Arrhythmias

Arrhythmia	Mechanism for Generation	Intervention	Effective drugs
Inappropriate sinus tachycardia	Enhanced normal automaticity	Decrease phase 4 depolarization	ß-blockers, digitalis
Ectopic atrial tachycardia	Abnormal automaticity	Maximum diastolic potential or phase 4 depolarization	Digitalis, class I (not lidocaine), class IV
Accelerated idioventricular rhythm	Abnormal automaticity	Maximum diastolic potential or phase 4 depolarization	Usually don't treat; lidocaine, other class I agents, possibly class IV
Ventricular tachycardia in German shepherds	Early afterdepolarizations (EADs)	Arrhythmias occur at slow heart rate	ß-Agonists or atropine (increase sinus rate)
Digitalis-induced arrhythmias	Delayed afterdepolarizations (DADs)	Suppress DADs or decrease calcium overload	Lidocaine or phenytoin, possibly class IV (verapamil)
Supraventricular tachycardia resulting from pre-excitation	Reentry (long or short excitable gap or calcium channel-dependent)	Prolong the refractory period or depress calcium channel-dependent conduction	Class I except Ib, class III, class IV, digitalis
Primary (slow) atrial fibrillation	Reentry (short excitable gap)	Prolong refractory period of atrial myocardium	Quinidine, class III
Secondary (fast) atrial fibrillation	Reentry with AV block	Prolong refractory period of AV node to slow ventricular rate	Digitalis, ß-adrenergic blockers, diltiazem
Sustained monomorphic ventricular tachycardia	Reentry (long excitable gap)	Depress conduction and excitability to suppress; prolong refractory period to prevent ventricular fibrillation	Mexiletine, class III, lidocaine for short-term suppression
Nonsustained polymorphic ventricular tachycardia	Reentry (short excitable gap)	Prolong refractory period to suppress and prevent ventricular fibrillation	Class III, possibly mexiletine, lidocaine for short-term suppression
Ventricular fibrillation	Reentry (short excitable gap)	Prolong refractory period to prevent fibrillation	Class III
Ventricular premature contractions	Reentry	Prolong refractory period to prevent fibrillation if >30 per minute, or multiform and if primary cause can not be eliminated	Class III, possibly mexiletine, lidocaine for short-term suppression
AV nodal reentrant (most supraventricular) tachycardias	Reentry (calcium channel dependent)	Depress conduction and excitability	Class IV, class II, digitalis

Common Antiarrhythmic Drugs

Drug (trade name)	Class	Species	Route	Dose
ß-Adrenergic blockers				
Atenolol (Tenormin)	II	Dog	PO	6.25-50 mg q12h (total dose; start low; titrate)
Atenolol (Tenormin)	II	Cat	PO	6.25-12.5 mg q12-24h (total dose; start low; titrate)
Esmolol (Brevibloc)	II	Both	IV	0.25-0.5 mg/kg (slow bolus) 10-200 µg/kg/min infusion
Propranolol (Inderal)	II	Dog	PO	0.1-2.0 mg/kg q8h (start low and titrate to effect in atrial fibrillation; higher doses used for other arrhythmias)
Propranolol (Inderal)	II	Cat	PO	2.5-10 mg (total dose; start low; titrate)
Propranolol (Inderal)	II	Both	IV	0.01-0.1 mg/kg (start low; titrate to effect for supraventricular arrhythmias)
Sotalol (Betapace)	II, III	Dog	PO	1-3 mg/kg q12h
Calcium channel blockers				
Diltiazem (Cardizem)	IV	Dog	PO	0.5-1.5 mg/kg q8h (start low; titrate to effect for A-fib)
Diltiazem (Cardizem)	IV	Dog	PO	0.5-3 mg/kg (start low; titrate to effect for SVT)
Diltiazem (Cardizem)	IV	Dog	IV	0.05-0.25 mg/kg (initial 0.05 mg/kg dose over 2-3 min; repeat every 5 min up to cumulative dose of 0.25 mg/kg)
Diltiazem (Cardizem)	IV	Cat	PO	7.5-15 mg q8h (total dose)
Verapamil (many)	IV	Dog	IV	0.05-0.25 mg/kg (initial 0.05 mg/kg dose over 2-3 min; repeat every 5 min up to cumulative dose of 0.15 mg/kg)
Positive chronotropes, for bradycardia				
Atropine (many)		Both	IV, SC	0.02-0.04 mg/kg
Glycopyrolate (Robinul)		Both	IV, SC	0.005-0.01 mg/kg
Isoproterenol (many)		Both	IV	0.01-0.1 µg/kg/min CRI (alternatively, 1 mg in 500 mL D5W or LRS and infuse to effect)
Terbutaline (Brethine, Bricanyl)		Dog	PO	2.5-10 mg (total dose; start low; titrate)
Ventricular antiarrhythmics				
Amiodarone (Cordarone)	III	Dog	PO	Loading dose: 10-30 mg/kg q24h for 7-10 days; maintenance dose: 5-15 mg/kg q24h
Lidocaine (Xylocaine)	Ib	Dog	IV	Loading dose: 2-4 mg/kg slow bolus over 1 to 3 minutes maintenance dose: 40-100 µg/kg/min
Mexiletine (Mexitil)	Ib	Dog	PO	5-10 mg/kg q8h
Phenytoin (Dilantin)	Ib	Dog	PO	20-35 mg/kg q8h
Procainamide (Pronestyl; -SR)	Ia	Dog	PO	10-30 mg/kg q6-8h
Procainamide (Pronestyl)	Ia	Dog	IV, IM	5-20 mg/kg (administer slowly; start low; titrate)
Quinidine (many)	Ia	Dog	PO, IM	6-16 mg/kg q6-8h
Sotalol (Betapace)	II, III	Dog	PO	1-3 mg/kg q12h
Tocainide	Ib	Dog	PO	10-15 mg/kg q8h

