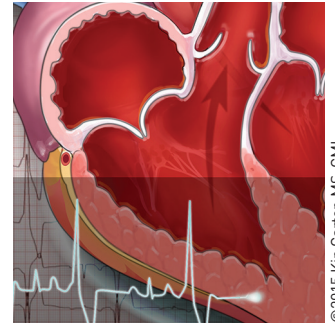




# Which Drugs Treat Ventricular Arrhythmias in Dogs & Cats?

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**Profile** → Most antiarrhythmic agents exert effects on normal myocardium to some extent and may have intrinsic arrhythmogenic (proarrhythmic) properties.<sup>1</sup> In general, the author uses antiarrhythmic drugs to manage life-threatening arrhythmias and minimize risk for sudden cardiac arrest.

**Antiarrhythmic classes** → Classified by function

- Class I: Na channel blockers
- Class II:  $\beta$ -blocker
- Class III: K channel blockers
- Class IV: Ca channel blockers

**Basis for objective** → Control acute life-threatening arrhythmias

- These arrhythmias may be hemodynamically compromising and are likely to degenerate into fatal arrhythmias.

**Basis for objective** → Lower risk for sudden cardiac arrest or death

- Prophylactic administration of antiarrhythmic agents to patients at increased risk for cardiac arrest or death may lower that risk.

**Achieving objectives** → Use of different antiarrhythmics can achieve both objectives, although some may be contraindicated in certain situations.

- It is important to
  - Understand the mechanism of action of antiarrhythmics
  - Ultimately appreciate the electrophysiology of arrhythmias to select a drug that will most likely abolish, suppress, or prevent an arrhythmia

**Clinical necessity** → Drug selection should be based on clinical necessity, as all antiarrhythmic agents are potentially proarrhythmic.

- Antiarrhythmic agents
  - Alter the properties of myocardium and specialized conduction tissue, suppressing abnormal electrical activity therein
  - Affect normal myocardial and conduction tissue to some extent
    - Antiarrhythmic agents may have intrinsic arrhythmogenic (proarrhythmic) potential.

## Procainamide

Procainamide is a fast sodium channel blocker that affects the QRS complex.

**Formulation** → IV only

**Dose (dogs)** → 5–15 mg/kg over 1 min<sup>2-4</sup>

- If effective in controlling the rhythm, establish 20–50 µg/kg/min CRI.<sup>2-4</sup>

**Dose (cats)** → 1–2 mg/kg slowly over 20 min<sup>2-4</sup>

### Key Points

- Procainamide effectively suppresses ventricular tachyarrhythmias via enhanced automaticity and reentry.<sup>1</sup>
  - The author uses procainamide only if other antiarrhythmics (eg, lidocaine [acutely], sotalol [chronically]) are ineffective.
- Has some autonomic effects and can enhance sympathetic tone
  - At therapeutic doses, vagolytic effects seen with other class I agents are negligible.<sup>1</sup>
- Contraindicated in patients with bradyarrhythmia
- In humans with chronic procainamide administration, systemic lupus erythematosus is an important side effect.<sup>5</sup>
  - Not documented in domestic animals, although changes in hair coat color with lupus-like dermatologic changes, along with thrombocytopenia, neutropenia, and pancytopenia, have been anecdotally reported.<sup>2-4</sup>

## Class Ia Antiarrhythmic

## Lidocaine

As a class 1b antiarrhythmic agent, lidocaine has no effect on the QRS complex.

**Formulation** → IV only

- Oral administration not effective because lidocaine rapidly and completely metabolized by the liver on first pass

**Dose (dogs)** → Initiate therapy with bolus of 2 mg/kg IV.<sup>2-4</sup>

- Can repeat up to 3 times in 10 minutes to control rate and malignancy of ventricular rhythm, but full eradication of ventricular arrhythmia should not be expected

## Class Ib Antiarrhythmics



**Class Ib  
Antiarrhythmics**  
*(continued)*

**Mexiletine has been shown to effectively suppress ventricular arrhythmias in dogs,<sup>8,9</sup> but its effects on survival are unknown.**

- If rhythm improves, establish 30–75 µg/kg/min CRI.  
—Titrate infusion to maintain rhythm control.

