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Source: Journal of Wildlife Diseases, 27(1) : 135-139

Published By: Wildlife Disease Association

URL: https://doi.org/10.7589/0090-3558-27.1.135

Journal of Wildlife Diseases, 27(1), 1991, pp. 135–139

Multicentric Intramuscular Lipomatosis/Fibromatosis in Free-Flying White-Fronted and Canada Geese

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ABSTRACT: Over a period of 9 yr, seven white-fronted geese (*Anser albifrons*) and one Canada goose (*Branta canadensis*) with multiple intramuscular mesenchymal tumors were encountered in Saskatchewan (Canada) and one similarly affected Canada goose was seen on Prince Edward Island (Canada). The tumors in these birds consisted either of adipose tissue, fibroblastic tissue, or a mixture of both types of tissues. The high prevalence of this condition in white-fronted geese suggested a genetic influence.

Key words: Neoplasm, lipomatosis, fibromatosis, muscle, white-fronted goose, *Anser albifrons*, Canada goose, *Branta canadensis*, case report.

Neoplasms, whether benign or malignant, are described infrequently in domestic or captive waterfowl and even more rarely in free-flying waterfowl. Siegfried (1983) reviewed the literature on this subject and reported eight neoplasms found in waterfowl during necropsy of more than 18,000 wild birds (predominantly waterfowl) at the U.S. National Wildlife Health Laboratory (Madison, Wisconsin 53711, USA).

In this report, we describe a proliferative condition found with high frequency among white-fronted geese (*Anser albifrons*) submitted to the diagnostic laboratory of the Western College of Veterinary Medicine (WCVM; Saskatoon, Saskatchewan, Canada S7N 0W0). A similar condition was observed in one Canada goose (*Branta canadensis*) submitted to the same laboratory and in another Canada goose submitted to the diagnostic laboratory of the Atlantic Veterinary College (AVC; Charlottetown, Prince Edward Island, Canada C1A 4P3).

Between 1 January 1969 and 1 January 1989, necropsies were performed on 818 free-flying geese at WCVM: 594 lesser snow geese (*Chen caerulescens caerulescens*), 117 Canada geese, 77 Ross' geese (*Chen rossii*) and 30 white-fronted geese. Specimens were submitted by conservation officers, hunters and other members of the public, or were collected by WCVM staff during disease investigations. During this period, a distinctive proliferative condition characterized grossly by multifocal lesions involving primarily the musculature was found in seven white-fronted geese and in one Canada goose (Table 1). A chi-square analysis indicated a highly significant ($P < 0.001$) association between this condition and the white-fronted geese. A Canada goose with gross lesions similar to those seen at WCVM was submitted to AVC in the fall of 1987 (Table 1). Necropsy records comparable to those at WCVM were not available from AVC. Samples from the lesions and from several internal organs of each bird were fixed in 10% formalin, processed routinely for light microscopic examination, and stained with hematoxylin and eosin (H&E).

Eight of the nine affected geese had been shot by hunters. The Canada goose examined at WCVM was from a group of four Canada geese collected alive but suffering from necrotic enteritis (Wobeser and Rainnie, 1987). In the nine geese, gross lesions included numerous white masses within several or most muscles of the body. Some of these masses were well circumscribed (Fig. 1), while others had an infiltrative pattern (Fig. 2). Most were 3 cm

TABLE 1. Signalment of nine geese with multicentric lipomatosis/fibromatosis.

Species	Age[a]	Sex[b]	Date collected	Location	History	Diagnosis
White-fronted	U	U	Nov 1979	Saskatchewan	killed by hunter	lipomatosis/ fibromatosis
White-fronted	A	U	Nov 1980	Saskatchewan	killed by hunter	lipomatosis
White-fronted	I	U	Sept 1981	Saskatchewan	killed by hunter	lipomatosis
White-fronted	I	F	Oct 1982	Saskatchewan	killed by hunter	lipomatosis/ fibromatosis
White-fronted	U	U	Sept 1984	Saskatchewan	killed by hunter	lipomatosis
Canada	I	F	Oct 1984	Saskatchewan	suffered from necrotic enteritis	lipomatosis
White-fronted	A	U	Oct 1984	Saskatchewan	killed by hunter	lipomatosis
Canada	U	U	Nov 1987	Prince Edward Island	killed by hunter	fibromatosis
White-fronted	A	M	Oct 1988	Saskatchewan	killed by hunter	lipomatosis

[a] Based on plumage. A = adult; I = immature; U = undetermined (eviscerated carcass submitted).
[b] F = female; M = male; U = undetermined (eviscerated carcass submitted).

or less in diameter, but some were as long as 10 cm. Similar abnormal tissue occurred in internal organs of two white-fronted geese. In one of them, it consisted only of small white foci, a few millimeters in diameter, in the wall of the distal region of the intestine and in the kidneys. The other goose had numerous masses, some up to 6 cm in diameter, involving the ceca, kidneys, bursa of Fabricius, cloaca, ovary and oviduct. Only one of the nine affected birds, a white-fronted goose, was considered very thin, based on the amount of fat present in the carcass.

