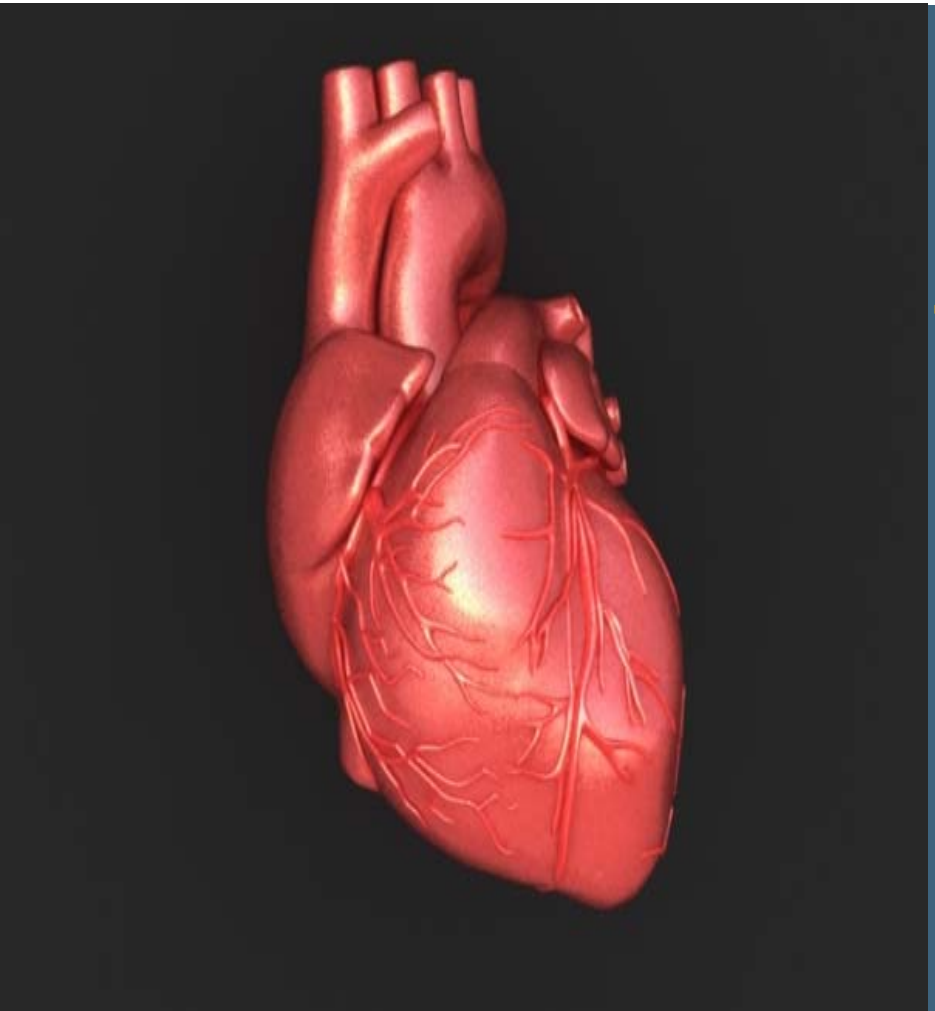
London Health Sciences Centre
Southwest Ontario Regional Base Hospital Program



Paramedic Rounds

Tachyarrhythmia's

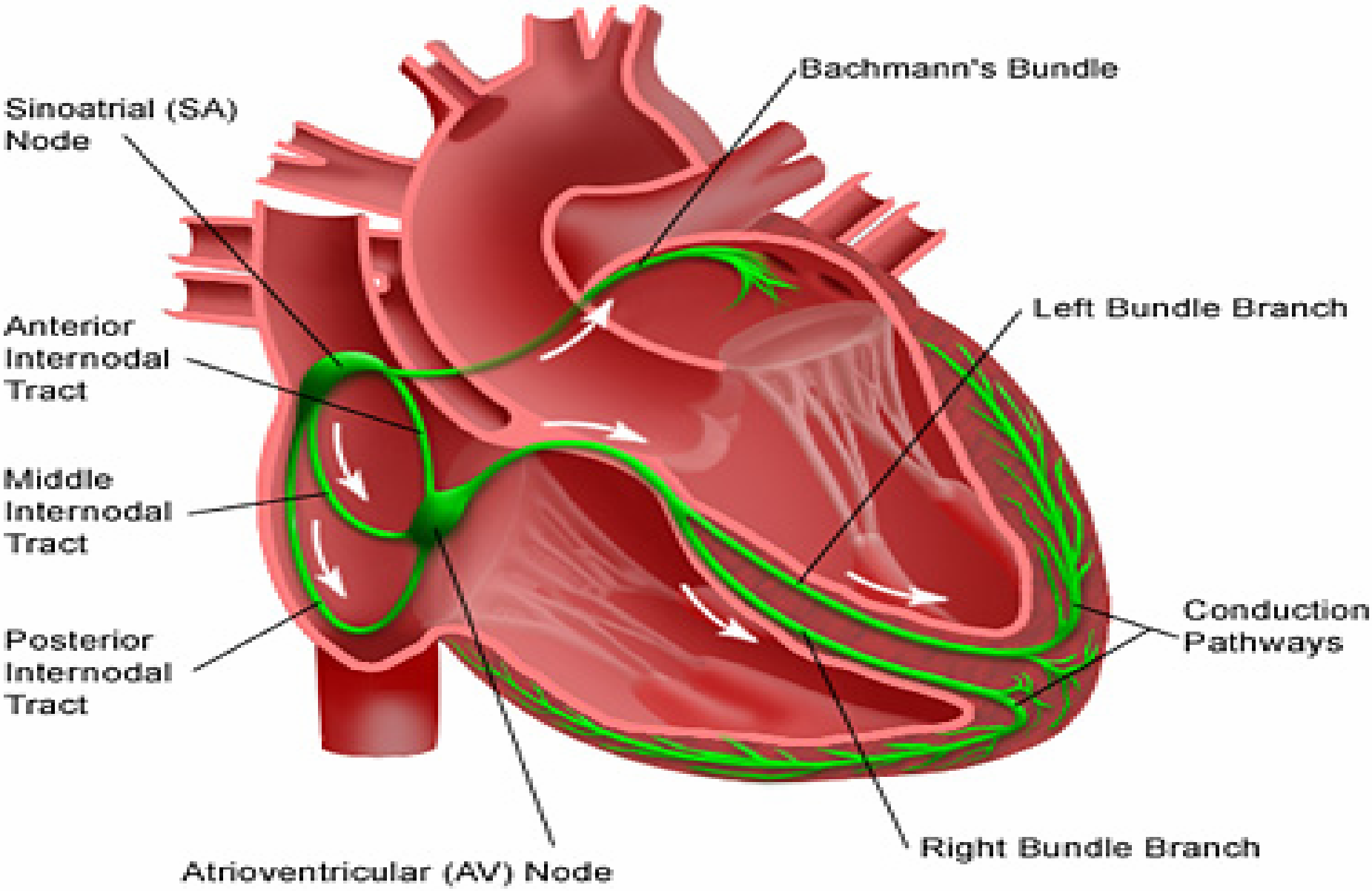
Sean Sutton
Dallas Wood

Objectives

At the end of this session, the paramedic will be able to:

