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Practical Approach to Arrhythmias

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2019

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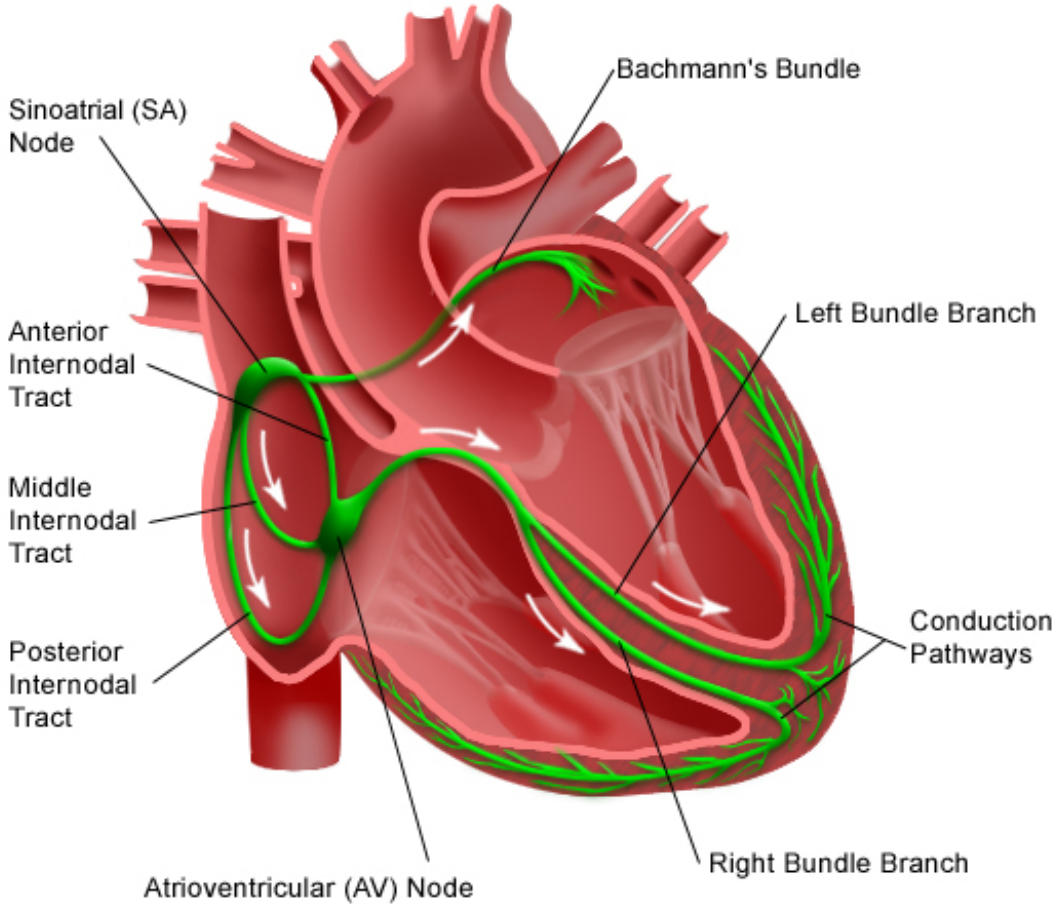
Agenda

- Review
  - Conduction system
  - ECG basics
- Approach to reading an ECG
- Common arrhythmias in small animals
- Diagnosis and treatment of arrhythmias
  - Bradyarrhythmias
  - Tachyarrhythmias

Conduction System



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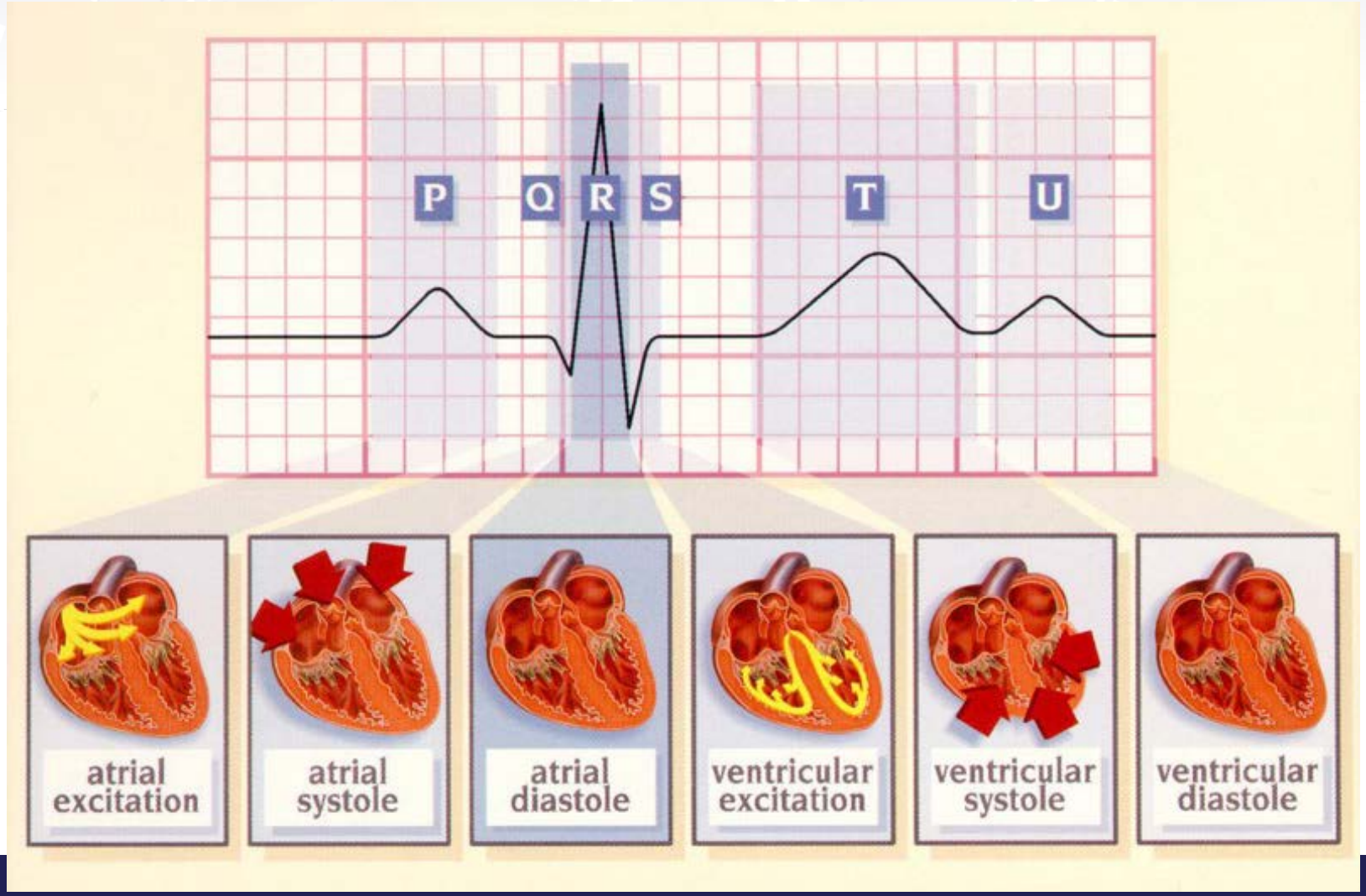
ECG Basics Revisited



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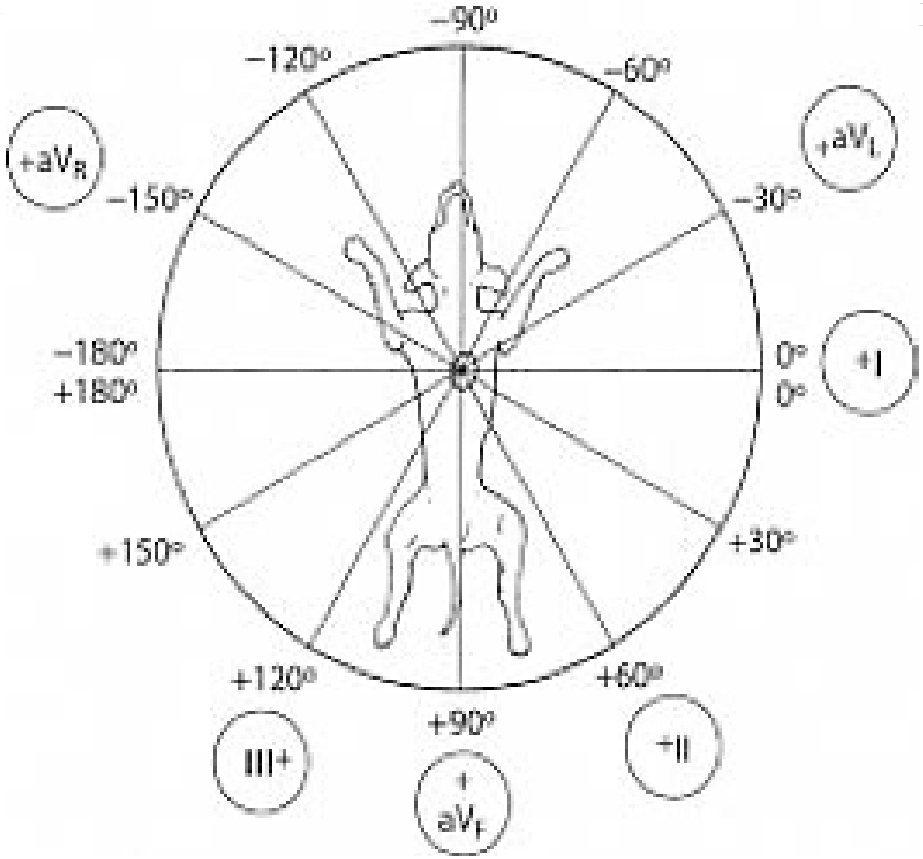
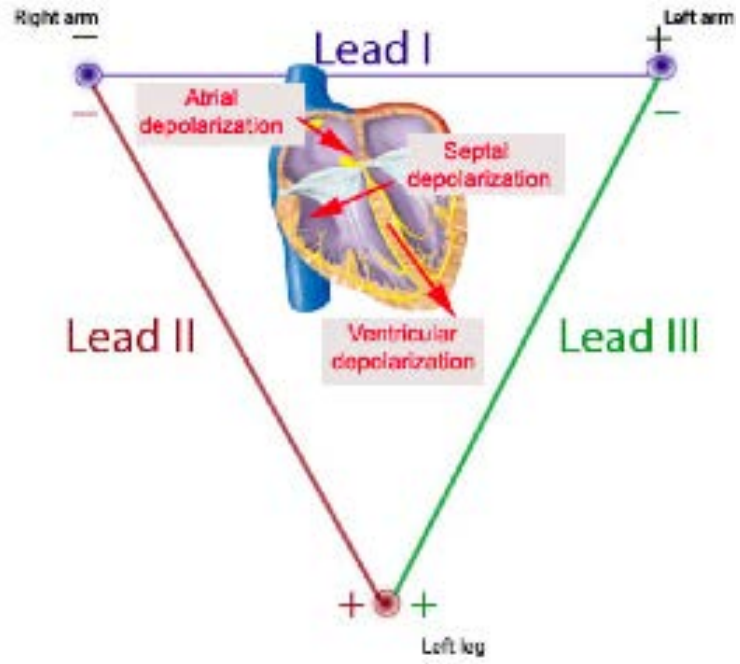
ECG Leads