Arrhythmia characteristics

Rhythm	P wave rate (bpm)	P wave rhythm	P wave configuration	QRS complex rate	QRS complex rhythm	QRS configuration	P-QRS relationship
Sinus	Normal	Regular	Normal	Same as *P*	Regular	Normal	1:1
Sinus bradycardia	<Normal	Regular	Normal	Same as *P*	Regular	Normal	1:1
Sinus tachycardia	>Normal	Regular	Normal	Same as *P*	Regular	Normal	1:1
Sinus arrhythmia	Normal	Regularly Irregular	Normal or wandering	Same as *P*	Irregular	Normal	1:1
Accelerated idioventricular rhythm	Normal	Regular	Normal (often buried in QRS)	70-150	Fairly regular; may be irregular	Wide	Dissociated; more QRSs than Ps
Atrial flutter	>350	Regular	Positive (sawtooth)	Less than *P* wave rate	Regular or irregular	Normal	More Ps than QRSs
Atrial fibrillation	>500	Irregularly Irregular	None to baseline undulation (f waves)	Less than *P* wave rate (100-280)	Irregular	Normal	No *P* waves; more undulations than QRSs
Atrial standstill	absent	absent	absent	Escape rate	regular	Normal if AV node escape	No P waves
Hyperkalemia	Normal if present	regular or absent	Tall and spiked if present, may be absent	70-150	Fairly regular; may be irregular	Wide	No or missing P waves
Left Bundle Branch Block	normal	regular	normal	normal	normal	Wide, tall R	1:1
Pre-excitation re-entry	>200	Regular	Short PR interval	>200	regular	Slurring of R wave (up)	1:1
Right Bundle Branch Block	normal	regular	normal	normal	regular	Wide, deep S wave	1:1
SA block	<normal	Regularly Irregular (skipped P waves multiple of PP interval)	Normal when present	Less than *P* wave rate (no QRS when P is skipped)	Regularly Irregular	Normal	More QRS than P
Second-degree AV block	Normal	Regular	Normal	<*P* wave rate	Irregular	Normal or wide	More Ps than QRSs
Sick Sinus Syndrome	Periods <normal, periods >normal	Grossly Irregular	normal	Variable from asystole to tachycardia	Grossly Irregular	normal	1:1 most of the time, may be escape rythms
Sinus arrest	absent	absent	absent	absent	absent	absent	Followed by escape beat, or death

Rhythm	P wave rate (bpm)	P wave rhythm	P wave configuration	QRS complex rate	QRS complex rhythm	QRS configuration	P-QRS relationship
Supraventricular tachycardia	>Normal	Regular	Positive, negative, absent, or buried	Same as *P*	Regular	Normal	1:1
Third-degree AV block	Normal	Regular	Normal	20-60	Regular	Normal or wide	Dissociated; more Ps than QRSs; irregular P-R interval
Ventricular fibrillation	Normal	Regular	Not discernible	>400	Grossly Irregular	No QRS complexes	Dissociated; no QRSs
Ventricular flutter	Normal	Regular	Not discernible	>350	Regular	Sine wave	Dissociated; more QRSs than Ps
Ventricular Premature Contractions	absent	absent	absent	variable	variable	Wide and bizarre. Deep S wave then upright T wave from RV; tall R wave then inverted T wave from LV.	Dissociated; onset prior to normal P wave; followed by compensatory pause.
Ventricular tachycardia	Normal	Regular	Normal (often buried in QRS)	150-350	Regular or Irregular	Wide	Dissociated; more QRSs than Ps

The Lown grading system for ventricular arrhythmias

Grade	*Criteria*
0	No VPCs
1	<30 VPCs/hr
2	>30 VPCs/hr
3	VPCs with more than one configuration (multiform)
4A	Two consecutive VPCs (pair or couplet)
4B	Three or more consecutive VPCs (ventricular tachycardia)
5	R on T (fast rate)