- State the key components of the cardiac conduction pathway, along with the phases of the cardiac action potential.
- Describe the physiology, causes and treatments of various tachyarrhythmia's (including A-fib, A-flutter, PSVT and V-tach).
- Explain Wolf-Parkinson-White Syndrome.
- Apply the stable/unstable tachycardia protocols to various case studies

Electrical System of the Heart



SA Node…

- Located in right atrium
- Chief pacemaker of heart
- Intrinsic rate 60–100/min
- What will increase this rate ?
- What will decrease this rate ?
- Sinus dysrhythmias…

Internodal Pathways…

- Pathway from SA Node to AV node
- There are three
- Located in right atrium and the inter-atrial septum

AV Node…

- Located in right atrium
- Intrinsic rate 40–60/min
- Electrical gateway to the ventricles
- Slows conduction from atria to the ventricles, allowing for "atrial kick"
- Adenosine, a class V antidysrhythmic decreases automaticity in the AV node

AV Junction…

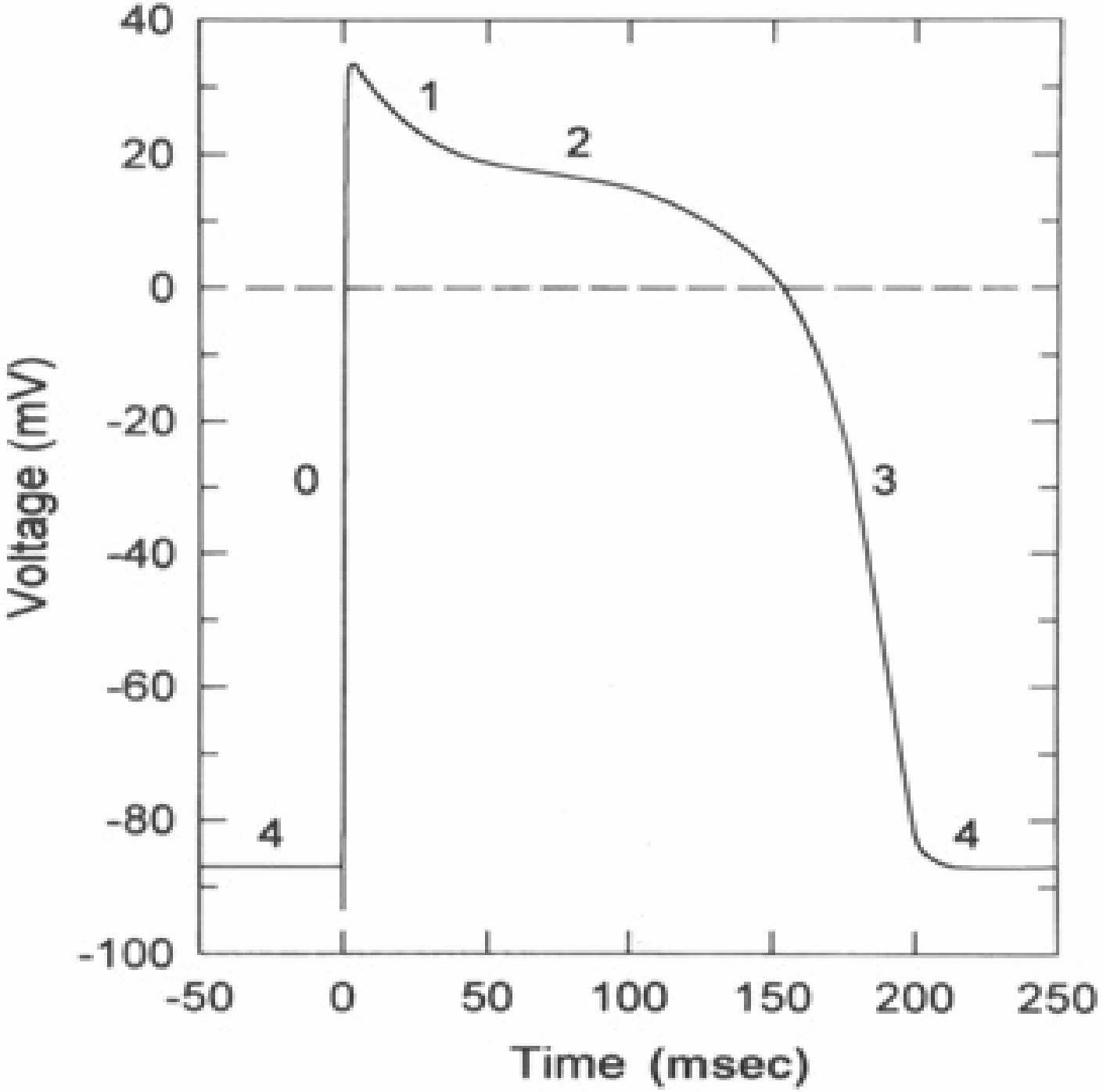
- Found partially in the walls of the right atrium, and in the interventricular septum
- Intrinsic rate 40–60/min
- “Bundle of His”
- The only normal route of communication between the atria and the ventricles

Right & Left Bundle Branches

- Located in interventricular septum
- Intrinsic rate 20–40/min
- RBB innervates the right ventricle
- LBB…

