Spontaneous Poxviral Dermatitis and Keratoconjunctivitis in Free-Ranging Mule Deer (Odocoileus hemionus) in Wyoming

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rently underway in our laboratory to determine the distribution and prevalence of viral infections in coyotes in the western United States (Thomas et al., 1984, J. Am. Vet. Med. Assn. 185: 1283–1287; Evermann et al., 1985, Am. J. Vet. Med. Res. 46: 218–220).

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Spontaneous Poxviral Dermatitis and Keratoconjunctivitis in Free-Ranging Mule Deer (*Odocoileus hemionus*) in Wyoming

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Poxviruses infect a variety of mammalian and avian hosts, causing many diseases of public health or economic importance (Lane et al., 1981, *In* Handbook Series in Zoonoses, Section B: Viral Zoonoses, Vol. II, Steele (ed.), CRC Press, Inc. Boca Raton, Florida, pp. 365–385; Tripathy et al., 1981, *In* Comparative Diagnosis of Viral Diseases, Vol. III, Vertebrate Animal and Related Viruses, Part A—DNA Viruses, Kurstak and Kurstak (eds.), Academic Press, New York, pp. 267–346). Poxviral diseases are well studied in domestic animals and humans. Although the list of wildlife hosts is long (Nakano, 1977, *In* Comparative Diagnosis of Viral Diseases, Vol. I, Human and Related Viruses, Part A, Kurstak and Kurstak (eds.), Academic Press, New York, pp. 287–330), relatively little is known about pox infections in wildlife. Five reports document poxviral infection of cervids; two describe experimental contagious ecthyma caused by a parapox virus. Lance et al. (1983, J. Wildl. Dis. 19: 165–169) produced small proliferative lesions in the mucocutaneous tissue of the oral cavity of young mule deer, white-tailed deer (*O. virginianus*), and elk (*Cervus elaphus nelsoni*) by inoculation of lesion material from a bighorn sheep (*Ovis canadensis*) with contagious ecthyma. Lesions in all species were mild and regressed by 19 days postexposure. In a similar study, Zarnke et al. (1983, J. Wildl. Dis. 19: 170–174) exposed a moose calf (*Alces alces*) and a caribou fawn (*Rangifer tarandus*) to contagious ecthyma virus isolated from a naturally infected Dall sheep (*Ovis dalli*). Small lesions of contagious ecthyma developed on the lips of both animals.

Spontaneous contagious ecthyma has been described in domesticated reindeer (*Rangifer tarandus tarandus*) in Norway by Kummeneje and Krogsrud (1979, Vet. Rec. 105: 60–61), but the virus was not isolated. Lesions were mild and limited to

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the oral cavity. Human disease was associated with the outbreak in reindeer (Falk, 1978, Br. J. Dermatol. 99: 647–654). In another study, complement-fixing antibodies to contagious ecthyma virus were found in sera of 5 of 53 free-ranging caribou in Alaska (Zarnke, 1983, J. Wildl. Dis. 19: 324–329).

An unidentified poxvirus was associated with keratoconjunctivitis and oral and cutaneous crusting lesions in all members of a herd of reindeer in a Canadian zoologic park (Barker et al., 1980, *In* The Comparative Pathology of Zoo Animals, Montali and Migaki (eds.), Smithsonian Institution Press, Washington, D.C., pp. 171–177). Lesions resolved in 4 to 5 wk. The virus was not isolated; however, morphological features of the virus did not resemble the parapox viruses.

Our first case was seen in August 1983, when a mule deer fawn was found in a weak condition near Basin, Wyoming. Several other dead fawns had been seen during the summer on this ranch, but were not examined. Clinical examination disclosed severe unilateral keratoconjunctivitis, crusty skin lesions on the face and nose (Fig. 1), and an abscess on the back associated with a puncture wound. Blood samples were taken and the deer was killed by intravenous injection of a euthanasia solution (T-61®, Taylor Pharmacal Co., Decatur, Illinois 62525, USA). Internal organs appeared normal on gross examination. Selected tissues were fixed in 10% phosphate buffered formalin and were submitted along with the frozen head and the blood samples to the Wyoming State Veterinary Laboratory. Tissue from the head was later submitted to the National Veterinary Services Laboratory, United States Department of Agriculture, Ames, Iowa. Blood parameters were 4.4×10^6 erythrocytes/μl, 16,000 leukocytes/μl, 22% packed cell volume, and 7.5 g hemoglobin/dl. The white blood cell differential count was 53% neutrophils, 40% lymphocytes, and 7% immature neutrophils. Microscopically, the skin was severely distorted by freezing; however, necrosis and severe ulceration of the epidermis and superficial dermis were obvious. Mononuclear inflammatory cells were numerous in the dermis and neutrophils occurred in dermis and within hair follicles. Bacterial colonies were abundant in the necrotic debris on the skin surface. *Staphylococcus aureus*, *Corynebacterium pyogenes* and *Pseudomonas aeruginosa* were cultured from the skin and conjunctiva. Fungal cultures of the skin were negative. The serum was negative for antibodies to bluetongue virus by the agar gel immunodiffusion test and New Jersey and Indiana strains of vesicular stomatitis virus by the complement fixation and serum neutralization tests. Impression smears of the cornea were negative for chlamydial inclusion bodies. Poxviruses were observed in large numbers on examination of negatively stained skin lesion preparations by electron microscopy. These viral particles resembled vaccinia (orthopox) viruses and were brick shaped, approximately 250 to 292 nm × 179 to 187 nm, with a surface structure of irregularly arranged filaments. A poxvirus was isolated from affected skin by inoculation of fetal ovine kidney cell cultures and the chorioallantoic membrane of chicken embryos after two passages, but it was not characterized.

