CEG FORMULARY:
Cardiac Medications for Dogs

CARDIAC EDUCATION group

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MEDICATION [Drug Class]	PREPARATIONS	TYPICAL DOSAGE	ADMINISTRATION NOTES & POTENTIAL ADVERSE EFFECTS
Amiodarone [antiarrhythmic]	For injection: Nexterone® (amiodarone without preservative) 150 mg (1.5 mg/ ml) or 360 mg (1.8 mg/ml) in premixed bags Tablets: 200, 400 mg	Parenteral: 2–5 mg/kg, IV infused over 30 to 60 minutes with careful BP and rhythm monitoring PO: 8–10 mg/kg, q12–24h for 7 to 10 days then reduce to 4–6 mg/kg, q24h chronically	• Do not use amiodarone preserved with polysorbate 80 intravenously due to risk of anaphylactoid reaction • Typically not the 1st line therapy • Long elimination half–life • Elevated liver enzymes/hepatotoxicity (common), monitoring recommended • Thyroid dysfunction, blood dyscrasia, proarrhythmia
Amlodipine* [arterial dilator]	Tablets: 2.5, 5, 10 mg	PO: 0.1–0.2 mg/kg, q12h or 0.2–0.4 mg/kg, q24h	• Up-titration of dose to desired BP effect • In resistant systemic hypertension, doses at the higher end of the dosage range are needed • In CHF, initial dosages should be at the lower end of the range • Hypotension, RAAS activation, gingival hyperplasia
Apixaban [factor Xa inhibitor - anti-thrombotic]	Tablets: 2.5 mg, 5 mg	PO: 0.25 to 0.5 mg/kg q8-12h	• Higher dosages are often used for the first 3 to 7 days for animals with active thrombosis, then lowered to a maintenance dosage for chronic preventative therapy
Atenolol* [beta–blocker]	Tablets: 25, 50, 100 mg	PO: 0.2–1.0 mg/kg, q12h	• Gradual up-titration required, especially in CHF or in DCM • Dogs without CHF can tolerate higher initial and target dosages • Gradual up-titration required, especially in CHF • Abrupt discontinuation should be avoided, gradual down-titration is recommended • Myocardial depression, bradycardia (sinus and AVB), hypotension
Atropine [anticholinergic]	For Injection: 0.05, 0.1, 0.4, 1.0 mg/ml as well as other concentrations (USP)	Parenteral (single) doses: 0.005 to 0.02 mg/kg, IV 0.02– 0.04 mg/kg, IM or SQ	• Intravenous administration can lead to (initial paradoxical) AVB • Sinus tachycardia, increased risk of ventricular ectopy • Drying of respiratory secretions, reduced GI motility

