MRS.RAJESWARI.R
PROFESSOR
ICON

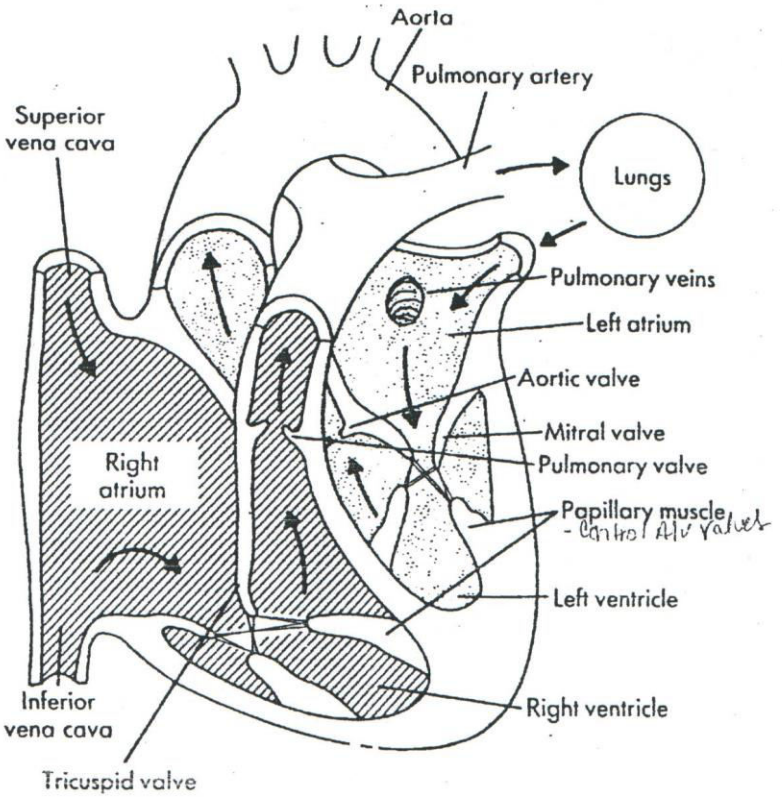
ARRYTHMIAS

Definition

- The term "arrhythmia" refers to any change from the normal sequence of electrical impulses. The electrical impulses may happen too fast, too slowly, or erratically – causing the heart to beat too fast, too slowly, or erratically.

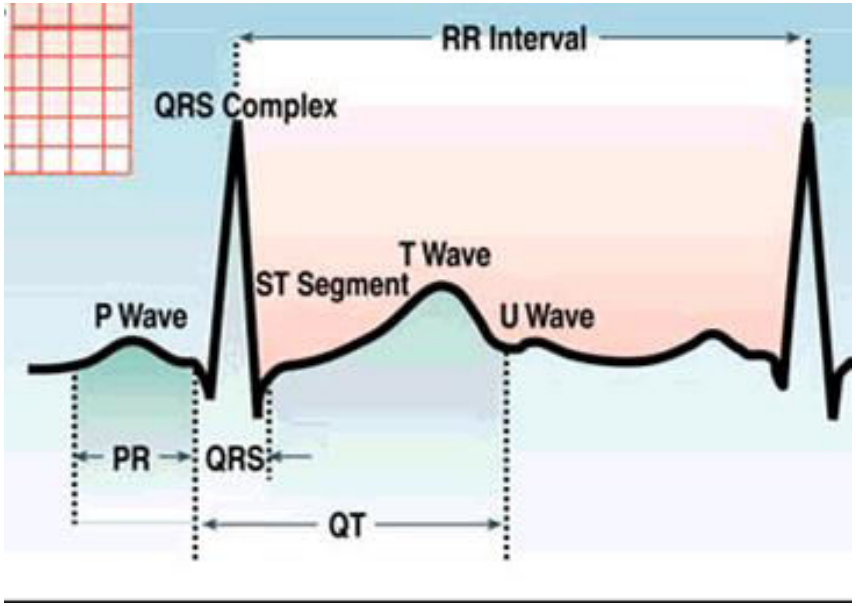
Anatomy & Physiology

- Blood Flow through heart
  - Superior and Inferior Vena Cava
  - Right Atrium
  - Right Ventricle
  - Pulmonary Artery
  - Lungs
  - Pulmonary Vein
  - Left Atrium
  - Left Ventricle
  - Aorta
  - Body



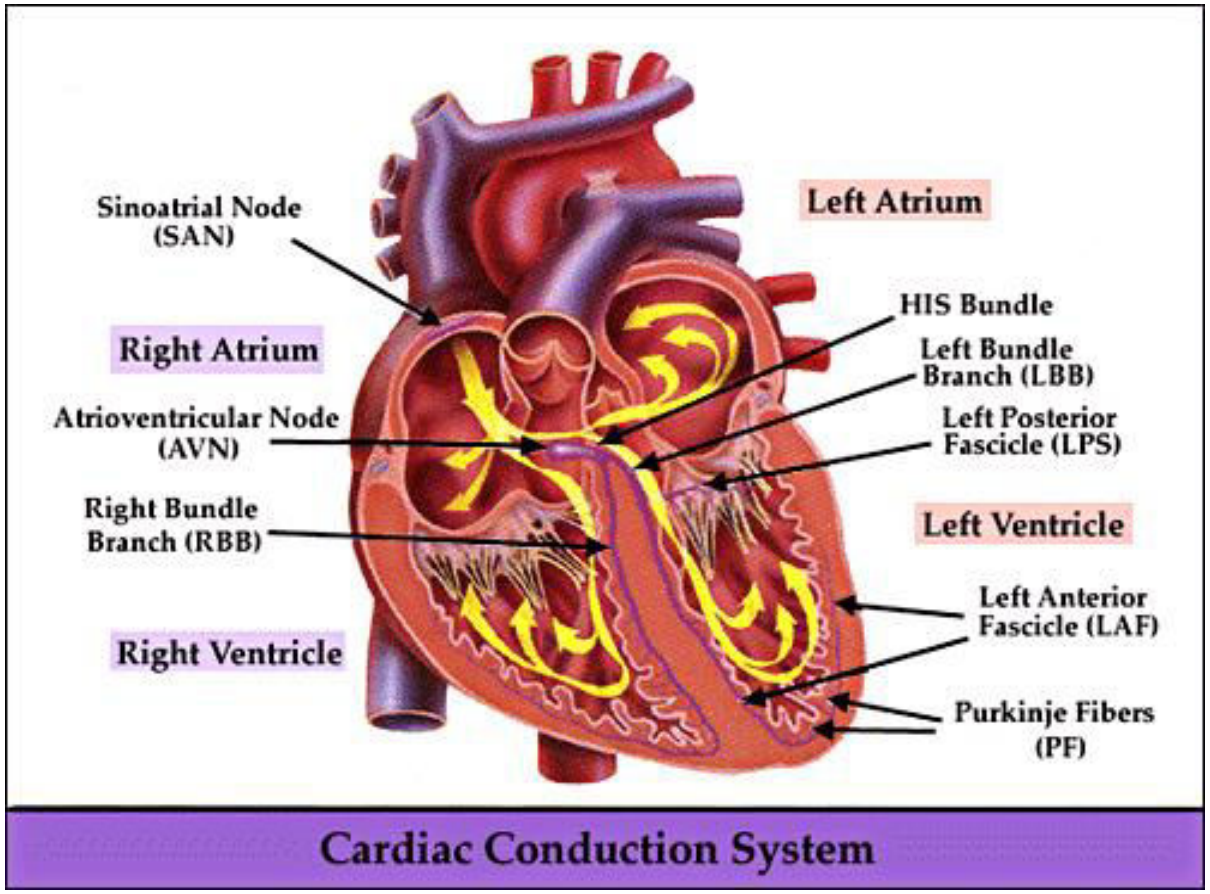
Conduction System

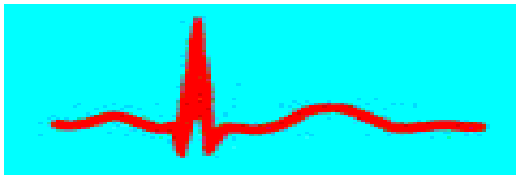
- The heart has a conduction system separate from any other system
- The conduction system makes up the PQRST complex
- An arrhythmia is a disruption of the conduction system



