Chronic cor pulmonale secondary to pulmonary atherosclerosis in an African Grey parrot

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Case Description—A 20-year-old sexually intact female African Grey parrot (Psittacus erithacus) was evaluated to determine the cause of lethargy, hyporexia, weight loss, and persistent ascites of 21 days’ duration.

Clinical Findings—Physical examination revealed a markedly distended abdomen and systolic heart murmur. Thoracic radiography revealed cardiomegaly and hepatomegaly. Doppler echocardiography revealed severe eccentric and concentric hypertrophy of the right ventricle with systolic dysfunction, moderate regurgitation through the right atrioventricular valve, a substantial increase in estimated systolic pulmonary arterial pressure, hepatic venous congestion, and coelomic effusion. A clinical diagnosis of chronic cor pulmonale was established.

Treatment and Outcome—The parrot was initially stabilized by use of coelomocentesis. During the next month, the parrot was treated by administration of furosemide, hydrochlorothiazide, spironolactone, benazepril, and pimobendan. The parrot appeared to be responding well to treatment but was found dead in its cage 35 days following initial examination. Post-mortem examination revealed substantial atherosclerosis of the large pulmonary arteries, with lesions extending into the medium-size arteries. Pulmonary atherosclerosis was suspected as a cause of the severe pulmonary hypertension.

Clinical Relevance—Although atherosclerosis most commonly affects the systemic and coronary arteries of parrots, sclerotic changes within the pulmonary vasculature should be considered as a possible cause of pulmonary hypertension and as a differential diagnosis for right-sided congestive heart failure in psittacine species. (J Am Vet Med Assoc 2009;234:1055–1059)

A 20-year-old sexually intact female African Grey parrot (Psittacus erithacus) was examined at Colorado State University Veterinary Medical Center because of a history of lethargy, hyporexia, weight loss, and ascites of 21 days’ duration. Multiple therapeutic coelomocenteses had been performed by the referring veterinarian to maintain the parrot’s comfort during the 21 days prior to examination at our facility. Results of fluid analysis and microscopic examination of the coelomic fluid aspirated by the referring veterinarian were consistent with a modified transudate (2.6 g of total protein/L, 112 nucleated cells/µL, and <100,000 RBCs/µL).

Initial examination at our veterinary medical center revealed that the parrot had a body weight of 0.49 kg (1.08 lb). The keel was moderately prominent, which was suggestive of atrophy of the pectoral muscles. The parrot had a markedly distended abdomen and was tachypneic and dyspneic. The respiratory effort became substantially worse when the parrot was tilted backward at an angle between 45° and complete dorsal recumbency. Cardiac auscultation revealed a regular rhythm and a grade 3/6 holosystolic murmur.

Results of a CBC were within the respective reference ranges; however, plasma biochemical analysis revealed severe hypoproteinemia (1.0 g/dL; reference range: 3.0 to 5.0 g/dL), hypoalbuminemia (0.4 g/dL; reference range: 1.37 to 3.23 g/dL), and hypocholesterolemia (64 mg/dL; reference range: 160 to 425 mg/dL); a mild decrease in aspartate aminotransferase activity (90 U/L; reference range, 100 to 350 U/L); and a mild increase in bile acids concentration (99 µmol/L; reference range, 12 to 96 µmol/L). Thoracic and abdominal radiography revealed severe generalized cardiomegaly (proportion for the width of the cardiac silhouette to width of the thorax, 70%; reference range: 51% to 61%; proportion for the width of the cardiac silhouette to width of the coracoid, 74%; reference interval, 54% to 67%); and marked hepatomegaly. Although the pulmonary parenchyma appeared normal, the air sacs were minimally visible because of severe compression from coelomic fluid. There was a reduction in detail of the serosa in the coelomic cavity.

With the parrot standing in an upright position, Doppler ultrasonographic-echocardiographic evaluation was performed to obtain horizontal and vertical views by use of a ventromedian approach described in another report. Specific measurements and calculations for the horizontal view were determined and compared with reference values reported elsewhere. A large amount of anechoic fluid was visible between the heart and liver, which was consistent with coelomic effusion. Marked distention of the hepatic venous system was also detected, which was suggestive of severe hepatic congestion (Figure 1). The right atrium (length, 8.4 mm; and width, 8.5 mm; respective reference ranges not established) was believed to be substantially dilated because it was larger in size than the left atrium (length, 6.0 mm; and width,
8.1 mm; reference range [mean ± SD], 4.8 ± 1.2 mm and 10.9 ± 2.5 mm, respectively). The right ventricular chamber was severely enlarged as well, with a marked increase in end-diastolic width (9.3 mm; reference range, 4.8 ± 1.1 mm) and length (21.3 mm; reference range, 11.5 ± 1.9 mm). The interventricular septum appeared to be skewed toward the left ventricle as a result of the severe enlargement of the right ventricular chamber. Thickness of the right ventricular wall (3.4 mm; reference range not established) exceeded that of the left ventricular wall (3.2 mm; reference range not established), and thickness of the interventricular septum (3.2 mm; reference range, 2.5 ± 0.3 mm) was increased. Typically, the left ventricle of a psittacine is heavily walled and approximately 2 to 3 times as thick as the right ventricular wall. Thus, echocardiographic findings were indicative of mixed concentric and eccentric hypertrophy of the right ventricle.

