Chronic wasting disease in a Rocky Mountain elk

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Abstract — A 24-month-old Rocky Mountain elk was presented because of suspected chronic wasting disease (CWD). The animal was emaciated, had retained its winter hair, and had abnormal behavior patterns suggestive of CWD, including bruxism, ptyalism, and diminished flight zone size. Immunohistochemical analysis of the brain confirmed the diagnosis of CWD.

Résumé — Syndrome de dépérissement chronique chez un élan des Rocheuses. Un élan des Rocheuses âgé de 24 mois présente des symptômes du syndrome de dépérissement chronique (SDC). L'animal est émacié, il a conservé son pelage d'hiver et présente des comportements anormaux laissant supposer la présence du SDC, y compris le bruxisme, l'hypersalivation et la diminution du périmètre de la zone de fuite. L'analyse immunohistochimique du cerveau confirme le diagnostic de SDC.

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The Canadian Food Inspection Agency (CFIA) was notified of a 24-month-old, female Rocky Mountain elk suspected of having chronic wasting disease (CWD) in June 2001. The owner had noticed that the animal had been unusually calm over the past week, and he was concerned about poor body condition and a retained winter hair coat. Although the farm where the animal was located did not have a known CWD problem, an animal purchased from a known infected farm had died 24 mo earlier, with no postmortem examination.

The animal was less responsive to handling than expected, with a diminished flight zone size. It was in poor body condition, with winter hair present over much of the neck and dorsum, which was inappropriate for midsummer. The remainder of the herd was in excellent body condition under the same management conditions. Ptyalism and bruxism were noted. The pulse was within normal limits at 130 beats/min, while the respiratory rate was somewhat elevated at 84 breaths/min and accompanied by increased lung sounds bilaterally. Blood collected at the time of examination had no hematologic abnormalities. There were mild elevations in serum urea (16.5 mmol/L, reference 5.6 to 9.8 mmol/L) and creatine kinase (569 mmol/L, reference 237 to 461 mmol/L), consistent with increased protein catabolism. Mild hypoglycemia (4.6 mmol/L, reference 5.8 to 9.2 mmol/L) was attributed to continued erythrocyte metabolism during sample transportation to the laboratory.

Clinical findings suggestive of CWD resulted in orders for the animal to be euthanized to allow for testing for CWD. It was tranquillized with 10 mL of xylazine (100 mg/mL) (Rompun; Bayer Animal Health, Toronto, Ontario) and 25 mL of ketamine (100 mg/mL) (Ketalean; Bimeda-MTC Animal Health, Cambridge, Ontario), administered IM, and then euthanized with 40 mL of embutramide (200 mg/mL), mebozonium iodide (50 mg/mL), and tetracaine hydrochloride (5 mg/mL) (T61 — Euthanasia Solution; Intervet Canada, Whitby, Ontario), administered IV.

Gross necropsy findings were limited to emaciation and rough hair coat with retained winter hair. On histologic examination, the lung parenchyma was congested and there were multiple foci of atelectasis. There was mild atrophy of hepatic lobules. Histological examination of the brain was performed at the CFIA's Animal Diseases Research Institute, Nepean, Ontario. The obex of the medulla had a moderate astrocytosis and marked vacuolation of neurons and neuropil in the dorsal vagal motor nuclei, the spinal tract, and the reticular formation. Immunohistochemical staining was performed on sections of obex using PrP antibodies (USDA-ARS F89.160 and F99/97) at 5 μg/mL and an automated immunostainer (Ventana NexEs; Ventana Medical Systems, Tucson, Arizona, USA). Dense bilaterally symmetrical staining was observed in the dorsal motor vagus nuclei, which is consistent with CWD. The positive immunohistochemical diagnosis of CWD was confirmed at another laboratory.

Chronic wasting disease is a fatal neurodegenerative disease of cervids caused by accumulation of the prion protein, PrP-res (1). The disease was first recognized in

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captive mule deer (*Odocoileus hemionus*) in 1967 and in captive Rocky Mountain elk (*Cervus elaphus nelsoni*) in 1979 (2). It is estimated to have been present in captive elk herds in Saskatchewan since 1989 (2002 personal communication, Byrnne Rothwell), and was made a reportable disease in Canada in 2001.

Clinical signs of CWD include altered reaction to handling; weight loss and emaciation; weakness; excessive salivation; bruxism; rough, dry hair coat; abnormal posture with the head lowered; and drooping ears (2). Isolation from the herd, anorexia, repetitive behaviors, and intractability have also been described (3). Loss of fear of humans is also associated with CWD in free-ranging elk (4). A small number of elk affected by CWD display polydipsia and polyuria (5).

Hematological and biochemical parameters from elk with CWD are within normal limits or reflect their catabolic state (2). Cerebrospinal fluid analysis in clinically affected animals reveals no abnormalities (2). Hepatic copper analysis is within normal limits (2). Low urine specific gravity occurs in a small number of cases, possibly reflecting a deficiency of antidiuretic hormone as a result of damage to hypothalamic nuclei (5).