Conduction System

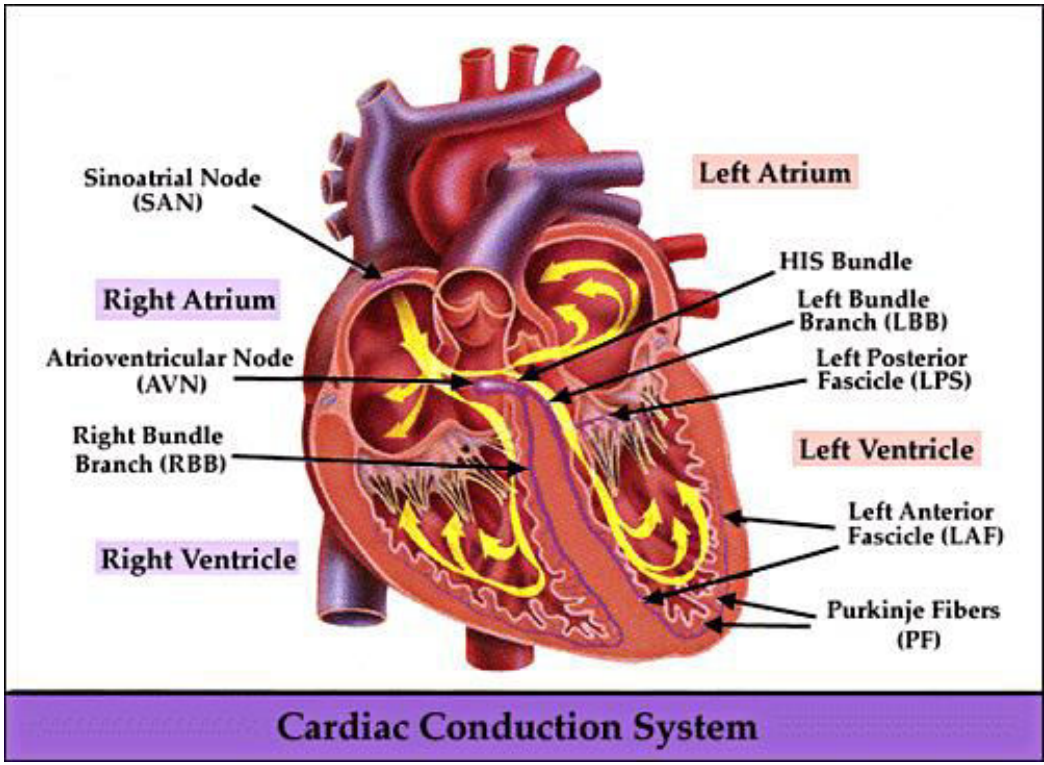
- SA Node
- Inter-nodal and inter-atrial pathways
- A-V Node
- Bundle of His
- Perkinje Fibers

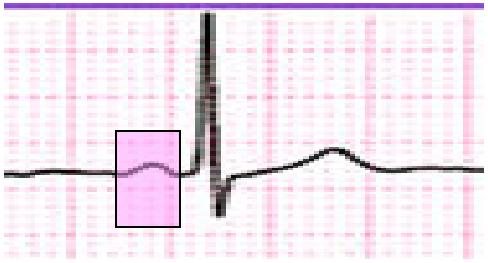




SA Node

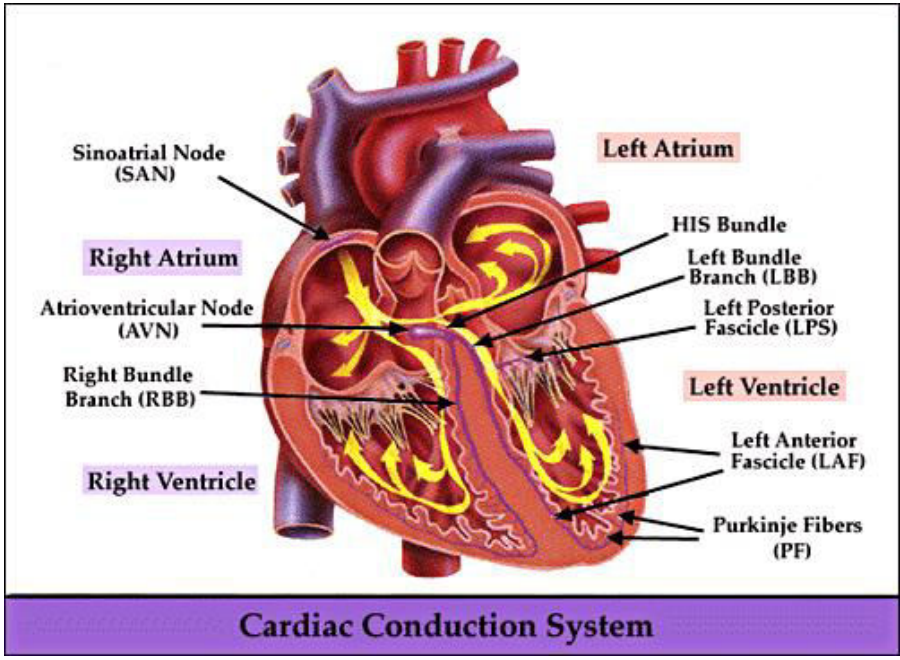
- The primary pacemaker of the heart
- Each normal beat is initiated by the SA node
- Inherent rate of 60-100 beats per minute
- Represents the P-wave in the QRS complex or atrial depolarization (firing)
- P wave <.12 sec, 2.5mm





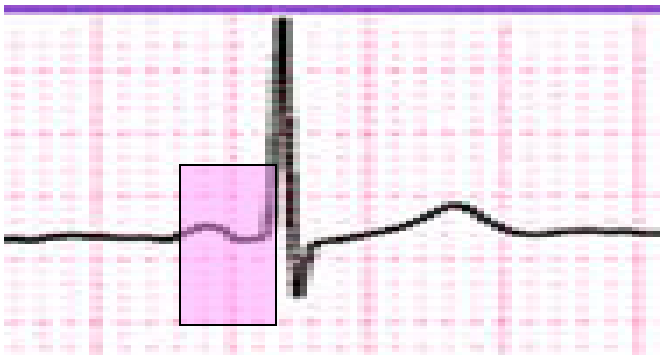
AV Node

- Located in the septum of the heart
- Receives impulse from inter-nodal pathways and holds the signal before sending on to the Bundle of His
- Represents the PR segment of the QRS complex



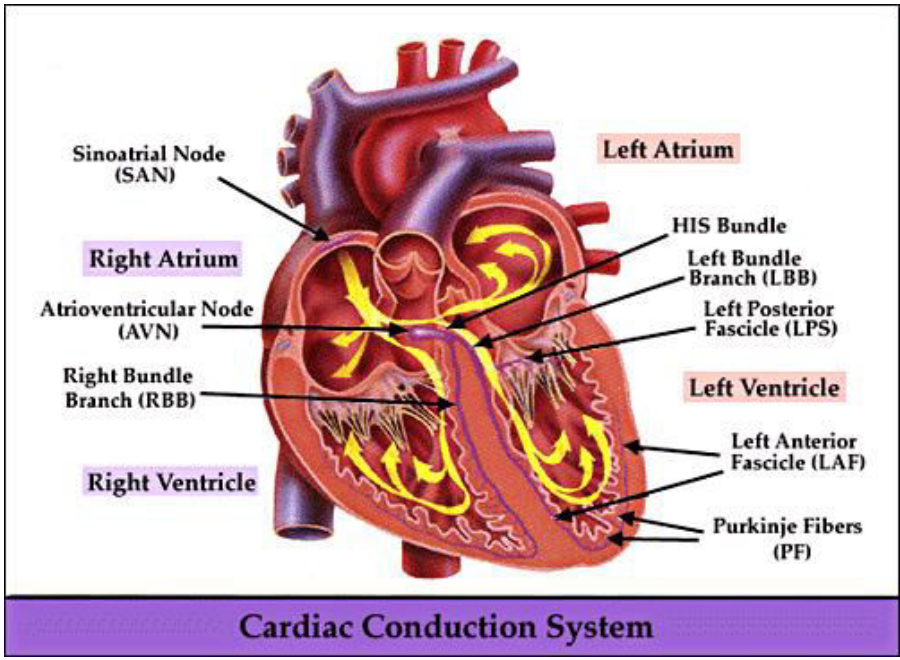
AV Node

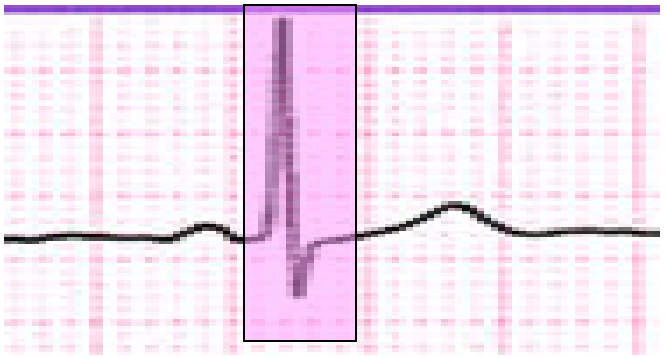
- Represents the PR segment of the cardiac cycle
- Has an inherent rate of 40-60 beats per minute
- Acts as a back up when the SA node fails
- Where all junctional rhythms originate



