Update on common congenital heart diseases in dogs and cats

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The identification of congenital cardiac disease in dogs and cats is clinically important. Even when the disease is severe, most patients with the most common congenital heart diseases present free of overt clinical signs, and disease is detected incidentally during routine puppy and kitten examination. Cardiac auscultation forms the basis for identification of most congenital cardiac defects.

Murmur recognition by cardiac auscultation: innocent versus pathological
Innocent murmurs (murmurs that are not associated with underlying cardiac pathology) are common in growing puppies and kittens. They may be related to physiologic anemia and hypoproteinemia associated with age, changes in cardiac geometry during growth, relative high heart rate, and other factors. Innocent murmurs are always low intensity (I–II/VI), early to mid-systolic, high frequency or musical in character, and located at the left parasternal region (often the heart base). Most innocent murmurs will disappear after 6 months of age, however innocent murmurs do continue to be recognized in some adults, which can pose a diagnostic dilemma.

Murmurs that persist through growth, murmurs of higher intensity, murmurs that have a diastolic component, or murmurs associated with other signs of cardiac disease warrant further investigation, even at young age. It is important to realize that there is not always a direct positive correlation between murmur intensity and severity of disease. Sometimes the opposite is even true (e.g., small ventricular septal defects produce loud murmurs while a large atrial septal defect will produce no or only a soft murmurs). Physical exam information should always be interpreted in conjunction with age and breed given the genetic basis of many congenital diseases.

The following diagram summarizes the murmur characteristics of most congenital heart diseases, after which the diagnostic work-up of several are discussed. Treatment options will be presented in my next talk.

Diagnosis	Murmur characteristics
Pulmonic stenosis *	Systolic, left base
Aortic stenosis *	Systolic, left base
Atrial septal defect	Systolic, left base, soft
Innocent murmur	Systolic, left base, soft and often dynamic
Mitral valve dysplasia #	Systolic, left apex
Ventricular septal defect #	Systolic, right apex
Tricuspid valve dysplasia	Systolic, right apex
Patent ductus arteriosus *	Continuous, left base

Table 1: Murmur characteristics of the most common congenital heart diseases in dogs and cats. # most common congenital heart diseases in cats; * most common congenital heart diseases in dogs.

PATENT DUCTUS ARTERIOSUS (PDA)
Patent ductus arteriosus is persistence of the communication between the main pulmonary artery and the descending aorta beyond the neonatal period, almost always resulting in left-to-right shunting from the aorta to the pulmonary artery and recirculation of the lungs and left side of the heart. Left uncorrected, the volume overload can cause left-sided congestive heart failure (lung edema) at potentially at a very young age depending on the size of the shunt. Patent ductus arteriosus is readily identified or at least suspected on physical examination by presence of the characteristic continuous left base heart murmur. In cats it is best heard more caudoventrally. Bounding femoral pulses are also quite characteristic. Thoracic radiography will often reveal left atrial and ventricular enlargement, evidence of pulmonary overcirculation (enlarged pulmonary arteries and veins), and distinct main pulmonary artery, ascending aorta, and "ductus bump" bulges on the DV view. Evidence of CHF may be present. The diagnosis can be almost certain on the basis of physical examination alone. Echocardiography serves to confirm the diagnosis, rule out other concurrent cardiac defects, and plan interventional closure (next talk).

Pulmonic Stenosis (PS)

Pulmonic stenosis is characterized by congenital malformation of the pulmonic valves and sometimes hypoplasia of the the pulmonic annulus region, resulting in obstruction to right ventricular outflow, pressure overload and concentric hypertrophy of the right ventricle. Left uncorrected, syncope, right-sided congestive heart failure (ascites, pleural effusion) and arrhythmias with risk of sudden cardiac death can occur. Especially in Bulldogs pulmonic stenosis may be accompanied by coronary artery anomalies. Pulmonic stenosis produces a systolic left base murmur that must be differentiated from aortic/subaortic stenosis. Femoral pulses are often normal in PS whereas they are often weak with severe AS/SAS. Thoracic radiography may reveal right-sided cardiomegaly and a distinct main pulmonary artery bulge on the DV view. Echocardiography is necessary to make the diagnosis, rule out other concurrent cardiac defects, and assess severity and suitability for intervention.

Aortic/Subaortic Stenosis (AS/SAS)

The majority of dogs with AS have a ridge of fibrous tissue below the aortic valve in the LV outflow tract, therefore subaortic in nature (SAS). This causes obstruction to left ventricular outflow, pressure overload and concentric hypertrophy of the left ventricle. Exercise intolerance, syncope, left-sided congestive heart failure (pulmonary edema) and arrhythmias with risk of sudden cardiac death are potential consequences, with sudden death being the most common outcome, and may occur at a young age in severe cases. Importantly, the lesions may not be present at birth but develop during the first 4–8 weeks of life. Therefore, it is not uncommon to not be able to hear a murmur at the first puppy check. SAS produces a systolic left base murmur that must be differentiated from PS. Femoral pulses are often weak. Severity of SAS increases with growth and maturity therefore murmur intensity increases during puppyhood. Thoracic radiography may reveal a prominent ascending aorta/aortic arch bulge and left ventricular enlargement, though concentric hypertrophy often does not produce gross cardiomegaly radiographically to the same extent that cardiac dilation does. Echocardiography is necessary to make the diagnosis, assess severity and candidacy for any therapy, and rule out other concurrent cardiac defects. Even with echocardiography, diagnosis of mild SAS can be very challenging.

Atrial and Ventricular Septal Defects

Defects in the development of the embryonic ventricular septum, atrial septa, or endocardial cushions may result in atrial septal defects (ASD) and/or ventricular septal defects (VSD). When the degree of left-to-right shunting is substantive, ASD results in volume overload of the right atrium, the right ventricle, and pulmonary tree, whereas VSD results in volume overload of the left side of the heart and pulmonary tree (the right ventricle just acts as a passive conduit). Atrial septal defects can be challenging to detect on physical exam since they may produce no murmur due to low flow velocity, or a soft murmur similar to that of mild PS or an innocent murmur. A split second heart sound can sometimes be detected. Small VSDs produce very intense murmurs, typically loudest on the right, whereas larger VSDs may be associated with much softer murmurs.

Atrioventricular valvular dysplasia

Dysplasia of either of the atrioventricular valves (mitral valve, tricuspid valve) can occur in both the dog and cat. It occurs when malformation of either valve leads to stenosis, and/or regurgitation. Mitral valve dysplasia can also cause a dynamic obstruction of the left ventricular outflow tract, especially in kittens. This leads to dilatation of the atria, which in turn, can lead to heart failure and arrhythmias. Clinical signs with mitral valve (MV) dysplasia include a left sided heart murmur, syncope (often associated with tachyarrhythmias), and left sided congestive heart failure. Thoracic radiography may show evidence of left atrial and left ventricular enlargement, and if present, pulmonary congestion and edema. Echocardiography is useful to assess the severity of valvular malformation, dynamic obstruction, regurgitation, stenosis (if present) and chamber enlargement. Treatment is usually limited to managing heart failure and arrhythmias. Once these occur, prognosis becomes guarded. Clinical signs with tricuspid valve (TV) dysplasia are similar except that a right sided heart murmur and right sided heart failure can occur.