Emaciation is the only gross lesion consistently observed at necropsy in elk with CWD (2–5). Aspiration pneumonia is occasionally observed (5). Histological examination of the brain reveals a number of abnormalities. Spongiform degeneration of grey matter neuropil, intraneuronal vacuolation, astrocytic hyperplasia and hypertrophy, and amyloid plaques are consistently noted in affected elk (5). The lesions are bilaterally symmetrical and noninflammatory (6). The most consistent lesions in the telencephalon affect the olfactory tubercle and amygdala (6). In the diencephalon, the ventrorostral, dorsomedial, dorsolateral, rostroventral, caudoventral, medial geniculate, lateral geniculate, and supraoptic nuclei are often affected, as well as the hypothalamus and pineal gland (6). The mesencephalon is mildly affected in elk, with the central grey substance, caudal colliculus, rostral colliculus, and tegmental nuclei most frequently involved (6). The most severe lesions on the pons tend to be located in the reticular formation, pontine nuclei, and dorsal trapezoid body nuclei (6). In the medulla, the lateral cuneate nuclei, the nuclei of the spinal tract of the trigeminal nerve, and the parasympathetic vagal nucleus are often the most severely affected (6). The reticular formation, hypoglossal nucleus, and medial cuneate nuclei are also frequently affected (4). Mild lesions are occasionally observed in the spinal cord, mostly affecting the dorsal horns (6). Peripheral nerves are unaffected (6). Changes in the cerebral cortex, hippocampus, basal nuclei, and cerebellum, if present at all, are mild (5). Scrapie associated fibrils are consistently observed with electron microscopy on brain tissue of CWD-affected animals (5). Immunohistochemical analysis of brain tissue for the PrP-res protein is a more sensitive diagnostic procedure for CWD than histologic examination (7). The most consistently affected areas are, in decreasing order of frequency, obex, cervical spinal cord, and mesencephalon (7).

The route of transmission of CWD in elk has not been fully described; however, epidemiological studies in captive and wild populations suggest that lateral transmission of the disease through direct contact and environmental contamination is the most important route (3,8). Apparent maternal transmission of the disease is most likely through the same routes as lateral transmission (3). After inoculation in mule deer, PrP-res appears to accumulate in the tonsils, retropharyngeal lymph nodes, Peyer's patches, and ileocaecal lymph nodes, and this may result in shedding of the prion in saliva and feces (9).

Certain PrP genotypes in elk appear to predispose to CWD in a manner similar to the genetic predisposition to new-variant Creutzfeldt-Jakob disease seen in humans (1). The PrP gene sequence in elk is highly conserved, with polymorphism observed only at codon 132 (methionine or leucine) (1). Individuals homozygous for methionine are at increased risk, compared with those with other genotypes, of developing CWD (1). The leucine allele is rare in wild populations in the surveys conducted by O'Rourke (1), suggesting that the majority of free-ranging elk are susceptible to the disease.

The transmission of CWD from cervids to cattle and other species is of concern from the perspective of food safety and maintenance of export markets. The bovine spongiform encephalopathy experience in the United Kingdom highlights the need for caution in disposal of potentially infected tissues from animals with transmissible spongiform encephalopathies. Although recent studies of PrP gene sequence homology between various mammalian species suggest that CWD will not cross easily into humans, cattle, or sheep (10,11), caution should still be exercised when developing policies to handle CWD-infected herds. At present, CWD is a limiting factor in Canada's export markets for deer and elk, and continuing efforts will be required to reestablish international markets. It will be of utmost importance for the eradication of the disease from Canada to prevent the spread of CWD into free-ranging cervid populations from the domestic herd. It will also be imperative to ensure that CWD does not enter the national cattle herd. As a consequence, it is important for practitioners to be able to recognize cases of the disease, so that it can be reported promptly to allow elimination of sources of the prion.

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References

1. O'Rourke KI, Besser TE, Miller MW, et al. PrP genotypes of captive and free-ranging Rocky Mountain elk (*Cervus elaphus nelsoni*) with chronic wasting disease. J Gen Virol 1999;80:2765–2679.

2. Williams ES, Young S. Spongiform encephalopathy of Rocky Mountain elk. J Wildl Dis 1982;18:465–471.
3. Miller MW, Wild MA, Williams ES. Epidemiology of chronic wasting disease in captive Rocky Mountain elk. J Wildl Dis 1998;34:532–538.
4. Spraker TR, Miller MW, Williams ES, et al. Spongiform encephalopathy in free-ranging mule deer (*Odocoileus hemionus*) and Rocky Mountain elk (*Cervus elaphus nelsoni*) in Northcentral Colorado. J Wildl Dis 1997;33:1–6.
5. Williams ES, Young S. Spongiform encephalopathies in Cervidae. Rev Sci Tech Off Int Epiz 1992;11:551–567.
6. Williams ES, Young S. Neuropathology of chronic wasting disease of mule deer (*Odocoileus hemionus*) and elk (*Cervus elaphus nelsoni*). Vet Pathol 1993;30:36–45.
7. Peters J, Miller JM, Jenny AL, Peterson TL, Carmichael KP. Immunohistochemical diagnosis of chronic wasting disease in pre-clinically affected elk from a captive herd. J Vet Diagn Invest 2000;12:579–582.
8. Miller MW, Williams ES, McCarty CW, et al. Epizootiology of chronic wasting disease in free-ranging cervids in Colorado and Wyoming. J Wildl Dis 2000;36:676–690.
9. Sigurdson CJ, Williams ES, Miller MW, Spraker TW, O'Rourke KI, Hoover EA. Oral transmission and early lymphoid tropism of chronic wasting disease PrP^{res} in mule deer fawns (*Odocoileus hemionus*). J Gen Virol 1999;80:2757–2764.
10. Raymond GJ, Bossers A, Raymond LD. Evidence of a molecular barrier limiting susceptibility of humans, cattle and sheep to chronic wasting disease. EMBO 2000;19:4425–4430.
11. Hamir AN, Cutlip RC, Miller JM, et al. Preliminary findings on the experimental transmission of chronic wasting disease agent of mule deer to cattle. J Vet Diagn Invest 2001;13:91–96.