QRS Complex

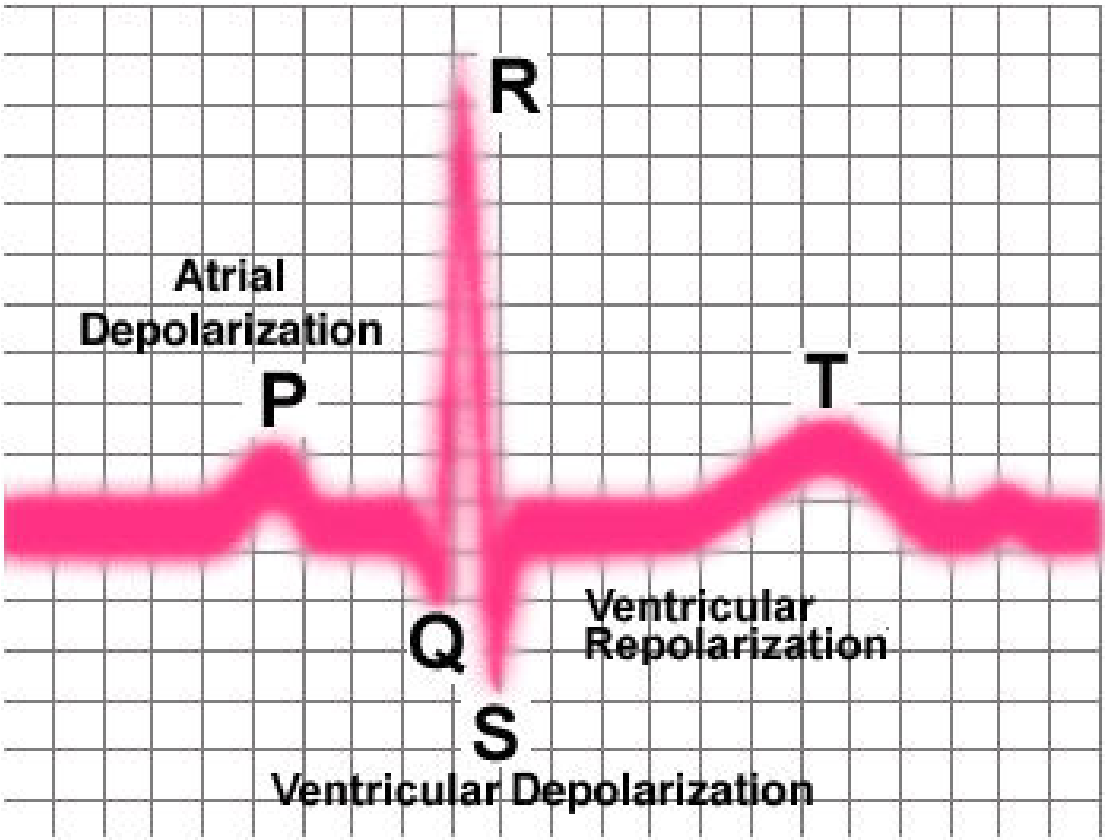
- Represents the ventricles depolarizing (firing) collectively. (Bundle of His and Perkinje fibers)
- Origin of all ventricular rhythms
- Has an inherent rate of 20-40 beats per minute





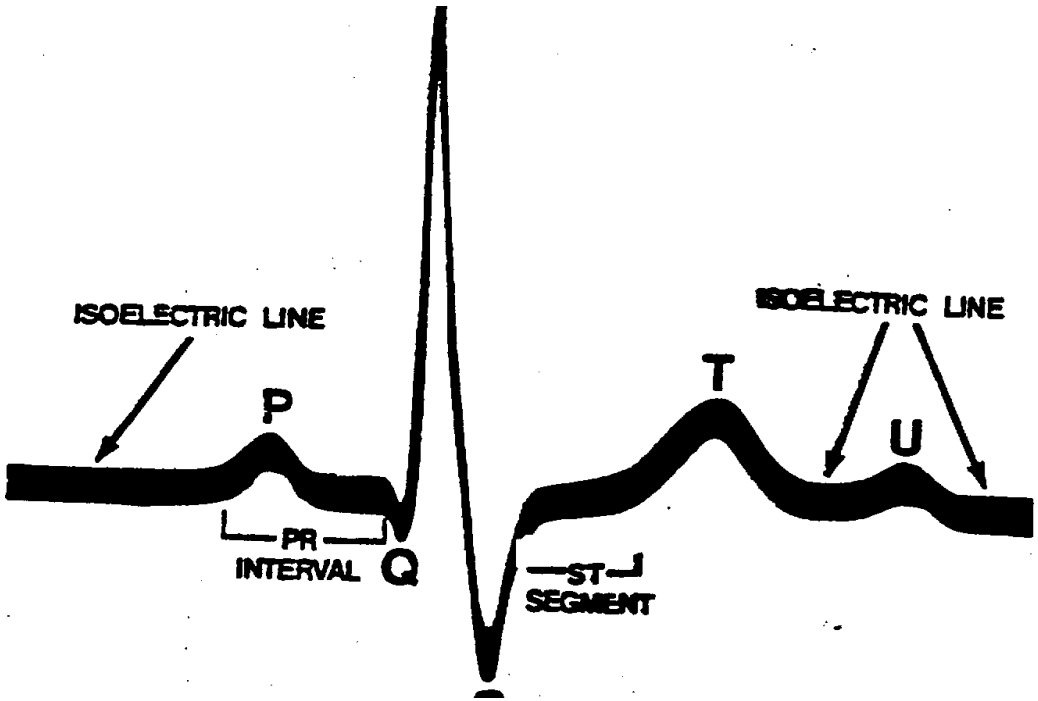
EKG Trace

- Isoelectric line (baseline)
- P-wave
  - Atria firing
- PR interval
  - Delay at AV



