Pleomorphic Liposarcoma of the Intrathoracic Cavity in a Meerkat (*Suricata suricatta*)

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ABSTRACT. Postmortem examination of a meerkat which had been captive for eight years in zoo, revealed multinodular white masses filling the thoracic cavity with systemic metastasis. Microscopically, the neoplastic cells were polygonal to spindle-shaped and had eosinophilic cytoplasm often with variable numbers of small lipid droplets. Immunohistochemically, the neoplastic cells were intensely positive for vimentin and occasionally weakly positive for S-100. Ultrastructurally, several lipid droplets without limiting membranes were observed in the cytoplasm. Based on the findings above, the tumor was diagnosed as a pleomorphic liposarcoma arising from the thoracic cavity. To date, neoplasms have seldom been reported in Herpestidae animals. To the authors' knowledge, this is the first reported case of liposarcoma in a meerkat.

KEY WORDS: liposarcoma, meerkat, systemic metastasis, thoracic cavity.

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Liposarcomas are rare neoplasms in domestic animals, but have been reported to occur in many species [1, 4, 5, 7–9, 11–13]. In Herpestidae animals, the neoplasms have seldom been reported and, to our knowledge, their occurrence has not been documented for meerkats so far [10]. Here we report the first case of pleomorphic liposarcoma in a meerkat, which developed in the thoracic cavity with systemic metastasis.

A female meerkat which had been in captivity for eight years in zoo was unresponsive to steroid therapy and died after 3 months history of progressive depression, anorexia, and respiratory distress. Postmortem examination revealed multinodular white masses filling the thoracic cavity (Fig. 1). The mass surrounded the heart and displaced the diaphragm toward the abdominal cavity (Fig. 2). The cut surface of the tumor was white in color and lobulated. The lungs were displaced dorsally and a number of white nodules were scattered on the surface. Numerous white nodules were found in the liver. Small neoplastic nodules were also present on the thoracic wall, omentum, mesentery, and surface of the abdominal organs.

For light microscopic examination, sections of the tumor and major organs were stained with hematoxylin and eosin (HE), periodic acid-Schiff (PAS), PAS with diastase digestion, and silver impregnation. Oil red O staining was performed on frozen sections to demonstrate fat droplets in the neoplastic cells.

Immunohistochemical staining was performed using primary mouse monoclonal antibodies to vimentin (vimentin, v9; Dakocytomation Denmark A/S, Glostrup, Denmark), S-100 protein (beta-chain specific) (S-100; JIMRO, Takasaki, Japan), neuron specific enolase (NSE, 1G4; Zymed Labora-

tories, San Francisco, U.S.A.), human desmin (desmin, D33; Dakocytomation Denmark A/S), and human smooth muscle actin (α -SMA, 1A4; Dakocytomation Denmark A/S). Microwave antigen retrieval was performed at 90°C for 9 min (vimentin, S-100, NSE, desmin). The tissues were incubated with primary antibodies at 4°C overnight. For secondary antibody reaction, tissues were incubated with mouse or rabbit primary antibodies for 30 min at room temperature using a peroxidase-conjugated Histofine-Simplestain kit (Simplestain MAX-PO, Nichirei, Tokyo, Japan). 3'3-diaminobenzidine was used to visualize the reaction products. The slides were counterstained with hematoxylin.

Positive and negative controls were provided in all tests. Samples of normal meerkat adipose tissue, peripheral nerves, and tracheal cartilage were provided as positive controls for S-100 and a sample of normal meerkat brain for NSE.

Fig. 1. Thoracic cavity; meerkat. Multinodular white masses filled the thoracic cavity.

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Fig. 2. Thoracic cavity; meerkat. The cut surface of the tumor appeared white. The mass surrounded the heart and the lungs were displaced dorsally. Bar=3 cm.

For electron microscopy, the formalin fixed tumor was diced into 1-mm cubes, postfixed in osmium tetroxide, embedded in epoxy resin, and stained with lead citrate and uranyl acetate.

Microscopically, the thoracic cavity tumor had a thin fibrous capsule and consisted of densely cellular sheets occasionally separated by thin fibrovascular stroma. There were multifocal areas of necrosis accompanied by severe macrophage infiltration in the tumor. The neoplastic cells were largely composed of two different types of cell; one was polygonal with abundant eosinophilic microvacuolated cytoplasm (Fig. 3) and the other was spindle-shaped with eosinophilic granular or microvacuolated cytoplasm (Fig. 4). Atypia was evident in both types of cells. The nuclei varied in size, and were often eccentric. Multinucleated neoplastic cells were often seen, whereas mitotic figures were rare. Oil red O staining revealed that the cytoplasm of the neoplastic cells often contained variable numbers of small lipid droplets (Fig. 5). Most of the neoplastic cells had

Fig. 3. Thoracic cavity mass; meerkat. Showing the area occupied by largely polygonal cells with abundant eosinophilic microvacuolated cytoplasm. HE stain. Bar=50 μ m.

