Cardio Summary

- Heart disease = abnormality of heart
- Heart failure = cardiac output is insufficient to deliver adequate blood to meet metabolic demand at normal cardiac filling pressures
  - Poor cardiac output: activation of compensatory mechanisms > tachycardia, increased force of contraction, loss of sinus arrhythmia, vasoconstriction, blood volume expansion
  - Congestion: left sided (pulmonary vasculature), right sided (systemic venous)
- Risk factor > subclinical > remodeling > failure
- Auscultate lungs before heart
  - Rate: Dogs: 70 - 160 bpm, Cats: 150 - 180 bpm
  - Rhythm
    - Normal: sinus rhythm/arrhythmias – cannot be in failure
    - Abnormal: bradyarrhythmias, tachyarrythmias
  - Area
    - Displacement: intrathoracic neoplasia, diaphragmatic hernia
    - Size: increased cardiomegaly, decreased microcardia
  - Audibility
    - Decreased: pericardial effusion, intrathoracic neoplasia, obesity, pleural effusion
    - Increased: sympathetic activation, emaciation
  - Sounds
    - S1 = “LUBB” ◦ Closure of AV valves ◦ Corresponds to onset of ventricular systole
    - S2 = “DUPP” ◦ Closure of semilunar valves and vibrations in great arteries ◦ Corresponds to onset of ventricular diastole
    - Gallop rhythm: intensified S3/4
    - Murmurs
    - Left base: aortic valve, pulmonic valev
    - Left apex: mitral valve
    - Right apex: tricuspid valve

Type of heart failure	Signs
Poor cardiac output	Tachycardia Weak peripheral pulses Cold extremities Prolonged CRT Pale MM
LCHF	Pulmonary oedema = crackles Pleural effusion cat = dull lung sounds ventrally, paradoxical breathing pattern Cyanosis Tachypnoea Restrictive breathing pattern
RCHF	Jugular pulses Ascites Hepatomegaly Pleural effusion dogs Hepatojugular reflux Cachexia

Loudness	1. **Quiet surroundings careful listening** 2. **Soft but easily heard** 3. **Moderate intensity** 4. **Loud** 5. **Loud + precordial thrill** 6. **Heard with stethoscope off chest**
Timing	Systolic – between lub dub Diastolic Continuous
Location	Systolic ● Left side: Base: pulmonic stenosis (supposed to be open), SAS (subaortic stenosis), ASD (atrial septal defect) Apex: Mitral regurgitation ● Right side: Base: SAS Apex: Tricuspid regurgitation, VSD Diastolic ● Left side: Base: Pulmonic / aortic regurgitation Apex: Mitral stenosis ● Right side: Apex: Tricuspid stenosis Continuous ● Left base: PDA

- Dx: thoracic radiographs, echocardiography, electrocardiography
  - Decreased SBP: poor cardiac output, subaortic stenosis
  - Increased SBP: lead to hypertrophic cardiomyopathy
  - cTnI: myocardial injury, myocarditis
  - NT-proBNP: ID heart failure in cats, DCM dogs
  - Echo: EPSS increased because ventricle has dilated or it is full because it is not contracting properly

Breed	Cardiac Issue
Cavalier	Mitral valve disease
Boxer	Severe aortic stenosis, idiopathic dilated cardiomyopathy, pulmonic stenosis
Doberman	idiopathic dilated cardiomyopathy
American Cocker Spaniel	idiopathic dilated cardiomyopathy – taurine

Innocent heart murmurs: vibrations associated with aortic and pulmonary ejection

Typical innocent	Red flags
Systolic – early or mid	Late systolic, pansystolic, holosystolic, diastolic or continuous
Low grade 1-2	Loud >3/6,
Audibility varies with HR, body position, exercise, stress	Cardiovascular dysfunction
Audible at left sternal border, basal	apical or right sided
Do not radiate	Radiates
Disappear 4-6m	Persistence beyond 6 m

Disease	Path	Clinical signs	DX	TX
chronic valvular heart disease	Most common cause of heart failure – dogs Mitral leaflets and chordae tendinae – less likely tricuspid valve Older dogs, small breeds A: risk B1: heart disease present B2: remodeling C: heart failure D: refractory to standard therapy	Murmur: left, apical, systolic Cough: left atrial enlargement + tracheobronchomalacia Arrythmia – LA enlargement > A fib Failure: decreased CO signs, LCHF, RCHF last Chordae tendinae rupture = acute deterioration Haemopericardium when atrium rupture due to jet back into due to leaky valves	PE + Cardiac assessment Thoracic x-ray: chamber enlargement (LA), pulmonary oedema (perihilar), pulmonary venous congestion US: B-lines perihilar LCHF Echocardiography: anatomy valves, valve prolapse, chamber size Electrocardiography: Sinus tachy, SVTC, A fib Blood pressure Selected blood test	A: no, educate, observe B1: ditto, echo B2: pimobendane (positive inotrope), sodium restriction, good BCS +/- ACE inhibitors (reduce vasoconstrictive drive as unsustainable) C acute: furosemide, oxygen, cage rest, pimobendane, drain effusion, judicious sedation (butorphanol) +/- vasodilators, ACE inhibitors, dobutamine (increase myocardial contraction force and HR) C chronic: pimobendane, furosemide, renal values and electrolytes, ACE inhibitor, +/- spironolactone, treat arrythmias, optimise caloric intake, cough suppressants D: higher doses furosemide/ pimobendane/ torasemide, vasodilators, cough suppressants, anti-arrhythmic, sildenafil pulmonary hypertension
	Not common, medium to LB dogs maybe associated with subaortic	Murmur: diastolic base i.e. aortic regurgitation		Parenteral AB, oral AB 4-6wks, choice based on C+S, empirical ampicillin and

