

The ABC's of ECG's Recognizing Abnormal ECGs In Canine and Feline Patients

Emi Menzen, DVM
VCA NWVS Emergency and Critical Care

Pump it up!

How the Heart Pumps Blood

The heart is divided into 2 parts. Each part is a pump, so the heart is a double pump.

From the body → **To the lungs** → **To the body** → **From the lungs**

The right side pumps deoxygenated blood to the lungs to pick up oxygen.

The left side pumps oxygenated blood to the rest of the body for use.

Basic Cardiovascular Anatomy Cardiac Conduction System Normal & Abnormal ECG Recordings Outcomes of Arrhythmias Some therapeutics

Presentation Objectives

The Electric Avenue

Cardiac Conduction system

Segments and Intervals

<https://youtu.be/RVZ4daFwMa8>

Heart Anatomy

Superior Vena Cava
Right Pulmonary Artery
Pulmonary Trunk
Right Atrium
Right Pulmonary Veins
Fossa Ovalis
Pectinate Muscles
Right Ventricle
Chordae Tendineae
Trabeculae Carneae
Inferior Vena Cava

Aorta
Left Pulmonary Artery
Left Atrium
Left Pulmonary Veins
Mitral (Bicuspid) Valve
Aortic Semilunar Valve
Pulmonary Semilunar Valve
Left Ventricle
Papillary Muscles
Interventricular Septum
Epicardium
Myocardium
Endocardium

Recording ECGs

Quiet area

No electrical equipment nearby (clippers)

Right lateral recumbency

Limbs perpendicular to body, try not to let them touch

No panting-- If dyspneic, can obtain standing or sitting

Evaluating ECGs

Calculate heart rate (R-R Interval)

Measure wavelengths such as P wave height/width, PR interval, etc

Determine rhythm

ECGs tell us: heart rate, rhythm, and chamber size/wall thickness (sometimes), +/- pericardial effusion and endocrinopathies (hormonal diseases)

The Quick and Dirty

- Is it sinus? (Is there a 'QRS' complex for every 'P' wave?)
- Is it regular?
- What's the rate? Is that normal, slow, or fast for this species?
- Any extra beats? Any weird complexes/runs?

What is normal? A Sinus Rhythm

Features include:

- ★ Originates from SA node
- ★ P waves are occurring regularly
- ★ The interval between the p and r wave is constant
 - and not too prolonged
- ★ There is a QRS complex for every p wave
- ★ The size and shape of p waves and QRS is within normal range (not too big or wide, etc)

Abnormal rhythms: tachycardia

Originating from:

- Sinoatrial (SA) node - sinus tach
- Atrial or AV node - SVT, atrial flutter, afib
- Ventricular - Vtach, VPCs

"Normal" rhythms

Sinus respiratory arrhythmia

Vagally mediated (parasympathetic tone) - increased rate on inspiration, decreased on expiration

DOGS ONLY (Esp breeds with increased underlying vagal tone - bulldogs)

Sinus tachycardia



Sinus rhythm, but faster

Causes:

- Increased sympathetic tone – fear, anxiety, pain, fever
- Drugs – methylxanthines, catecholamines, thyroid oversupplementation, atropine
- Systemic/compensatory – In response to hypovolemia, sepsis, etc

Treat the underlying cause!

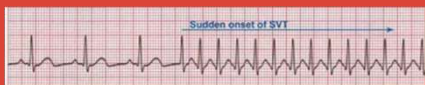
Supraventricular Tachycardia (SVT)

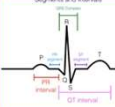
Includes atrial tachycardia and AV junctional tachycardia

- ★ rapid rate
- ★ regular rhythm
- ★ upright narrow complexes
- ★ +/- hidden P waves.
- ★ Can be caused by abnormal electrical circuit or cardiomyopathy

