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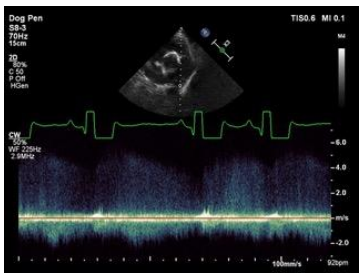
Echo Case Challenges for Advanced Practitioners Mini Series

Session Three: Practical approach to Congenital Heart Defects

Jose Novo Matos DVM DipECVIM (Cardiology) MRCVS
RCVS and European Specialist in Small Animal Cardiology



Echo Case Challenges: a problem-oriented approach

Jose Novo Matos DVM DECVIM (Cardiology) MRCVS

Session 3: 'Congenital heart defects- problem-oriented approach'

The diagnosis of congenital heart diseases are probably the most challenging echos in clinical cardiology, but the most interesting ones as well! It is important to have a thorough and systematic approach in cases suspicious of congenital heart defects. This is of paramount importance to correctly characterise the defect, evaluate its severity and decide the best therapeutic approach.

The most frequent congenital cardiac defects cause either concentric or eccentric ventricular hypertrophy (some more complex/uncommon defects do not cause changes in the ventricular chambers though, but these are beyond the scope of this talk). There are several possible approaches to congenital heart diseases on echo, the one I describe/suggest below starts by defining the main cardiac phenotype as concentric vs eccentric hypertrophy (i.e. ventricular hypertrophy vs dilation, respectively) and the differential diagnoses are build from this starting point.

Most common congenital heart defects in dogs and cats based on their hemodynamic effect (cardiac phenotype)

Cardiac phenotype	**Ventricle**	**Differential diagnoses & Echo Tips**
Concentric hypertrophy (Pressure overload)	Left ventricle	*Aortic stenosis* Most commonly sub-valvular stenosis> look for a fibromuscular ridge under the aortic valve in RPLA 5ch view. Measure peak flow velocity ideally in a subcostal view*
	Right ventricle	Pulmonic stenosis* Most commonly valvular stenosis> classically 2 types: - Type A: valve leaflets slighted thickened and fused> dome-shaped (normal PA diameter) - Type B: PA annulus hypoplasia, thickened leaflets Subvalvular stenosis may be caused by an anomalous prepulmonic coronary artery> most common in English bulldogs
		Double Chambered RV Fibromuscular mid-ventricular obstruction at the level of the supraventricular crest (subinfundibular)> check RPSA heart base view dorsally to the aorta
		Pulmonary hypertension (Eisenmenger physiology) Complex condition where a long-standing large left-to-right shunt causes severe pulmonary vascular disease/remodeling with pulmonary hypertension and shunt reversal (right-to-left). Right ventricle frequently shows both concentric and eccentric hypertrophy
Eccentric hypertrophy (Volume overload)	Left ventricle	Patent ductus arteriosus (PDA) Color Doppler interrogation of the main PA in a RPSA heart base view and ideally left cranial PA view as well
		Ventricular septal defect (VSD) Most commonly perimembranous and restrictive> interrogate with colour Doppler just under the aortic valve in a RPLA 5ch view and RPSA heart base dorsally to the aorta and cranial to the tricuspid valve
		Mitral dysplasia May cause both insufficiency and stenosis, assess colour Doppler profile across the MV carefully both in systole and diastole. Evaluate PW mitral inflow profile for hints of stenosis (prolonged E wave deceleration time> prolonged pressure halftime)
	Right ventricle	Tricuspid dysplasia
		Atrial septal defect Uncommon in small animals, most frequent types are ostium primum and secundum, low and mid-atrial septal defect, respectively.
Others		
*Assessment of stenosis severity based on Doppler derived pressure gradients: • Mild: Vmax <3.5 m/s, PG<50 mmHg • Moderate: Vmax 3.5-4.5 m/s, PG 50-80 mmHg • Severe: Vmax 4.5 m/s, PG>80 mmHg Most common congenital defects in dogs are PDA, subaortic and pulmonic stenosis, whilst in cats is VSD		

RPLA 5ch: right parasternal long-axis 5 chamber view; PA: pulmonary artery; RV: right ventricle; RPSA: right parasternal short-axis view; MV: mitral valve; PW: Pulse wave Doppler; PDA: patent ductus arteriosus

Bubble Study

Contrast echocardiography may be very useful in certain congenital heart defects, especially in cases of pulmonary hypertension with suspicion of a right-to-left shunt. The most common type of contrast echo uses agitated saline. Saline air bubbles do not flow across the pulmonary capillaries, as they are bigger than normal capillaries. Therefore saline bubbles are not normally seen in the left heart or aorta after injection of agitated saline in a peripheral vein. If bubbles are seen in the left cardiac chambers within 3 cardiac cycles following contrast opacification of the right ventricle this suggests an intra-cardiac shunt. In cases of suspicion of an extra-cardiac shunt (e.g. reverse PDA) the abdominal aorta should be scanned after contrast injection in a peripheral vein.

Bubble study protocol:

Hand-agitated saline injected into a peripheral vein

- IV catheter
- Two 5 ml syringes + three-way stopcock
- 2-5 ml of saline in one syringe and no air/fluid in the other
- Bubbles created by pushing the 2 syringes plungers back and forth until homogeneous opaque solution is created
- Immediately injected by forced hand injection

REMOVE any large air bubbles! If right-to-left shunt large air bubbles increase the risk of air systemic embolism (e.g. stroke)