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Approach to Reading an ECG

A systematic approach to interpreting an ECG is essential for correct diagnosis:

1. Determine HR
2. Determine rhythm
3. Assess P waves, PR interval, QRS complexes
4. Assess for premature or late beats

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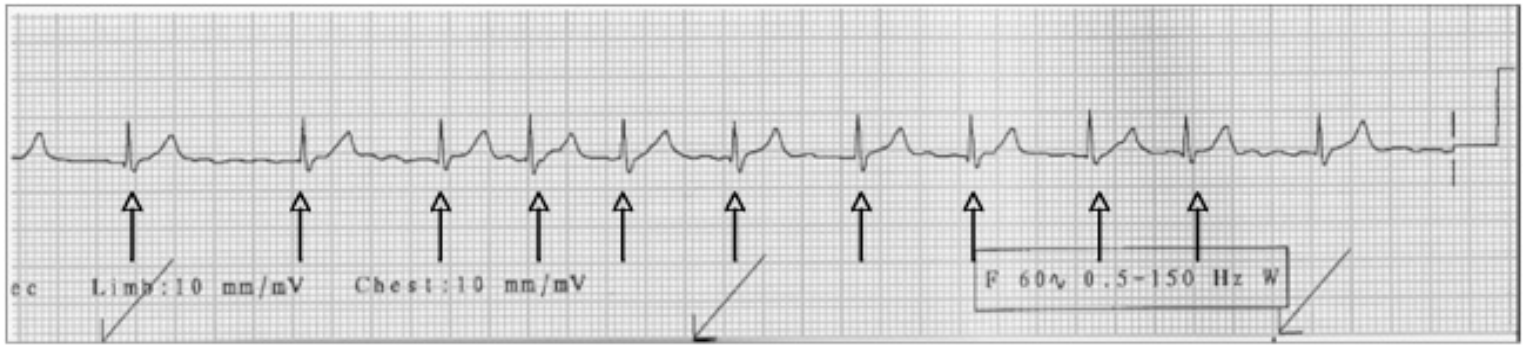
1) Determining Heart Rate

- Know your paper speed
- Instantaneous rate – used if the R-R interval is consistent
  - 50 mm/s – 3000/number of small boxes per 1 min
  - 25 mm/s – 1500/number of small boxes per 1 min

1) Determining Heart Rate

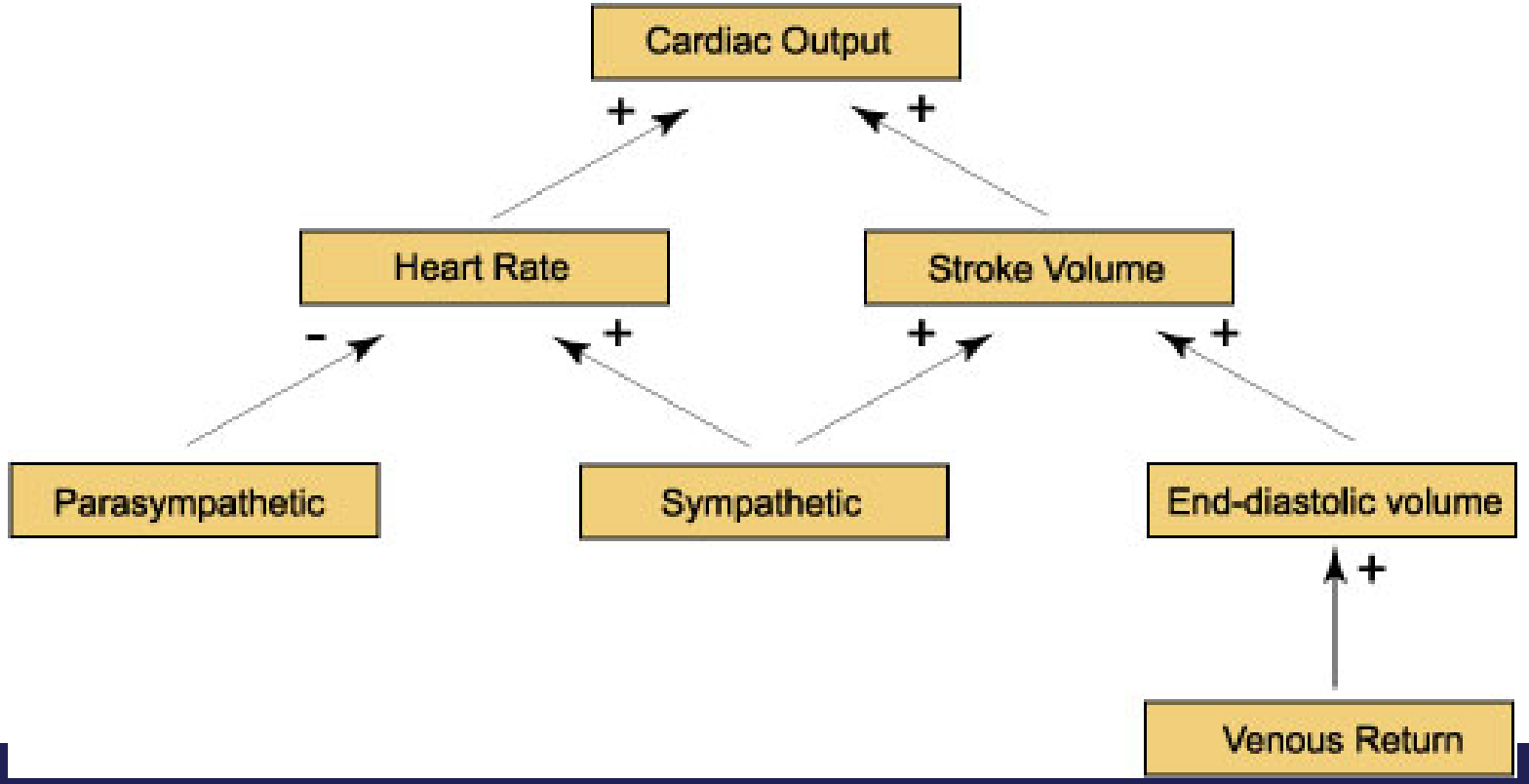
- Average rate – used when the rhythm is irregular
- # of complexes in 6 sec x 10 OR 3 sec x 20
- "Bic" Pen Trick (pen = 3 sec)
  - 50 mm/s - # R waves/pen length x 20
  - 25 mm/s - # R waves/pen length x10



10 QRS complexes within 6 seconds
represents 100 bpm (10 cycles x 10)

Why is heart rate important?

Summary of Factors Controlling Cardiac Output



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How is heart rate controlled?

- **Parasympathetic fibers**
  - Release acetycholine
  - Slows the pacemaker potential of the SA node (↓ HR)

- **What causes a slow heart rate?**
  - Increased parasympathetic tone
    - Respiratory disease, GI disease, Neuro disease (increased CSF pressure)
  - Hypothyroidism
  - Hypothermia
  - Hyperkalemia
  - Hypoglycemia
  - Drugs (ex. beta blockers)

- **Sympathetic fibers**
  - Release norepinephrine
  - Speed up pacemaker potential of SA node (↑ HR)

- **What causes a fast heart rate?**
  - Pain
  - Fever,
  - Anemia
  - Reduced cardiac output (ex. blood loss)
  - Hyperthyroidism
  - Excitement, fear, anxiety, stress
  - Heart failure

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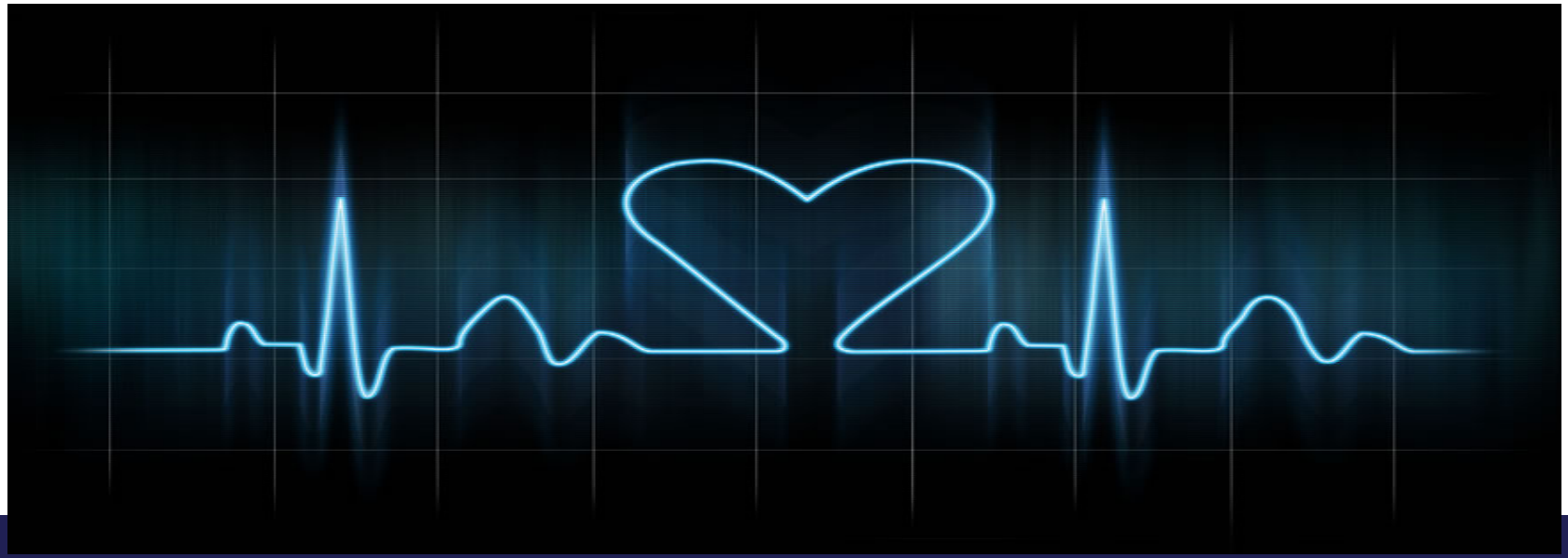
What is a normal heart rate?