Benazepril* [ACEI]	Tablets: 5, 10, 20, 40 mg	PO: 0.25–0.5 mg/kg, q12–24h	• Generally start at lower range and increase to maximal dose with monitoring of renal function, serum potassium and BP • Contraindications: dehydration, hyponatremia • Hyperkalemia, azotemia, acute renal failure
Benazepril & Spironolactone (ACEI / aldosterone receptor blocker)	Chewable (Cardalis®) Tablets: 2.5/20, 40/5, 10/80 mg	PO: 0.25 mg/kg benazepril & 2 mg/kg spironolactone	• Dose using a suitable combination of whole and/or half tablets • All tablet strengths are scored and the calculated dosage according to dog's weight should be to the nearest half-tablet increment • Should be administered with food • Contraindications: dehydration, hyponatremia, hyperkalemia, azotemia, acute renal failure
Butorphanol [anxiolytic]	For injection: 2 mg/ml or 10 mg/ml concentrations Tablets: 1, 5, 10 mg	Parenteral: 0.1–0.5 mg/kg, IV/ IM/SC PO: 0.5–1.0 mg/kg, q4–6h	• Effects range from "antianxiety" to heavy sedation depending on dose • Usual dose for anxiolysis in acute heart failure is 0.1–0.2 mg/kg, IM; repeated in 30 to 60 minutes if needed
Capromorelin [appetite stimulant]	Oral solution (Entyce®): 30 mg/ml	PO: 3 mg/kg q24h	• Typically used as an appetite stimulant for dogs with advanced heart disease who develop hyporexia • Long-term use (beyond 4 days) has not been studied
L-Carnitine [amino acid]	Tablets/Capsules: 250, 500 mg	PO: 1000–3000 mg per dog q12h	• Do not substitute with racemic mixtures of L– and R–carnitine • See taurine (below)
Carvedilol* [beta–blocker, alpha– blocker]	Tablets: 3.125, 6.25, 12.5, 25 mg Quartering of tablets is difficult due to pill shapes	PO: 0.1–0.5 mg/kg, q12h for cardioprotection in dogs with myocardial failure (e.g., DCM) PO: 0.1–1.0 mg/kg, q12h for dogs with normal myocardial function	• Gradual up-titration required (weeks to months) • Beware: precipitation of CHF in dogs with advanced heart disease especially DCM • Dogs without CHF can tolerate higher initial and target dosages • Abrupt discontinuation should be avoided, gradual down-titration is recommended • Myocardial depression, bradycardia (sinus and AVB), hypotension
Digoxin [cardiac glycoside]	Tablets: 0.125, 0.25 mg tablets Elixirs: 0.05 mg/ml, 0.15 mg/ml	PO: 0.003–0.011 mg/kg, q12h Note: round the dose down to limit toxicity	• Initial dosages should be at the lower end of the dosing range • Elixir preparation may be better absorbed – use lower end of dosing range if elixir is used • Up–titrate based on measurement of serum digoxin levels • Target serum concentrations (8–12h post pill) to 0.8 to 1.2 ng/ml • Impaired renal function and hypothyroidism can slow elimination • Hypokalemia predisposes to toxicosis even at usual dosages • Inappetence, vomiting, diarrhea (common) • Bradyarrhythmias, premature complexes, tachyarrhythmias

Diltiazem [calcium channel blocker]	For injection: 5 mg/ml (in 5, 10 and 25 ml vials) Tablets: 30, 60, 90, 120 mg Sustained release capsules: 60, 120, 180, 240 mg including the Dilacor-XR® formulation (contains four, 60–mg tablets within a 240 mg capsule that is opened) Cardizem-CD®: 120, 180, 240 mg	Parenteral: 0.05–0.2 mg/kg, IV over 5 minutes; can repeat to cumulative dose of 0.3 mg/ kg (then reassess or begin oral therapy) PO: 2–8 mg/kg, total daily dose, divided q8h (regular diltiazem) or q12h (extended release)	• Cardizem CD® can be reformulated into lower- dose capsules • Monitor BP with IV administration • Initial therapy at the lower end of the dosage range • Up-titration of dose to control rhythm or heart rate • Dogs without CHF can tolerate higher initial and target dosages • Hypotension, myocardial depression, AVB
Dobutamine [positive inotrope]	For injection (by CRI): Dobutamine 12.5 mg/ml Must be diluted in 5% dextrose solution or saline solution	Parenteral: 2.5–15 µg/kg/min constant rate intravenous infusion (CRI)	• Do not bolus • Gradual up–titration to effect • Increase infusion rate based on a targeted systolic BP and clinical response (increased temperature, improved perfusion) • Tachycardia, premature complexes, tachyarrhythmias, seizures
Enalapril* [ACE–inhibitor]	Tablets: 2.5, 5, 10, 20 mg	PO: 0.25–0.5 mg/kg, q12h	• Generally start at lower range and increase to maximal dose with monitoring of renal function, serum potassium and BP • Contraindications: dehydration, hyponatremia • Hyperkalemia, azotemia, acute renal failure
Esmolol [beta–blocker]	For injection: 10 mg/ml, 20 mg/ml as vials or infusion bags	Parenteral: 0.05 to 0.2 mg/kg, IV (3-5 minute) bolus 0.025 to 0.1 mg/kg/min, IV-CRI	• Rapidly hydrolyzed, short-duration of action, sustained effect requires CRI • Monitor heart rate, ECG and BP during administration • Do not use in dogs with CHF • Dogs with normal ventricular function can tolerate higher dosages • Myocardial depression, bradycardia (sinus and AVB), hypotension
Flecainide [antiarrhythmic]	Tablets: 50, 100, 150 mg Capsule: 200 mg extended release (Tambocor®)	PO: 1–4 mg/kg, q8 to 12h	• Start at the lower end of the dosage range • Myocardial depression – use with caution in CHF • Proarrhythmia including polymorphic ventricular tachycardia