**Dose (cats)** → Slow bolus of 0.25–0.5 mg/kg, followed by 10–25 µg/kg/min CRI if effective in controlling rhythm<sup>2-4</sup>

- Definitive IV antiarrhythmic agents rarely needed in cats (see **Cautions** below for contraindications)  
—Oral products (eg, sotalol) usually sufficient

**Key Points**

- Lidocaine is considered the drug of choice for controlling all types of acute ventricular tachyarrhythmias, but especially those resulting from ischemic myopathy.<sup>1-4</sup>
- Clinical application  
—Can be used in patients with dangerous and sustained ventricular dysrhythmias causing hemodynamic compromise<sup>1-4</sup>
- Because lidocaine does not depress contractility or produce vasodilation, can be safely used in patients with congestive heart failure (CHF)<sup>2-4</sup>
- Effectiveness depends on extracellular potassium concentrations.  
—Low concentrations antagonize depressant actions.  
—High concentrations increase conduction velocity depression, membrane responsiveness, and automaticity.
- **Cautions**  
—Contraindicated in patients with bradyarrhythmias because can suppress subsidiary pacemaker cells<sup>1</sup>  
—Severe adverse events uncommon
  - Nausea and inappetence not uncommon
  - GI side effects most noticeable
    - More common in cats, so dose should be carefully calculated and side effects carefully monitored
  - CNS excitability can occur in both dogs and cats, resulting in seizures.
    - Cats very sensitive to CNS effects
    - Diazepam can be used if lidocaine toxicity suspected<sup>6</sup>

**Mexiletine**

Mexiletine is used *in dogs only*. Like lidocaine, it has no effect on the QRS complex.<sup>7</sup>

The author uses mexiletine when other antiarrhythmic medications (eg, sotalol) might be contraindicated because of systolic dysfunction or myocardial failure (eg, Doberman pinscher with dilated cardiomyopathy and ventricular arrhythmias, boxer with severe myocardial dysfunction and ventricular arrhythmias).

**Formulation** → Oral

**Dose (dogs)** → 4–8 mg/kg PO q8h<sup>2-4</sup>

- Effective after oral administration and slowly metabolized by liver, resulting in elimination half-life of 5–7 hours

**Key Points**

- Mexiletine has electrophysiologic, hemodynamic, and toxic properties almost identical to those of lidocaine.
- Shown to effectively suppress ventricular arrhythmias in dogs,<sup>8,9</sup> but effects on survival unknown
- To increase efficacy, commonly combined with atenolol<sup>9</sup>
- May cause anorexia, diarrhea, or other GI disturbances

**Atenolol** ←

Atenolol is a cardioselective  $\beta$ -adrenergic blocker, also categorized as a  $\beta_1$ -receptor antagonist.

**Formulation** → Oral

**Dose (dogs)** → 0.2–2 mg/kg q12–24h<sup>2-4</sup>

**Dose (cats)** → 6.25–12.5 mg total dose per cat q12–24h<sup>2-4</sup>

- Can be formulated into suspension

**Key Points**

- Because of apparent lack of efficacy, generally not used as monotherapy for ventricular arrhythmias in dogs but commonly used in combination with other antiarrhythmic agents (eg, mexiletine)<sup>9</sup>
- Can be used in cats with less severe ventricular arrhythmias<sup>2-4</sup>
  - If good antiarrhythmic control of the ventricular rhythm difficult to maintain, select more effective ventricular antiarrhythmic agent (eg, sotalol).
- **Cautions**
  - Although atenolol does not block all  $\beta$ -receptors, it has significant  $\beta$ -blocking effects and should therefore be used with caution.
    - Slowly titrate in patients with significant ventricular systolic dysfunction.<sup>2-4</sup>
  - Should not be combined with another  $\beta$ -blocker
  - Should be used carefully in conjunction with other drugs that block atrioventricular node (eg, calcium channel blockers)

**Sotalol** ←

Sotalol blocks potassium channels and increases the effective refractory period of myocardial cells by prolonging repolarization.