Systolic right ventricular myocardial function was severely depressed as determined by an increase in end-systolic width (8.5 mm; reference range, 2.8 ± 0.9 mm) and length (16.8 mm; reference range, 9.2 ± 1.4 mm) and a marked reduction in fractional shortening (9.4%; reference range, 39.6 ± 11.4%). The left ventricle appeared mildly volume contracted (end-diastolic width, 7.3 mm, and end-diastolic length, 20.1 mm; reference range, 9.1 ± 1.5 mm and 23.9 ± 1.9 mm, respectively), and left ventricular systolic function (end-systolic width, 3.1 mm; end-systolic length, 17.7 mm; and fractional shortening, 57.2%; reference range, 7.0 ± 1.1 mm, 22.2 ± 1.9 mm, and 23.1 ± 4.6%, respectively) was considered normal.

Color Doppler echocardiography revealed moderately severe insufficiency of the right atrioventricular valve, with a regurgitant jet that was subjectively assessed to occupy...
approximately a third of the right atrial area (Figure 1). By use of the simplified Bernouilli equation, peak velocity of the regurgitant jet through the right atrioventricular valve measured with continuous-wave Doppler echocardiography (4.5 m/s) predicted that the systolic right ventricular pressure was 80.5 mm Hg greater than the right atrial pressure. Absence of pulmonary valve stenosis or obstruction of the right ventricular outflow tract was concluded on the basis of a lack of structural abnormalities because accurate measurements of outflow tract velocity could not be obtained. Because the right atrium and hepatic veins were severely dilated and there was coelomic effusion, the mean right atrial pressure was assumed to be increased to at least 10 mm Hg. Consequently, the systolic pulmonary arterial pressure was estimated by use of Doppler echocardiography to be at least 90 mm Hg. The clinical and diagnostic findings supported a diagnosis of right-sided congestive heart failure secondary to pulmonary hypertension.

Coelomocentesis was performed to improve respiratory function by providing more room for expansion of the air sacs. Clinicians were careful to remove as little fluid as possible to provide patient comfort while minimizing worsening of the hypoproteinemia. After successful stabilization, the parrot was discharged to the owner later the same day with instructions to administer several cardiac medications, including furosemide (1 mg/kg [0.45 mg/lb], PO, q 12 h), benazepril (0.5 mg/kg [0.23 mg/lb], PO, q 24 h), and pimobendan (0.25 mg/kg [0.114 mg/lb], PO, q 12 h). It was also recommended that the parrot be fed a high-protein diet.

One week later, the parrot was returned to our veterinary medical center for reevaluation. The owner reported that the parrot was doing better and had improvements in attitude and appetite. Although less abdominal distention was evident during physical examination and the respiratory rate and effort had improved, the keel appeared more prominent, which suggested additional muscle atrophy. Renal function remained normal, as estimated on the basis of uric acid and phosphorus concentrations. Although the amount of coelomic fluid was subjectively assessed as being reduced on an echocardiogram, there was still a substantial amount of effusion. The combination diuretic spironolactone-hydrochlorothiazide (1 mg/kg, PO, q 12 h) was added to the medications administered to the parrot. Although reportedly doing well on the prescribed cardiac medications, the parrot was found dead in its cage by the owner 35 days after initial examination at our veterinary medical center. Necropsy revealed that the coelomic cavity contained approximately 10 mL of serosanguineous fluid with mild hydropericardium and pericardial thickening. The heart had a globoid appearance with marked dilatation of the right ventricle. The ratio of the thickness of the right ventricular free wall to thickness of the left ventricular free wall was approximately 1:1. Gross examination of the ascending aorta and main pulmonary artery revealed diffuse and irregular thickening with lumens that were variably narrowed. The liver was diffusely pale gray in color but of normal consistency.

Histologic examination of the pulmonary vasculature revealed circumferential expansion of the tunica media and subintimal layers of the large pulmonary arteries attributable to multifocal scattered islands of hyaline cartilage suspended in amphophilic to basophilic ground substance (Figure 2). The resultant thickening of the tunica media and subintima substantially narrowed the vessel...
Atherosclerosis has been described in a variety of species, including mammals, birds, and reptiles. In mammals, the incidence of atherosclerosis is well-documented, with studies showing a high prevalence in humans and other primates. In birds, the incidence of atherosclerosis is less well-known, but recent studies have suggested that it may be more prevalent than previously thought.