Purkinje System

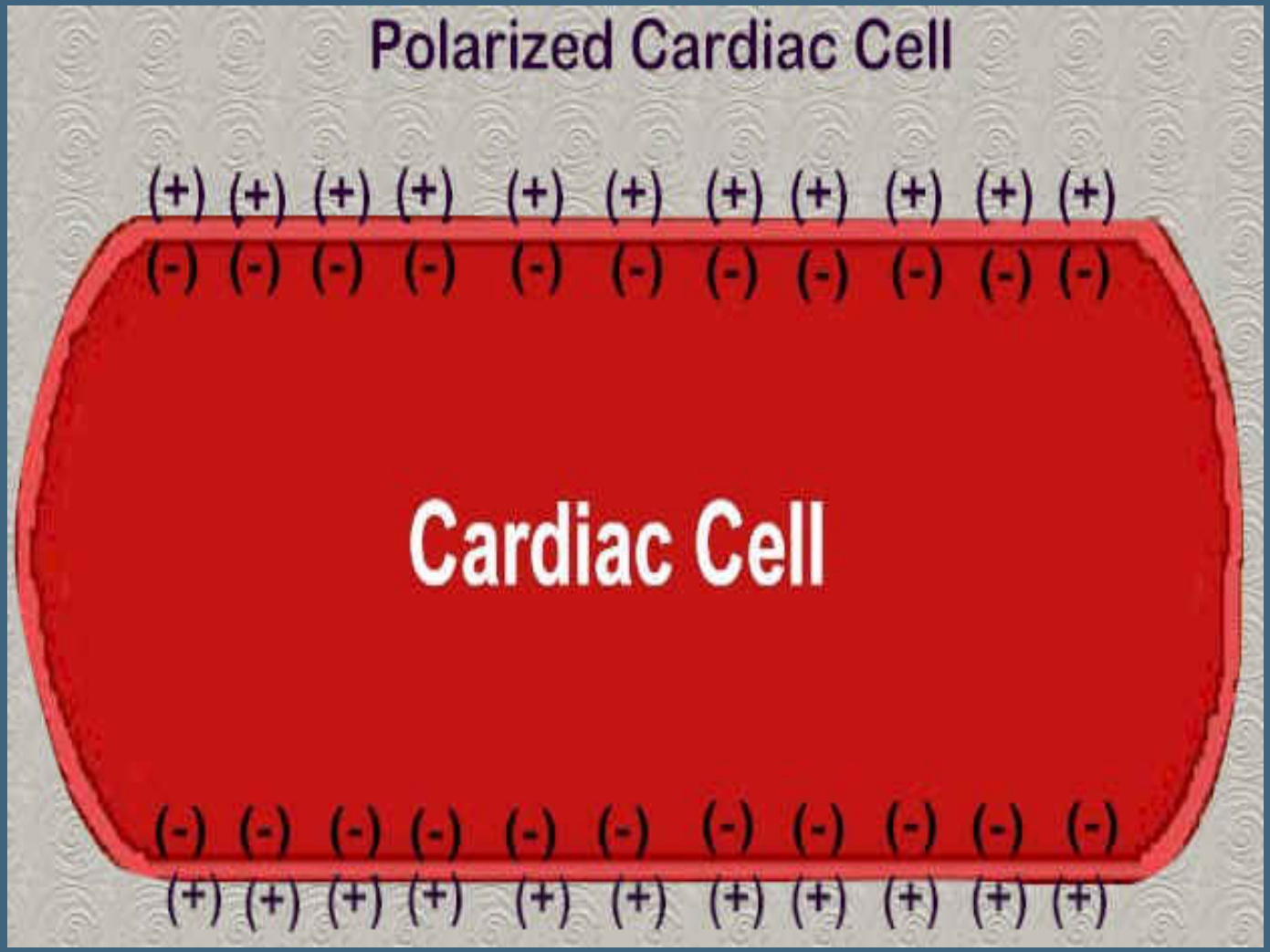
- Spread throughout the ventricular myocardium
- Intrinsic rate 20–30/min
- The Purkinje system is made up of individual cells.
- Purkinje fibers distribute the electrical excitation to the myocytes of the ventricles.
- Ventricles contract = heartbeat


40
20
0
-20
-40
-60
-80
-100
Voltage (mV)
-50
0
50
100
150
200
250
Time (msec)
0
1
2
3
4
4

Cardiac Action Potential

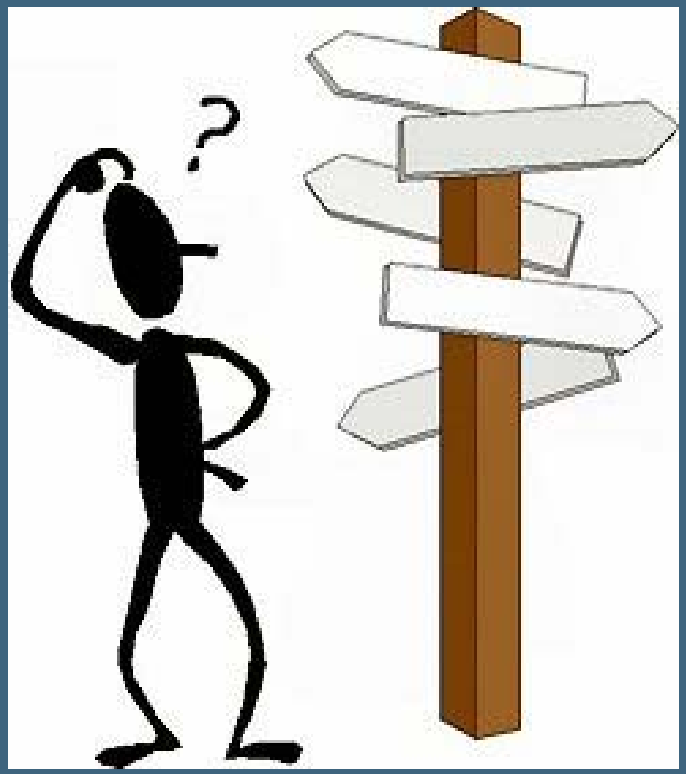
- Occurs when a stimulus is strong enough to cause a cardiac cell to reach threshold and depolarize, spreading form cell to cell and resulting in a heartbeat.
- Divided into 5 phases (0–4)
- When the cell is in its resting state, the electrical charge difference is the **resting membrane potential**
- Normally –70 to –90 mV
- Sodium ions rest on the outside of the cell, while potassium ions rest inside the cell.
- Sodium/potassium pumps
- Where is Calcium ?

Action Potential Cont…



Action Potential Cont…

- What about this refractory stuff ?
- Absolute vs. Relative refractory periods



Phase 0

- Rapid depolarization phase
- Represented as the rapid upstroke of the action potential, this occurs when the cell membrane reaches threshold potential
- Fast sodium channels open, resulting in the rapid entry of sodium into the cell
- Inside of the cell now more positive then the outside which leads to a muscular contraction
- Lidocaine is a sodium channel blocker

Phase 1

- Early rapid repolarization phase.
- Fast sodium channels close, therefore the flow of sodium into the cell stops
- Potassium continues to be lost from the cell, resulting in a decrease in the number of positive electrical charges inside of the cell
- Drop in membrane potential represented as a drop in action potential

Phase 2

- Plateau phase
- Calcium slowly enters the cell through the slow calcium channels, potassium continues to leave
- At the same time calcium is released from intracellular storage sites, which aids in the contraction process
- How do calcium channel blockers work ?

