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Cardiology Crash Course Online 'Mini Series'

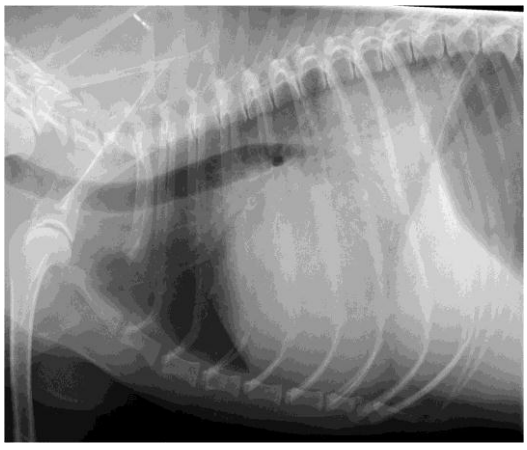
Session 3:
Congestive Heart Failure Therapy

Nuala Summerfield

BVetMed(Hons) CertSAM DipECVIM-CA MRCVS

BVM&S DipACVIM (Cardiology) Dip ECVIM-CA (Cardiology) MRCVS

RCVS Recognised Specialist in Cardiology



Congestive Heart Failure Therapy

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ACVIM Consensus Statement: Guidelines for the Diagnosis and Treatment of Canine Chronic Valvular Disease (Published JVIM 2009)

- **Stage A** - at risk (predisposed breed, family history)
- **Stage B1** - asymptomatic with no heart enlargement
- **Stage B2** - asymptomatic with heart enlargement
- **Stage C1** - acute heart failure (HF) (requiring hospitalisation)
- **Stage C2** - past or present HF (managed at home)
- **Stage D1** - refractory HF (requiring hospitalisation)
- **Stage D2** - refractory HF (managed at home)

N.B. Refractory means unresponsive or poorly responsive to medications and is a feature of end-stage HF

Remember that the above staging system is a continuum.

Natural history of disease

- Progression of compensated heart disease to heart failure happens over many years
- Key question that we need to answer in each individual patient with acquired heart disease is where they are along that time course of progression
- This is vital information when making decisions concerning treatment, follow-up and prognosis

What defines CHF (stage C)?

- Clinical signs

Respiratory rate (RR) is very useful indicator of CHF
Resting RR in clinic and sleeping RR at home (monitored serially by owner)

- Radiography showing pulmonary oedema
- Echocardiographic evidence of advanced MMVD or DCM

What is the "normal" RR for dogs with heart disease?

No CHF (at home): Resting RR **<30 /min**
CHF (at home): Resting RR **>35-40 /min**
CHF (in hospital): Resting RR **>40-45 /min**

So what do the ACVIM Consensus Statement Guidelines advise regarding treatment at each stage of heart disease?

MMVD Stage A - Dogs at risk of heart disease

- ACVIM Consensus Statement Guidelines say that no drug or dietary therapy is required
- Screening of *at risk* dogs is indicated

MMVD stage B1 - Asymptomatic dogs with heart disease but no cardiomegaly

- ACVIM Consensus Statement Guidelines say that no drug or dietary therapy is required
- Re-examination every 12 months

MMVD Stage B2 - Asymptomatic dogs with heart disease and cardiomegaly

- No consensus for therapy recommendations in stage B2 dogs
- **As NO CHF** – Diuretics (Furosemide) NOT indicated yet!
- **If treated**, survey of cardiologists revealed dogs in B2 stage CHF with significant LA, LV enlargement most commonly receive ACE-I

In specific circumstances the following were prescribed:
Pimobendan, Spironolactone Digoxin, Amlodipine, B-blockers, cough suppressants

MMVD Stage C – Dogs in heart failure

Stage C1 ACUTE therapy recommendations:

Consensus reached for:
- Hospitalisation for cage rest and close monitoring
- Oxygen therapy
- Thoracocentesis / Abdominocentesis as required
- **Furosemide** IV, IM or SC

Boluses of 1-4 mg/kg boluses or CRI @ 1 mg/kg/hr
Use severity of dyspnoea and RR as guide to treatment success
- **Pimobendan** 0.25 – 0.3 mg/kg PO q 12 hr

No consensus reached on:
- ACE-Inhibitors
- Nitroglycerine ointment

Stage C2 CHRONIC therapy recommendations:

Consensus reached for:
- **Furosemide** (1-2 mg/kg PO q 12hr, but can be increased to 4-6 mg/kg PO q 8hr if necessary)
- **ACE-I** (e.g. enalapril 0.5 mg/kg PO q 12hr)
- **Pimobendan** (0.25 – 0.3 mg/kg PO q 12hr)

No consensus reached on the use of the following:
- Spironolactone (although frequently used in class C2 dogs)
- Digoxin +/- Diltiazem for rate control for atrial fibrillation
- Beta-blockers (CARE if ventricular systolic dysfunction!)
- Bronchodilators / cough suppressants
- Diet - restrict Na, monitor K, omega-3 supplement

MMVD Stage D – Dogs with refractory heart failure

Stage D1 ACUTE therapy recommendations:

Consensus reached for:
- Hospitalisation for cage rest and close monitoring
- Oxygen therapy
- Thoracocentesis / Abdominocentesis as required
- **Furosemide** IV

Boluses of 2-4 mg/kg boluses or CRI @ 1 mg/kg/hr
Use severity of dyspnoea and RR as guide to treatment success
- **Pimobendan** 0.25 - 0.3 mg/kg PO q 12hr
- **Amlodipine** 0.05 - 0.1 mg/kg PO q 24 hr (afterload reduction)

In ICU setting could use IV nitroprusside or PO hydralazine

No consensus reached on:

- ACE Inhibitors, nitroglycerine ointment, IV dobutamine CRI, off-label use of high-dose pimobendan (0.3 mg/kg PO q 8 hr)

Stage D2 CHRONIC therapy recommendations:

Consensus reached for:

- **Furosemide** (1-2 mg/kg PO q 12 hr, but can be increased to 4-6 mg/kg PO q 8 hr if necessary)

Monitor renal function closely (24 - 48 hr after dose increase), some degree of azotaemia may be unavoidable in stage D2 patients
Consider increasing frequency of dosing i.e. from q 12 hr to q 6 - 8 hr to spread diuresis effect
Consider substituting 1 oral furosemide dose per day with subcutaneous furosemide (watch for sterile abscesses)
Sequential nephron blockade (triple diuretic therapy)
i.e. consider adding in K sparing diuretic +/- hydrochlorothiazide

- **ACE-I** (e.g. enalapril 0.5 mg/kg PO q 12 hr)
- **Pimobendan** (0.25 – 0.3 mg/kg PO q 12 hr)

Consensus Panel Authors' note (but not part of D2 guidelines):

- Consider replacing one or more furosemide doses per day with **torsemide** at 0.1 times the furosemide dose
- Consider increasing pimobendan frequency to q 8 hr

No consensus reached on the use of the following:

- Spironolactone (although frequently used in class C2 dogs)
- Digoxin +/- Diltiazem for rate control for atrial fibrillation
- Beta-blockers (CARE if ventricular systolic dysfunction!)
- Bronchodilators / cough suppressants
- Diet - restrict Na, monitor K, omega-3 supplement

Clinical presentation of congestive heart failure (CHF)

- Backward failure:
    - Left sided CHF
        - Increased respiratory rate and effort
        - Coughing (often during night / early morning)
            - Dogs NOT cats
    - Right sided CHF
        - Jugular distention/Hepatomegaly/Ascites
- Forward Failure:
    - Exercise intolerance
    - Weakness, collapse

Goals of congestive heart failure therapy

- Regardless of underlying pathology, principles for treating CHF are similar, and based on:
    - Clearing fluid accumulations
    - Supporting myocardial function (i.e. attempting to improve systolic or diastolic function (or both)
    - Decreasing myocardial work load
    - Controlling heart rate to optimise cardiac output

Standard congestive heart failure therapy

- Typically use a combination of the following drugs:
    - Diuretics
    - ACE Inhibitors
    - Inodilators
        - i.e. positive inotropes with vasodilatory properties

Diuretics

- Control oedema formation
- Oedema in CHF is usually due to increase in circulating blood volume
- Blood volume can be increased by as much as 30 % in severe CHF
- N.B. Do NOT use diuretics unless patient is in CHF – unnecessary stimulation of RAAS may cause more rapid progression of disease!

Types of diuretics used:

- Loop
    - Furosemide
    - Torsemide

- Potassium Sparing
    - Spironolactone
    - Amilioride

- Thiazide
    - Hydrocholorothiazide

Furosemide

- Action in thick portion of ascending Loop of Henle
- **First-line diuretic in CHF**
- Dosage range is VERY wide
- IV (bolus or CRI), IM, (SC) for emergencies
- PO (SC) for chronic home administration

Always aim to maintain patient on the lowest dose of furosemide necessary to control CHF signs, to minimise RAAS activation

N.B. Bronchodilating properties when given IV and antitussive action (affects laryngeal nerve sensitivity) Explains why some dogs wrongly treated with furosemide stop coughing, eventhough not in CHF!

- Furosemide CRI can be effective in dogs with severe left-sided CHF with poor response to furosemide boluses
    - Studies in humans (healthy and CHF) and healthy dogs and horses, suggest that CRI furosemide results in more diuresis, less volatility in plasma volume, more natriuresis and calciuresis, less kaliuresis and possibly less activation of RAAS, than IV bolus furosemide

Torsemide

- Loop diuretic like furosemide
- 10x more potent than furosemide but with less potassium excretion
- Also blocks aldosterone
- Not licensed and very little clinical information
- Oral dosage = 0.1 – 0.3 mg/kg PO q 12 – 24 hr
- Used when patients become refractory to Furosemide (expensive)

Spironolactone

- Usually added to Furosemide
- Oral route only
- Action in collecting duct/distal convoluted tubule
- Potassium sparing effect
- **Aldosterone antagonist**
    - *May be important property independent of diuretic action*

Hydrochlorothiazide

- Combined with Amilioride = “Moduretic”
- PO route only
- Add to Furosemide → Triple diuretic therapy (for refractory CHF cases)
- Action in distal convoluted tubule