Dogs

- Adults 70-160 bpm
- Toy breeds Up to 180 bpm
- Puppies Up to 220 bpm

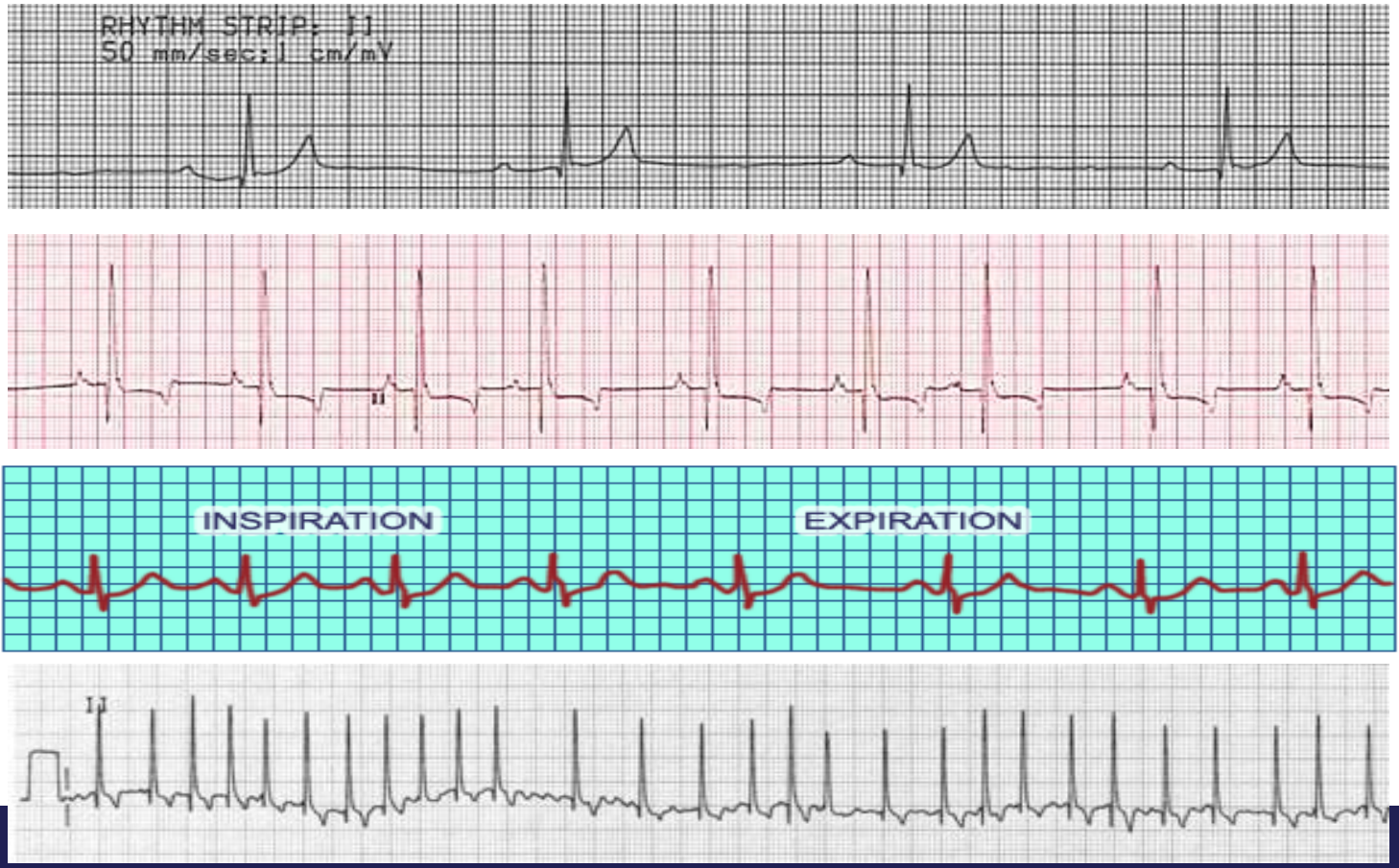
Cats

- 160-240 bpm

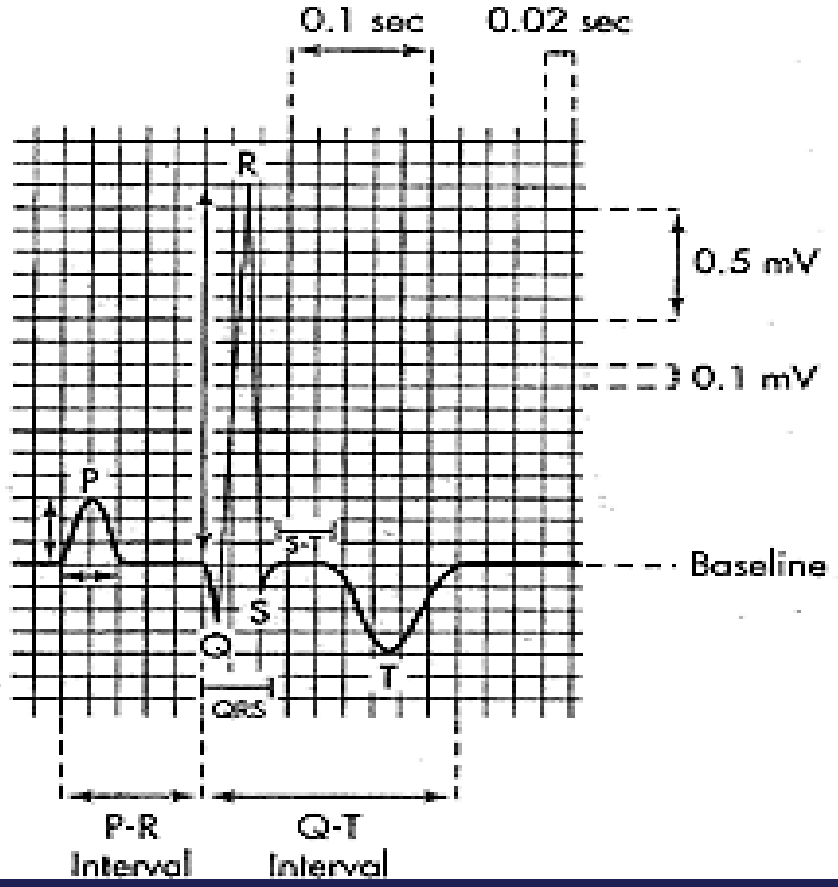


2) Determine Regularity

- Are the complexes regular, occasionally irregular, regularly irregular or irregularly irregular?



3) Assess P waves, PR interval and QRS Complex



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Artifact

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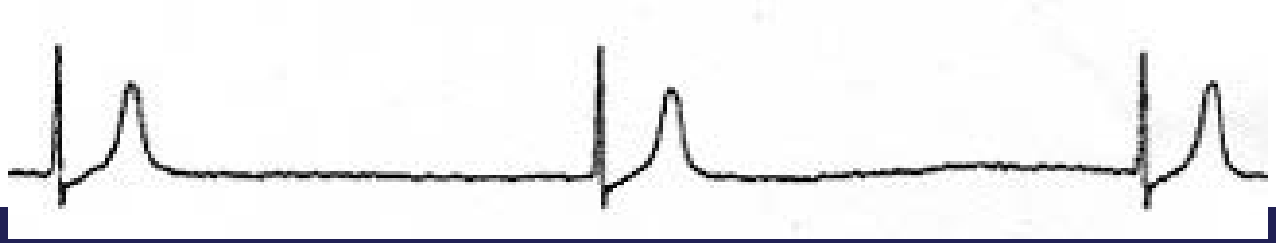
Most Common Arrhythmias in Small Animals

- Ventricular arrhythmias
  - VPCs
  - Ventricular tachycardia
  - Accelerated idioventricular rhythm
- Atrial fibrilllation
- Supraventricular tachycardia
- Sick sinus syndrome
- Atrioventricular block

Causes of Arrhythmias

- Influences of the Autonomic Nervous System
  - Increased Sympathetic and Parasympathetic Tone

- Cardiac Causes
- Extracardiac Causes



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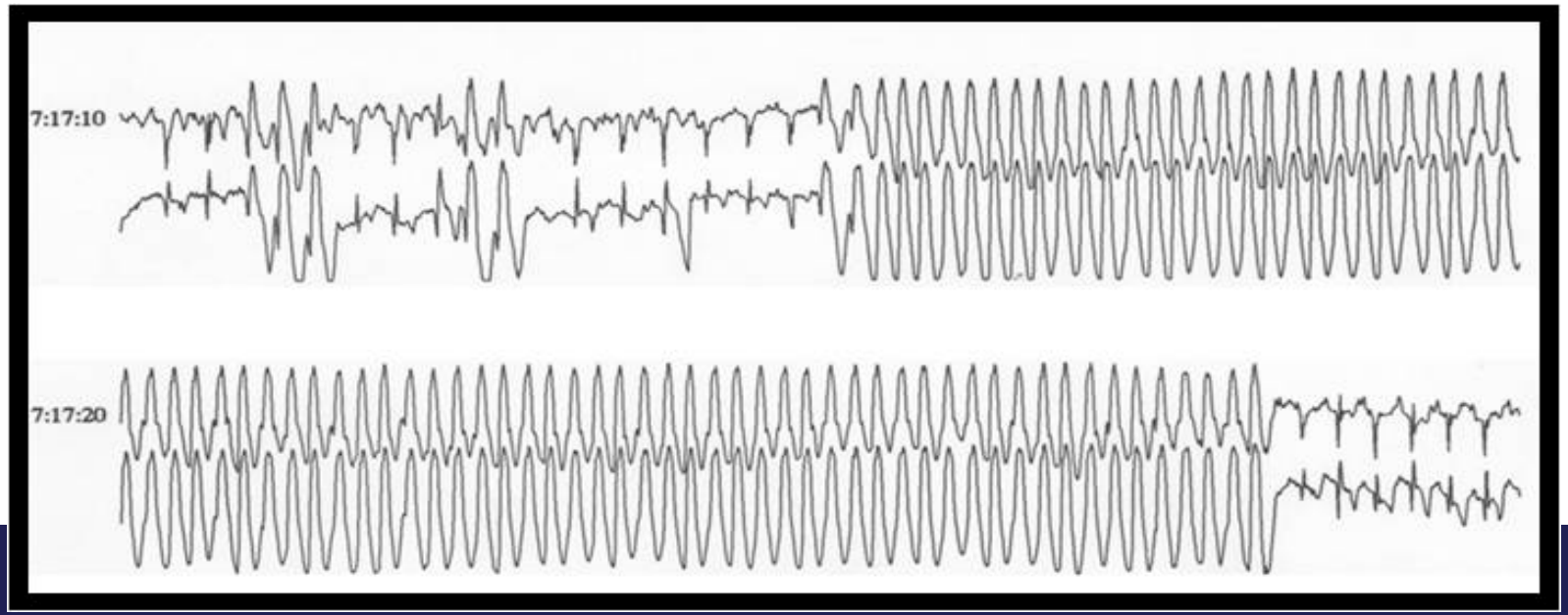
Does An Arrhythmia Need To Be Treated?

