Providing the best quality care and service for the patient, the client, and the referring veterinarian.
Overview

- Electrical and mechanical coupled heart
- Treatment of common arrhythmias
  - Supraventricular – SVT, AF
  - Ventricular – VPCs, VT
- Advanced treatment of arrhythmias:
  - Pacemaker implantation
  - Implantable cardioverter defibrillator placement
  - Electrical cardioversion of atrial fibrillation
  - Electrophysiological mapping/ablation therapy
It’s all about ATP, lytes and sympathetic tone

- Coupled electrical and mechanical activity of heart
- Effective drugs & side effects
- Importance of blood work
Supraventricular tachycardia (SVT) treatment depends upon…

● Cause
  – Myocardial disease
  – Systemic disease

● Clinical signs
  – Duration dependent
  – Rate dependent
    ● Slow SVT
    ● Fast SVT 250 - 300 bpm
      – Weakness, collapse
      – Poor perfusion
Maneuvers & drugs of acute SVT

- If weakness/collapse → MEDICAL EMERGENCY!!

- Acute therapy:
  - Physical maneuvers (vagal or thump)
  - Drugs = BCP
    - B = Beta blockers
    - C = Calcium channel blockers
    - P = Procainamide
Physical maneuvers

- Vagal maneuvers
  - Slow conduction through AV node (break re-entry) or slow ventricular response rate
  - Ocular pressure
    - Controlled digital pressure to both globes
  - Carotid sinus massage
    - Gentle, sustained digital pressure to one or both carotid sinus (caudal to dorsal aspect of the larynx)

- Precordial thump – induce a VPC
  - 5 J shock to myocardium
Drugs – acute SVT therapy

- Slow conduction through AV node (break re-entry) or slow ventricular response rate (atrial tachycardia)

- **Beta blockers**
  - Esmolol: 0.05 - 0.1 mg/kg IV boluses every 5 minutes up to max dose of 0.5 mg/kg; then CRI (10 - 200 µg/kg/min) (**short acting**)
  - Propanolol: 0.02 mg/kg IV slowly (**longer acting**)

- **Calcium channel blockers**
  - Diltiazem: 0.05 - 0.15 mg/kg IV over 5 - 10 minutes up to max dose of 0.3 mg/kg; then CRI (0.12 - 0.24 mg/kg/h)

*All doses are canine only unless indicated otherwise*
Drugs – acute SVT therapy

- To convert focal atrial tachycardia and some re-entrant SVT

- **Lidocaine**
  - IV boluses of 1 - 2 mg/kg (up to 6 - 8 mg/kg total)

- **Procainamide**
  - IV boluses of 2 - 5 mg/kg up to 20 mg/kg total; each dose over 5 minutes

- **Sotalol**
  - 1 - 2 mg/kg PO q 12 h

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Chronic management = BCDs

- **B OR C** with **D** for AV nodal dependent SVT
- **Beta blockers**
  - Atenolol: 0.25 - 1 mg/kg PO q 12 - 24 h
  - TITRATION – when in doubt, start low
  - Caution with myocardial failure
- **Calcium channel blockers**
  - Diltiazem: 0.5 - 2 mg/kg PO q 8 h
  - Diltiazem ER (Dilacor): 2 - 3 mg/kg PO q 12 h
- **Digoxin**: Increases vagal tone, weak positive inotrope
  - Dose: 0.0045 - 0.005 mg/kg PO q 12 h

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Other chronic management

- Conversion of focal atrial tachycardias (non-reentrant)
  - Class III anti-arrhythmics
    - Sotalol: 1 - 2 mg/kg PO q 12 h
  - Class I anti-arrhythmics
    - Procainamide, quinidine
- Or slow ventricular response rate with BCDs
  - B OR C with D

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Atrial fibrillation (AF)

- BCDs
- Preference:
  - Diltiazem ER: 2 - 3 mg/kg PO q 12 h
  - Digoxin: 0.0045 mg/kg PO q 12 h
- Holter monitor
- Lone AF, AF 2nd to vagal/sympathetic tone

