According to one retrospective study, the most common tumors in ferrets are insulinoma, adrenocortical neoplasia, and lymphoma. The fourth most commonly encountered neoplasms are those affecting the integument, including mast cell tumor (30%), sebaceous gland adenoma (22%), hemangiomma (13%), benign cystic adenoma (9%), and adenocarcinoma of the prepuce (7%). Dermatofibroma, carcinoma, fibroma, fibrosarcoma, histiocytoma, sarcoma, and squamous cell carcinoma account for 22% of skin tumors.

In one review, squamous cell carcinoma was the most prevalent skin tumor, followed by sebaceous gland adenocarcinoma. In another study of 57 cutaneous neoplasms in ferrets, a high incidence of basal cell tumor (58%) was reported, followed by mastocytoma (16%) and fibroma (11%). This column details the management of a perianal mass in a ferret that was diagnosed as a probable carcinoma based on cytologic examination of a fine-needle aspirate (FNA). Histopathology subsequently characterized the tumor as an apocrine gland tubular adenocarcinoma.

Case Report
Evaluation and Clinical Findings
A 5-year-old spayed ferret was presented for examination of a 0.5 x 0.5–cm mass in the right perianal area. Cytologic examination of a fine-needle aspirate of the mass revealed a likely diagnosis of carcinoma. Rapid growth of the mass precluded surgical resection; therefore, a definitive course of radiation therapy was initiated. The mass recurred several times at secondary sites and was later diagnosed as an apocrine gland tubular adenocarcinoma. A combination of surgery and radiation therapy was used to manage the mass and regional lymph node metastases.

Treatment
The ferret was anesthetized and...
A 1.0–cm mass was found intimately 2.5 cm in a ferret. April 2001

The ferret was subsequently premedicated with diphenhydramine at 2 mg/kg and were consistent with diphenhydramine at 2 mg/kg and oxygen, and radiation therapy was administered with an isocentric (80 cm) cobalt-60 teletherapy unit. The ferret was positioned in lateral recumbency and the tail pulled dorsally to exclude it from the treatment field. Right and left lateral, equally weighted, parallel-opposed treatment fields were used for each treatment and encompassed the mass and a 1.5 to 2.0–cm margin of clinically normal tissue. Included in the radiation field were portions of the vulva, rectum, skin, subcutis, and part of the musculature of the tail and hindlimbs. The minimum dose for each treatment was 400 cGy, with treatments administered three times weekly (i.e., Monday, Wednesday, Friday). Twelve treatments were given over 25 days for a total dose of 4800 cGy. Tissue equivalent bolus material was used at each treatment to ensure the prescribed dose to the superficial tumor cells. Because of an initial reaction to isoflurane inhalant anesthesia, including vomiting and hyperemia of the skin and mucous membranes, the ferret was subsequently premedicated with a bolus of isoflurane at 2 mg/kg PO 15 to 30 minutes before induction. Tumor response (diminished size) to radiation therapy was noted within 3 days of the first treatment. After the course of radiation, the tumor was no longer palpable. Mild erythema of the skin at the radiation site was noted but improved within 1 week following topical application of wet tea bags to the area.

Approximately 5 weeks after radiation therapy, an enlarging mass was noted at the original tumor site. The ferret was anesthetized and maintained with 2% to 2.5% isoflurane gas and oxygen. A 1-inch incision was made horizontally from the edge of the rectum to the popliteal node on the right leg. Subcutaneous fat was removed and a dark, approximately 1.0 × 1.0–cm mass was found intimately associated with the rectum and colon. The mass, which was carefully resected to avoid perforating the colon, appeared to be an anal sac; however, a tattoo in the right ear indicated that the ferret was produced by a breeder who routinely removes anal sacs prior to sale. The subcutaneous tissue and skin were closed with 4-0 polydioxanone suture (PDS). Histologic findings included inflammation with hemosiderosis. No neoplastic cells were identified and the tissue could not be identified as anal sac.

Two months later, a complete blood count revealed a high-normal lymphocyte count (3772/μl). A serum chemistry profile demonstrated hypoglycemia (77 mg/dl; reference range, 92 to 207 mg/dl). The ferret experienced one hypoglycemic episode during venipuncture that included weakness, hypersalivation, and nausea. Estradiol levels were elevated (219 pmol/L; reference range, 30 to 180 pmol/L) and were consistent with clinical signs of adrenal gland disease, including a rough haircoat. Ultrasonography of the abdomen demonstrated an enlarged left adrenal gland, and adrenalectomy was performed. Partial pancreatectomy was performed to remove a pancreatic nodule. A biopsy of a colonic lymph node was obtained to rule out lymphoma. Histopathologic examination of the tissue revealed an adenocortical adenoma with nodular hyperplasia of the adrenal gland, multifocal islet cell adenoma of the pancreatic nodule, and diffuse follicular hyperplasia of the lymph node.

Approximately 1 month later, two masses were identified in the area of the inguinal lymph nodes. The ferret was anesthetized and the masses removed. Histopathology revealed an aggressive apocrine gland tubular adenocarcinoma that was invading nearby stromal tissue (Figure 2). Following the histopathology report, thoracic radiography and abdominal ultrasonography were performed to check for metastasis. Although thoracic radiographs had not changed from the initial films, the abdominal ultrasonogram revealed enlarged sublumbar and mesenteric lymph nodes in addition to a “moth-eaten” appearance to the spleen. Cytologic examination of an FNA of the sublumbar lymph nodes revealed a metastatic carcinoma. Chemotherapy was offered as the next treatment option with a poor to grave prognosis. The owner declined this option with the exception of oral prednisone and requested that symptomatic treatment be given. Prednisone was initiated at 1 mg/kg PO q12h.