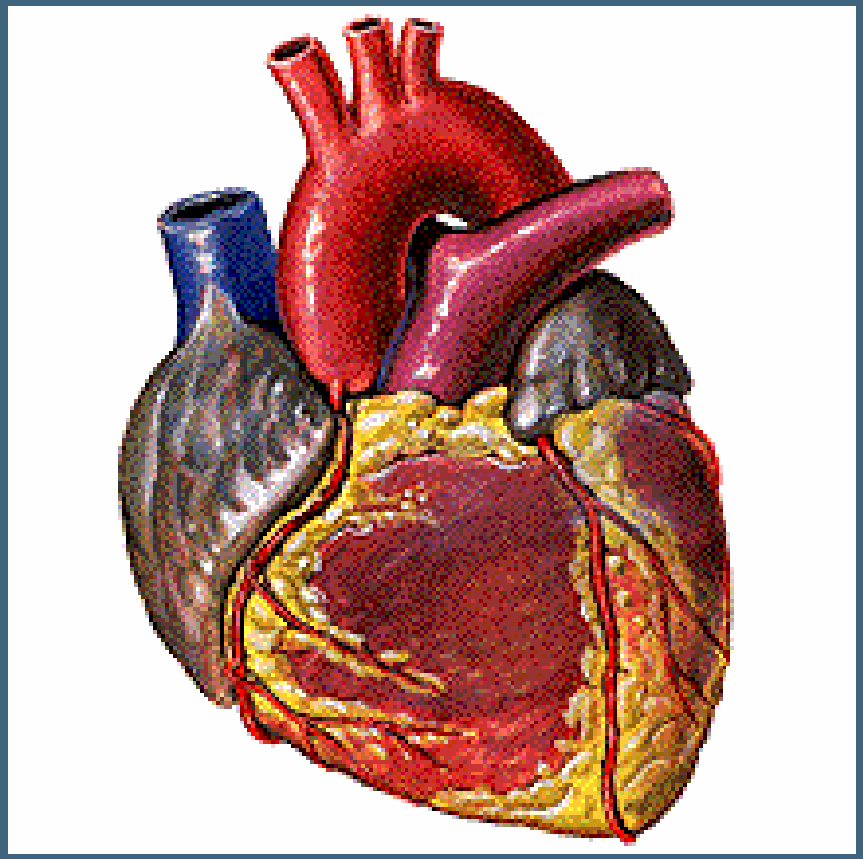
Phase 3

- Terminal phase of rapid repolarization
- Inside of the cell becomes negative
- Slow calcium channels close
- Outflow of potassium
- Repolarization ends
- Amiodarone is a Potassium channel blocker

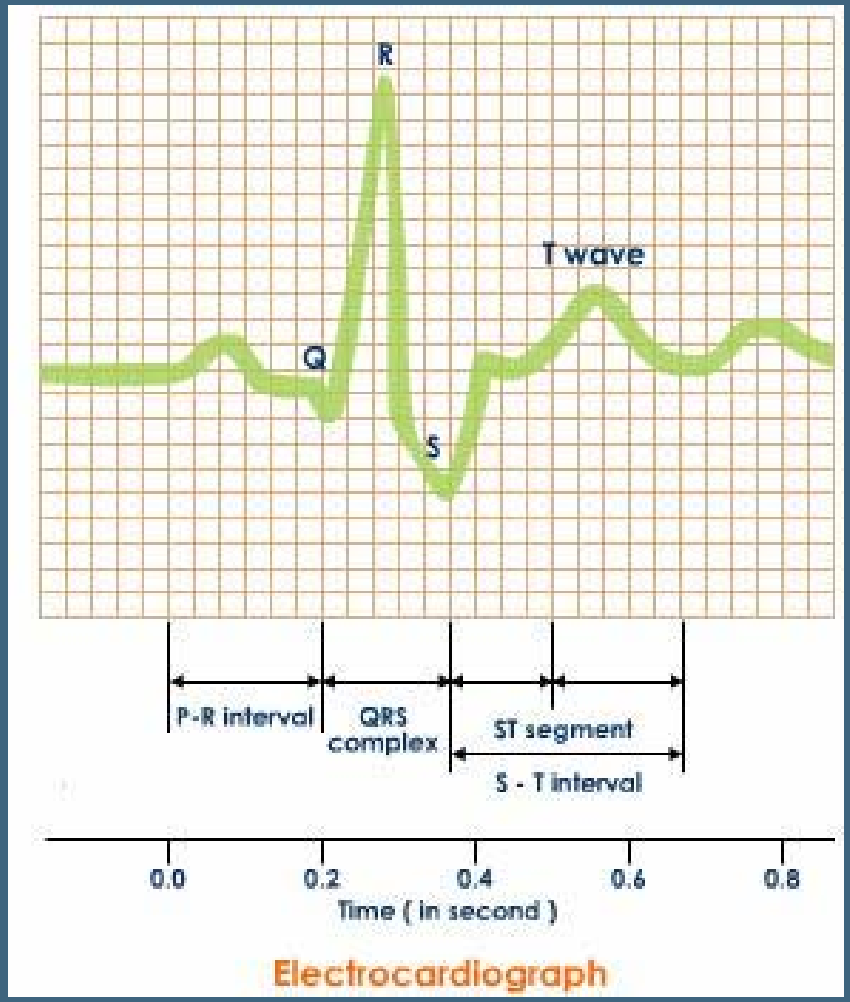
Phase 4

- Represents the period between action potentials
- Resting membrane potential
- Inside of the cell is negative, outside positive
- Still an excess of sodium inside and potassium outside of the cell
- Sodium-potassium exchange pumps are activated
- …results in ↑Na out & ↑K in
- Beta blockers diminish Phase 4 depolarization

…and it all results in a heart beat



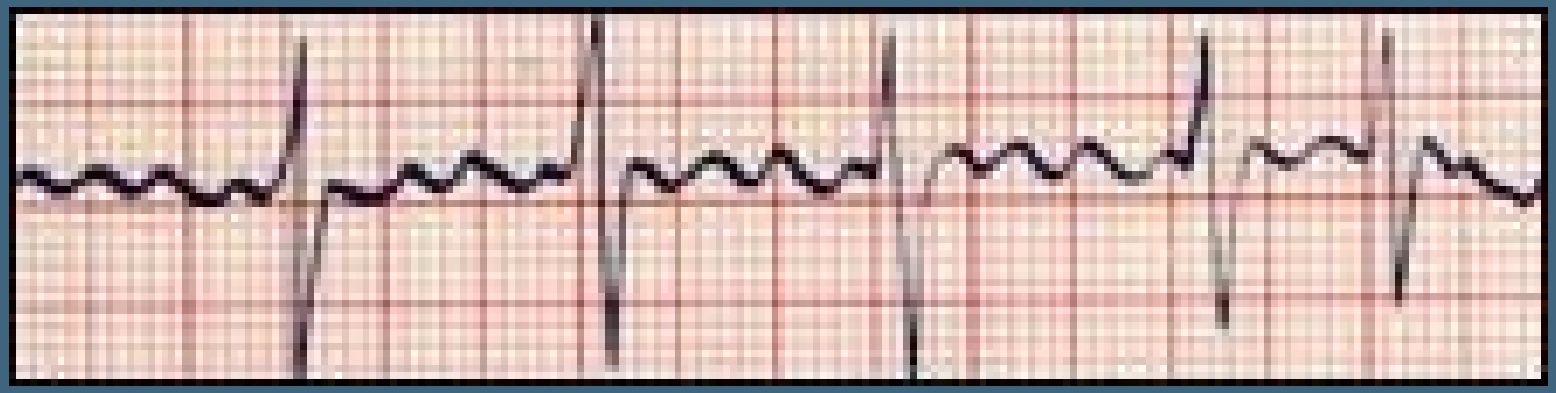
Which is represented on an ECG as…



Let's take a look @ some specific tachyarrhythmia's

Can you Identify the following Rhythms ?

What is the rhythm?