- Could the arrhythmia result in clinical signs?
- Could it lead to or worsen signs of CHF?
- Could it lead to sudden death?
- Is there evidence of cardiac disease?



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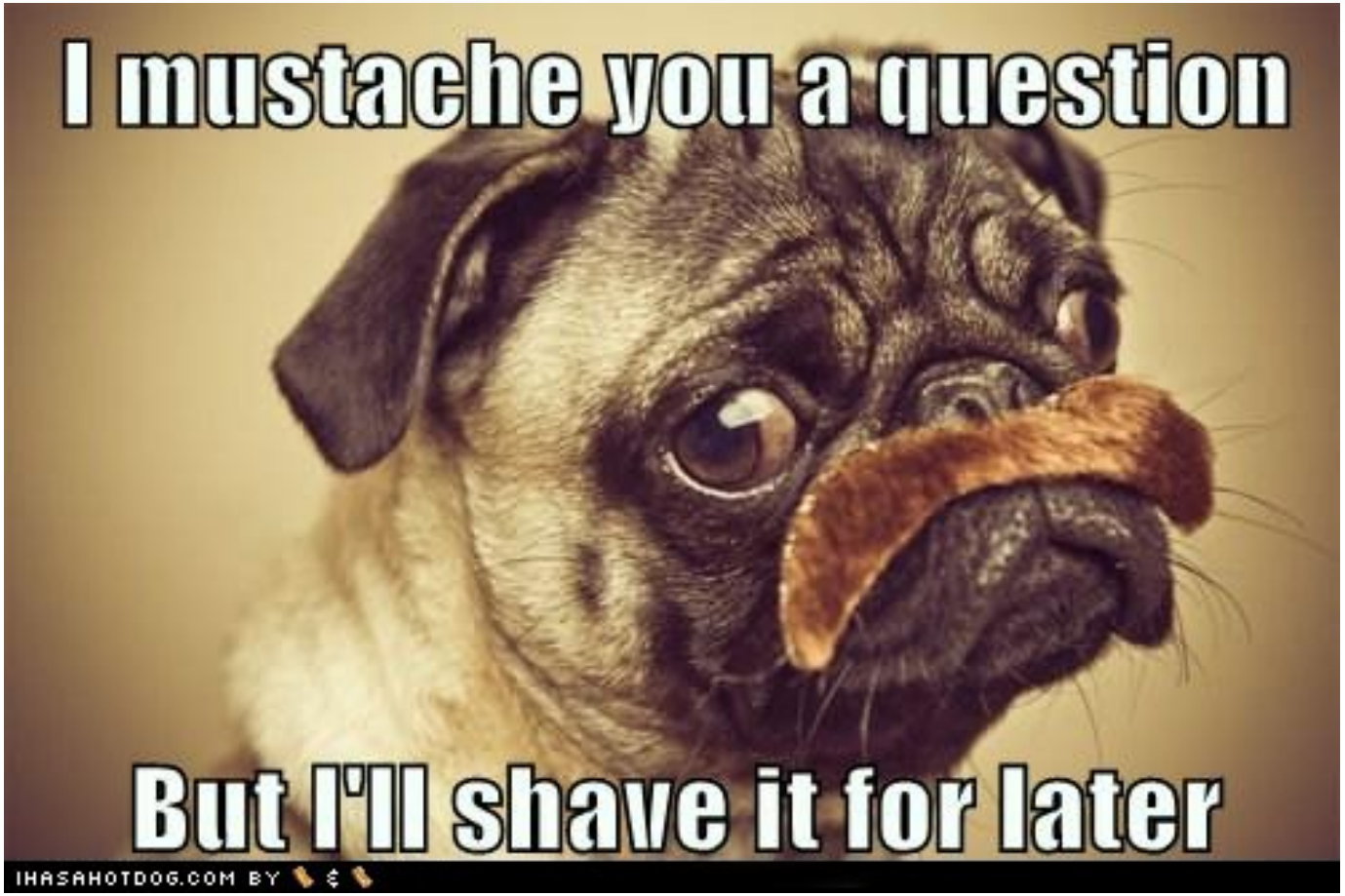
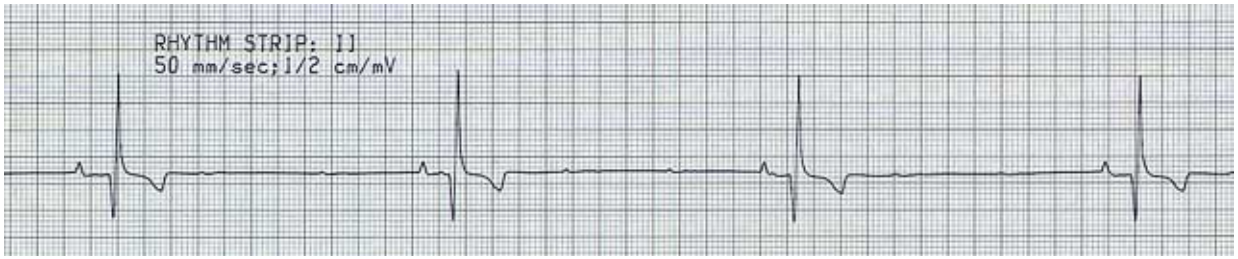
Any Questions So Far?



Sinus Rhythm

- Would you treat?



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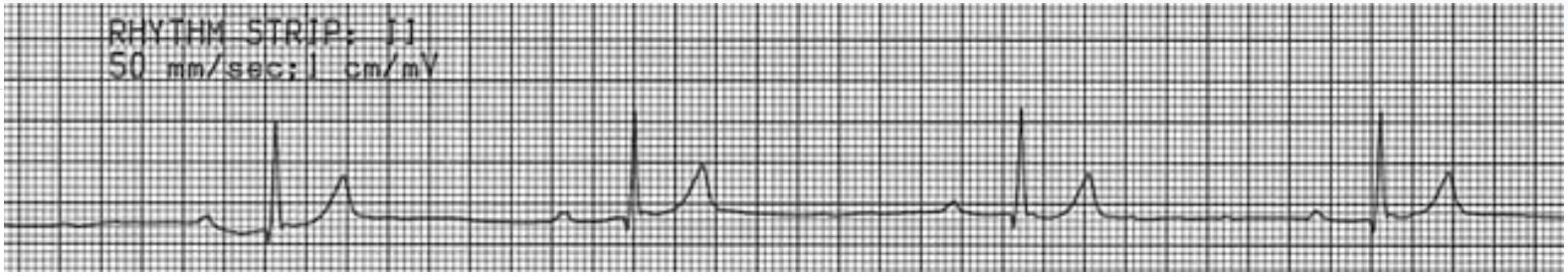
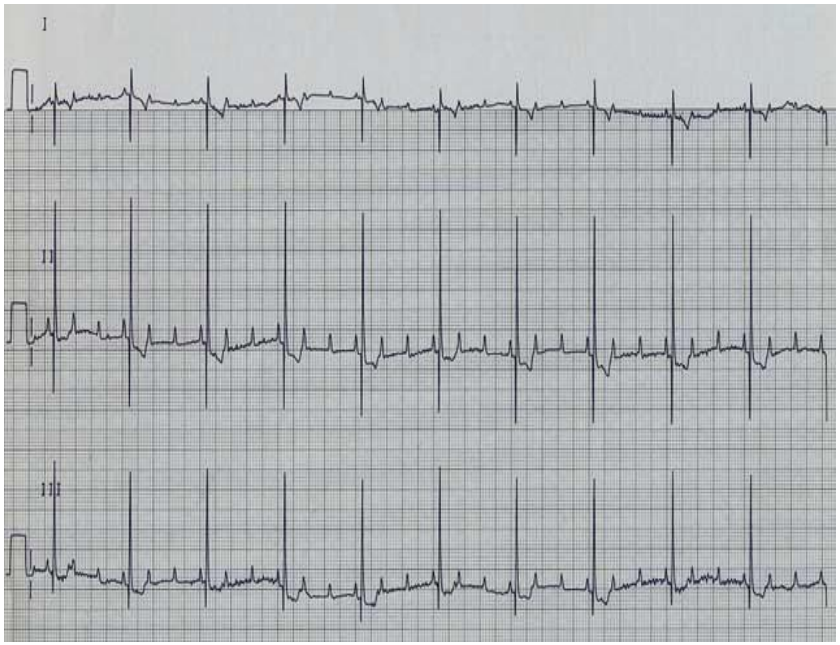
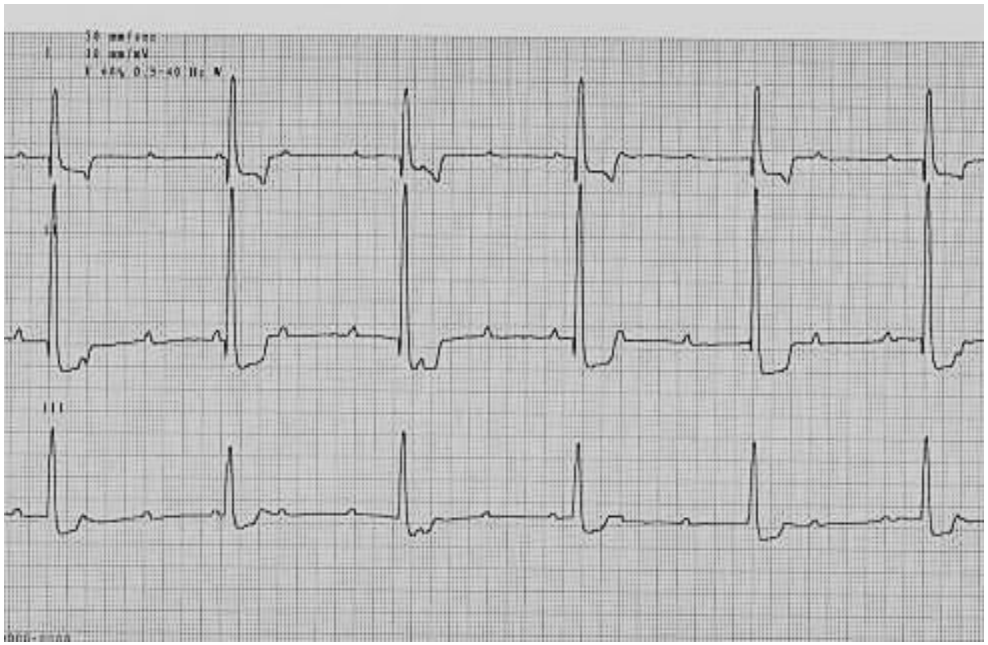
Bradyarrhythmias