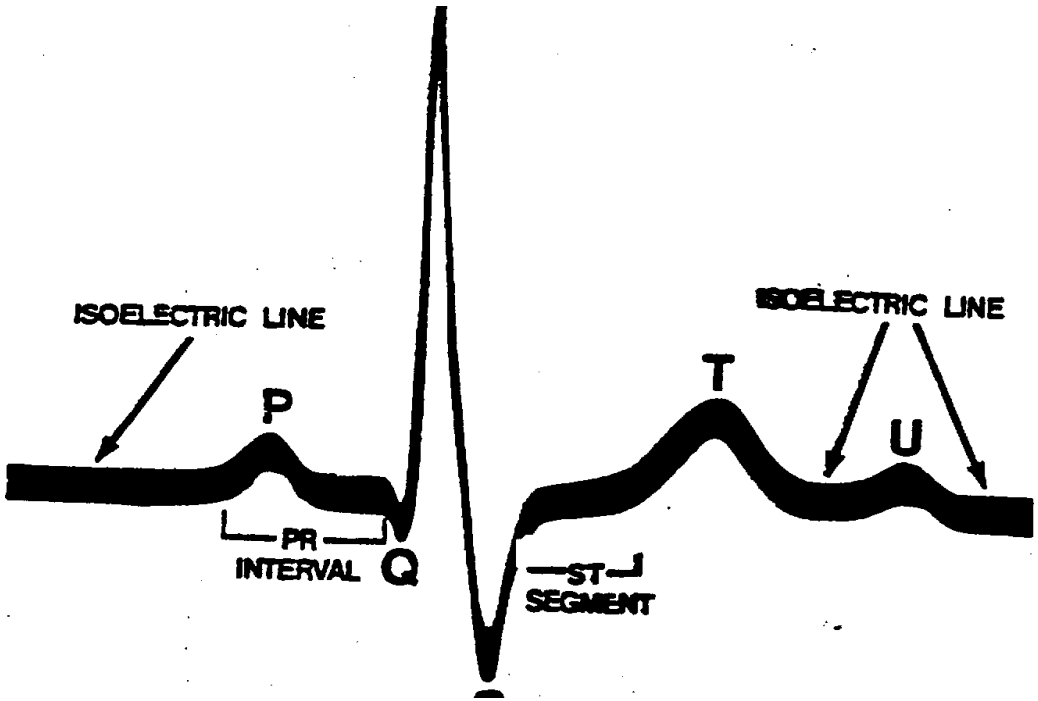
EKG Trace

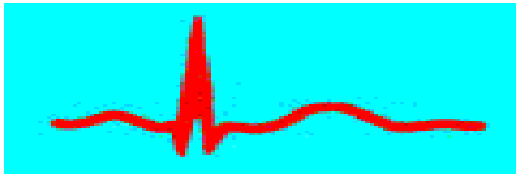
- QRS
  - Ventricles firing
- T-wave
  - Ventricles repolarizing



EKG Trace

- ST segment
  - Ventricle contracting
  - Should be at isoelectric line
  - Elevation or depression may be important
- U wave
  - Perkinje fiber repolarization?

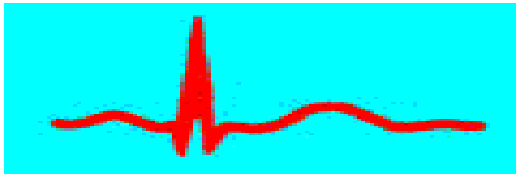




Waveform Analysis

– For each strip it is necessary to go through steps to correctly identify the rhythm

1. Is there a P-wave for every QRS?
   - P-waves are upright and uniform
   - One P-wave preceding each QRS
2. Is the rhythm regular?
   - Verify by assessing R-R interval
   - Confirm by assessing P-P interval
3. What is the rate?
   - Count the number of beats occuring in one minute
   - Counting the p-waves will give the atrial rate
   - Counting QRS will give ventricular rate

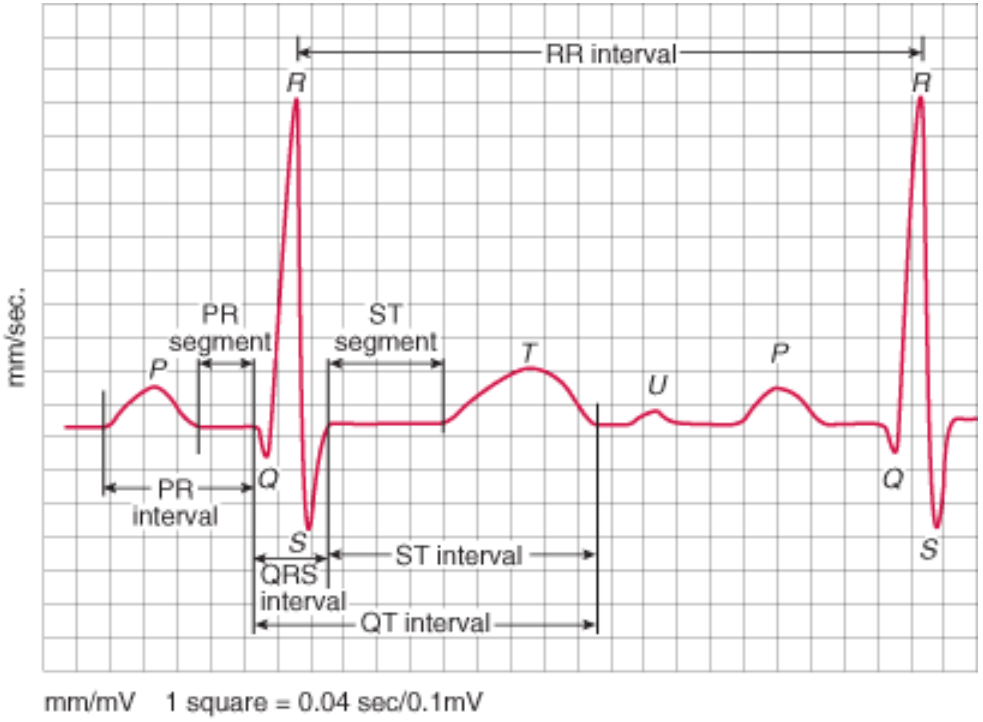


Summary

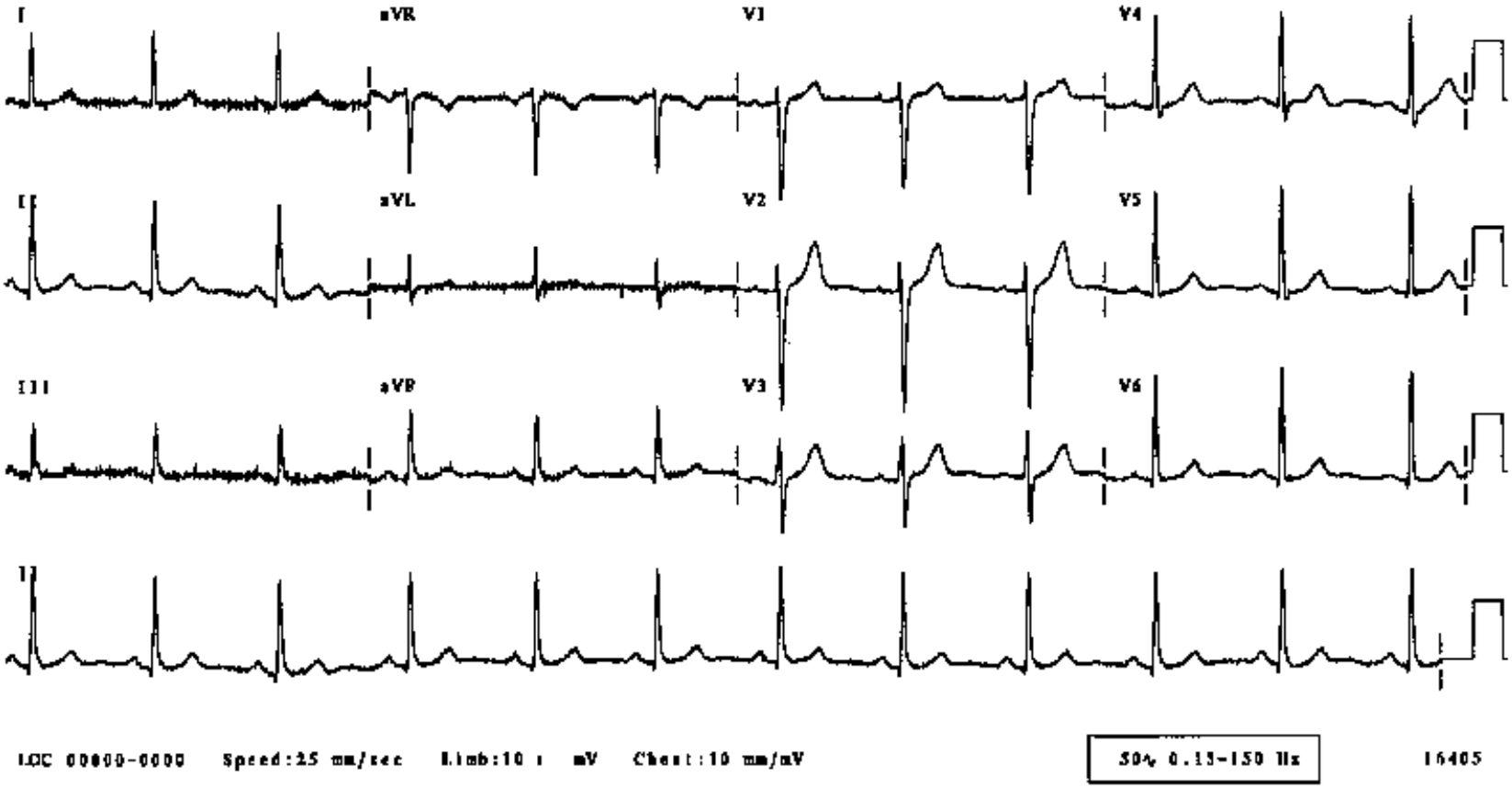
- Normal
  - Heart rate = 60 – 100 bpm
  - P wave = <0.12, 2.5 mm
  - PR interval = 0.12 – 0.20 sec
  - QRS interval <0.12
  - T wave = <0.12 , 2.0-3.5 mm
  - SA Node discharge = 60 – 100 / min
  - AV Node discharge = 40 – 60 min
  - Ventricular Tissue discharge = 20 – 40 min

