Atherosclerosis in Birds

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Atherosclerosis is a disease of the elastic and muscular arteries. Atherosclerotic lesions are characterized by the presence of intracellular and extracellular lipid, cell proliferation, fibrosis, necrosis, mineralization, chondroid metaplasia, and neovascularization. There is considerable variability in the nature of atherosclerotic lesions between species, between individuals within the same species, and even within different arteries within the same individual. Each lesion may contain all of the listed characteristic changes or comprise only a few. Atherosclerotic lesions cause disease by narrowing affected arteries, by being a nidus for thrombus formation, or disrupting the arterial wall resulting in an aneurysm or complete arterial rupture.

The pathogenesis of the atherosclerosis is complex. Multiple factors including genetic factors, diet, hypertension, exposure to cigarette smoke, and even infectious agents, are considered risk factors for this disease.

In birds, atherosclerosis has been most extensively studied in the white Carneau pigeon[3,10,12] and the chicken.[6] White Carneau pigeons have a genetic predisposition for this disease.[12] They develop disease spontaneously, although the incidence and severity of disease can be increased by feeding a diet high in cholesterol.[3] In these pigeons, atherosclerotic lesions predominated in the aorta, brachiocephalic trunks, carotid arteries, and coronary vessels. Advanced cased of atherosclerosis resulted in death due to ischemic heart disease. Ischemia was thought to be induced by arterial narrowing, thrombus formation at the site of the lesion, or thrombi breaking free of their initial site of origin and lodging in small arteries down stream. Aortic root lesions may also contribute to the ischemic heart disease by obstructing blood flow into the coronary arteries.[10]

Marek's disease herpesvirus is a cause of atherosclerosis in chickens.[6] Affected arteries in the chicken included the aorta, brachiocephalic trunks, carotids, and coronary arteries. Unlike the white Carneau pigeons, the gastric, mesenteric, and celiac arteries were also involved. As with the white Carneau pigeon study, cholesterol feeding caused the lesions to be more extensive and severe. This study also found that less severe atheromatous lesions could be induced in the chicken with a high cholesterol diet without virus infection.

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In nondomestic bird populations, atherosclerosis is uncommon to rare, but is found in a wide range of species. Generally atherosclerosis is an incidental finding at necropsy; less frequently it is the primary cause of death. In a review of 1,618 necropsies of avian zoological specimens, only 2% of these birds were found to have atheromas and in only 0.3% of the total number of birds was atherosclerosis considered to be the cause of death. The youngest bird in this study was a toucan (*Rhamphastos culminatus*) at seven months of age. The oldest bird in the study was a 31 year-old secretary bird (*Sagittarius serpentarius*). Egg or meat eating birds and female birds had the highest incidence of disease.[7]

In a limited study of eight tawny frogmouths (*Podargus strigoides*) atherosclerotic lesions were found in 2 birds. The lesions in these carnivorous and insectivorous birds were exclusively in the coronary arteries.[5]

Falconiformes may have a slight predisposition to atherosclerosis.[2] In these birds the aorta appears to be the most commonly affected artery, lesions in other arteries occur inconsistently. Of 4 birds of known age, 3 were 13 years-old or older.

As with other avian species, atherosclerosis is an uncommon disease in parrots and is most often an incidental finding at necropsy. In one study,[2] only 25% of parrots with atherosclerosis were thought to die directly as a result of this disease. Atherosclerosis in parrots appears to have a predilection for the Amazon parrot, particularly the blue-front Amazon (*Amazona aestiva*), but has also been reported in cockatoos, cockatiels (*Nymphicus hollandicus*), African grey parrots (*Psittacus erithacus*), macaws, conures, and eclectus parrots (*Eclectus roratus*). Again, a single bird in this study was found to be less than 1 year-old but most were 5 years of age or older and 34% were 15 years-old or older. No sex predilection was observed. Atherosclerotic lesions in the parrot, appear to have a similar distribution to those seen in the white Carneau pigeon. Typically, when the disease is severe, atherosclerotic lesions can be observed grossly extending from the root of the aorta to the brachiocephalic trunks and into the thoracic aorta. Lesions generally involve the carotid arteries but only extend as far as the thyroids. Coronary artery involvement is not a consistent finding but may occur in up to 19% of the cases.[2]