Atrial flutter

- Common dysrhythmia in middle aged & older adults who have heart disease
- Almost always the result of a rapid atrial re-entry focus
- Atrial rate 250-350 BPM
- Ventricular rate 125-175 BPM

A flutter cont…

- Usually manifests a 2:1 atrioventricular conduction
- 1:1 conduction rates can cause patients to become unstable very quickly
- No p waves, they are replaced by saw-toothed “f” waves
- Common causes include…
- Treatment is aimed @ controlling ventricular response by suppressing AV node conduction
- This includes…

What is the rhythm ?

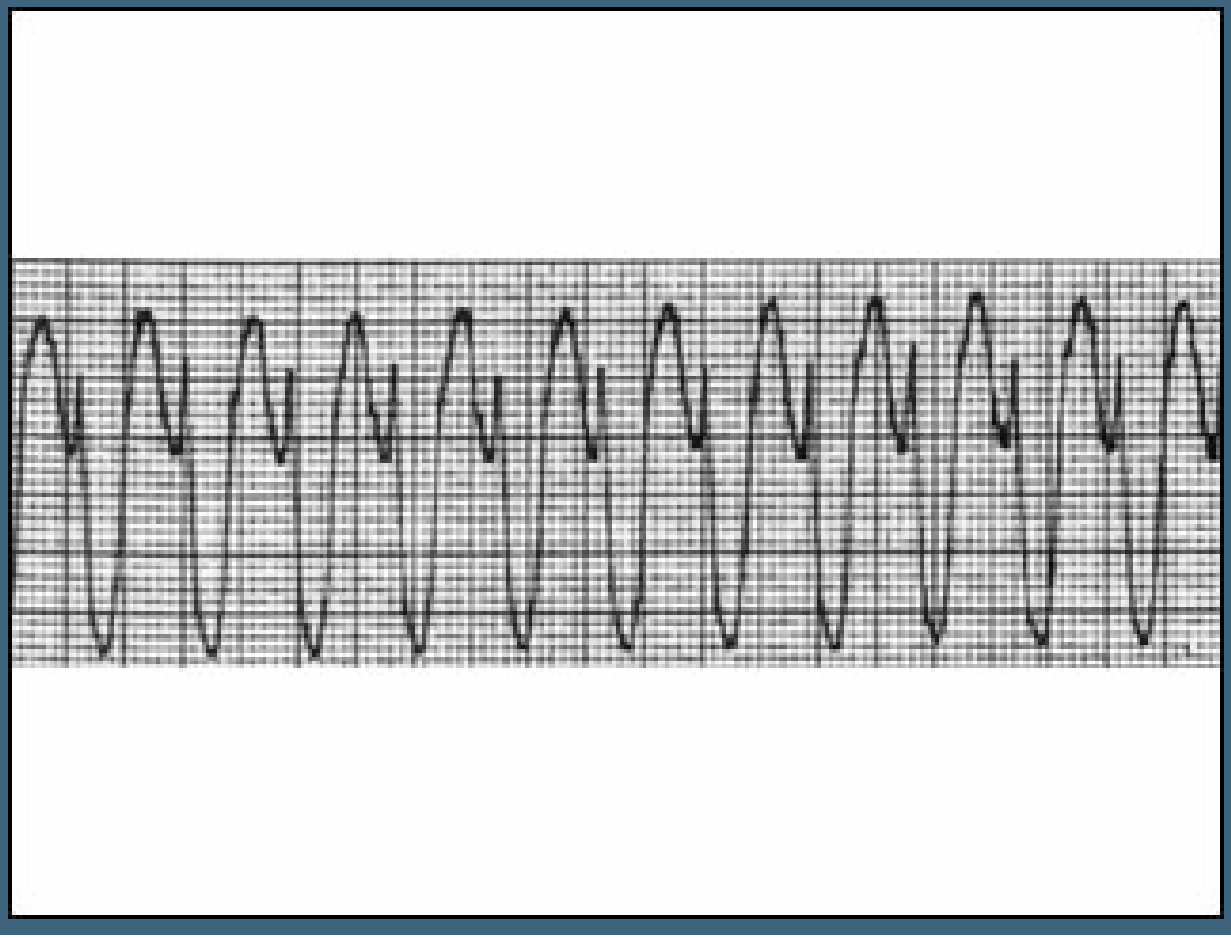
Atrial fibrillation

- Most common dysrhythmia seen in elderly patients
- Results from multiple areas of re-entry within the atria
- Multiple ectopic foci of atrial cells generate 350-450 impulses per minute
- This results in an irregular ventricular response, that's usually rapid
- Irregularly irregular
- Controlled vs. uncontrolled A fib

A fib cont…

- Common causes…
- Treatment similar to atrial flutter, this includes…
- ↑ risk of embolism formation if this rhythm is rapidly converted without the use of anticoagulant therapy, however unstable patients may need to be treated in the field.

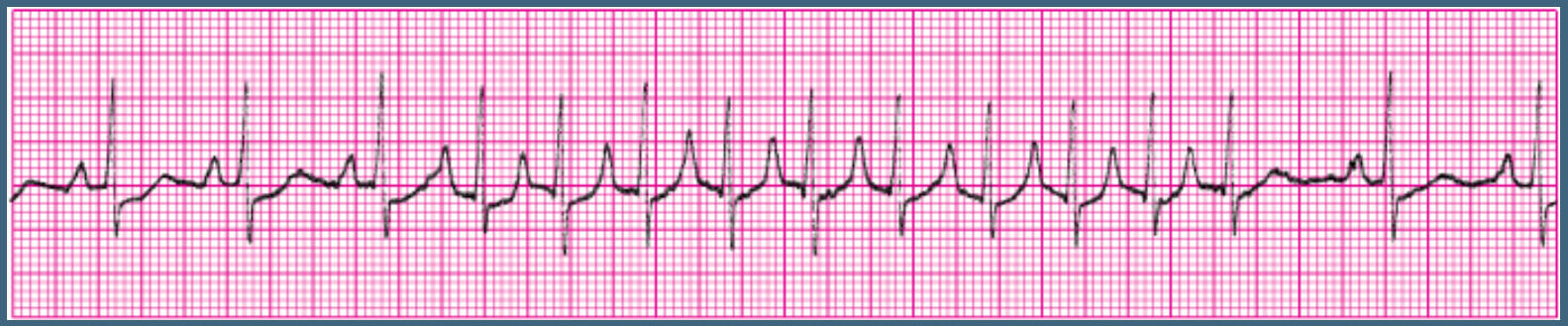
What is the rhythm ?



Ventricular tachycardia

- Triggered by premature ventricular complex
- Defined by 3 or more consecutive ventricular complexes occurring @ a rate ↑ 100 BPM
- Wide complex tachycardia
- Monomorphic vs. polymorphic
- Torsades de pointes ?
- Common causes include…
- Stable vs. unstable…
- Treatment ?

What is the rhythm ?



Paroximal supraventricular tachycardia

- Results from rapid atrial or junctional impulse firing that overrides the rate of the SA node
- Re-entry tachycardia
- Common rhythm associated with Wolf-Parkinson-White Syndrome
- Rate 150-250 BPM
- Stable vs. unstable…
- Treatment ?

What is the rhythm ?