Normal Intervals

- PR
  - 0.20 sec (less than one large box)
- QRS
  - 0.08 – 0.10 sec (1-2 small boxes)
- QT
  - 0.36 to .45 sec in men, .46 sec in women
  - Based on sex / heart rate
  - Half the R-R interval with normal HR



Sinus rhythm



Sinus Rhythms

Normal Sinus Rhythm

Heart Rate	Rhythm	P Wave	PR Interval (sec.)	QRS (Sec.)
60 - 100	Regular	Before each QRS, Identical	.12 - .20	<.12

Sinus Rhythms

Sinus Bradycardia

Heart Rate	Rhythm	P Wave	PR Interval (sec.)	QRS (Sec.)
<60	Regular	Before each QRS, Identical	.12 - .20	<.12

Sinus Rhythms

Sinus Tachycardia

Heart Rate	Rhythm	P Wave	PR Interval (sec.)	QRS (Sec.)
>100	Regular	Before each QRS, Identical	.12 - .20	<.12

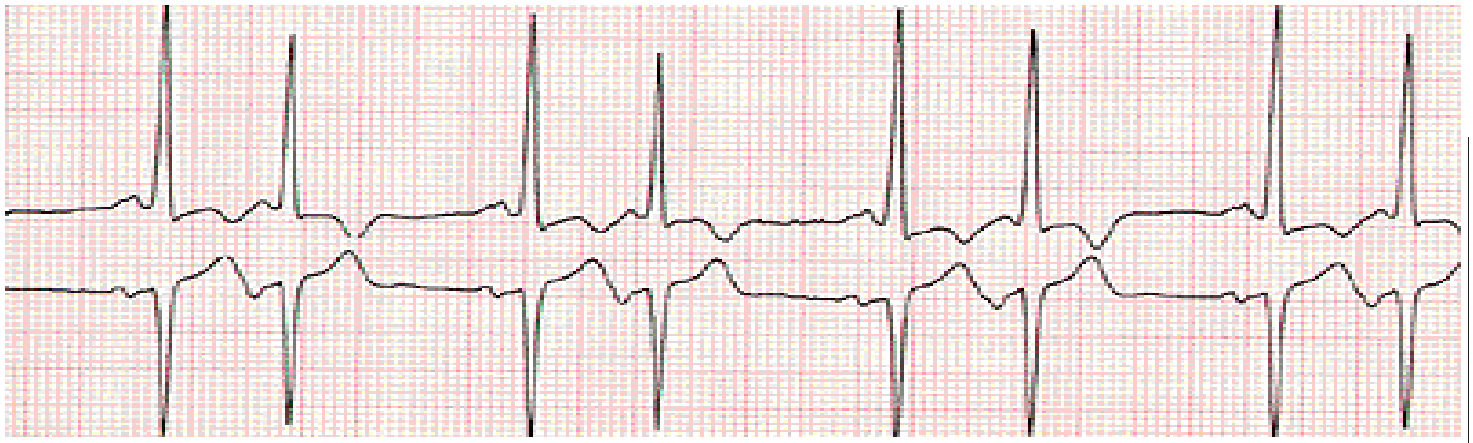
Sinus Rhythms

Sinus Arrhythmia

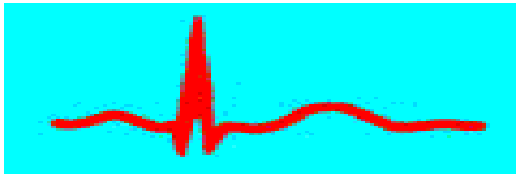
Heart Rate	Rhythm	P Wave	PR Interval (sec.)	QRS (Sec.)
Var.	Irregular	Before each QRS, Identical	.12 - .20	<.12

Atrial Rhythms

Premature Atrial Contraction (PAC)

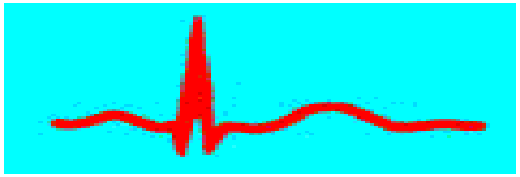


Heart Rate	Rhythm	P Wave	PR Interval (sec.)	QRS (Sec.)
NA	Irregular	Premature & abnormal or hidden	.12 - .20	<.12



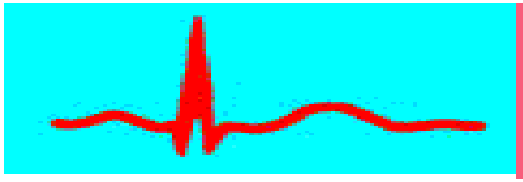
Atrial Rhythms

- Atrial Fibrillation (con’t)
  - **Often a chronic condition**, medical attention only necessary if patient becomes symptomatic
  - Patient will report history of atrial fibrillation.



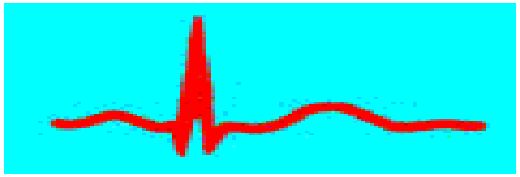
Atrial Rhythms

- Atrial Flutter
  - Atrial flutter is classified as a ratio of p-waves per QRS complexes (ex: 3:1 flutter 3 p-waves for each QRS)
  - Not considered life threatening, consult physician is patient symptomatic



Ventricular Rhythms

- Ventricular Tachycardia
  - *No discernable p-waves with QRS*
  - Rhythm is regular
  - Atrial rate cannot be determined, ventricular rate is between 150-250 beats per minute.
  - Must see 4 beats in a row to classify as v-tach



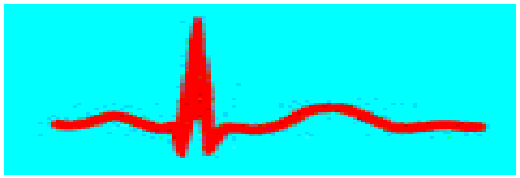
Ventricular Rhythms

- Ventricular Tachycardia
  - **THIS IS A DEADLY RHYTHM**
    - Check patient:
      - If patient awake and alert, monitor patient and call physician
      - If patient has no vital signs, call code and start CPR
        - » Defibrillate

Ventricular Rhythms

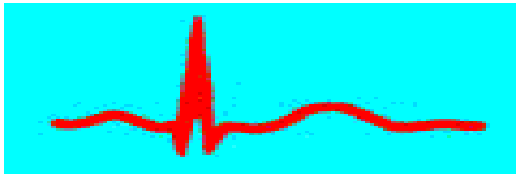
Ventricular Fibrillation

Heart Rate	Rhythm	P Wave	PR Interval (sec.)	QRS (Sec.)
0	Chaotic	None	NA	None



Ventricular Rhythms

- Ventricular Fibrillation
  - *No discernable p-waves*
  - *No regularity*
  - *Unable to determine rate*
  - *Multiple irritable foci within the ventricles all firing simultaneously*
  - *May be coarse or fine*
  - **This is a deadly rhythm**
    - Patient will have no pulse
    - Call a code and begin CPR