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Ventricular ectopy

- VPCs vs. ventricular tachycardia (VT)
  - Treatment same as VT if needed
- Underlying cardiac disease
  - Holter monitor, echocardiogram
  - Breeds – Boxers, Dobermans, GSD
  - Disease – ARVC, DCM, SAS, inherited VT
- Accelerated idioventricular rhythm
VT – when to treat

- Hemodynamic compromise
  - Cardiac disease
  - Poor pulse quality, weak, hypotensive

- Risk of degenerating into ventricular fibrillation
  - Cardiac disease – ARVC, DCM, SAS
  - Faster rates
  - Polymorphic > monomorphic
  - Repetitive forms > single forms
Acute therapy of VT

- Lidocaine
  - IV bolus of 1 - 2 mg/kg (up to 6 - 8 mg/kg total); then CRI (25 - 80 mcg/kg/min)
  - Positive response = rate slowed or abolished
  - Toxicity – neurologic; cats > dogs
  - May not be effective if:
    - Hypokalemia
    - Incorrect diagnosis (actual rhythm is SVT)
    - Slower rates

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Acute therapy of VT

- **Procainamide**
  - IV boluses of 2 - 5 mg/kg (up to 20 mg/kg total); each dose over 3 - 5 minutes
  - CRI dose 10 - 50 mcg/kg/min
  - Side effects – neurologic, esp. if lidocaine prior
  - SVT and VT

- **Magnesium**

- **Amiodarone**

- **Anesthesia and cardioversion**

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Chronic therapy

- **Sotalol**
  - 1 - 2 mg/kg PO q 12 h
  - Boxers with ARVC
  - Some beta blocking properties

- **Mexiletine**
  - 3 - 8 mg/kg PO q 8 h
  - Give with FOOD (GIT upset)

- **(Atenolol)**
  - Mildly effective, used in combination
  - Negative inotrope

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Advanced arrhythmia management
Pacemaker implantation

**Indications:**
- Sick Sinus Syndrome
- AV block (2\textsuperscript{nd} and 3\textsuperscript{rd} degree)
  - Risk of sudden death
  - Right sided CHF
- Atrial standstill

**Dual chamber, biventricular**

**Advanced programming**
Temporary pacemaker
Permanent lead implantation
Confirming final placement
Post procedure radiographs
ECG post pacemaker implant – atrial sensing lead
Follow up and long term care

- One month recheck, 6 - 12 months
- Jugular venipuncture CONTRAINDICATED
- Cautery – interference
- Surgery – antibiotics, heart rate setting
- Risk of infection
  - Management of endocrine diseases
  - Dog fight wounds, dental procedures, pyoderma
Implantable cardioverter defibrillators (ICDs)

- Pacemaker with ability to shock/capture myocardium
- Indications:
  - Treatment of malignant ventricular arrhythmias not controlled with medication
  - Risk of sudden death
- Combination therapy
Mortality reduction

Reductions in Mortality with ICDs Compared to Antiarrhythmic Drugs

- AVID\(^1\): 31% reduction (3 years)
- CASH\(^2\): 39% reduction (2 years)
- CIDS\(^3\): 20% reduction (3 years)
- MADIT\(^4\): 54% reduction (2 years)

\(^3\) Connoly SJ. Circulation. 2000;101:1297-1302.
ICDs in dogs

- Research dogs
- Clinical patients


(DFT = defibrillation threshold)
Electrical conversion of atrial fibrillation (AF)

- Indications:
  - Spontaneous or vagally mediated AF
  - Minimal to no structural disease
- Interrupt re-entry
- General anesthesia
- Medical management
- Lidocaine
Mapping and ablation therapy of tachyarrhythmias

- SVT
  - Reentrant circuits (accessory pathways)
  - Atrial fibrillation
  - Focal atrial tachycardia
- VT

Anatomic distribution and electrophysiologic properties of accessory atrioventricular pathways in dogs

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Electrophysiologic Characteristics and Topographic Distribution of Focal Atrial Tachycardias in Dogs

R.A. Santilli, M. Perego, A. Perini, P. Moretti, and G. Spadacini