Wolf Parkinson's White

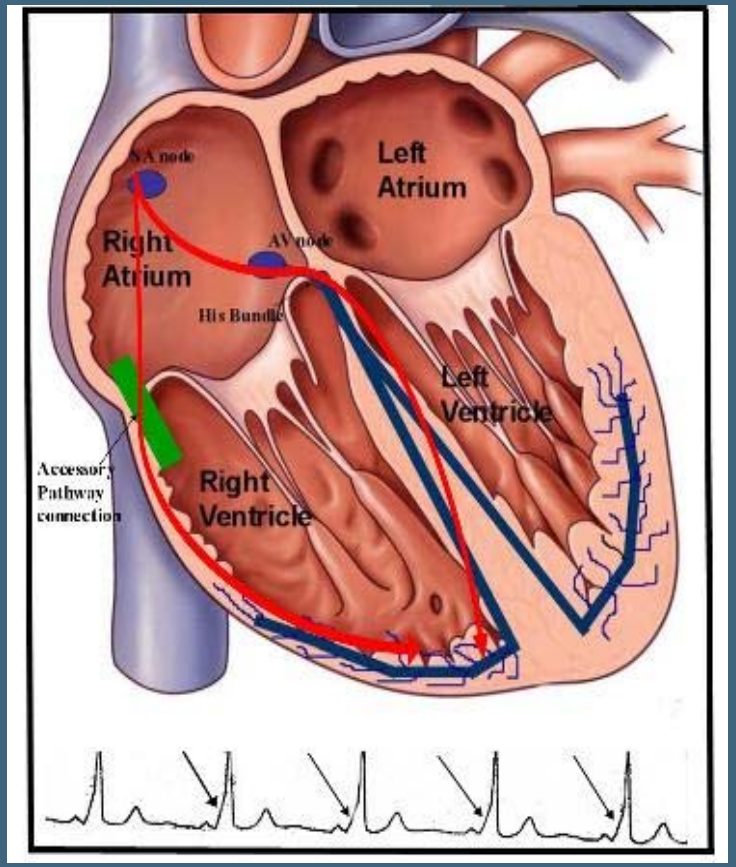
- Pre-excitation syndrome of the ventricles
- Accessory pathway (most common bundle of kent)
- Connects atria to ventricles bypassing AV node
- 1:1 Direct conduction from atria to ventricles with each impulse
- Most common arrhythmias are PSVT and atrial fibrillation

Who's affected

- 0.1 to 0.3% of population
- Most commonly recognized in children and young adults
- 60-70% of these individuals are male and have no evidence of heart disease
- Sudden death due to dysrhythmias 0-4% of patients
- Many patients are unaware of there underlying condition

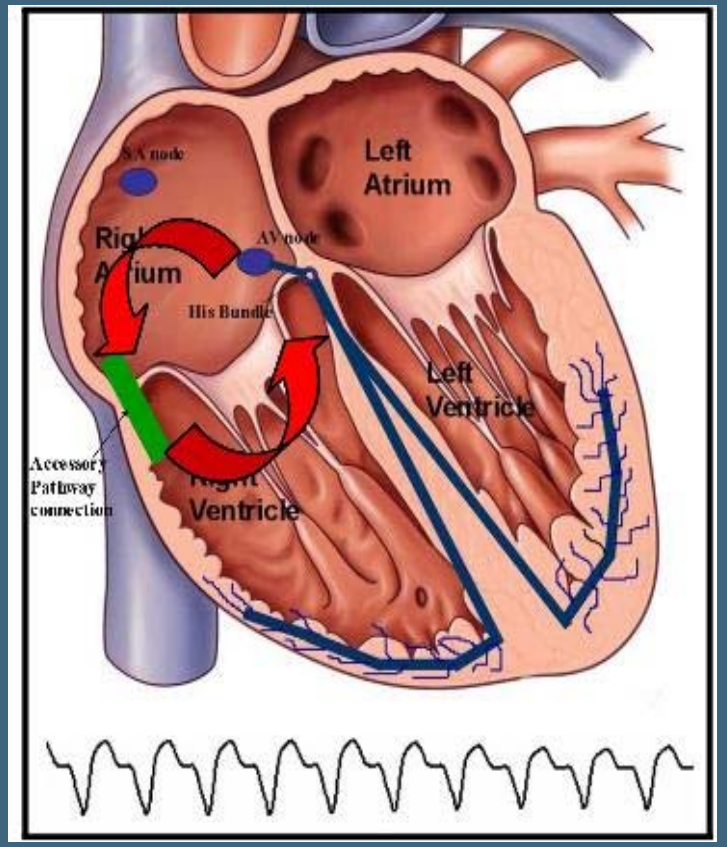
Diagnosis

- Diagnosis made from ECG monitoring in conjunction with history and physical examination
- Shortened PR interval (<0.12sec)
- Slurring & slow rise of initial upstroke of QRS complex (Delta wave)
- Depends on accessory pathway ECG can vary from classic to near normal



Antidromic Conduction

- Shorter refractory period of most pathways
- Impulse down Accessory pathway is used (anterograde) to stimulate ventricles.
- Preexcitation of ventricle
- Delta wave present
- QRS wide, rhythm faster & regular

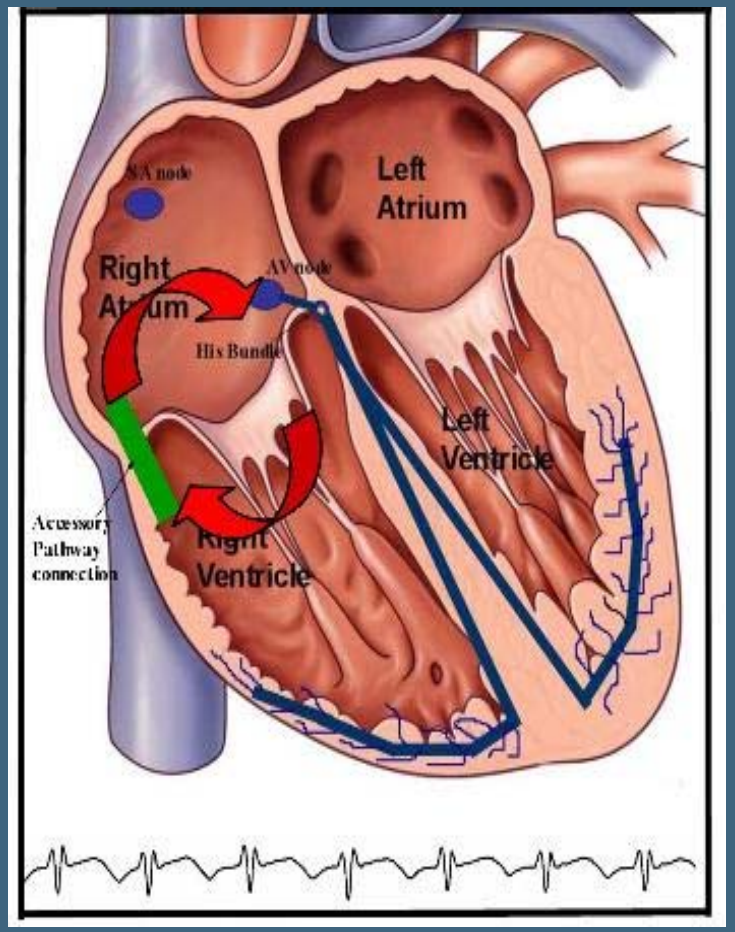


A-Fib

- AV reentrant tachycardia can disorganize into A-fib
- Very common incidence of 11-38%
- Deadliest arrhythmia for WPW patients
- Possibility of deterioration into V-Fib
- Atrial impulse can reach an accessory pathway at rate of 300-400 bpm
- 1:1 conduction to ventricles
- A-fib through accessory pathway appear bizarre, wide-complex, irregular tachycardia
- Rates often 250bpm or greater
- Hemodynamically unstable
- Treatment- cardioversion