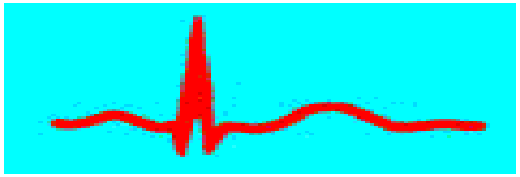
Asystole

- *No p-waves*
- *No regularity*
- *No Rate*
- **This rhythm is associated with death**
  - Check patient and leads
  - No pulse
- Begin CPR

Heart Block

First Degree Heart Block

Heart Rate	Rhythm	P Wave	PR Interval (sec.)	QRS (Sec.)
Norm.	Regular	Before each QRS, Identical	> .20	<.12

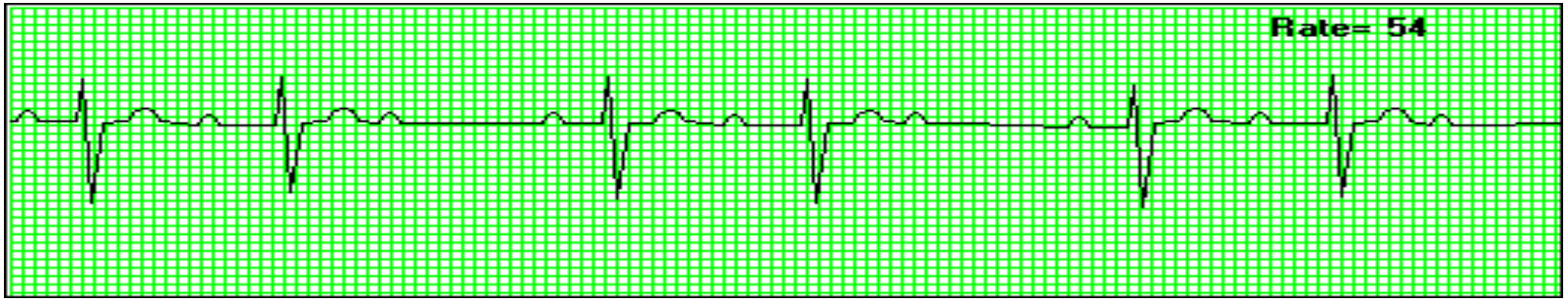


Heart Block

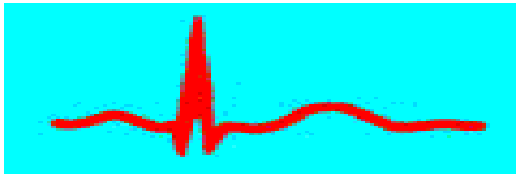
- First Degree Heart Block
  - P-wave for every QRS
  - Rhythm is regular
  - Rate may vary
  - *Av Node hold each impulse longer than normal before conducting normally through the ventricles*
  - *Prolonged PR interval*
    - *Looks just like normal sinus rhythm*

Heart Block

Second Degree Heart Block
Mobitz Type I (Wenckebach)



Heart Rate	Rhythm	P Wave	PR Interval (sec.)	QRS (Sec.)
Norm. can be slow	Irregular	Present but some not followed by QRS	Progressively longer	<.12



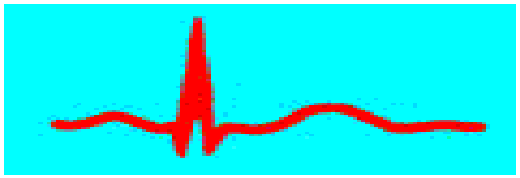
Heart Block

- Second Degree Heart Block
- Mobitz Type I (Wenckebach)
  - *Some p-waves are not followed by QRS complexes*
  - Rhythm is irregular
    - R-R interval is in a pattern of grouped beating
  - Rate 60-100 bpm
  - *Intermittent Block at the AV Node*
    - *Progressively prolonged p-r interval until a QRS is blocked completely*

Heart Block

Second Degree Heart Block
Mobitz Type II (Classical)

Heart Rate	Rhythm	P Wave	PR Interval (sec.)	QRS (Sec.)
Usually slow	Regular or irregular	2 3 or 4 before each QRS, Identical	.12 - .20	<.12 depends



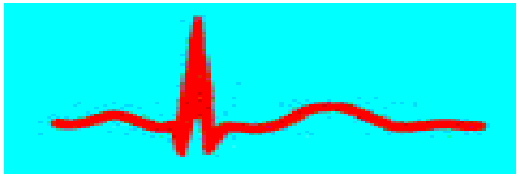
Heart Block

- Second Degree Heart Block
- Mobitz Type II (Classical)
  - *More p-waves than QRS complexes*
  - *Rhythm is irregular*
  - *Atrial rate 60-100 bpm; Ventricular rate 30-100 bpm (depending on the ratio on conduction)*
  - *Intermittent block at the AV node*
    - *AV node normally conducts some beats while blocking others*

Heart Block

Third Degree Heart Block (Complete)

Heart Rate	Rhythm	P Wave	PR Interval (sec.)	QRS (Sec.)
30 – 60	Regular	Present but no correlation to QRS may be hidden	Varies	<.12 depends



Heart Block

- Third Degree Heart Block (Complete)
  - *There are more p-waves than QRS complexes*
  - Both P-P and R-R intervals are regular
  - Atrial rate within normal range; Ventricular rate between 20-60 bpm
  - *The block at the AV node is complete*
    - *There is no relationship between the p-waves and QRS complexes*

Classification of Anti-Arrhythmic Drugs (Vaughan-Williams-Singh..1969)

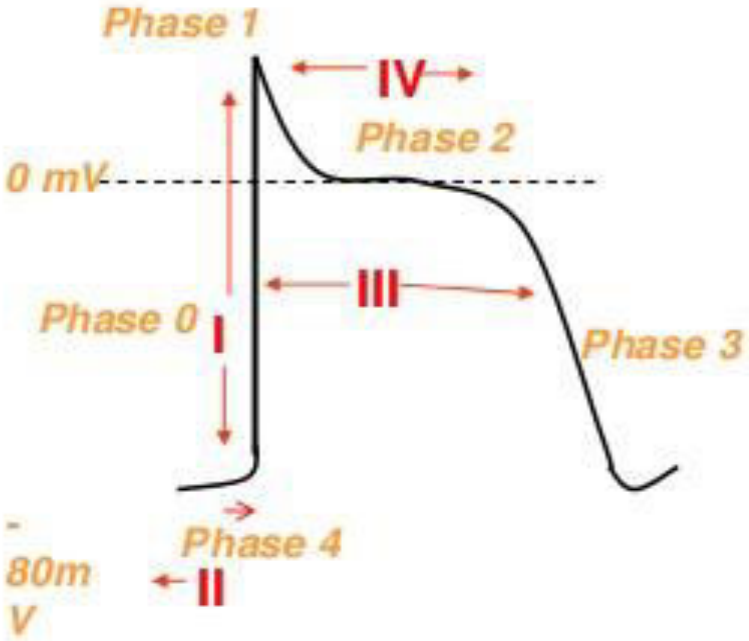
Class I: block Na^+ channels

Ia (quinidine, procainamide, disopyramide) (1-10s)
Ib (lignocaine) (<1s)
Ic (flecainide) (>10s)

Class II: ß-adrenoceptor antagonists (atenolol, sotalol)

Class III: prolong action potential and prolong refractory period (amiodarone, dofetilide, sotalol)