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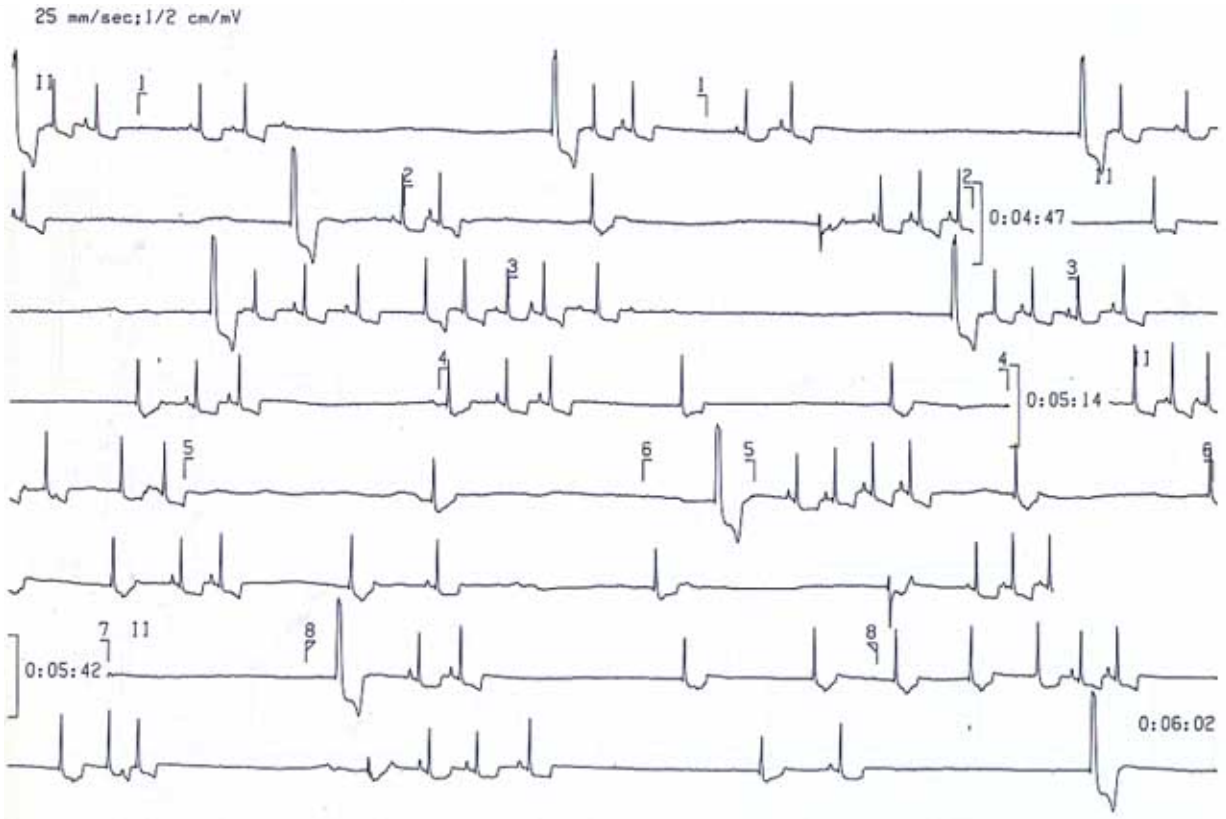
What's Your Diagnosis?



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Atropine Response Test

- Is arrhythmia due to increased vagal tone?
  - Sinus bradycardia vs SSS
  - AV block
- Rx possible?
- Atropine 0.04 mg/kg IM or SC
- Repeat ECG in 30 min
- Normal response
  - Return of AV conduction
  - Increase in HR of 150% or > 150 bpm

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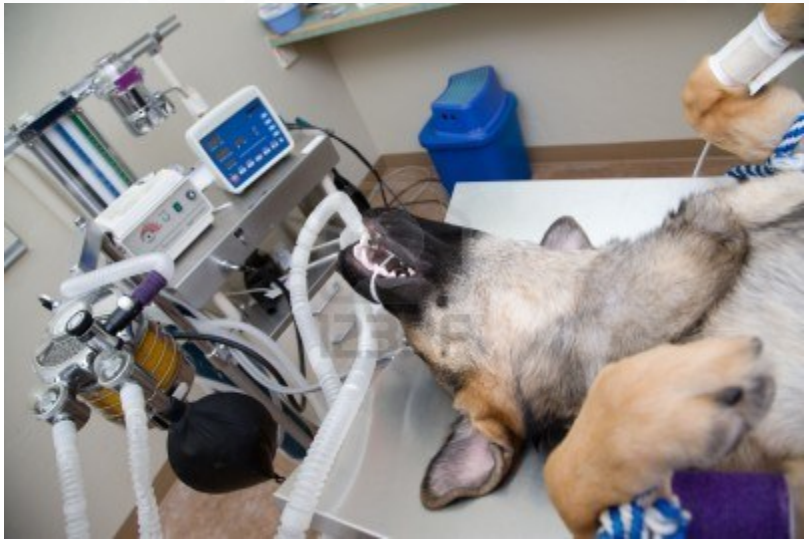
What's your diagnosis?



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Ventricular Escape Beat

- Self-generated electrical discharge initiated by the ventricles
- Follows a long pause
- Acts to prevent cardiac arrest
- Indicates a failure of the electrical system of the heart to stimulate the ventricles
- Treatment = ATROPINE!

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Treatment of Bradyarrhythmias

- Theophylline 5-10 mg/kg PO BID-TID
- Terbutaline 0.2 mg/kg PO BID-TID
  - Or, 2.5-5 mg (total) PO BID-TID
- Can cause hyperactivity, nervousness, tremors, GI upset, PU/PD

- Hyoscyamine (Levsin) 0.003-0.006 mg/kg PO BID-TID
- Propantheline 7.5-20mg total PO BID-TID
- Can cause urinary retention, constipation, vomiting

- Isoproterenol 0.04-0.09 mcg/kg/min IV CRI

- Drugs may lose effectiveness over time

ermanent Transvenous Pacemaker

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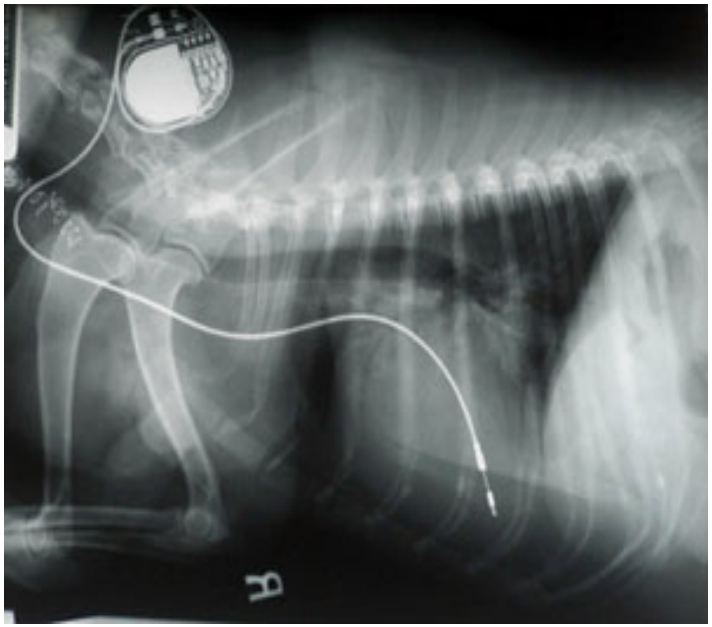
- Treatment of choice for High grade 2nd degree AV block, Complete AV block and SSS
- Main complication = lead dislodgement within 1st month of implantation
- NO - jugular venipuncture, neck leads/collars, aggressive play, MRIs, electronic devices near generator
- Performed in Vienna (or, Fairfax) and Towson