Within 3 months, the ferret began exhibiting stranguria and dyschezia, presumably from pressure on the colon, rectum, bladder, or urethra by the enlarged sublumbar lymph nodes. A course of palliative radiation therapy was instituted to treat the enlarged sublumbar lymph nodes and an inguinal mass. Abdominal radiography

Figure 1—Perianal mass measuring approximately 2.0 × 2.5 cm in a ferret.
was used to identify the margins of the lymph nodes and the small mass in the inguinal area (Figure 3). Lead blockers were positioned to shield the bladder and small intestines from the radiation beam, and port films were made to confirm shielding. Radiation was administered on days 0, 7, and 21 by equally weighted left and right parallel-opposed portals. The dose for each treatment was 800 cGy (total dose, 2400 cGy). At the end of the palliative radiation treatment period, the sublumbar lymph nodes had decreased markedly and the ferret was urinating and defecating normally. The inguinal mass, which was presumed to be carcinoma metastasis, had also decreased in size. Nine months after initial presentation, the client described the patient as clinically normal.

Approximately 1 month after the completion of palliative radiation therapy and 10 months following original presentation, the ferret again displayed stranguria. Symmetric masses were felt on abdominal palpation and were presumed to be enlarged sublumbar lymph nodes. Neurologic deficits were evident in the hindlimbs and included proprioceptive deficits and intermittent paresis. At this time, the hindlimb deficits were attributed to pressure on peripheral nerves by the enlarged sublumbar lymph nodes or to potential spinal cord metastases of the adenocarcinoma. The client elected euthanasia for the ferret because of concerns for quality of life. A necropsy was refused by the owner.

**Discussion**

Several case reports have described the treatment of adenocarcinoma in ferrets using surgical resection, chemotherapy, or radiation therapy. Miller and colleagues described a case of recurrent adenocarcinoma of preputial gland or sweat gland origin in a ferret. After three successive surgical excisions, subsequent recurrence of the tumor was treated with cobalt-60 teletherapy. The tumor completely regressed with radiation therapy but later recurred. A second course of radiation therapy was performed; however, the tumor metastasized to the retroperitoneal space. No further treatment was attempted, and the ferret was euthanized. Brown described three ferrets with preputial adenocarcinoma that were treated with aggressive surgical excision. The excised tumor recurred at the same site in all three ferrets. Surgical resection of the mass and doxorubicin therapy were used without success to treat one ferret. Two ferrets with apocrine gland adenocarcinomas have been reported by Parker and Picut. In one ferret, the tumor was excised with no recurrence or metastasis reported. The second tumor was reportedly inoperable; therefore, the ferret was euthanized. Orcutt described a sweat gland adenocarcinoma on the lateral aspect of the tail in a 2.5-year-old intact male ferret treated with an excision biopsy. Within 2 months of removal, metastasis occurred to deep tissues of the right thigh and perianal area. A sublumbar mass was observed on radiography and believed to be lymph node enlargement secondary to metastasis. Carpenter and colleagues described adenocarcinomas in five black-footed ferrets, three of which had metastases evident. In one of the ferrets, an adenocarcinoma of sebaceous or sweat gland origin was removed from the tail without evidence of recurrence on the death of the ferret 11 months later.

In the case described in this paper, the tumor was believed to be a carcinoma. If a biopsy had been obtained initially rather than an FNA, histopathology may have provided a more conclusive diagnosis. Because of concerns of delayed healing following radiation therapy and rapid tumor growth, however, a biopsy of the tu-
mor was not initially performed. Histopathology of the recurrent tumor revealed an apocrine gland tubular adenocarcinoma.

Management of the primary perianal mass and subsequent metastasis involved a combination of surgery and radiation therapy. Although chemotherapy was offered as an option, the owner declined. In retrospect, it might have been beneficial to irradiate the sublumbar lymph nodes at the time of the initial radiation treatment, helping to prevent or slow metastasis to the sublumbar lymph nodes.

It is interesting to note that the ferret in this report had other types of tumors, including an adrenocortical adenoma with nodular hyperplasia of the adrenal gland and multifocal islet cell adenoma of a pancreatic nodule. It is possible that the stress of surgery to remove the enlarged adrenal gland and the pancreatic nodule could have played a role in the rapid metastasis of the perianal adenocarcinoma to the inguinal lymph nodes 1 month after abdominal surgery. In contrast to some dogs with perianal apocrine gland adenocarcinoma, the ferret in this report did not have hypercalcemia.

Based on this and other case reports describing adenocarcinoma treatment and the response of ferrets, a guarded prognosis must be given with this diagnosis. Attempted complete surgical removal, with adjunct radiotherapy or chemotherapy as needed to prevent or treat metastases, appears to be the most effective treatment. Radiography and ultrasonography are helpful in identifying regional or distant metastases. In this case, the patient was successfully managed for 10 months following initial presentation.

Conclusion

This case report describes the management of a perianal mass determined to be an apocrine gland tubular adenocarcinoma. A combination of radiation therapy and surgery was used to manage the mass and its metastases for 10 months following original presentation. When adenocarcinoma occurs in ferrets, complete excision should be attempted. Radiation therapy or chemotherapy can be used adjunctively in an attempt to prevent or treat metastasis.

Acknowledgments

The authors wish to thank Drew Smith, BS; Cheryl B. Greenacre, DVM; Branson W. Ritchie, DVM, PhD; and Leann Pack, DVM, for their assistance with this case.

References