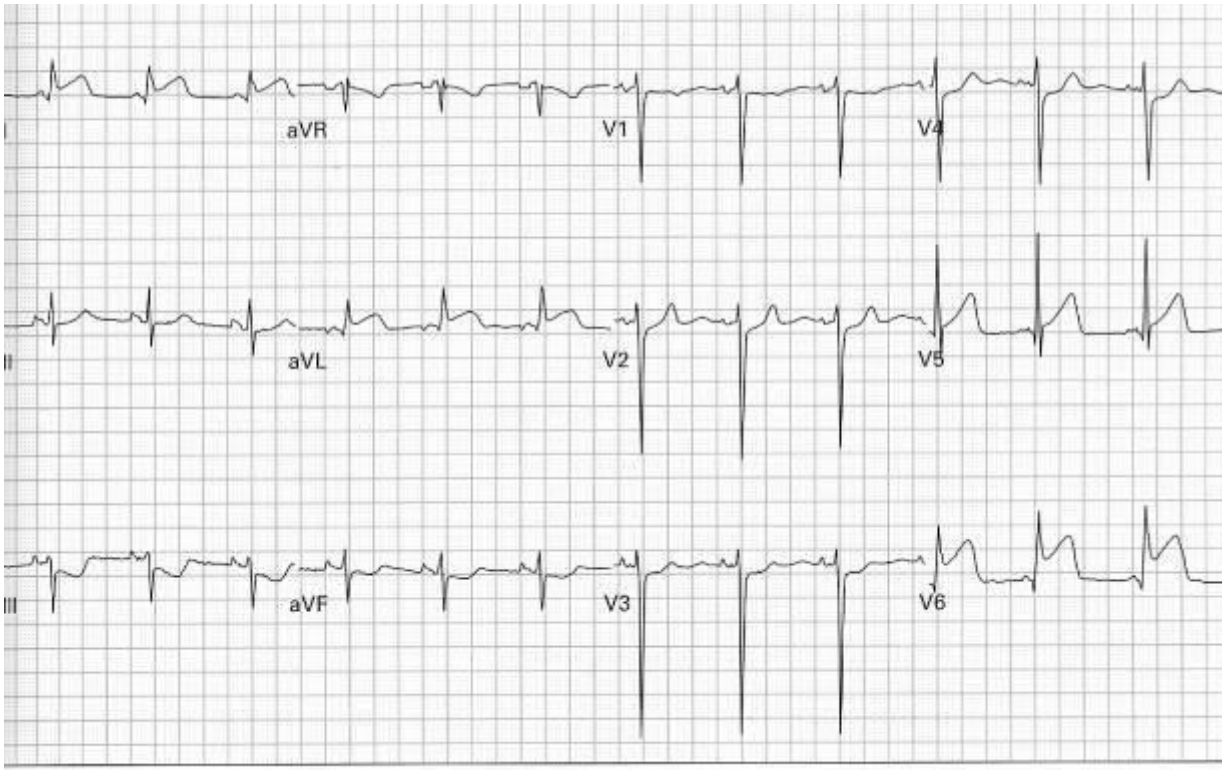
Class IV: Ca^{2+} channel antagonists (verapamil, diltiazem)



Prolonged QT

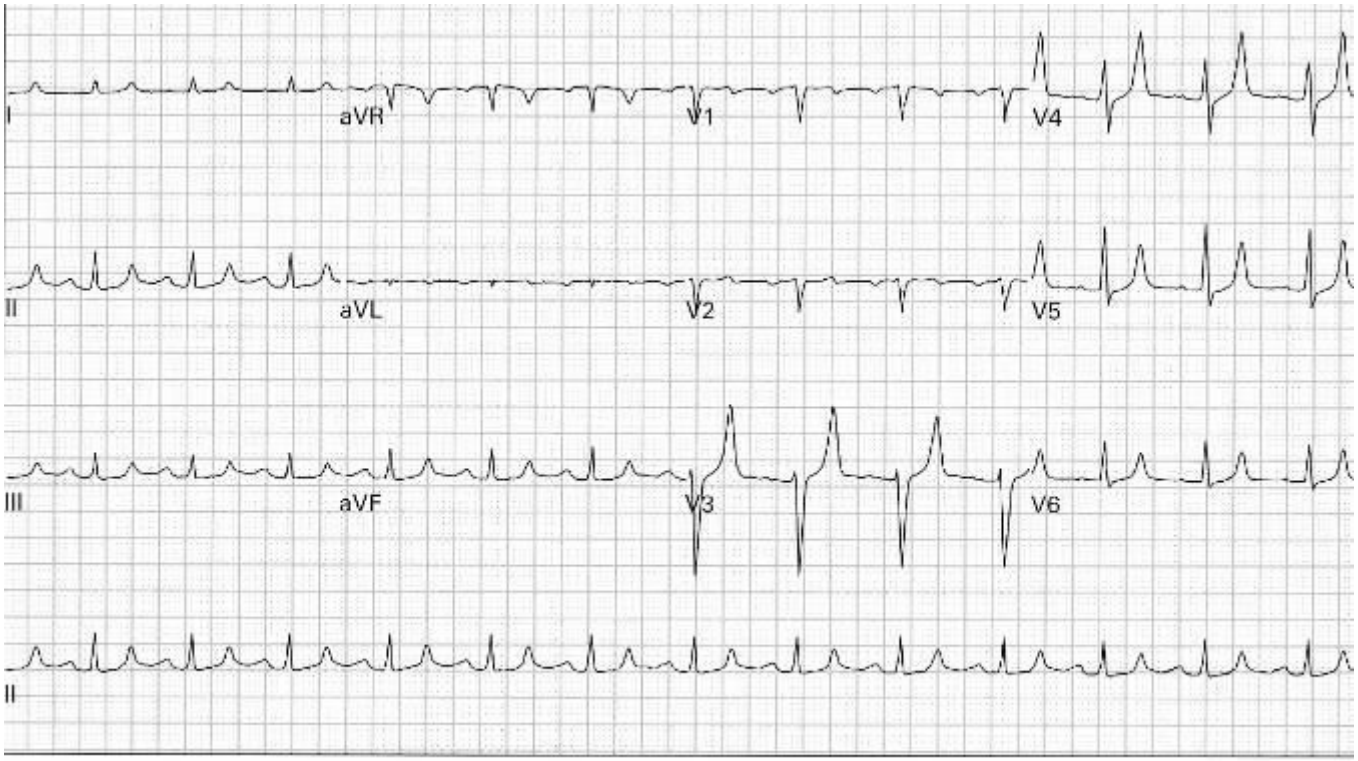
- Normal
  - Men 450ms
  - Women 460ms
- Corrected QT (QTc)
  - QTm/√(R-R)
- Causes
  - Drugs (Na channel blockers)
  - Hypocalcemia, hypomagnesemia, hypokalemia
  - Hypothermia
  - AMI
  - Congenital
  - Increased ICP

MI



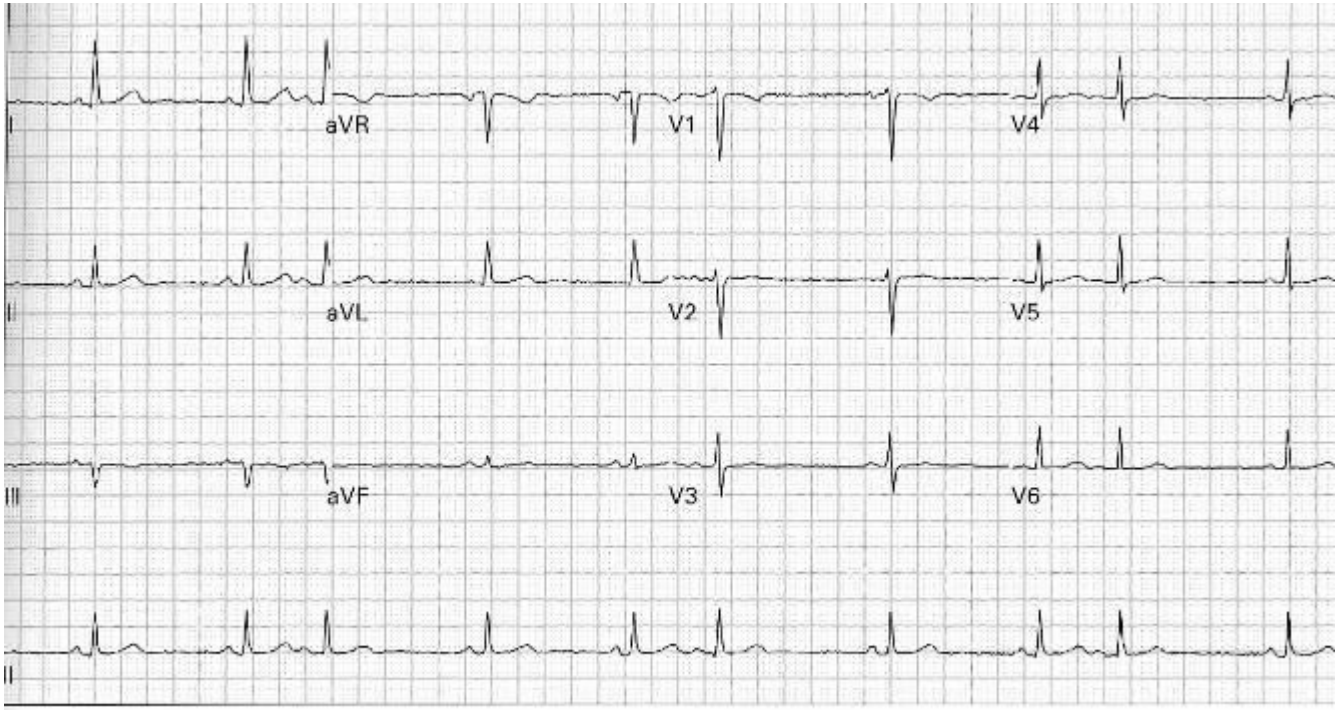
60. 43 year old man reports eight hours of left chest and arm pain

