VASCULAR DISEASES IN BIRDS OF PREY

Michael P. Jones, DVM, Dip. ABVP (Avian)

Abstract

In birds of prey, vascular disease can be caused by a number of infectious or noninfectious agents and is in all likelihood underdiagnosed. This review attempts to provide a discussion of the available literature regarding vascular diseases in raptors by describing a number of conditions or etiological agents (e.g., atherosclerosis, aneurysms, bacterial and septicemic conditions, thromboembolic disease, and viral, fungal, parasitic, and miscellaneous diseases) and the vascular pathology that may occur with each.

Key words: atherosclerosis; birds of prey; emboli; raptors; thrombi; vasculitis

In avian species, the underlying cause of vascular disease is associated with various noninfectious and infectious etiologies. A review of current birds of prey vascular disease or pathology publications suggests that this disease condition occurs with less frequency than in companion avian species. In general, most reviews of morbidity and mortality in captive and free-ranging raptors focus on broad disease categories.[1-7] However, earlier reviews[8-17] of necropsy reports from various institutions and the literature at the time provide more detailed descriptions of the prevalence of vascular disease in raptors as well as descriptions of primary, secondary, and incidental pathologic lesions noted within the vasculature. Of those vascular diseases reported, atherosclerosis occurred with the greatest frequency in a number of raptor species. The relative frequency with which cardiovascular diseases were reported in birds of prey in earlier review articles suggests that these diseases may be underreported in the current literature.

The objectives of this article are to review and discuss conditions and etiological agents (e.g., atherosclerosis, aneurysms, bacterial and septicemic conditions, thromboembolic disease, and viral, fungal, and parasitic diseases) that cause vascular disease in raptors and to describe the vascular pathology associated with each.

NONINFECTIOUS VASCULAR DISEASES

Atherosclerosis

Atherosclerosis is the most commonly reported vascular disease in birds of prey,[2,15,16,18-25] and lesions of varying severity have been reported or described in a number of captive and free-ranging species including bald eagles (*Haliaeetus leucocephalus*), a golden eagle (*Aquila chrysaetos*), an African sea eagle (*H. vocifer*), a crowned hawk-eagle (*Stephanoaetus coronatus*), a Steppe eagle (*A. nipalensis*), a Bonelli's eagle (*A. fasciata*), a Harpy eagle (*Harpia harpyja*), a monkey-eating eagle (*Pithecophaga jefferyi*), a Chilean eagle (*Geranoaetus melanoleucus*), Bateleur eagles (*Terathopius ecaudatus*), a Verreaux's eagle (*A. verreauxii*), a white-tailed sea eagle (*H. albicilla*), Forster's caracara (*Phalcoboenus australis*), goshawks (*Accipiter gentilis*), red kites (*Milvus milvus*), a black kite (*M. migrans*), an American kestrel (*Falco sparverius*), a prairie falcon (*F. mexicanus*), a peregrine falcon (*F. peregrinus*), an Erlanger's falcon (*F. biarmicus erlangeri*), secretary birds (*Sagittarius serpentarius*), a Lammergeyer or bearded vulture (*Gypaetus barbatus aureus*), a white-backed vulture (*Pseudogyps africanus*), Occipital or white-headed vultures (*Trigonoceps occipitalis*), a Cinereous vulture (*Aegypius monachus*), American black vultures (*Coragyps atratus*), a Kolbe's or Cape Griffon (*Gyps coprotheres*), an Andean condor

From the Department of Small Animal Clinical Sciences, The University of Tennessee, Veterinary Medical Center, Knoxville, TN USA. Address correspondence to: Michael P. Jones, DVM, Dip. ABVP (Avian), The University of Tennessee, Veterinary Medical Center, 2407 River Drive, Room C247, Knoxville, TN 37996. E-mail: mpjones@utk.edu.

