat, lung, pleura: The predominant population of neoplastic cells are round to polygonal arranged in dense sheets. Hematoxylin and eosin. 600 \times .

Fig. 6. Pygmy goat, lung, pleura: Multifocally, the neoplastic cells are polygonal to spindle and whorl around islands of larger more mature neoplastic chondrocytes embedded in abundant matrix. Hematoxylin and eosin. 400 \times .

Fig. 7. Pygmy goat, lung, pleura: Diffusely the neoplastic cells demonstrate strong nuclear immunoreactivity to S-100 protein. S-100 protein. 400 \times .

Fig. 8. Pygmy goat, lung, pleura: Diffusely the neoplastic cells demonstrate strong cytoplasmic immunoreactivity to Vimentin. Vimentin. 400 \times .

commonly affect the thoracic and craniofacial bones, while the remainder are reported as being extraskeletal soft tissue tumors²⁵. This variant is characterized by regional swaths of poorly differentiated mesenchymal cells which variably undergo chondrous differentiation forming islands of mature neoplastic chondrocytes bounded by an amorphous matrix³. In the veterinary literature, mesenchymal chondrosarcomas have been described through single case reports in various organs in dogs^{5,6,8}, a cat¹⁹ and a cow¹³.

Exfoliation and implantation of certain types of neoplasm are well described in the medical literature to include costal chondrosarcoma seeding the pleura²⁶. Similar processes have been reported in a variety of veterinary studies to include mesotheliomas within the thoracic cavity, renal cell carcinomas, ovarian and uterine carcinomas, hepatocellular carcinomas and pancreatic carcinomas in the peritoneal cavity to name a few^{27–29}. The neoplastic cells have poor cohesion to one another and may result in diffuse spontaneous seeding of the pleural or peritoneal cavities with resultant implantation of neoplastic cells within the serosal surfaces, generally termed as a carcinomatosis. Additionally, there is abundant literature describing iatrogenic surgical or needle driven seeding of neoplastic cells into body cavities^{30–32}.

This case is interesting in the finding of widespread seeding throughout the thoracic cavity from the presumed point of origin within the partially effaced rib, and while chondrosarcomas are not a particular diagnostic challenge in any species, the description of the mesenchymal variant in a goat is of importance to the body of veterinary neoplastic disease literature. Based on a thorough review of the current literature, this is the first description of a mesenchymal chondrosarcoma in a goat and the second report of pleural and pericardial seeding of a chondrosarcoma in a domestic species.

Declaration of Conflict of Interests: E. D. Lombardini is a Lieutenant Colonel in the US Army. The opinions or assertions herein are those of the authors and do not necessarily reflect the view of the Department of the Army or The Department of Defense.