Hyperkalemia



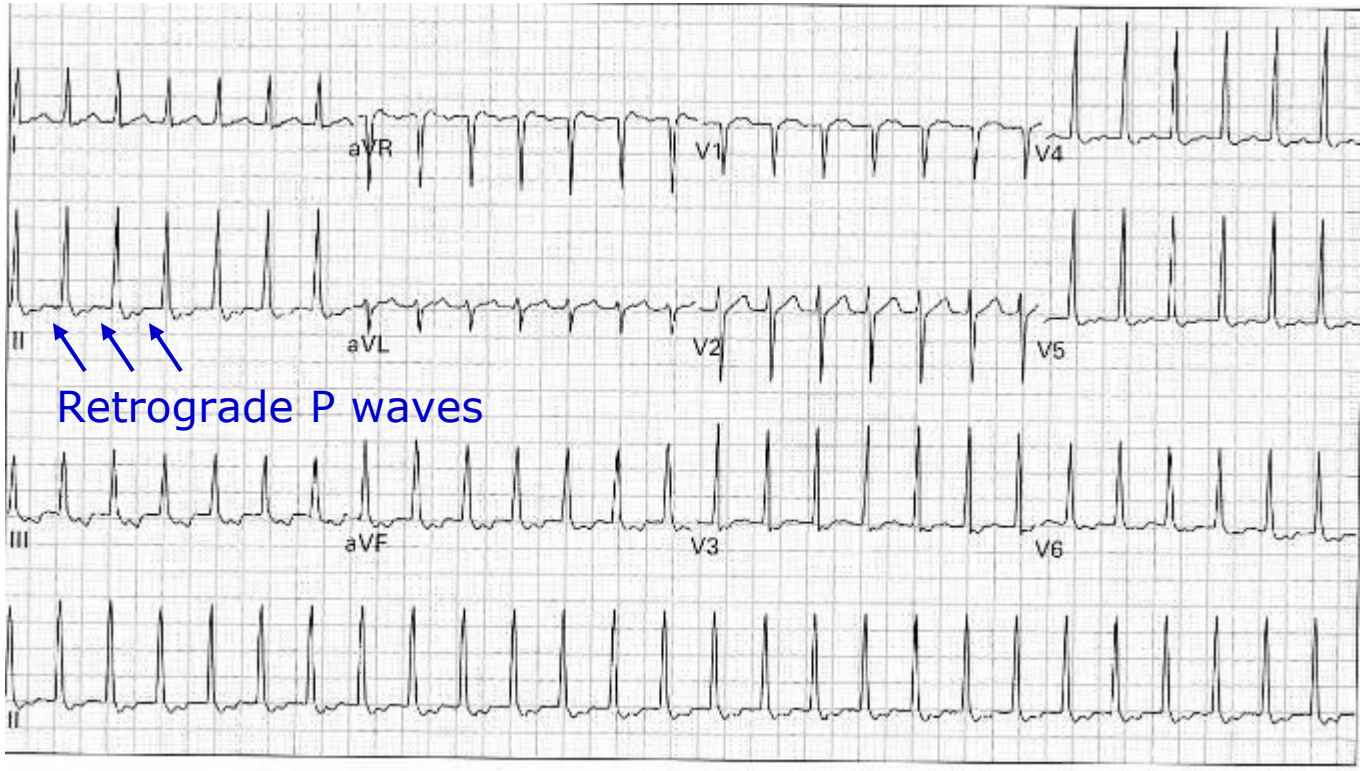
52. 62 year old man with renal failure complains of progressive dyspnea and orthopnea after missing his last two hemodialysis sessions

PAC



34. 41 year old woman with nausea and vomiting

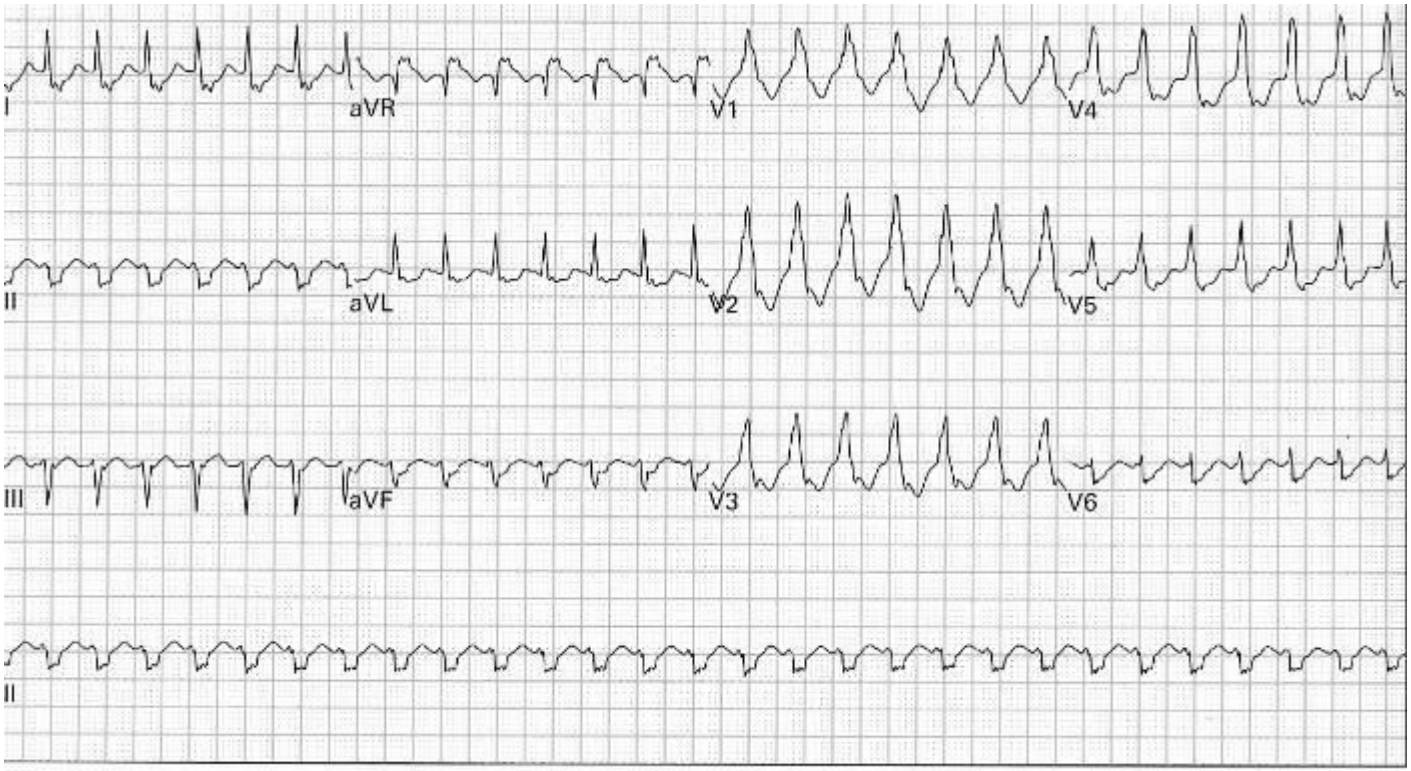
Supraventricular Tachycardia



27. 40 year old woman with palpitations and lightheadedness

Narrow complex, regular; retrograde P waves, rate <220

Ventricular Tachycardia



9. 74 year old man with chest pain and palpitations