Orthodromic Conduction

- Travels down intranodal pathway through AV node
- Retrograde back through accessory pathway (loop circuit)
- Narrow complex (psvt)
- Limited by AV node

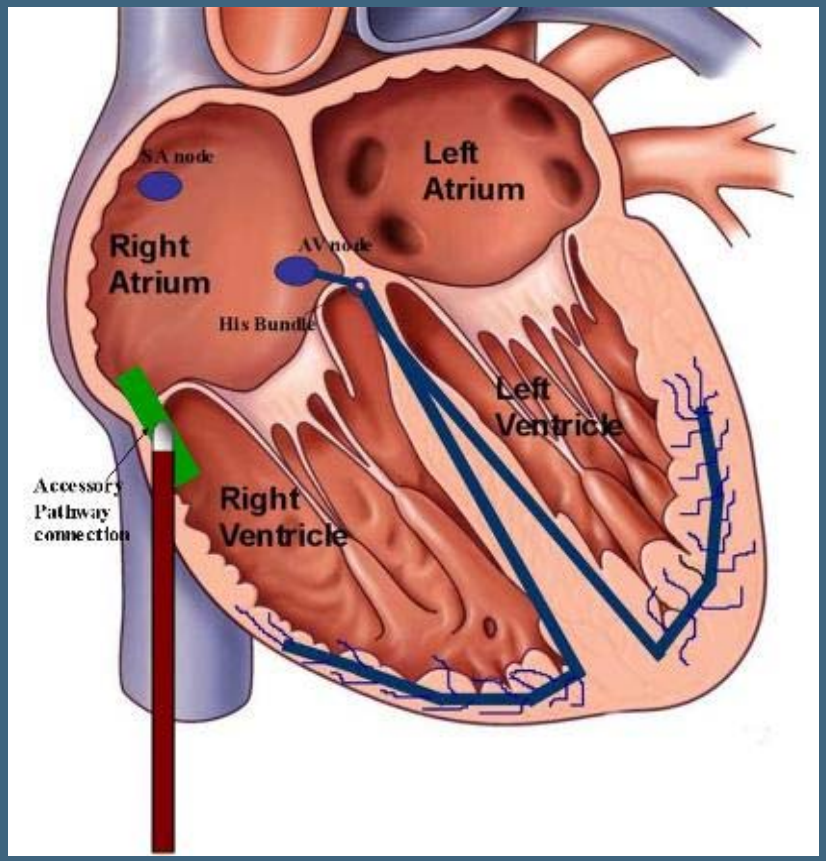


Signs & Symptoms

- History of rapid heart rate
- Palpitations
- Dizziness
- Weakness
- Hypotension
- Syncope
- Chest pain
- Cardiopulmonary compromise
- Potential cardiac arrest

Ablation Treatment

- Performed in an electrophysiology laboratory
- Intracardiac electrodes placed in heart via femoral veins
- Accessory pathway mapped with electrical guidance & fluoroscopic machine
- Radiofrequency energy via tip of catheter heats up & kills local cell tissue enough to eradicate cell function.
- Prevents further use of accessory pathway



Pre-hospital Treatment

- Degree of stability and specific dysrhythmia.
- Confirm by 12 lead
- Regular, narrow >150bpm - valsalva maneuver, Adenosine
- Regular, wide QRS > 0.2 seconds, > 120bpm- Amiodarone, lidocaine
- Assume any wide regular tachycardia v-tach until proven otherwise
- Unstable- cardioversion
- Most cases of regular wide tachycardia associated with WPW can be treated with adenosine and converted to NSR

Case study #1

- Called for a 7 year old patient with a history of WPW c/o ↑ palpitations with dizziness and mild SOB