Infective endocarditis	stenosis/ bacteraemia, aortic and mitral valves affected. Infection of endocardium. Acute or chronic	Pyrexia, other areas of infection, sequelae to septic thromboemboli, bounding pulse	Clinical signs, echocardiography, blood culture poor sensitivity	fluoroquinolone or gentamicin Antithrombotics Treat CHF as necessary
Secondary cardiomyopathy	Myocarditis, doxorubicin-induced myocardial failure, tachycardia-induced myocardial failure, thyrotoxicosis, hypertension, acromegaly, muscular dystrophy, diet-associated cardiomyopathy, taurine deficiency			
Idiopathic dilated cardiomyopathy	Genetics, diet?? LB or giant, Doberman, boxer, American cocker spaniel, male, middle aged to older	Congestive HF: left more common, decreased CO signs, sudden death, Murmur: left, apical, systolic, cardiac cachexia Occult dz: malignant arrythmias in D + B before myocardium fails to function, tachyarrhythmias D: protracted occult disease (VC), progress to CHF (short survival), develop syncope, die suddenly B: ventricular tacchyarrythmias, 1 mild, 2 severe (syncope and sudden death), 3 myocardial failure with LCHF) LB: systolic dysfunction, arrythmias uncommon	Echocardiography: Increased LV diameter, rounding LV lumen, increased LA size, Increased E point to septal separation, decreased fractional shortening, wall thinning X-ray: generalised heart enlargement, D+B minimal cardiomegaly, pulmonary oedema, pulmonary veins, pleural effusion ECG: always, tachyarrhythmias (ventricular, A fib), halter monitor Routine CBC/B prior to tx NT-proBNP: predict onset	Control CHF, increased survival time, decrease risk of sudden death ECC: furosemide, oxygen, cage rest, pimobendane MUST, drain effusions +/- judicious sedation, vasodilators, ACE inhibitors, dobutamine Chronic: pimobendane, ACE-inhibitors, diuretics, tx arrhythmias, salt restricted, exercise restricted, carnitine and taurine Ventricular arrhythmias: lidocaine, magnesium > sotalol, mexilitine A fib: treat CHF, digoxin, Ca channel blocker (amlodipine - ve inotrope/chronotrope care not sympathetic compensation keeping alive) Occult disease with systolic dysfunction: pimobendane, ACE

				inhibitors D, tx arrhythmias
Pericardial effusion	LB Goldies + GS, small breed left atrial rupture with mitral valve disease Cardiac tamponade (effusion squishes heart) – RCHF > decreased CO > shock > death. Mostly idiopathic: middle aged, LB Neoplasia: older, haemangiosarcoma, mesothelioma, chemodectoma (boxer, English bulldog, boston), ectopic thyroid carcinoma, metastatic neoplasia	Depends: volume, rate of formation, distensibility of pericardial sac Chronic: lethargy, anorexia, weakness, collapse, tachypnoea, muscle wastage, RCHF Acute: collapse, shock, death Reduced heart sounds	Clinical path for systemic disease Echocardiography: definitive, diastolic collapse of RA/RV = cardiac tamponade, ID mass ECG: sinus tachycardia, low voltage QRS, electrical alternans x-ray: enlarged cardiac silhouette, rounded, sharp edges	Diuretics NOT used, pericardiocentesis ECC Once stable > cardiac tNL higher with cardiac haemangiosarcoma, echocardiogram for mass (not always visible) Idiopathic 50% resolves following pericardiocentesis, partial pericardiectomy, percutaneous balloon pericardiotomy less Haemangiosarcoma BAD Chemodectoma – long term relief Mesothelioma medium
HCM cats	Genetic maine coon and American shorthair Secondary: hypertension, hyperthyroidism, acromegaly Symmetric hypertrophy of left ventricular free wall and interventricular septum Asymmetric hypertrophy > narrowed LVOT > systolic anterior	CHF with pleural effusion (pulmonary oedema), thromboembolic disease, sudden death Murmur: parasternal Gallop rhythm Left sided HF Decrease CO: tachycardia RCHF= ARVC	Echocardiography: increased wall thickness, LA size, LV outflow tract, lungs and pleural space Exclude secondary causes X-ray: cardiomegaly, valentine heart shape, congestive heart failure, pleural effusion (pulmonary oedema)	Minimal exam and stress Stage B1: none Stage B2: thromboprophylaxis = Clopidogrel, aspirin, LMWH, treat arrhythmias Stage C: oxygen, furosemide, thoracocentesis, sedation butorphanol, pimobendane if CHF (do echo first as need to r/o LV outflow tract, not licenced) C chronic: furosemide, thromboprophylaxis