Microscopically, the neoplastic tissue in

FIGURE 1. Several discrete white masses of adipose tissue in pectoral, abdominal and leg muscles of a white-fronted goose.

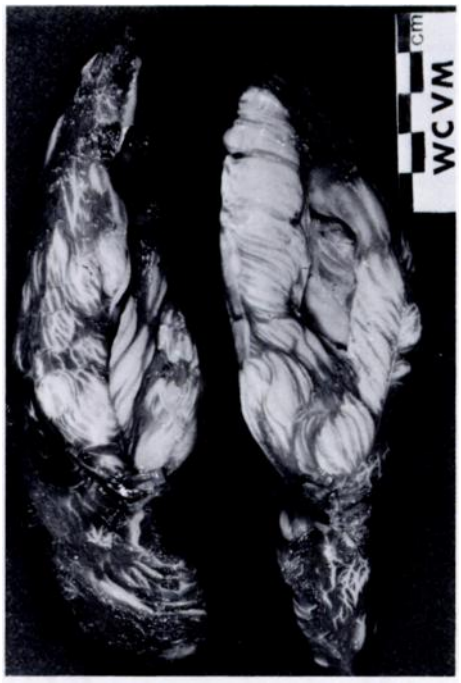

FIGURE 2. Portions of pectoral muscle from a white-fronted goose, showing a diffuse infiltration of the muscle mass by adipose tissue.

five white-fronted geese and in the Canada goose examined at WCVM consisted of adipocytes, although, in the white-fronted geese, myofibers at the periphery of the masses of adipocytes were also infiltrated by a variable amount of fibroblastic tissue (Fig. 3). The adipocytes had a small darkly staining nucleus, and their cytoplasm was abundant and completely filled with a single large or, more commonly, several small round vacuoles that stained with oil red O (Luna, 1968). In the Canada goose examined at AVC, all masses were composed of highly cellular fibroblastic tissue that formed thick sheets running at different angles to each other. The fibroblastic cells were moderately elongated and had a darkly staining or slightly vesicular nucleus of small to moderate size and a small amount of acidophilic cytoplasm. In the two remaining white-fronted geese, those with gross lesions in internal organs, the masses consisted of a mixture of adipocytes and fibroblasts in various proportions. In the goose with numerous internal lesions, the latter were composed almost exclusively of fibroblastic tissue. This goose was the only one with areas of necrosis within neoplastic masses. Mitotic figures were rare in all tumors. Small aggregates of lymphoplasmacytic cells and granulocytes were seen frequently within the neoplastic tissue in all birds.

The term "multicentric intramuscular lipomatosis/fibromatosis" was thought to best describe the condition in these geese. There was no clear evidence that this condition was causing the birds significant ill effect at the time of collection, since most of them were killed by hunters and since the masses present in the muscle tissue seemed to act only as space-occupying lesions. However, these masses may have affected the flight performance of the birds and rendered them more susceptible to being shot by hunters. The gross appearance of the muscle lesions resembled closely that described by Siegfried (1983) as a disseminated fibrosarcoma "of possible nerve-sheath origin" in four Canada geese (two

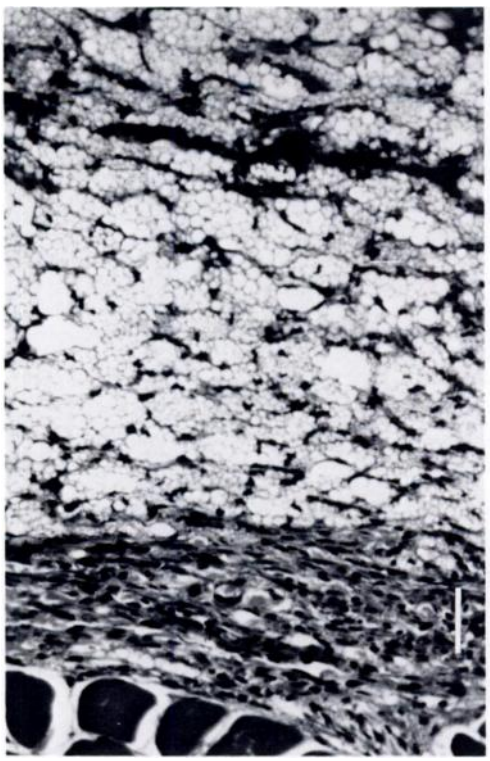

FIGURE 3. Section of skeletal muscle from a white-fronted goose with multicentric lipomatosis. The neoplastic adipocytes have a multivacuolated cytoplasm. Myofibers (bottom) are separated from these adipocytes by a layer of fibroblastic tissue. H&E. Bar = 30 μm.

from Wisconsin, one from Oregon, origin of the fourth bird unspecified); three of these geese had been found dead or moribund. Locke (1963) also described a "multicentric neurofibrosarcoma" in a moribund adult Canada goose collected in Maryland (USA). Microscopically, the masses in geese in the present report were composed of adipocytes or fibroblasts or a mixture of both cell types. Neither cell type showed cytological evidence of anaplasia, although both displayed extensive local invasion.