In mammals, atherosclerosis is characterized by the accumulation of lipids and inflammatory cells in the intima of the arterial wall. This leads to the formation of atherosclerotic plaques, which can eventually rupture and cause thrombosis, leading to myocardial infarction or stroke. In birds, the morphology of atherosclerotic plaques may differ from that seen in mammals, with a greater prevalence of fibrous plaque formation and a lesser occurrence of lipid-rich plaques.

The risk factors for atherosclerosis in birds are similar to those in mammals, including age, obesity, and hyperlipidemia. However, the effects of these risk factors may differ between species. For example, hyperlipidemia in birds may be associated with increased autonomous nerve activity, whereas in mammals, it is associated with increased sympathetic nerve activity.

The clinical consequences of atherosclerosis in birds are also similar to those in mammals. In birds, atherosclerosis can lead to myocardial ischemia, dysrhythmias, and cardiac arrest. In some cases, the disease may be characterized by intermittent or chronic neurologic dysfunction.

The pathogenesis of atherosclerosis in birds is not fully understood, but it is likely that a combination of genetic and environmental factors play a role. In mammals, atherosclerosis is associated with the development of proinflammatory cytokines, which activate endothelial cells and smooth muscle cells, leading to the formation of atherosclerotic plaques. In birds, it is not clear whether a similar mechanism is at play.

The diagnosis of atherosclerosis in birds is challenging, as there are no validated diagnostic tests. However, the presence of atherosclerotic plaques may be detected on gross examination of the heart or aortas of birds with chronic neurologic dysfunction or sudden death. In some cases, atherosclerotic plaques may be detected on radiographic examination of the thoracic cavity.

The treatment of atherosclerosis in birds is supportive and may include the use of anti-inflammatory medications, such as nonsteroidal anti-inflammatory drugs or glucocorticoids. However, the efficacy of these drugs in birds is not well-documented.

The prognosis for birds with atherosclerosis is variable and depends on the severity of the disease and the presence of comorbidities. In some cases, the disease may be managed successfully with medical therapy, whereas in others, it may be associated with a poor prognosis.

In conclusion, atherosclerosis is a significant health concern in birds and warrants further research to better understand its pathogenesis, diagnosis, and treatment. Further investigations are needed to determine the prevalence of atherosclerosis in different bird species and to develop effective therapeutic strategies.
The specific goals of cardiac treatment in the African Grey parrot reported here were to decrease right atrial and right ventricular filling pressures through the use of diuretics and venodilation and to improve right-sided cardiac output by increasing right ventricular contractility and decreasing right ventricular afterload (ie, pulmonary arterial pressure). For these reasons, the phosphodiesterase-III inhibitor pimobendan was used for both its positive inotropic effect on the right ventricular myocardium and its smooth muscle-relaxing effects within the pulmonary arterial vasculature. Theoretically, these benefits increase right ventricular stroke volume, improve pulmonary blood flow, and indirectly reduce right ventricular filling pressures. Aggressive treatment with diuretics (furosemide, hydrochlorothiazide, and spironolactone) was used to reduce right-sided preload, thereby decreasing hepatic venous congestion and colomic fluid accumulation. Inhibition of angiotensin-converting enzyme by use of benazepril was also instituted to counteract the deleterious effects of the renin-angiotensin-aldosterone system, which was assumed to be activated as a result of right-sided heart failure. Systemic effects of the renin-angiotensin-aldosterone system were antagonized through reduction of the sodium concentration and retention of water by inhibition of aldosterone secretion and through reduction of angiotensin II–induced venous and arteriolar vasoconstriction.

It is important to mention that the specific goals for management of heart failure and use of the pharmacologic agents in the African Grey parrot were adapted from treatment of nonavian species with heart failure. Beneficial effects have been reported in humans and several other mammalian species and consequently were only speculative in the parrot described here. Pharmacokinetics, pharmacodynamics, efficacy, and safety margins of the specific agents used have not been established in avian species. Case reports have described treatment of birds with cardiac failure by use of a variety of drugs, including digoxin, enalapril, and furosemide. However, the actual efficacy and pharmacokinetics of these agents in birds are not known, and doses are extrapolated and empirical.

The information reported here described pulmonary atherosclerosis in an African Grey parrot that resulted in chronic cor pulmonale. Cardiac disease in captive birds is currently believed to be more common than previously suspected. Although atherosclerosis usually affects the systemic and coronary arteries of parrots, there can be sclerotic changes within the pulmonary vasculature that may result in an increase in pulmonary arterial pressure as vascular resistance increases and compliance decreases. For this reason, pulmonary atherosclerosis and resultant pulmonary arterial hypertension should be considered as a differential diagnosis for right-sided congestive heart failure in psittacine species.

References