Sudden onset of SVT

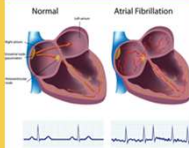



Atrial Fibrillation




Irregularly Irregular, upright and fast, no p's


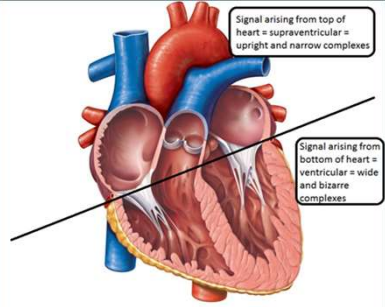
Causes: structural heart disease (atrial enlargement, cancer, etc), non cardiac dz (GDV), drugs

Atrial flutter

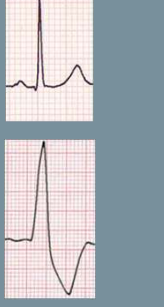


Rapid atrial rate
"Saw tooth" atrial complexes aka 'F' waves
Causes: Severe structural heart disease

Signal arising from top of heart = supraventricular = upright and narrow complexes

Signal arising from bottom of heart = ventricular = wide and bizarre complexes

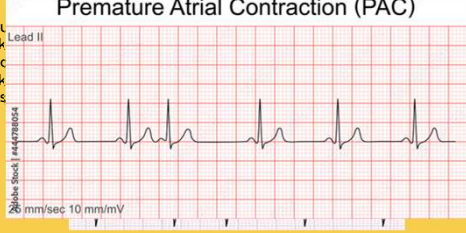


Atrial Premature Contractions (APC)

Premature Atrial Contraction (PAC)

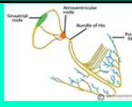
Occur
Look
Look
Caus

Lead II



mm/sec 10 mm/mV

Ventricular premature complexes - VPCs




Early complex originating from ventricles - no 'P' wave

Unifocal vs multiform; Couplets, Triplets, Runs, AIVR, Vtach

QRS is 'wide and bizarre', usually a pause after

Causes: structural heart disease, boxer cardiomyopathy, hypoxia, anemia, uremia, GDV, splenic torsion/neoplasia, pancreatitis, myocarditis, drugs, etc, etc, etc



VPC examples

Abnormal rhythms: bradycardia <140 bpm cat, <60 bpm dog

Originating from:

- **Sinus Node:** Sinus arrest, Sinus bradycardia, Sick sinus syndrome
- **Atrial Myocardium:** Atrial Standstill
- **AV Node:** AV Block - 1st, 2nd degree (Type I and II) and 3 AVB

Accelerated Idioventricular Rhythm (AIVR)

Runs of VPCs in succession; rate less than ~160

Does not necessitate treatment unless **R on T** phenom, **multiform**, or **hemodynamically unstable patient**

Potential for development of Vtach and Vfib

Sick Sinus syndrome

(Sinus bradycardia, sinus arrest, paroxysmal atrial tachycardia, intermittent AV nodal block, lack of ventricular escape complexes)

More common in older female: miniature schnauzers, cockers, dachshunds, pugs, westies

Idiopathic

Collapse, weakness

Medical therapy -- sometimes works, but often need pacemakers

Ventricular tachycardia

Complexes are wide and bizarre, with a fast, regular rhythm (>160-180 bpm)

Causes: in dogs more often due to systemic disease, most often heart disease in cats



Predisposes to ventricular fibrillation

Vfib = CPA = bad news!!

SSS

Sinus arrest - impulse does not leave the SA node, the heart either waits for next beat, or fires an escape beat

Atrial standstill


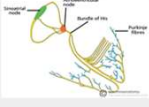
Features:

- No P waves
- usually slow, regular rhythm with supraventricular QRS complexes
- 'tall tented T's'

Causes:

- Hyperkalemia/high potassium (blocked cats, Addison's, renal failure, DKA, uroabdomen)
- Atrial muscular dystrophy (English Springer Spaniels)

Atrioventricular block (AVB)