Furosemide* [loop diuretic]	Veterinary formulations (Salix®): Tablets: 12.5 and 50 mg Human formulations: Tablets: 20, 40, 80 mg 1% syrup (10 mg/ml)	Parenteral: 2–4 mg/kg, q1h–6h IV, IM,SC Dosing intervals depend on the response to therapy; initial boluses every 1 to 2 hours; thereafter q4 to 8 hours. Constant rate IV infusion: 0.25–1 mg/kg/hour PO: 1–6 mg/kg, q8–12h to a maximal total daily dosage of 12 mg/kg, daily	• CRI for treatment of life threatening pulmonary edema is tapered over 12–24h as pulmonary edema and clinical signs resolve • Typical initial PO dose in CHF is ≈ 2 mg/kg, q12h • Compounded liquids (from tablets) may be better-tolerated than the commercially available 1% (alcohol–based) syrups • Polydipsia, polyuria can exacerbate urinary incontinence • Azotemia, hypochloremia, hypokalemia, hypomagnesemia, hyponatremia, metabolic alkalosis are common side-effects
Hydralazine [arterial dilator]	Tablets: 10, 25, 50 mg	PO: 0.5–3 mg/kg, q12h	• Gradual up-titration to effect is required • Monitor BP carefully when used for acute afterload reduction • In dogs with CHF the first dose should be low (0.5 mg/kg, q12h) • In resistant systemic hypertension dosages at the higher range may be needed • If used for systemic hypertension, concurrent use of an ACEI is recommended • Anorexia, hypotension, reflex tachycardia, activation of the RAAS system, azotemia
Hydrochlorothiazide* [thiazide diuretic]	Tablets: 25, 50 mg	PO: 1–4 mg/kg, q12–24h	• In dogs receiving furosemide, start with a low dose, q24–48h, evaluate renal function & electrolytes before increasing dose • A small (≈25%) reduction in furosemide dosage may limit adverse effects when a hydrochlorothiazide is initiated in chronic CHF • Volume depletion, azotemia, acute renal failure, hypokalemia/hyponatremia/hypochloremia are very common
Hydrocodone with homatropine [cough suppressant]	Tablet: 5 mg hydrocodone (+1.5 mg homatropine per tablet) Syrup: 1 mg/ml concentration (5 mg hydrocodone + 1.5 mg homatropine per 5 ml)	PO: 0.25–1 mg/kg, q6–12h (or PRN)	• Schedule II drug with the potential for human abuse (homatropine added to reduce abuse potential) • Carefully monitor dispensing and prescribing • Start with low dose and titrate up • Sedation, GI upset, constipation
Hyoscyamine [oral anticholinergic]	Tablet (Levsin®): 0.125, 0.15, 0.25 mg	PO: 0.003-0.006 mg/kg, q8-12h	• Use for symptomatic sinus node dysfunction, atrio ventricular block • Palliative, should not be used in lieu of pacemaker placement if that option is available • Maybe be beneficial in reflex mediated or vaso-vagal syncope