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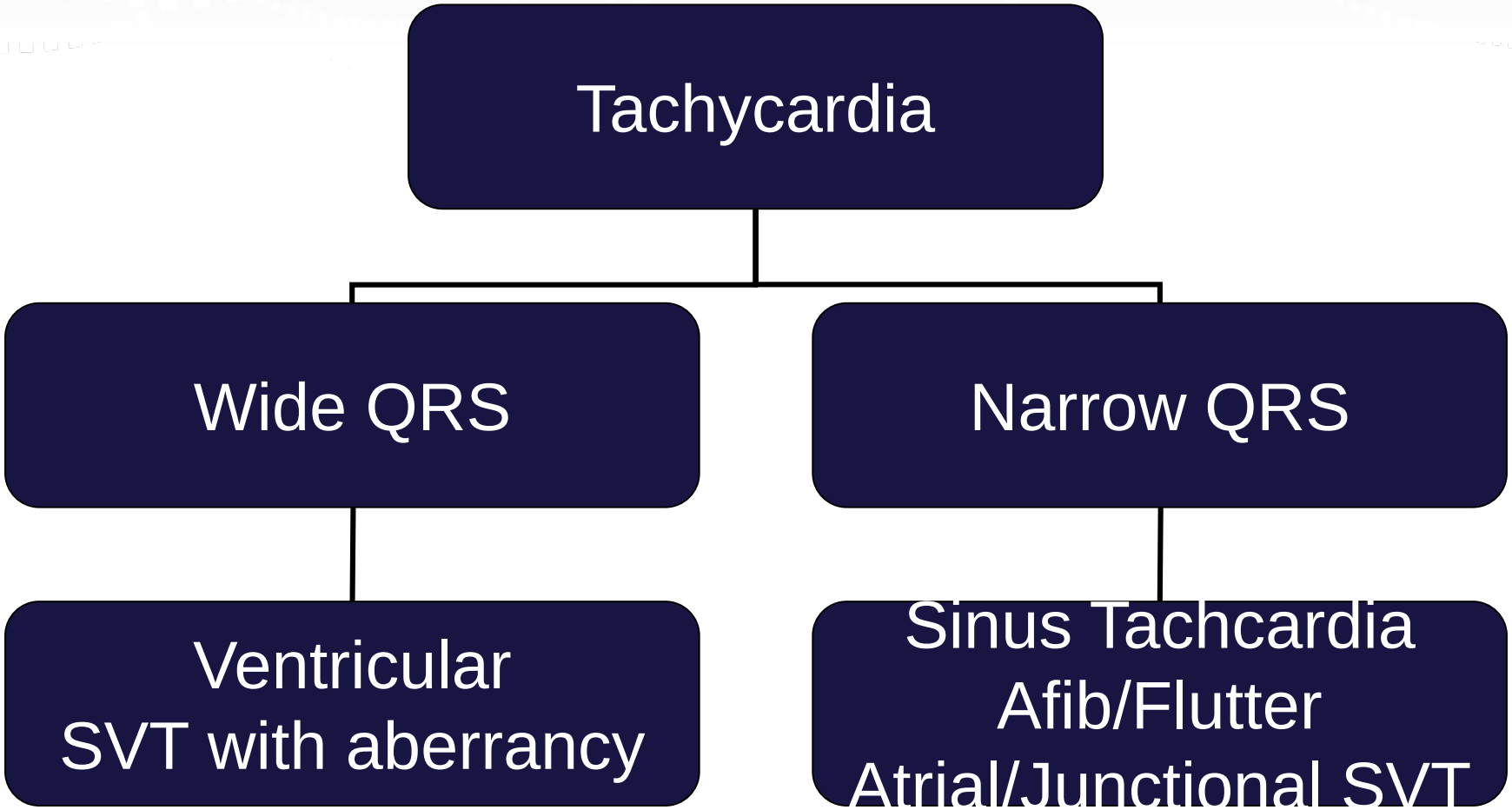
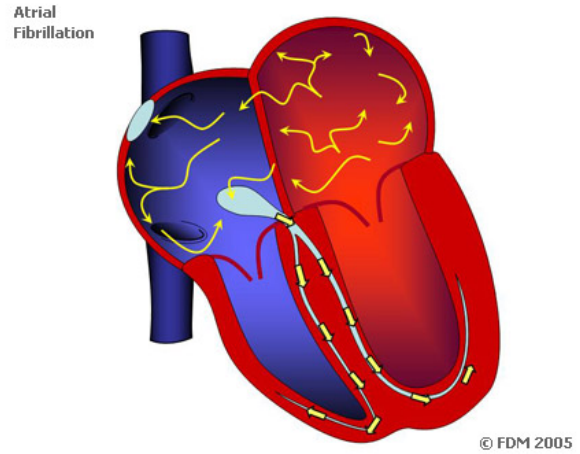
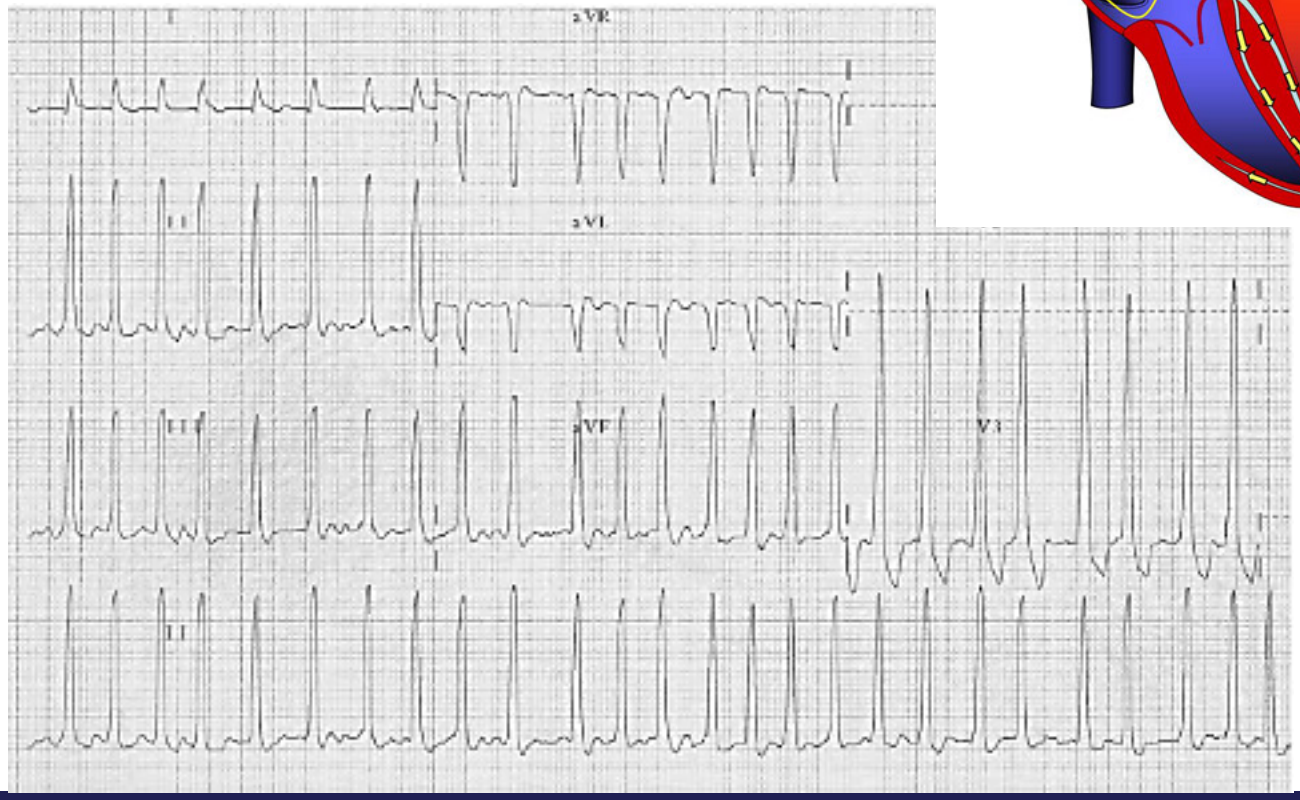
Tachyarrhythmias



Tachycardia arising from the atria

- Atrial fibrillation





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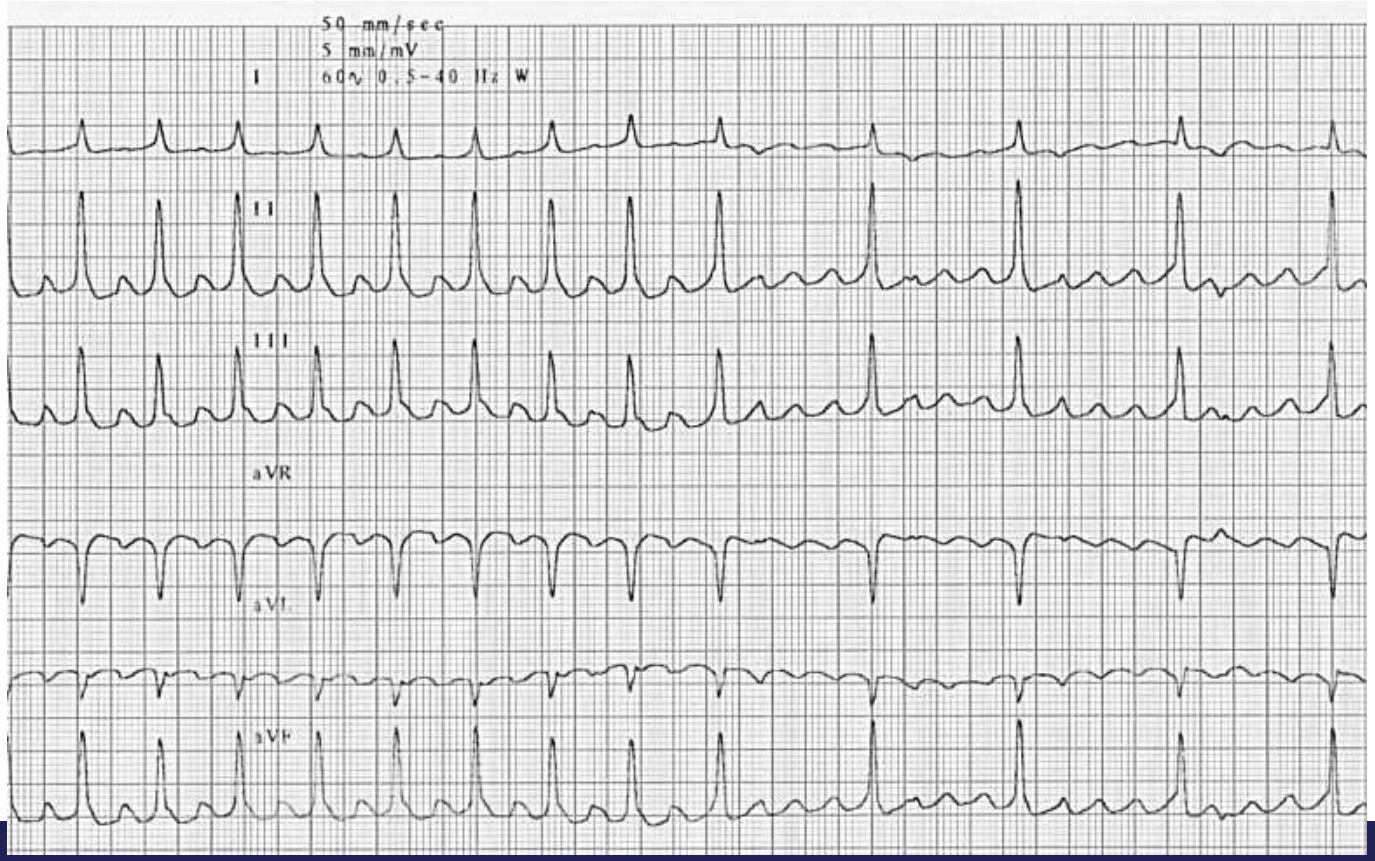
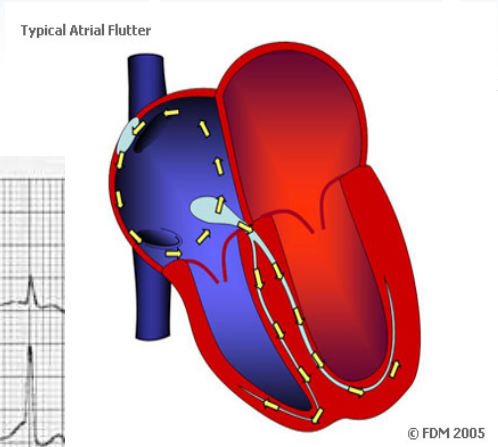
Treatment of Atrial Fibrillation