**Class II  
Antiarrhythmic**

**Class III  
Antiarrhythmics**

CHF = congestive heart failure



**Class III** → **Antiarrhythmics**  
(continued)

**Sotalol is useful in suppressing sustained refractory ventricular tachycardias in cats with arrhythmogenic right ventricular cardiomyopathy.**

**Formulation** → Oral

**Dose (dogs)** → 1–3 mg/kg q12h<sup>2-4</sup>

**Dose (cats)** → 1–3 mg/kg q12h<sup>2-4</sup>

- Can be reconstituted into liquid formulation

**Key Points**

- Clinical applications
  - Author initiates sotalol therapy when dangerous ventricular rhythm identified but hemodynamic compromise not present
  - In author's experience, therapy also indicated in at-risk breeds (eg, boxer) with single monomorphic ventricular premature complexes and history of possible cardiovascular collapse
- Sotalol also exhibits potent nonselective class II activity (adrenergic antagonist).
- Especially useful in reducing frequency and malignant characteristics/grade of ventricular arrhythmias and syncopal events in boxers with arrhythmogenic right ventricular cardiomyopathy
  - Impact on long-term survival in boxers with this disease remains unknown.<sup>10</sup>
- Useful in suppressing sustained refractory ventricular tachycardias in cats with arrhythmogenic right ventricular cardiomyopathy
- **Cautions**
  - Although not pure  $\beta$ -adrenergic blocker, has significant  $\beta$ -blocking effects
    - Use with caution and slowly titrate in patients with significant ventricular systolic dysfunction.<sup>2-4</sup>
    - Most side effects attributed to drug's  $\beta$ -blocking properties

**Amiodarone**

Amiodarone, an agent used *in dogs only*, prolongs action potential and increases effective refractory period of cardiac tissue by blocking potassium channels and slowing repolarization.

**Formulation** → Oral

**Dose (dogs only)** → 10–20 mg/kg PO q24h for 7–10 days, then reduced to 3–15 mg/kg PO q24–48h<sup>2-4</sup>

- Use low end of dose range first; slowly titrate only if necessary.
  - Because of potential side effects, use lowest dose possible.

**Key Points**

- For ventricular arrhythmias refractory to aforementioned antiarrhythmic agents, amiodarone is typically initiated in lieu of, or carefully in addition to, other antiarrhythmic agents.

- Antiarrhythmic profile superior to other antiarrhythmic agents
- In both humans<sup>11-13</sup> and dogs,<sup>14,15</sup> toxicity and adverse reactions to long-term administration are common.
- Blocks fast sodium channels (class I effect), noncompetitively blocks  $\alpha$ - and  $\beta$ -adrenergic receptors (class II effect), and blocks slow calcium channels (class IV effect)
- Efficacy generally thought to exceed that of other antiarrhythmic compounds; however, with chronic use side effects are significant and/or severe.<sup>11</sup>
  - May cause anorexia from elevated liver enzymes
    - Liver enzymes should be evaluated before starting, periodically while administering amiodarone, and if anorexia develops.
  - May cause neutropenia of unknown clinical significance, neurologic signs, and/or ataxia, especially at higher doses and with prolonged use<sup>11</sup>
- Can be combined with  $\beta$ -adrenergic blocker
- Does not appear to have significant negative inotropic effects
  - Safe to use in patients with ventricular myocardial dysfunction<sup>11</sup>

**Amiodarone is safe to use in patients with ventricular myocardial dysfunction.**

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