References

1. Slayter MV, Boosinger TR, Inskip W, Pool RR, Dämmrich K, and Larsen S. World Health Organization, Histological Classification of Bone and Joint Tumors of Domestic animals, Second Series, Vol. 1. MV Slayer (ed). Armed Forces Institute of Pathology, Washington DC. 11–13. 2007.
2. Thompson K. Bones and Joints. In: Jubb, Kennedy and Palmer's Pathology of Domestic Animals, 5th ed. MG Maxie (ed). Elsevier Saunders, Philadelphia. 121–124. 2007.
3. Thompson KG, and Pool RR. Tumors of bones. In: Tumors in Domestic Animals, 4th ed. DJ Meuten (ed). Iowa State Press, Ames. 245–317. 2002.
4. Chikata S, Nakamura S, Katayama R, Yanagisawa S, Matsuo Y, Yamane I, and Takahashi K. Primary chondrosarcoma in the liver of a dog. *Vet Pathol.* **43**: 1033–1036. 2006. [[Medline](#)] [[CrossRef](#)]
5. Miller JM, Walshaw R, and Bourque AC. Primary splenic mesenchymal chondrosarcoma in a dog. *Can Vet J.* **46**: 163–165. 2005. [[Medline](#)]
6. Munday JS, and Prah A. Retroperitoneal extraskeletal mesenchymal chondrosarcoma in a dog. *J Vet Diagn Invest.* **14**: 498–500. 2002. [[Medline](#)] [[CrossRef](#)]
7. Patnaik AK. Canine extraskeletal osteosarcoma and chondrosarcoma: a clinicopathologic study of 14 cases. *Vet Pathol.* **27**: 46–55. 1990. [[Medline](#)] [[CrossRef](#)]
8. Rhind SM, and Welsh E. Mesenchymal chondrosarcoma in a young German shepherd dog. *J Small Anim Pract.* **40**: 443–445. 1999. [[Medline](#)] [[CrossRef](#)]
9. Hendrick MJ, and Goldschmidt MH. Chondrosarcoma of the tail of ferrets (*Mustela putorius furo*). *Vet Pathol.* **24**: 272–273. 1987. [[Medline](#)]
10. Nielsen SW. Comparative pathology of bone tumors in animals, with particular emphasis on the dog. *Recent Results Cancer Res.* **54**: 3–16. 1976. [[Medline](#)]
11. Riddle WE Jr, and Wheat JD. Chondrosarcoma in a horse. *J Am Vet Med Assoc.* **158**: 1674–1677. 1971. [[Medline](#)]
12. Acland HM. Condrosarcoma in a cow. *J Comp Path.* **93**: 585–589. 1983. [[Medline](#)] [[CrossRef](#)]
13. Uno K, Kataoka H, and Kadota K. Extraskeletal mesenchymal chondrosarcoma in a cow. *J Comp Pathol.* **101**: 31–38. 1989. [[Medline](#)] [[CrossRef](#)]
14. Janardhan KS, Ganta CK, Andrews GA, and Anderson DE. Chondrosarcoma in a dromedary camel (*Camelus dromedarius*). *J Vet Diagn Invest.* **23**: 619–622. 2011. [[Medline](#)] [[CrossRef](#)]
15. Schmid T, Hilbe M, Ohlert S, and Nuss K. Chondrosarcoma in the humerus of a goat. *Vet Comp Orthop Traumatol.* **23**: 273–276. 2010. [[Medline](#)] [[CrossRef](#)]
16. Albers TM, Alroy J, Garrod LA, Brown D, and Pennink D. Histochemical and ultrastructural characterization of primary cardiac chondrosarcoma. *Vet Pathol.* **34**: 150–151. 1997. [[Medline](#)] [[CrossRef](#)]
17. Serin G, and Aydogan A. Chondrosarcoma in the mammary gland of a bitch: A case report. *Vet Med-Czech.* **54**: 543–546. 2009.
18. Wilson GJ, and Anthony ND. Chondrosarcoma of the tongue of a horse. *Aust Vet J.* **85**: 163–165. 2007. [[Medline](#)] [[CrossRef](#)]
19. Romanucci M, Bongiovanni L, Petrizzi L, and della Salda L. Cutaneous extraskeletal mesenchymal chondrosarcoma in a cat. *Vet Dermatol.* **16**: 121–124. 2005. [[Medline](#)] [[CrossRef](#)]
20. Bailey SC, and Head HD. Pleural chondrosarcoma. *Ann Thorac Surg.* **49**: 996–997. 1990. [[Medline](#)] [[CrossRef](#)]
21. Jain A, Safaya R, Jagan C, and Sharma SK. Extraskeletal mesenchymal chondrosarcoma of the pleura: Report of a rare case. *Indian J Pathol Microbiol.* **54**: 144–146. 2011. [[Medline](#)] [[CrossRef](#)]
22. Al-Dissi AN, and Philibert H. A case of biphasic mesothelioma with osseous and chondromatous differentiation in a cat. *Can Vet J.* **52**: 534–536. 2011. [[Medline](#)]
23. Yousem SA, and Hochholzer L. Malignant mesotheliomas with osseous and cartilaginous differentiation. *Arch Pathol Lab Med.* **111**: 62–66. 1987. [[Medline](#)]
24. Wolfe DF, Carson RL, Hudson RS, Boosinger TR, Mysinger PW, Powe TA, Claxton MS, and Angel KL. Mesothelioma in cattle: Eight cases (1970–1988). *JAVMA.* **199**: 486–491

1991. [[Medline](#)]
25. Hoang MP, Suarez PA, Donner LR, Y Ro J, Ordóñez NG, Ayala AG, and Czerniak B. Mesenchymal Chondrosarcoma: A small cell neoplasm with polyphenotypic differentiation. *Int J Surg Pathol.* **8**: 291–301. 2000. [[Medline](#)] [[CrossRef](#)]
 26. Pandolfo I, Gaeta M, Blandino A, La Spada F, Casablanca G, and Caminiti R. Costal chondrosarcoma with pleural seeding: CT findings. *J Comput Assist Tomogr.* **9**: 408–409. 1985. [[Medline](#)]
 27. Cullen JM, Page R, and Misdorp W. An overview of cancer pathogenesis, diagnosis and management In: *Tumors in Domestic Animals*, 4th ed. DJ Meuten (ed). Iowa State Press, Ames. 15. 2002.
 28. Kumar R, Nair MG, Lakkawar AW, and Varshney KC. Ovarian adenocarcinoma in a guinea fowl (*Numida meleagris*) - a case report. *Veterinarski arhiv.* **74**: 245–249. 2004.
 29. Wilson M, Hermes R, Bainbridge J, and Bassett H. A case of metastatic uterine adenocarcinoma in a southern white rhinoceros (*Ceratotherium simum simum*). *J Zoo Wildl Med.* **41**: 111–114. 2010. [[Medline](#)] [[CrossRef](#)]
 30. Ray-Coquard I, Ranchere-Vince D, Thiesse P, Ghesquière H, Biron P, Sunyach MP, Rivoire M, Lancry L, Méeus P, Sebban C, and Blay JY. Evaluation of core needle biopsy as a substitute to open biopsy in the diagnosis of soft-tissue masses. *Eur J Cancer.* **39**: 2021–2025. 2003. [[Medline](#)] [[CrossRef](#)]
 31. Warren-Smith CM, Roe K, de la Puerta B, Smith K, and Lamb CR. Pulmonary adenocarcinoma seeding along a fine needle aspiration tract in a dog. *Vet Rec.* **169**: 181. 2011. [[Medline](#)] [[CrossRef](#)]
 32. Zekas LJ, Crawford JT, and O'Brien RT. Computed tomography guided fine-needle aspirate and tissue-core biopsy of intrathoracic lesions in thirty dogs and cats. *Vet Radiol Ultrasound.* **46**: 200–204. 2005. [[Medline](#)] [[CrossRef](#)]