- No clear advantage to rhythm control vs rate control
- Rhythm Control = DC Cardioversion
  - Atrial size and duration of AFib impact chances of conversion and maintenance of sinus rhythm
    - AFib leads to structural and electrical remodeling
- Rate Control
  - Target HR 120-160 bpm
    - >180 bpm will lead to tachycardia-induced cardiomyopathy over several weeks

Tachycardias Arising From the Atria

- Atrial Flutter





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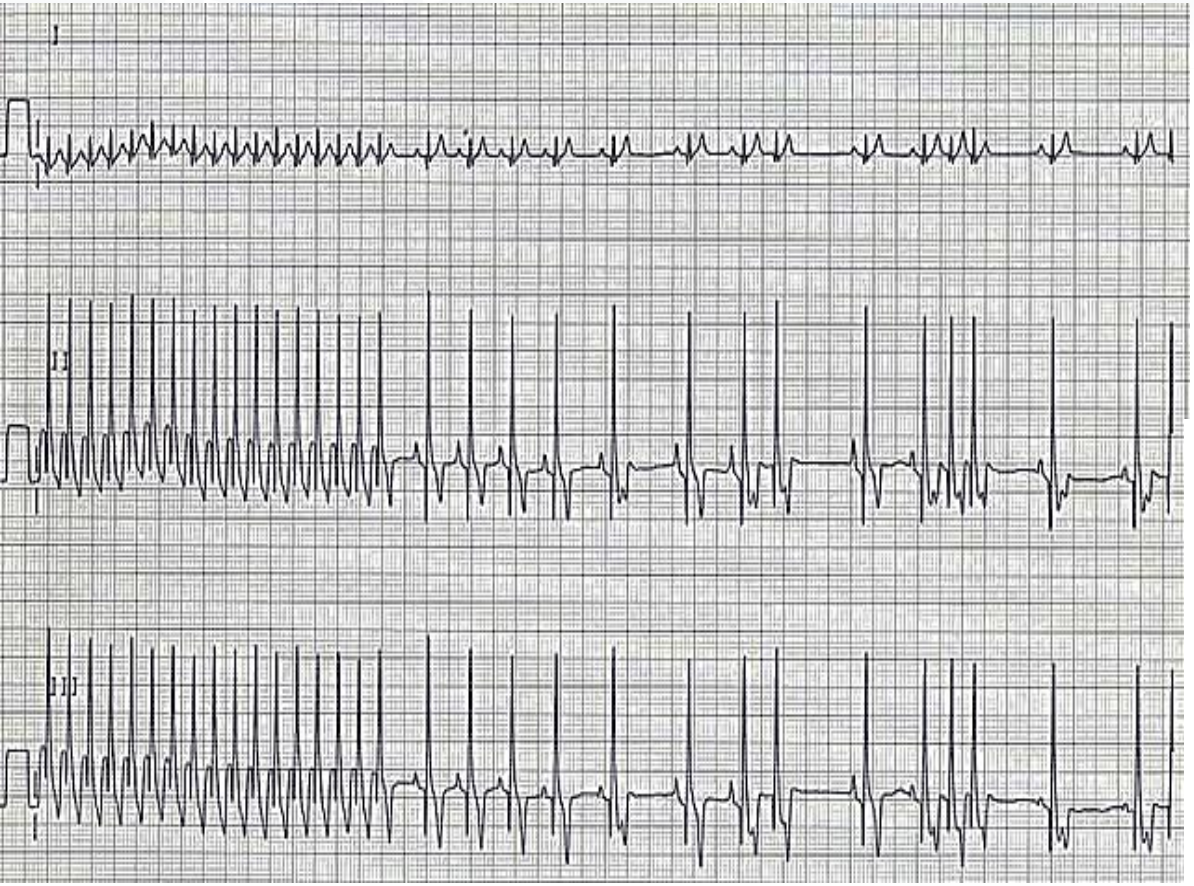
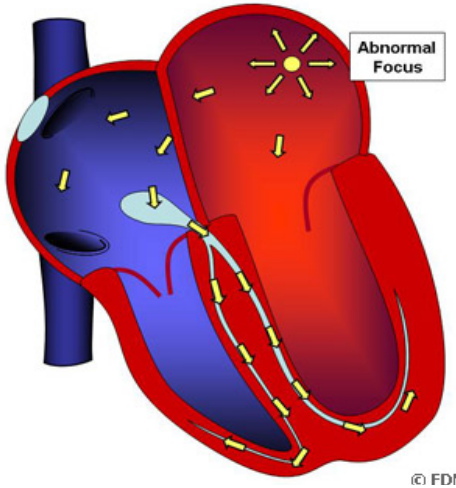
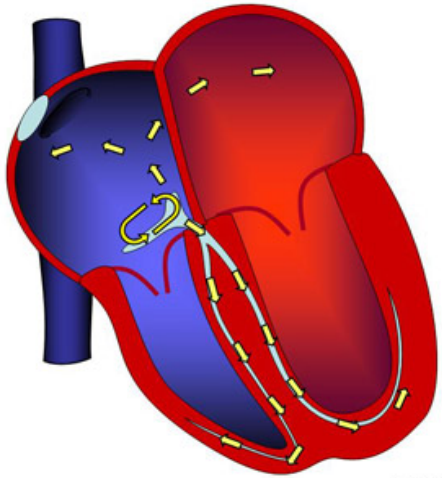
Supraventricular Tachycardia



Focal Tachycardia (here, in the left atrium)



Supraventricular Tachycardia due to AV Nodal Reentry



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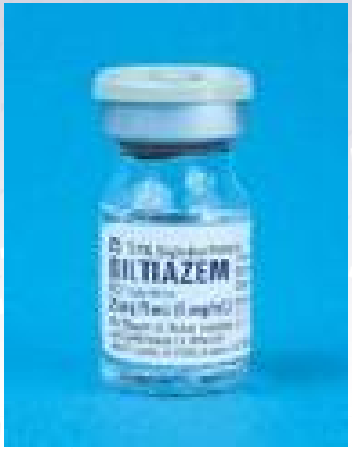
Tips to DDx SVT vs Sinus Tach

- Sinus Tachycardia = physiologic rhythm
- SVT = pathologic rhythm
  - Regular RR interval tachycardia that requires atrial +/- AV nodal tissue for initiation and maintenance
- Look at patient
  - Any conditions causing decreased CO or increased sympathetic tone?
    - Hypotension, sepsis, hypoxemia, fear, pain, excitement, etc.
- Look at breed
  - Most common breeds w/ SVT are Labs and Boxers

ER Treatment of SVT



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- HR >250 bpm
  Standing vs. Recumbent
- Diltiazem 0.1-0.25 mg/kg IV over 4-5 min
- Esmolol 0.25-0.5 mg/kg IV over 1 min
- Lidocaine 2 mg/kg IV over 1 min
  - Little effect on atrial conduction/refractoriness, but helpful in some cases
- Procainamide 5-8 mg/kg IV over 4-5 min
  - Depresses conduction in normal and abnormal tissue

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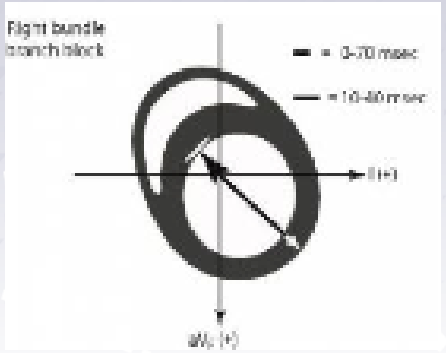
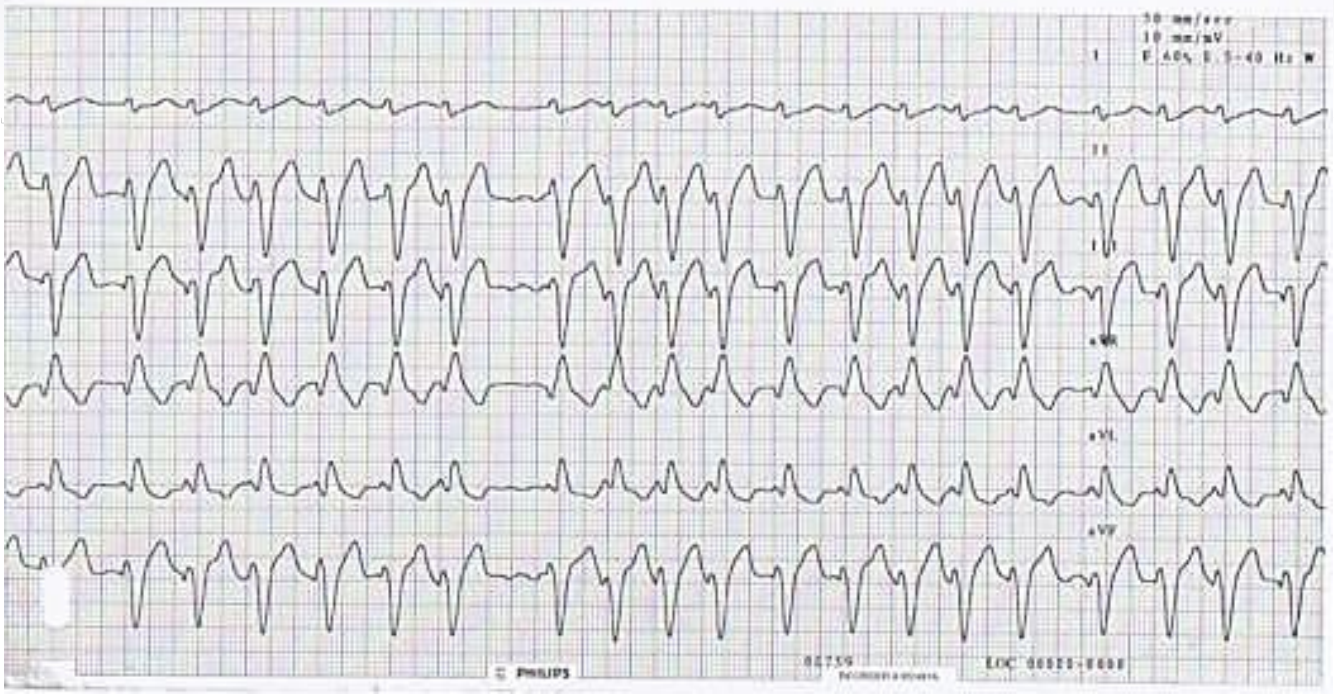
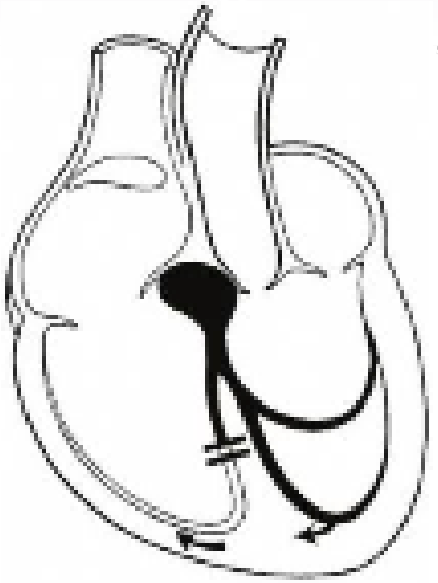
Long-Term Tx of SVT