	motion of the mitral valve (sucked into LVOT)	Hypothermia	ECG: SV/V ectopic complexes NT-pro-BNP Confirms CHF as cause of dyspnoea	+/- pimobendane, ACE-inhibitors, calcium channel blockers, beta blockers (-ve chronotropes/inotropes, antiarrhythmias, propranolol)
Dilated cardiomyopathy	Taurine deficiency Idiopathic	CHF Retinal degeneration Taurine deficiency	Echocardiography Plasma taurine	Taurine, pimobendane, heart failure as before
Restrictive cardiomyopathy		Similar to HCM	Echo: diastolic dysfunction, moderate to marked LA or biatrial dilation, hyperechoic wall segments = fibrosis, absence of hypertrophy ECG: arrhythmias X-ray: LA/ biatrial enlargement	As per HCM
Aortic thromboembolism	Secondary to feline cardiomyopathy, enlarged LA = risk factor Sites: aortic trifurcation/ iliac arteries, renal arteries, mesenteric artery, cerebral artery, coronary artery, brachial artery	Pain, cardiac disease, hypothermia = poor prognostic factor, cold extremities, absent pulses, cyanosis, muscles firm and swollen, loss of motor function, decreased cutaneous sensation and limb reflexes	Increased AST and CK, stress hyperglycaemia, metabolic acidosis, azotaemia, hyperkalaemia, peripheral v central blood glucose Echo Aortic US abdomen	Supportive: analgesia, treat heart, cage rest, IV fluids, monitor electrolytes Thromboprophylxis: prevents more, Clopidogrel, low molecular weight heparin, rivaroxaban, aspirin, oral factor Xa inhibitors Thrombolytic therapy/ surgical thrombectomy only if very early
		Continuous machinery murmur left base		

Patent ductus arteriosus	Extra-cardiac shunt: between pulmonary artery and aorta, poodles and females, **dog**	Widened pulse pressure water hammer pulse Precordial thrill LCHF Right to left rarer: pulmonary hypertension, cyanosis caudally, erythrocytosis, loss of murmur	Echo: anomalous vessels, cardiac remodelling x-ray: cardiac enlargement DV triple bulge	L>R: surgery, coil embolization or canine duct occluder placement No repair If R>L, concurrent cyanotic heart disease, management of erythrocytosis main therapy (phlebotomy)
Ventricular septal defect	Intracardiac shunt, membranous part of the interventricular septum, L>R, **cat**	Murmur right parasternal edge, loud with small defects and soft with large, LCHF more common	Echo: doppler shunting jet and chamber enlargement X-ray: cardiomegaly	No tx in small, moderately: reduce shunt flow with arteriolar vasodilators/sx creation of mild pulmonic stenosis, treat CHF
Pulmonic stenosis	Valvular, subvalvular or supravalvular (rare). Predisposed English bulldog, boxers, beagle = **dog**	Ejection murmur left heart base, exertional fatigue, pulse strength often fair, RCHF rare	x-ray: right heart enlargement, post stenotic dilations echo: right side remodeling, post stenotic dilation, grade via jet velocity + pressure gradient	Severe tx, moderate often asymptomatic, mild don't tx. Balloon dilation or surgery if aberrant coronary artery prevents balloon
Aortic stenosis	Subaortic most common, LB **dog**	Exertional syncope and sudden death, reduce CO, peripheral vasodilation, arrhythmias, LCHF rare, harsh systolic ejection murmur left heart base, pulse weak	x-ray: LV enlargement, post stenotic dilation echo: pressure gradient, left sided remodeling, post-stenotic dilation	Not for mild, exercise restriction and beta blockers, AB If risk of bacteraemia as higher risk of endocarditis
AV malformation	Insufficiencies, mitral valve dysplasia most common in **cats**	Left or right CHF	Echo: valve leaflets thick/absent/displaced chordae	Based on signs – mitral valve dysplasia similar to chronic valvular heart disease

			tendinae short or absent	

Drugs and how they work

- Pimobendan: B2, positive inotrope, vasodilatory (decreases afterload)
- ACE inhibitors: inhibit RAAS, reduce fluid accumulation, decreases preload and afterload
- Furosemide or torasemide (longer acting SID): diuretic, decrease fluid accumulation
- Torbutamine: positive inotrope, if contractility poor if in hospital
- Spironolactone: weak diuretic but potassium sparing
- Interpreting ECG

1. Calculate rate (10 complexes in 3sc = 3 x 20 = 60s so 10 x 20 = 200 complexes/min, 20 complexes in 6 sec, 6x 10 = 60sec, so 20 x 10 = 200 complexes/min)
2. Rhythm regular or irregular: are the R-R intervals normal
3. Arrhythmia > intermittent (premature or escape), sustained (tachy or escape or idoventricular)