Lidocaine [antiarrhythmic]	For injection: 2% lidocaine (20 mg/ml)	Parenteral: 2–4 mg/kg IV to a cumulative dose of 8 mg/kg, over 30 min CRI: 25–75 µg/kg/min	• Initial bolus is typically 2 mg/kg, administered over ≈ 1 minute • IV bolus effects are short-lived; repeated dosing or a CRI may be necessary to maintain rhythm control • Tremors, seizures, vomiting
Mexiletine [antiarrhythmic]	Capsule: 150, 200, 250 mg	PO: 4–6 mg/kg, q8h	• Administer at lowest effective dose • Administer with food • Anorexia, vomiting, tremors, idiosyncratic hepatotoxicity
Nitroglycerine ointment [vasodilator]	2% paste: 1 inch = 15 mg	Topical administration: 4–12 mg (up to 15 mg in giant breeds) q12h; remove after ≈6h to provide a "nitrate-free interval"	• Delivered dose affected by perfusion of the application area • Apply to hairless / well-perfused skin sites • Duration of administration typically 24 to 48 hours • Hypotension is possible
Nitroprusside sodium [vasodilator]	For injection (by CRI): 25 mg/ml Dilute in 5% dextrose solution and protect solution from light.	Parenteral: 1.25–10 µg/kg/ min IV, as a CRI (do not bolus!) with therapy usually limited to 24h duration.	• Do not bolus • Continuous monitoring of BP (ideally direct method) advised • In CHF target systolic BP is ≈ 90 mm Hg • Potential for cyanide toxicity with prolonged use (> 48 hrs) • Hypotension, reflex tachycardia, renal failure
Omega-3 Fatty Acids [nutraceuticals fish oil]	Docosahexaenoic acid (DHA) and Eicosapentaenoic acid (EPA) combined in a fixed-dose capsule (typically 1.5:1 or 2:1 EPA:DHA) Note: most commercial 1 gm (1000mg) omega 3 capsules contain 180 mg EPA & 120 mg DHA; EPA and DHA are also available as separate capsules.	PO: EPA 40 mg/kg, daily dosage PO: DHA 25 mg/kg, daily dosage PO: combination formulation = 1gm (1000mg) capsule per 5kg body weight, q24 hr	• Gelcaps or soft pills with 180 mg EPA and 120 mg DHA are often appropriately sized for dogs • Avoid products with Vitamin A or D (Vitamin E is a safe additive) • Some dogs do not tolerate / will not ingest fish oils • Gastrointestinal
Pimobendan [inodilator]	Chewable (Vetmedin®) tablets: 1.25, 2.5, 5, 10 mg Capsules (available in some countries outside of USA): 1.25, 2.5, 5 mg	PO: 0.25–0.3 mg/kg, q12h Frequency may be increased to 0.25–0.3 mg/kg, q8h in Stage D CHF	• Do not reformulate into a suspension • Initial dose should be given on an empty stomach if a rapid onset of action is desired • Some dogs do not readily accept the chewable tablet • Potential idiosyncratic side effects (none consistently reported)
Procainamide [antiarrhythmic]	For injection: 100 mg/ml, 500 mg/ml Tablets and capsules (regular and sustained-release) are currently unavailable in US	Parenteral: 2 mg/kg, slow IV bolus, to a maximum cumulative dose of 25 mg/kg 25–40 µg/kg/min CRI 10–20 mg/kg, q4–6h, IM/SQ PO: 4-6 mg/kg q 2-4h (regular) PO: 10–20 mg/kg, q 8 h (sustained release)	• IV bolus: give 2mg/kg, over 2-3 minutes to 25 mg/kg • After 8–10 mg/kg, careful monitoring of BP is advised • If bolus therapy effective, can continue as IV-CRI, IM, or SQ • Myocardial depression, vasodilation, hypotension • Proarrhythmia, prolongation of QRS duration & Q–T interval, conduction blocks including AVB • Alteration of hair coat color (chronic)