Even in advanced cases of atherosclerosis, unexpected death of the bird may be the first sign of disease.[2] Antemortem clinical signs have rarely been observed, and when they have, they appear to have been caused by either reduced blood flow to the brain or spinal cord or heart failure. In three instances neurologic signs have been noted.[2,9] Two of these birds showed signs of decreased oxygenation of the brain with development of a semi-conscious state in one,[2] and syncopal episodes responsive to oxygen therapy in the other.[9] The third bird had a short course of hind limb paresis and paralysis in the few days preceding its death. Seizures of more than a year duration have been reported in an African grey parrot with atherosclerosis of the carotid arteries.[11] Whether this bird's signs were related to decreased blood perfusion

of the brain or another disease is not known. Necropsy findings in 4 cases have suggested that atherosclerosis resulted in heart failure.[2,8] In two of these cases dyspnea due to pulmonary edema was a common presenting sign.[2,8]

Antemortem recognition of atherosclerosis in parrots is difficult and the restraint necessary for ancillary testing can be life threatening. Nonspecific neurologic signs or respiratory difficulty in mature or old parrots should cause the practitioner to suspect this disease. Radiographically, pulmonary edema, prominence of the aorta and bracheocephalic trunks, and cardiomegaly, are also suggestive of atherosclerosis and its complications. Ultrasound of the heart may also demonstrate enlarged heart chambers. In one case where atherosclerosis of the aorta and brachiocephalic trunks was believed to result in heart failure, angiography was beneficial in recognizing dilation of the right and left ventricles and decreased perfusion of the aorta and brachiocephalic trunks.[8] Cardiomegaly, pulmonary edema, a small rounded liver, and subsequently a perihepatic effusion were other radiographic features of this disease.

Once clinical signs have been recognized, these birds have a guarded prognosis. Perfusion of the heart is likely to be compromised either by coronary artery disease, or aortic atheromas obstructing coronary artery blood flow. Narrowing of the aorta and other arteries creates an outflow impedance that increases the work load of the heart, decreasing peripheral vascular perfusion. Decreased peripheral perfusion will result in arteriole contraction with peripheral hypertension further increasing the heart's work load and even further decreasing peripheral perfusion. Successful treatment requires that peripheral perfusion be improved and that the primary arterial disease be treated. Renin-angiotensin inhibitors combined with diuretics have the capability of increasing the compliance of the diseased arteries and decreasing systemic vascular resistance.[4] Renin-angiotensin inhibitors also are valuable in that they dilate capacitance vessels decreasing the effects of venous hypertension. A change in diet to a low fat, low cholesterol diet, and the use of hypolidemic agents such as resins that sequester bile acids and niacin may cause plaque regression.[1]

The author has treated one case of atherosclerosis with captopril, a renin-angiotensin inhibitor. The bird survived for several days and appeared to be improving but died while being restrained for venupucture.[9]

The role that diet plays in the development of atherosclerotic lesions in parrots is not known. However, it is clear that diet can effect serum cholesterol concentrations. Recently, the author was made aware of a pair of eclectus parrots who were fed eggs on a daily basis. Both these birds had cholesterol levels in excess of 800 mg/dl. Cholesterol concentrations of less than 250 mg/dl are typical of parrots in the author's practice. As parrots, like humans, live for many years, it is perhaps prudent to encourage parrot owners to feed a diet low in fat and cholesterol.

In conclusion, atherosclerosis is an infrequent disease of many species of birds. Though rarely causing clinical signs, it may do so by impeding blood flow to the central nervous system or by causing heart failure. Early recognition of this disease and aggressive treatment are required if these birds are to have a chance of survival. While atherosclerosis can affect birds of any age, two large retrospective studies suggest that it is more frequent in older birds. Based on these observations, it is expected that as our parrot populations age, atherosclerosis will be seen more frequently.

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