The cause of the proliferative condition described herein is unknown. Because metastasis of malignant neoplastic cells to skeletal muscle is rare (Robbins et al., 1984b; Thomson, 1984), and because of the exclusive involvement of the musculature in most of the geese in this report,

the majority of the masses in these birds were considered to have had a multicentric origin rather than to have resulted from metastasis of a primary tumor. Conditions in humans that bear some similarity to that in our geese include infiltrative lipomas, systemic multicentric lipoblastosis, congenital generalized fibromatosis, and neurofibromatosis. Infiltrative lipomas, also reported in dogs, are histologically benign but locally aggressive tumors of adipose tissue that infiltrate soft tissues, particularly muscle (Dionne and Seemayer, 1974; McChesney et al., 1980). They occur most often in adult life, consist of single or multiple masses confined to one anatomical region of the body, and often recur after surgical excision. Systemic multicentric lipoblastosis is a rare condition of adults characterized by multiple masses, mainly within the subcutis and body cavities (Tedeschi, 1946). These masses are composed mainly of mature adipocytes, but also contain undifferentiated mesenchymal cells, as well as fibrous and myxomatous tissues. Recurrence of individual masses after their excision is common. Congenital generalized fibromatosis consists of multiple nodular infiltrative fibroblastic lesions in superficial and deep soft tissues, viscera, and bone (Shuman, 1971). It usually is present at birth or appears shortly thereafter and may represent a developmental disturbance of the fibrous tissue characterized by the continued proliferation of fibroblasts in the postnatal period ("fibromatous hamartomatosis"). This condition can be fatal, but mild forms of the disease also occur. In one case, a familial relationship was described in which four members of one family were affected by this condition. Neurofibromatosis consists of multiple tumors originating from Schwann cells and fibroblasts of the peripheral nervous tissue and dispersed anywhere in the body (Robbins et al., 1984a). This disease often starts to develop at an early age but, in many patients, is not discovered until adult life. Malignant transformation of the tumors occurs in 10 to 15% of cases. About 50% of humans with neurofibromatosis have a family history consistent with autosomal dominant transmission.

Precedents for a viral cause of multicentric tumors exist in animals. The avian leukosis-sarcoma group of oncoviruses can cause a wide variety of benign and malignant neoplasms of soft tissues that typically have a multicentric origin. These include fibromas and fibrosarcomas of the subcutis, muscles and occasionally internal organs (Purchase and Burmester, 1978). Chickens are the only natural host of these viruses, and vertical transmission is the most common mode of propagation of the disease although lesions do not usually become evident until 14 wk of age. Feline sarcoma virus (FeSV) is an oncovirus that typically causes multicentric subcutaneous fibrosarcomas in cats less than 5-yr-old (Hardy, 1981). This virus is formed by recombination of a specific section of the cat's genome with genetic material from the feline leukemia virus (FeLV), following horizontal transmission of the latter. Most FeSV strains induce fibrosarcomas, but one strain induces formation of malignant melanomas when injected subcutaneously or intraocularly. FeLV was isolated from a liposarcoma involving the subcutis, kidneys, and liver of a cat with a concurrent malignant lymphoma (Stephens et al., 1983). Inoculation of fragments of this liposarcoma into newborn kittens failed to reproduce this type of tumor, although seven of eight inoculated kittens developed malignant lymphoma (Stephens et al., 1984). Fibromatosis of gray squirrels (*Sciurus carolinensis*) and fibromas of Cervidae consist of benign cutaneous tumors that usually regress spontaneously (Sundberg and Nielsen, 1981; Yuill, 1981). Squirrel fibromatosis is caused by a leporipoxvirus, and at least some of the fibromas of Cervidae are caused by a papovavirus. In both cases, transmission is mechanical, and arthropods are presumed to be important vectors. The tumors in naturally infected animals often occur as multiple cutaneous masses. However, it is

not clear whether these masses develop at sites of individual inoculation or result from systemic distribution of the virus from a primary site. Experimental inoculation of squirrel fibromatosis virus into very young squirrels has resulted in generalized cutaneous nodules (Kilham, 1955) as well as pulmonary adenomata (Kirschstein et al., 1958) in some animals.

The most striking feature of the epidemiological information available on the condition in our geese is the great disparity between its prevalence in white-fronted geese and that in other goose species. Birds with multicentric mesenchymal tumors accounted for almost 25% of the 30 white-fronted geese examined at WCVM, whereas only one of 117 Canada geese and none of 594 snow geese and 77 Ross' geese had a similar condition. This suggests a genetically influenced susceptibility to the disease in white-fronted geese. The etiologic relationship, if any, between the condition in the white-fronted geese and that in the Canada geese is unknown. The occurrence of an affected Canada goose on Prince Edward Island indicates that this condition is not confined to the central flyway of North America, since populations of Canada geese are highly localized with regard to their migration pathways and winter and summer grounds (Bellrose, 1976).

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Received for publication 15 May 1990.