Rivaroxaban [factor Xa inhibitor - anti-thrombotic]	Tablets: 2.5, 10, 15, 20 mg	PO: 1-2 mg/kg q12h	• Higher dosages are often used for the first 3 to 7 days for animals with active thrombosis, then lowered to a maintenance dosage for chronic preventative therapy
Sildenafil* [PDE–V inhibitor]	Tablets: 80, 120, 160, 240 mg	PO: 1–3 mg/kg, q12h	• Use with caution and at the lower end of dosage range in CHF or DCM or when combined with mexiletine • Dogs without myocardial failure can tolerate higher initial and target doses • Do not combine with other beta–blockers • Myocardial depression, bradyarrhythmia (sinus and AV block), proarrhythmia
Sotalol* [antiarrhythmic & beta–blocker]	Tablets: 80, 120, 160, 240 mg	PO: 1–3 mg/kg, q12h	• Use with caution and at the lower end of dosage range in CHF or DCM or when combined with mexiletine • Dogs without myocardial failure can tolerate higher initial and target doses • Do not combine with other beta–blockers • Myocardial depression, bradyarrhythmia (sinus and AV block), proarrhythmia
Spironolactone* [aldosterone receptor blocker, K+ sparing diuretic]	Tablets: 25, 50, 100 mg	PO: 1–2 mg/kg, q12h or 2 mg/ kg, q24h	• Negligible to weak diuretic effect; administered for cardioprotective/anti–fibrotic effects • Higher dosages sometimes used for right-sided CHF • Hyperkalemia may be exacerbated by cotherapy with an ACEI inhibitor or telmisartan
Taurine [amino acid]	Tablets/Caplets/Capsules: 250, 500, 1000 mg Powders of various strengths	PO: Small dog: 250–500 mg, q12h Medium-sized dog: 500 mg, q12h Large breed dog: 500–1000 mg, q12h	• Empirical therapy can be administered in suspected deficiency • Deficiency can be confirmed by measuring whole blood/plasma concentrations • Often co-administered with L-carnitine in cases of deficient protein intake (e.g., vegan diet) and DCM in non-traditional breeds and cocker spaniels
Telmisartan [ARB]	Oral suspension: 10 mg/ mL† Tablets: 20, 40, 80 mg	PO: 1-2 mg/kg q24h	• Generally start at lower range and increase to maximal dose with monitoring of renal function and serum potassium and BP • Contraindications: dehydration, hyponatremia • Hyperkalemia, azotemia, acute renal failure • Caution with concurrent use of ACE-inhibitor
Theophylline [bronchodilator]	Sustained release Tablets/ Capsules: 100, 200, 300, 450 mg	PO: 10 mg/kg, q12h	• Starting at lower dosages and up-titrating may limit side effects • Serum concentrations can be measured in human laboratories • Anxiety, hyperactivity, tremors, gastrointestinal signs, tachycardia, polyuria

Torsemide [loop diuretic]	Tablets: 5, 10, 20 mg	PO: 0.1–0.4 mg/kg, q12–24h	• Potent diuretic, generally given instead of furosemide after furosemide resistance (e.g., >8 mg/kg/day) occurs • At dosages less than 0.2 mg/kg/day, torsemide appears to be 10x as potent as furosemide on a mg/kg basis, though is up to 20x as potent at dosages of 0.4 mg/kg/day • As first-line therapy, dosage is 0.13 to 0.25 mg/kg/ day for mild pulmonary edema; temporary high dosage course of 0.26 to 0.4 mg/kg/day can be given for the first 5 days in cases with severe edema, then dosage is reduced to maintenance at 0.13 to 0.25 mg/kg/day • Evaluate renal function and serum electrolytes within a week of initiating torsemide or increasing the dosage • Hypochloremia, hypokalemia, hypomagnesemia, hyponatremia, azotemia, renal failure
Trazodone [anxiolytic]	Tablets: 50, 100, 150 mg	PO: 3 to 10 mg/kg q12h Starting doses: <10kg: 7 mg/kg 10-25kg: 5 mg/kg >25kg: 3 mg/kg	• Smaller dogs may require higher dosage than larger dogs, see suggested starting dosages • Can be administered 1 hour prior to clinic visit to reduce anxiety or scheduled for in-hospital sedation • Use caution if given concurrently with medications that prolong the QT interval (e.g., sotalol, amiodarone)

Note

This is a CANINE formulary only; typical dosage ranges are shown; clinicians should be familiar with the pharmacology, indications, contraindications, monitoring and toxicity of any drug prescribed. When wide dosage ranges are shown, the clinician should understand potential needs for up-titration of doses as well as potential for cardiac depression and hypotension in dogs with heart failure or impaired ventricular function.

When proprietary names are not indicated, there are usually generic equivalents available.

*These drugs are generally available as a suspension or solution from a compounding pharmacy. Consult with a registered pharmacist regarding stability and storage.

Drugs not associated with an asterisk should not be reformulated or reconstituted without consultation with a registered pharmacist.

†This is a veterinary formulation labeled for use in another species.

With the (possible) exception of nitroglycerine ointment, cardiac medications are ineffective when administered topically.

Abbreviations used in this table:

ACEI = angiotensin-converting enzyme inhibitor
ARB = angiotensin receptor blocker
AVB = atrioventricular block BP = blood pressure
CHF = congestive heart failure
CRI = constant rate infusion (intravenous)
DCM = dilated cardiomyopathy
IM = intramuscularly IV = intravenously
PDE-V = phosphodiesterase V
PO = per os (by mouth)
q_h = every hours
RAAS = renin-angiotensin-aldosterone system
SQ = subcutaneously