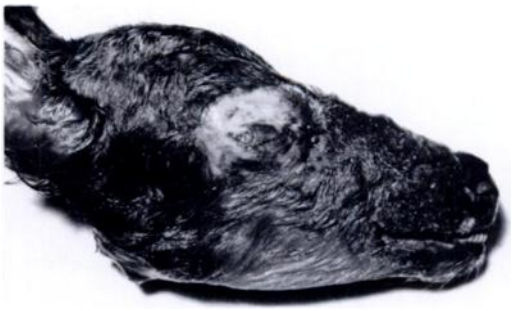

FIGURE 1. Mule deer fawn with poxviral dermatitis.

FIGURE 2. Electronmicrograph of deer poxviral particles stained with potassium phosphotungstic acid. Note envelope-like structures surrounding particles on the right. ×64,125.

A second case was studied in September of 1984. A fawn was observed to be blind and near death on a ranch near Burlington, Wyoming, about 40 km from the location of the first case. It died that night and was frozen for 5 days prior to transport to the laboratory. On gross examination there was severe mucopurulent bilateral keratoconjunctivitis with central corneal ulceration. The skin was crusty around the eyes, lips, muzzle, and chin. Ulcerative dermatitis occurred at the coronary bands of the hind feet with separation of the hoof walls. An abscess was present in the tissue surrounding the pastern joint with purulent exudate in tendon sheaths. Three small (5-mm-diameter) circular ulcers were on the hard palate and two slightly larger ulcers were beneath the tongue. Microscopically, the skin lesions were similar to those observed in the first case. Necrosis of epidermis, superficial dermis and hair follicles was the primary change with an infiltration of neutrophils, lymphocytes, and plasma cells. Clearly defined intracytoplasmic viral inclusion bodies were not observed. Bacterial colonies were numerous in the overlying debris. The cornea was vascularized, the epithelium was lost in many areas, and neutrophils were abundant. Neutrophils admixed with fibrin were in the anterior chamber. There was marked atrophy of the thymus. *Corynebacterium pyogenes* was isolated from the surface of the cornea and the abscess in the hind foot. Only coagulase negative *Staphylococcus* sp. was recovered from skin. Impression smears of the conjunctiva were negative for chlamydial inclusion bodies by the fluorescent antibody test or when stained with Gimenez and Giemsa stains. Numerous vaccinia-like virus particles of a size (227 to 292 nm × 162 to 207 nm) similar to those from the first case were observed on negatively stained skin preparations by electron microscopy (Fig. 2). A poxvirus was isolated at the Wyoming State Veterinary Laboratory by inoculating Vero M cell monolayers.

Diagnosis of spontaneous poxviral infection in two mule deer is of interest for several reasons. This represents the first diagnosis of a poxvirus-induced disease in free-ranging cervids and only the third time a spontaneous poxviral disease has been reported in cervids.

The disease in both fawns was severe and a significant factor in the death of the animals. This contrasts with the very minor lesions experimentally induced in mule deer and other cervids with contagious ecthyma viruses from wild sheep (Lance et al., 1983, op. cit.; Zarnke et al., 1983, op. cit.) and with the small localized lesions in a spontaneous outbreak of presumed contagious ecthyma in reindeer (Kummeneje and Krogsrud, 1979, op. cit.). The disease in our fawns was very similar in clinical and pathologic appearance to the poxvirus induced dermatitis and keratoconjunctivitis described by Barker et al. (1980, op. cit.) in reindeer at the Toronto Zoo.

It is interesting that both fawns came from the Bighorn Basin of Wyoming in localities approximately 40 km apart. This suggests a focus of poxvirus activity in the Bighorn Basin, especially as the cases occurred in different years, and raises questions about the epizootiology of the disease in this area. Similar disease has not

been identified in cervids in other locations in Wyoming. Nothing is known about the importance of this disease in the mule deer population.

The relationship of these viruses to poxviruses present in domestic animal populations in Wyoming is unknown. Contagious ecthyma is common in sheep flocks in Wyoming and many sheepmen vaccinate sheep with a live virus vaccine. Bovine papular stomatitis and pseudocow pox, bovine diseases caused by parapox viruses, have been identified in a few animals in the state within the last two years. Other poxviral diseases of domestic or wild animals may have gone unrecognized. Characterization of the deer viruses and transmission studies are presently underway to investigate some of the questions raised by the presence of poxviral-induced disease in free-ranging mule deer.

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Salmonellosis in a Wild Turkey

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In May 1982, an emaciated adult female free-ranging wild turkey (*Meleagris gallopavo*), weighing 2.27 kg, was killed in Dallas County, Alabama, because it was exhibiting unusual behavior. The carcass was frozen and subsequently submitted for necropsy.

At necropsy, there were miliary pinpoint yellow-white foci scattered throughout the liver. The ceca were distended severely by large cores of caseous debris, and the cecal mucosa was ulcerated extensively and covered by a thick yellow diphtheritic membrane. Samples of cecum, liver, spleen, kidney, lung, and heart were fixed in 10% buffered formalin, embedded in paraffin, sectioned at 7 μm, and stained with hematoxylin and eosin. Gram's and acid-fast stains also were applied to sections of liver and cecum.

Histologically the liver contained multiple granulomas, 100 μm to 500 μm diameter, characterized by a central core of macrophages surrounded by a single layer of multinucleated giant cells (Fig. 1). Myriads of gram-negative, non-acid-fast bacterial rods were observed within many of the granulomas. Sinusoids immediately surrounding the granulomas contained hyaline fibrin thrombi (Fig. 1). Similar thrombi also were present in sinusoids throughout the liver unassociated with granulomas. The cecal mucosa was dif-

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