Important considerations when using diuretics

- Azotaemia
- Electrolyte imbalances
    - particularly with triple diuretic therapy – monitor K^+ levels
- Monitor renal parameters and electrolytes regularly
- Every 6-8 weeks

ACE-Inhibitors

Rationale for ACE inhibitor use

- Improve clinical signs of CHF
- Reduce capillary pressure
- Reduce oedema formation
- Increase perfusion of vascular beds
- Reduce myocardial hypertrophy and remodelling

Types of ACE-Inhibitors

- Benazepril
- Enalapril
- Ramipril
- Imidipril

Important considerations when using ACE-Inhibitors

- Azotaemia
- Hypotension
- Monitor renal parameters regularly
- Benazepril may be more suitable for patients with renal disease, as less dependant on renal excretion (hepatic route of excretion also)

Inodilators

- **Pimobendan**
    - Calcium-sensitizing drug
    - Positive inotrope
    - PDE III inhibitor

- Vasodilation

Considerations when using Inodilators

- More powerful positive inotrope than digitalis glycosides
- Minimal risk of azotaemia

Digoxin

- Weak positive inotrope
  - Increases contractility but to a lesser degree than pimobendan
  - Rarely used for this purpose since pimobendan has become available, unless pimobendan is not tolerated or if owners cannot afford pimobendan
- Negative chronotrope
  - Decreases heart rate
  - Useful for controlling sinus tachycardia, frequent APCs, atrial fibrillation
- Increases vagal tone, decreases sympathetic tone
- Alters baroreceptor sensitivity

Considerations when using Digoxin

- Predominantly renal excretion
- Avoid drug or decrease dose in renal failure
- Digoxin toxicity!
  - GI signs, lethargy, arrhythmias
  - Measure serum digoxin level
  - Digoxin toxicity risk increased with hypokalaemia

Other therapies to consider

Nitroglycerine ointment

- *Topical – wear gloves and label cage!*
- Venodilator (preload reducer)
- Best to used "pulsed" therapy i.e. 12 hrs on, 12 hrs off, to avoid tolerance
- Apply to hairless area in groin, NOT pinnae

Amlodipine

- 2nd generation calcium channel blocker

Arteriodilator
Inhibit calcium influx to the arterial vascular cells
Dose: 0.05 – 0.1 mg/kg PO q 24 hr
Slow effect
May cause hypotension
Need to monitor BP if use this drug

Neutraceuticals

- Co Enzyme Q10
- Omega 3 fish oils (Cardiguard)
- Taurine / L-Carnitine

Cardiac prescription diets

- Palatability?

Sodium restriction

Important to remember!

- Animals in acute CHF can be VERY unstable cases for diagnostics / GA
- Stress can cause further decompensation!
- May be best to wait until the patient is more clinically stable before taking radiographs, doing a full echocardiogram, ECG etc
- If cannot take a radiograph at presentation to confirm diagnosis of pulmonary oedema, if suspicion of CHF is high, treat presumptively and assess response to treatment closely.
    - Pulmonary oedema WILL respond to furosemide as long as dose is sufficient

- Start oral furosemide and other oral cardiac medications deemed necessary, when IV furosemide is stopped (i.e. when RR normal, <30/min)

- Patient can be sent home once CHF has resolved (emphasize to owner the importance of rest, minimal stress or excitement)
- Patient will go home on oral CHF medications (stress to owner the importance of dosing frequency)
- Provide pill boxes, pill splitters, comprehensive instructions to increase owner compliance
- Check renal values/electrolytes before send patient home
- Re-evaluate patient in 3-5 days time to assess response to therapy and repeat blood work

Tachyarrhythmias can complicate the management of canine CHF

- **Atrial tachycardia**
- **Atrial fibrillation**
- **Ventricular tachycardia**

Supraventricular tachyarrhythmias

E.g. atrial tachycardia and atrial fibrillation

- Aim is to slow conduction through the AV node, which will slow HR
    - Drug options:
        - **Diltiazem** (calcium channel blocker)
            - 0.5 – 2 mg/kg PO q 8 hr
        - **Atenolol** (beta blocker)
            - 0.2 – 1 mg/kg PO q 12-24 hr
        - **Digoxin**
            - < 22kg: 0.005 - 0.008 mg/kg q 12 hr
            - > 22 kg: 0.003 – 0.005 mg/kg q 12 hr *or* 0.22 mg/m^2 PO q 12 hr

Ventricular tachycardia

- Needs to be treated urgently is rapid and sustained as potentially life-threatening
- IV catheter placement
- IV bolus **Lignocaine**

2 mg/kg IV slow (up to total of 8 mg/kg i.e. 4 boluses)

- Followed by CRI of Lignocaine

25-80 mcg/kg/min

Then wean onto oral ventricular antiarrhythmics:

- Drug choices:

Sotalol (class III antiarrhythmic)
0.5 - 2 mg/kg PO q 12 hr
Mexiletine (class I antiarrhythmic)
4 - 8 mg/kg PO q 8 hr
Combination of sotalol & mexiletine
Or switch to mexiletine & atenolo