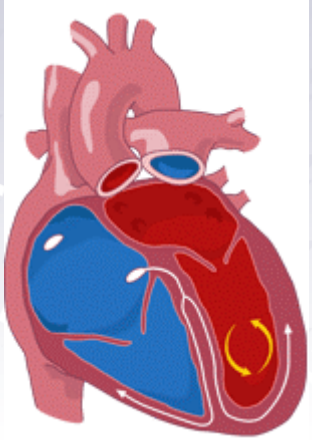
- Suppress atrial ectopy and/or impair conduction through AV node
  - Digoxin – 0.003-0.01 mg/kg BID
  - Diltiazem – 0.5-2.0 mg/kg TID
    - Cardizem CD 10 mg/kg BID
    - Dilacor 2-6 mg/kg BID
  - Atenolol – 0.2-1.0 mg/kg BID
  - Sotalol – 1-2 mg/kg BID

Aberrancy









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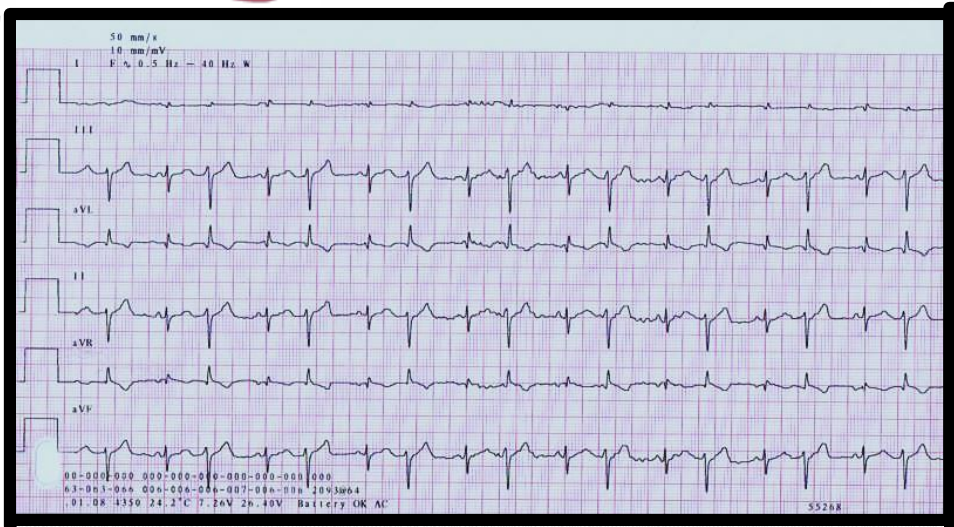
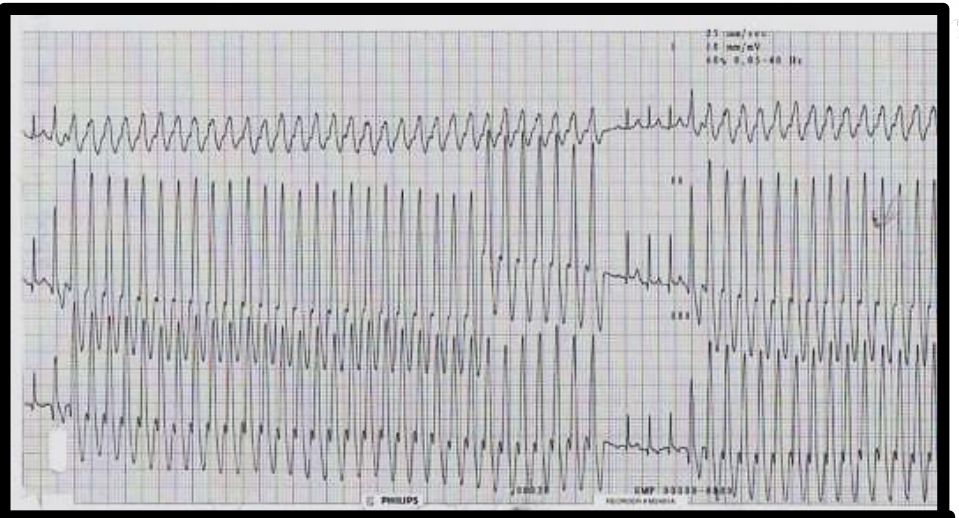
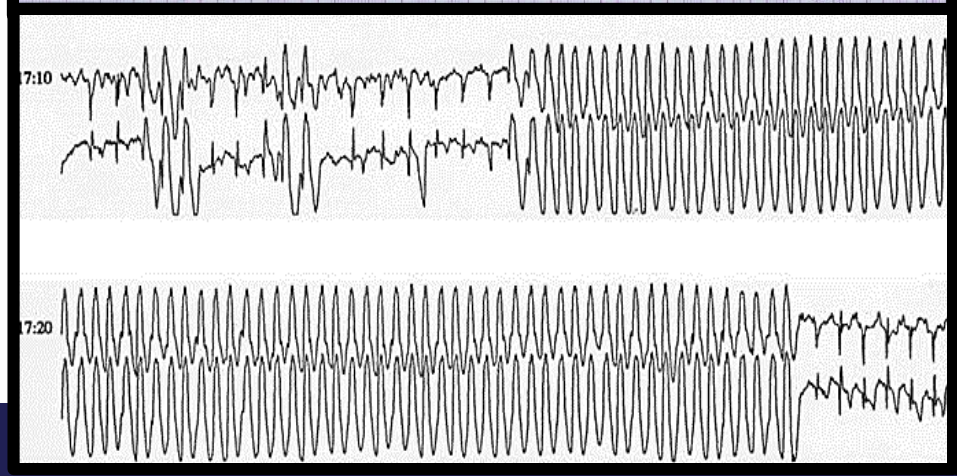
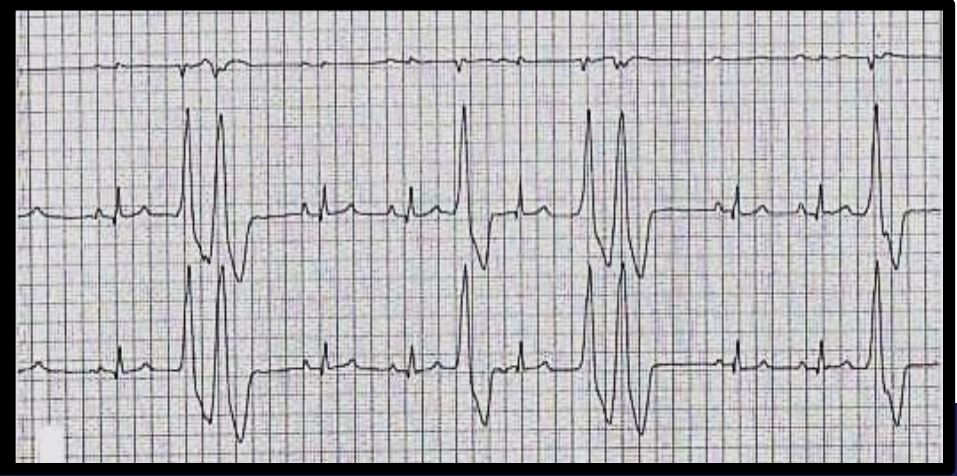
Ventricular Arrhythmias









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Ventricular Arrhythmias DDx

- Structural Cardiac Disease
  - Cardiomyopathy
    - Dogs - DCM, ARVC, occasionally DMVD (usually hypoxic/CHF)
    - Cats - HCM, RCM/UCM, DCM, ARVC
  - Advanced DMVD
  - Cardiac tumors
  - Congenital disease
    - SAS, PS, PDA
- Drugs
  - Digoxin
  - Barbiturates
  - Anti-arrhythmics can be pro-arrhythmic

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Ventricular Arrhythmias DDx

- Stress/anxiety (catecholamine release)
- Abdominal disease
  - Splenic mass, adrenal mass, GDV
- Hypoxemic states
  - CHF, GDV, anemia
- Metabolic derangements
  - Acidosis, hypokalemia
- Neoplasia, SIRS, Major illness or trauma
  - Circulating cytokines
- Myocarditis
  - Tick-borne diseases, Neospora, Toxoplasmosis, Chagas disease
- Idiopathic

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When to Tx Ventricular Arrhythmias

- When to Tx
  - Holter results, if surface ECG does not warrant Tx
  - Symptomatic due to arrhythmia
  - Risk of degenerating into Vfib
    - > 20 VPC/min
    - Presence of couplets, triplets
    - Presence of multiform VPCs
    - Presence of R-on-T phenomenon
  - Risk for sudden death to severity of arrhythmia or presence of structural heart disease associated with sudden death (esp. DCM, ARVC)

Control of Ventricular Arrhythmias

- Lidocaine 2-4 mg/kg IV slow bolus (8 mg/kg)
  - ~1 mL/20 lbs with 2% lidocaine
  - CRI 40-80 ug/kg/min
- Procainamide – 5-8 mg/kg over 3-5 minutes (16-20 mg/kg)
  - CRI 25-50 ug/kg/min
- Sotalol 1-2 mg/kg q12 hr
- Atenolol 0.2-1.0 mg/kg q12hr
- Mexiletine 5-8 mg/kg q8-12 hr
- Amiodarone
  - 10-15mg/kg BIDx7d, then 5-7.5mg/kg BID x14d, then 5-7.5mg/kg QD
  - Digoxin – decrease dose by ½ if concurrently prescribed

ER Tx Not Effective?

- Is it Vtach or SVT w/ aberrancy? Vagal maneuver change rhythm?
- What is HR? AIVR? Use-dependent drug (lidocaine)
- What is potassium? Class I drugs less effective when K+ low
- What is magnesium? MgSO4 30 mg/kg IV Slow
- Provide supplemental O2
  - Coronary perfusion occurs during diastole
- Beta blocker (esmolol = short-acting)
- Amiodarone – 5mg/kg IV over 10-15 min
  - Pre-medicate w/ Benadryl/DexSP (reaction to vehicle)
  - If respond, give 10mg/kg PO immediately
- DC Cardioversion

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Comments / Questions

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