Case study #1

A – patent

B – lung sounds clear, mild distress

C – rapid/weak radial pulse

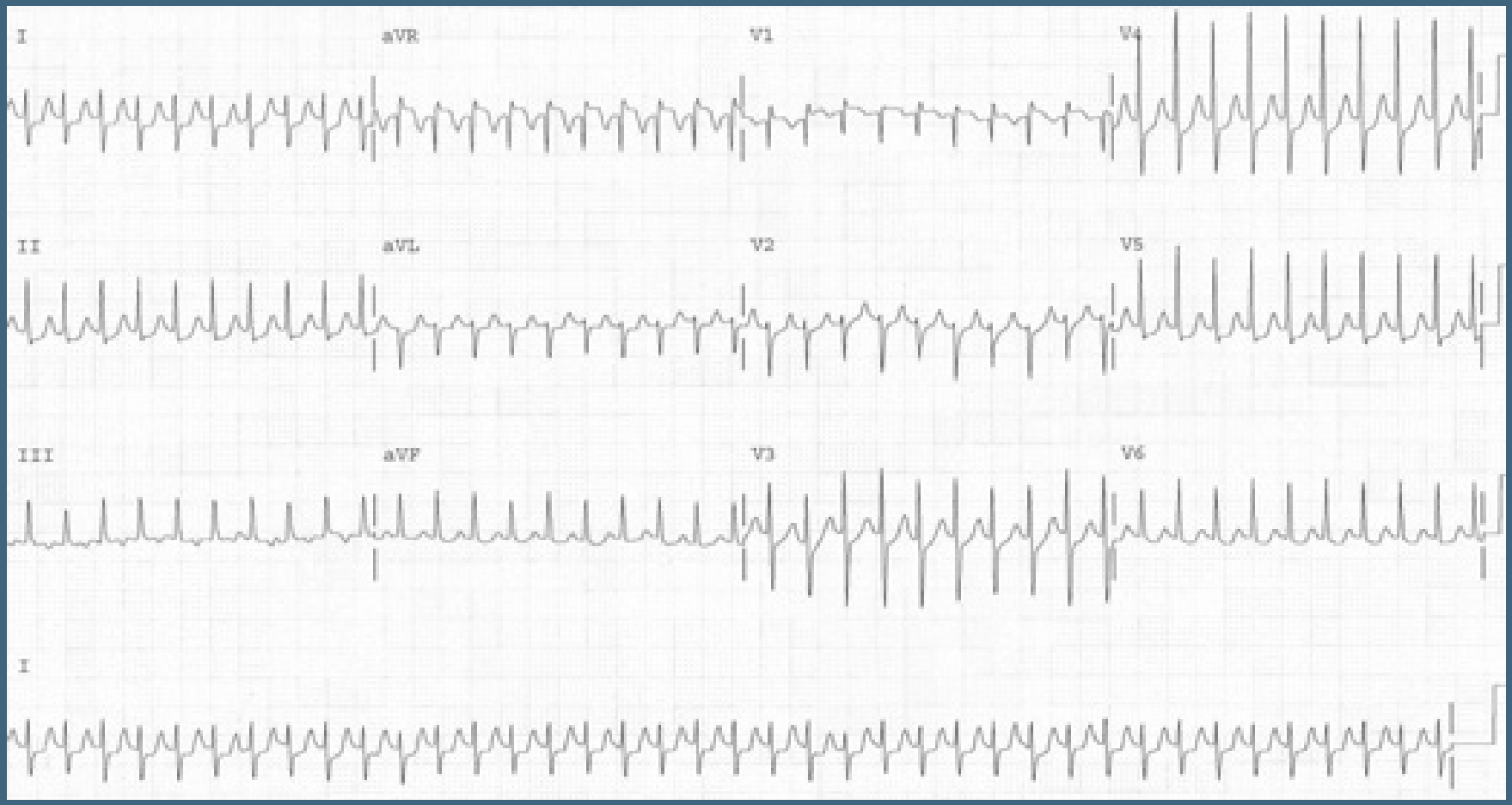
skin cool/pale/clammy

cap refill <3 secs

Case study #1

O2 applied via ped nrb
Cardiac monitor- 12 lead
IV initiation
vitals

Case study #1



Case study #1

Pulse – 180 BPM, regular/weak
Resps – 30, regular/shallow
BP – 90/52
Spo2 – 96%
Temp – 36.5˚C
GCS – 15
PEARRL

What Next ?

Case study #1

- BHP patch
- ? Valsalva
- ? Adenosine
- ? cardioversion

Case study #2

- Called to the Men's Mission for ↓ LOC
- Arrive to find a 51 yr old regular asleep under a tree
- Patient responds to loud voice prompts with eye opening & incomprehensible moaning
- Patient smells of Listerine with a half empty bottle beside him

Case study #2

A – patent

B – lung sounds clear, No obvious distress

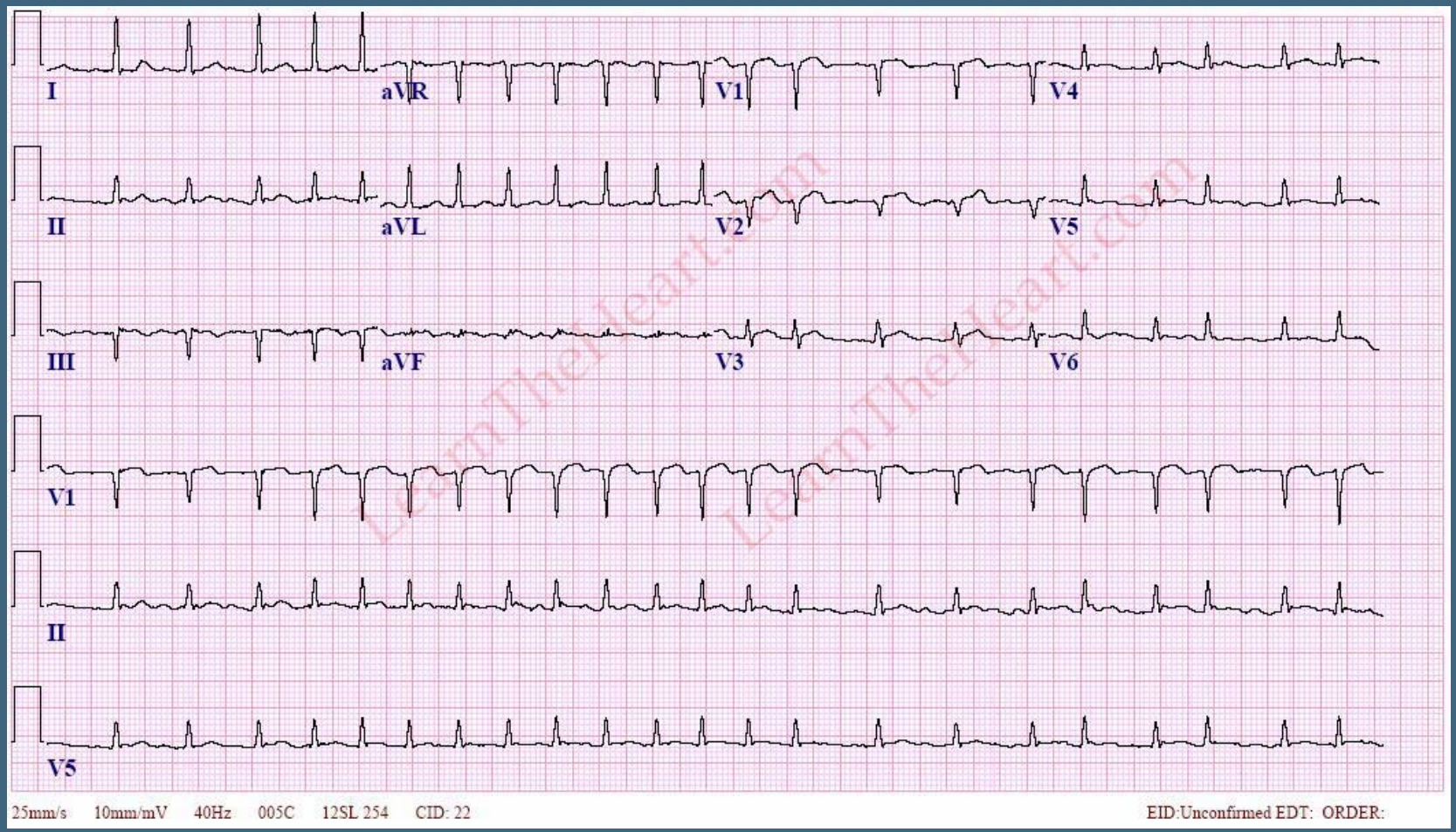
C – rapid/weak carotid pulse

CNO radial pulse

Case study #2

O2 applied NRB @ 12 L/min
Cardiac monitor- 12 lead
IV initiated
vitals

Case study #2


I
aVR
V1
V4
II
aVL
V2
V5
III
aVF
V3
V6
V1
II
V5
25mm/s 10mm/mV 40Hz 005C 12SL 254 CID: 22
EID:Unconfirmed EDT: ORDER:

Case study #2

Pulse – 193 irregular/weak
Resps – 10 regular/full
BP – 80/50
Spo2 – 92%
Temp – 35.5˚C
GCS – 9
PEARRL
Blood glucose – 7.2

Is this patient stable/unstable ?

Case study #2

- BHP patch
- ? Cardioversion
- ? Analgesia/sedation

The End