Fig. 4. Thoracic cavity mass; meerkat. Showing the area occupied by largely spindle-shaped cells with eosinophilic granular cytoplasm. HE stain. Bar=50 μ m.

Fig. 5. Thoracic cavity mass; meerkat. The neoplastic cells contained lipid droplets of various sizes in the cytoplasm. Oil red O staining. Bar=50 μ m.

Fig. 6. Thoracic cavity mass; meerkat. Transmission electron microscopy demonstrated several lipid droplets without limiting membranes, and mitochondria in the neoplastic cells. Bar=2 μ m.

PAS-positive granular materials in their cytoplasm and treatment with PAS with diastase completely removed the staining. Throughout the tumor tissue, fine argentaffin fibrils encircled individual neoplastic cells and separated them from each other. Intra- or extra- capsular invasions were found, and foci of the neoplastic cells were also observed in the lymphatic and blood vessels.

The neoplastic cells in the liver were poorly demarcated from the surrounding normal tissue and showed invasive growth. Metastatic foci were essentially similar to the tumor in the thoracic cavity, except that the cells in the foci were more spindle-shaped and lipid droplets in their cytoplasm were less in number. Invasion into the blood vessels and lymphatics occurred and tumor thrombi were found in the portal veins. Multifocal invasive growths were found in the portal areas. Hematogenous and lymphatic metastasis was found in the lung, spleen, and lymph nodes in the thoracic and abdominal cavities, and transcoelomic metastasis to the thoracic wall, pericardium, omentum, mesentery, and surface of abdominal organs were observed. Lymph nodes were completely replaced by the neoplastic cells.

Immunohistochemically, most of the neoplastic cells were intensely positive for vimentin, and the polygonal cells with microvacuolated cytoplasm were occasionally weakly positive for S-100. They were uniformly negative for NSE, desmin, and α -SMA. Normal meerkat adipose tissues were weakly positive for S-100.

Ultrastructurally, though morphological variation was observed, most of the polygonal neoplastic cells contained several lipid droplets without limiting membranes, and mitochondria (Fig. 6). The nuclei showed irregular contours. Spindle-shaped cells contained an oval nucleus, mitochondria and a small number of lipid droplets. Specific cell adhesions were not found. In general, routine transmission electron microscopy reveals slightly electron-dense lipid droplets; however, in the present case, the lipid droplets

were electron-lucent, due to various solvents used during the preparation process.

The tumor was diagnosed as liposarcoma on the basis of the following findings: (1) the cytoplasm had numerous small vacuoles, which were identified as lipid droplets with Oil red O staining [5, 6]; (2) fine argentaffin fibrils encircled individual neoplastic cells [8]; (3) ultrastructurally, the neoplastic cells had several lipid droplets without limiting membranes [4, 7, 8, 12]. Based on the gross and microscopic findings, and the result of immunohistochemistry and electron microscopy, the tumor was diagnosed as a pleomorphic liposarcoma arising from the thoracic cavity with systemic metastasis.

Liposarcomas have been classified histologically into well-differentiated, pleomorphic, and myxoid types under the World Health Organization classification scheme for domestic animals [6]. In humans, the biologic behavior of these tumors is quite variable and ranges from no metastatic potential (well-differentiated liposarcoma) to a 30–50% rate of metastasis and 40–50% mortality rate (pleomorphic liposarcoma) [2, 3]. However, in animals, a retrospective study of 56 liposarcomas in dogs evaluating biologic behavior and potential prognostic indicators found no significant association between survival time and histologic type [1]. In dog cases, recurrence of liposarcoma following surgical removal is reportedly common, but metastasis is rarely documented [5]. In this case, the findings of hematogenous, lymphatic and transcoelomic metastasis and severe invasive growth suggest that the tumor had a malignant biologic behavior.

Neoplasms have seldom been reported in Herpestidae animals including meerkats [10], and to date, liposarcoma has not been reported. The low number of reported cases may indicate that neoplasm is rare in these animals in comparison with other species. However, in the past we have identified three meerkat tumors: a hypophyseal tumor, a hepatocellular carcinoma and a mast cell tumor (unpublished). This suggests that research may still be insufficient and that more studies are necessary to evaluate neoplasm incidence in meerkats.

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