First degree - delayed conduction through AV node

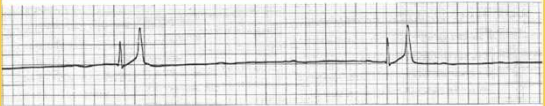
- ★ prolonged PR interval
- ★ due to AV node fibrosis, drugs, vagal tone, electrolyte disturbances

Second degree - intermittent blockade - two types (I & II)

Third degree - Complete heart block/dissociation

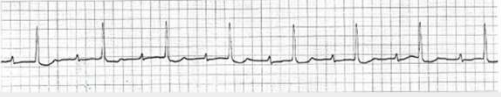

- ★ infiltrative disease, rickettsial myocarditis, hyperkalemia, etc

Hyperkalemia in urethral obstruction




Stabilization methods — calcium gluconate 10%-23% solution (0.5-1.5ml/kg), 1-2 puffs of albuterol, IV fluids - (yes you can start before unblocking them!), dextrose (+/- insulin - 1 unit regular IV), and unblocking

1st degree AVB = NBD


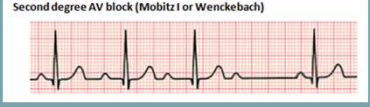
Stabilize my heart and get me unblocked asap!!



© AP

2nd AV Block - mobitz type 1 - Wenckebach


Progressive elongation of the PR interval then a dropped beat

Second degree AV block (Mobitz I or Wenckebach)

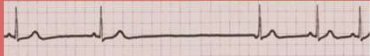
2nd AV Block - Mobitz type II

Second degree without the progressive stretching of PR interval
 Can have a pattern for example 2:1 - two p's for every QRS
 High grade: more than 2 consecutive blocked p's (which may result in clinical signs due to hemodynamic effects)




Escape rhythms -- DO NOT SUPPRESS THEM!

Junctional escape beats - when AV node fires spontaneously (often after a pause in the sinus rhythm) - rate of 40-60 bpm



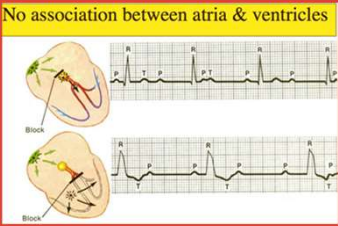
Ventricular escape beat - ventricular depolarization due to lack of atrial and AV impulses at a rate of 30-40 bpm



3rd degree AVB

Complete heart block

No association between atria & ventricles

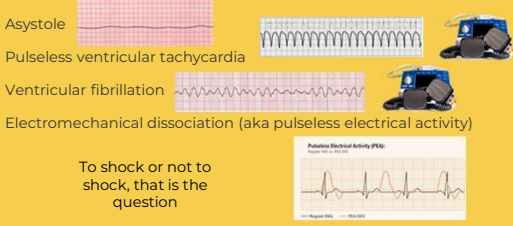


Dangerous Rhythms

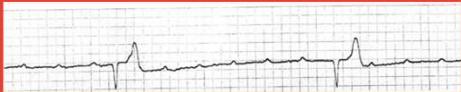
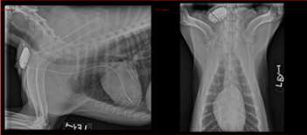

Four rhythm disturbances that result in cardiac arrest:

- Asystole
- Pulseless ventricular tachycardia
- Ventricular fibrillation
- Electromechanical dissociation (aka pulseless electrical activity)

To shock or not to shock, that is the question



<https://www.768.org/shockable-vs-non-shockable-heart-rhythms/>

SUMMARY

Make sure the ECG was properly performed (are the electrodes on the correct limbs?, etc)

Determine: Rate (normal, fast, slow), rhythm (regular vs irregular), is the underlying pattern - sinus vs supraventricular vs ventricular?, extra beats?

If things look concerning get more info - blood pressure, blood gas, lytes, lactate, pulse oximetry, cbc/chem, CXR/AXR, AFAST/TFAST!

If you aren't sure what you are seeing on the tracing, call an adult! If you are the adult, call an adultier adult (aka cards)

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