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(*Vultur gryphus*), a Woodford's owl (*Ciccaba woodfordii*), a Fraser's eagle-owl (*Bubo poensis*), a Javan fish-owl (*Ketupa ketupu*), an eagle-owl (*B. bubo*), a Magellan eagle-owl (*B. virginianus magellanicus*), an Aharoni's eagle-owl (*B. bubo interpositus*), spotted eagles (*B. africanus*), a Kenya eagle-owl (*B. capensis mackinderi*), a bare-footed scops (*Otus bakkamoena glabripes*), white-faced scops (*Sceloglaux albifacies*), tawny owls (*Strix aluco*), a snowy owl (*Nyctea scandiaca*), and, most recently, a red-tailed hawk (*Buteo jamaicensis*).[8-12,14-16,18,24,26-29]

Finlayson[15] suggests that carnivorous avian species are particularly susceptible to degenerative arterial diseases; however, the prevalence of atherosclerosis reported in birds of prey varies among authors. Fox[28] found that 3% (13/349) of Falconiformes, which at the time included both the current Falconiformes and Accipitriformes orders that died at the Philadelphia Zoo, had lesions consistent with atherosclerosis. A later review[14] revealed a higher prevalence (54%) of atherosclerosis in the order Falconiformes than in any other order of birds or other animals when necropsy reports from the Zoological Society of London and available literature concerning vascular diseases of captive animals were reviewed. Interestingly, this survey did not include birds of the order Strigiformes. In a subsequent review of 125 postmortem records of birds of prey that died as a result of diseases of uncertain etiologies, Keymer[16] determined that 8% (10/80) of Falconiformes and 15.6 % (7/45) of Strigiformes examined had lesions consistent with atherosclerosis. A more recent retrospective review of morbidity and mortality in free-ranging birds of prey indicated that 1.8% (6/409) died of atherosclerosis.[2]

The pathogenesis of atherosclerosis in raptors is likely similar to that described in other animals and humans and is characterized by degenerative changes in the internal and medial tunics of arteries that consist of varying degrees of dystrophic calcification, chondroid metaplasia, collagen and fibrin deposition, lipid (primarily cholesterol) deposition and retention, proteolytic injury, chronic inflammation, and necrosis of arterial walls.[18,30] The result is the development of atherosclerotic plaques that significantly affect the elasticity of the arterial wall and may lead to varying degrees of narrowing of the vascular lumen or even rupture of the vessel wall.[15,25,29,30] Atherosclerotic lesions may be present in any artery; however, the brachiocephalic trunk, aortic arch, and distal aorta appear to be the most commonly affected vessels in birds of prey.[16-18,30] Additional lesions have also been described in the carotid, subclavian, pectoral, and femoral arteries. Lesions within the coronary arteries may cause myocardial infarction associated with thickening of the intima of small coronary arteries and thrombosis of coronary veins.[15,24,31]

The exact cause of atherosclerosis is not completely clear; however, risk factors such as obesity, age, lack of exercise, long periods of inactivity, and high-fat diets may play a role.[15,16,20,30] Obese raptors that undergo rapid weight loss, such as during weight reduction for training or as sequelae to disease, may also be at risk. Atherosclerosis may affect raptors of any age, although it may be more likely to occur in older birds of prey (greater than 5 years of age).[20] Most reports that consider age as a risk factor are based upon captive birds of prey, but it is unknown whether age plays a significant role in the pathogenesis of disease in free-ranging raptors[16] because no studies address this issue. The prevalence of advanced atherosclerotic lesions was associated with several risk factors in psittacines including age, female sex, and some genera (as discussed by Beaufrère in this issue); however, this has not been determined in birds of prey. In humans, the development of atherosclerotic plaques is believed to be accelerated by systemic hypertension. Bohorquez and Stout[18] and Lumeij and Ritchie[30] also suggest that the relatively high blood pressure and serum cholesterol levels of birds are linked to the higher incidence of atherosclerosis observed in avian species in general.

Raptors affected by atherosclerosis may have subclinical disease for a significant period of time and then die suddenly or may show a more chronic progression of disease marked by poor body condition, weakness, dyspnea, and neurologic signs.[23] In general, clinical signs are associated with reduced blood flow through affected arteries and plaque-induced thrombus formation.[30] In companion avian and raptor species, sudden death may be associated with myocardial infarction or severe narrowing of the carotid arteries resulting in decreased blood flow to the brain.[22,24] Other sequelae may include hypertrophy of the left ventricle, which ultimately results in right heart failure.

Isoxsuprine, a peripheral vasodilator, may be therapeutically helpful, but there is no specific treatment for atherosclerosis. Therefore, prevention of cardiovascular disease in captive raptors is essential. Captive birds of prey should not be allowed to become obese. This can be managed by