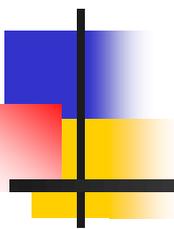
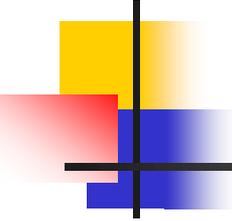


# Electrocardiography – Abnormalities (Arrhythmias) 7



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Faisal I. Mohammed, MD, PhD



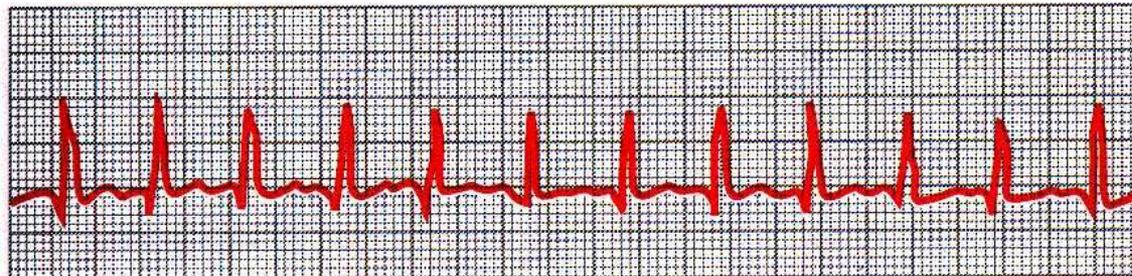
# Causes of Cardiac Arrhythmias

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- Abnormal rhythmicity of the pacemaker
- Shift of pacemaker from sinus node
- Blocks at different points in the transmission of the cardiac impulse
- Abnormal pathways of transmission in the heart
- Spontaneous generation of abnormal impulses from any part of the heart

# Abnormal Sinus Rhythms

- Tachycardia means a fast heart rate usually greater than 100 beats /min.
- Caused by (1) increased body temperature, (2) sympathetic stimulation (such as from loss of blood and the reflex stimulation of the heart), and (3) toxic conditions of the heart



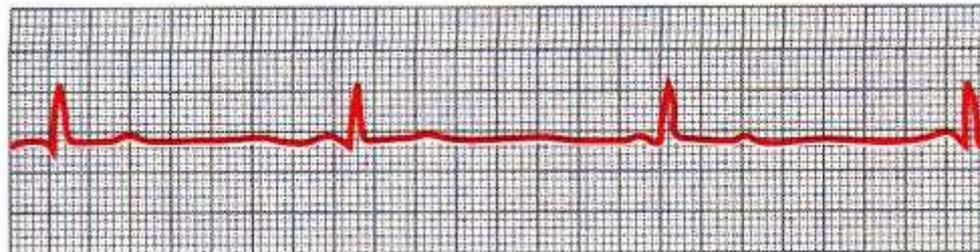
# Sinus Tachycardia



- **Etiology:** SA node is depolarizing faster than normal, impulse is conducted normally.
- Remember: sinus tachycardia is a response to physical or psychological stress, not a primary arrhythmia.

# Abnormal Sinus Rhythms (cont'd)

- Bradycardia means a slow heart rate usually less than 60 beats /min
- Present in athletes who have a large stroke volume
- Can be caused by vagal stimulation, one example of which is the carotid sinus syndrome



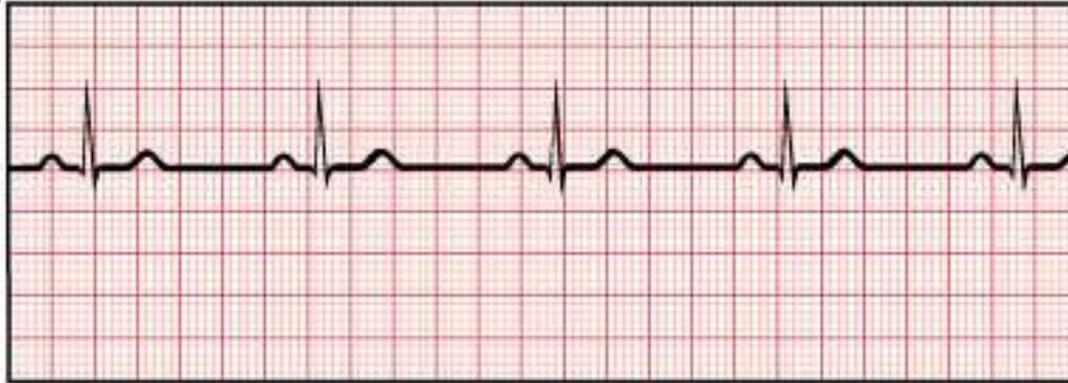
Heart  
Rate?

# Sinus Bradycardia

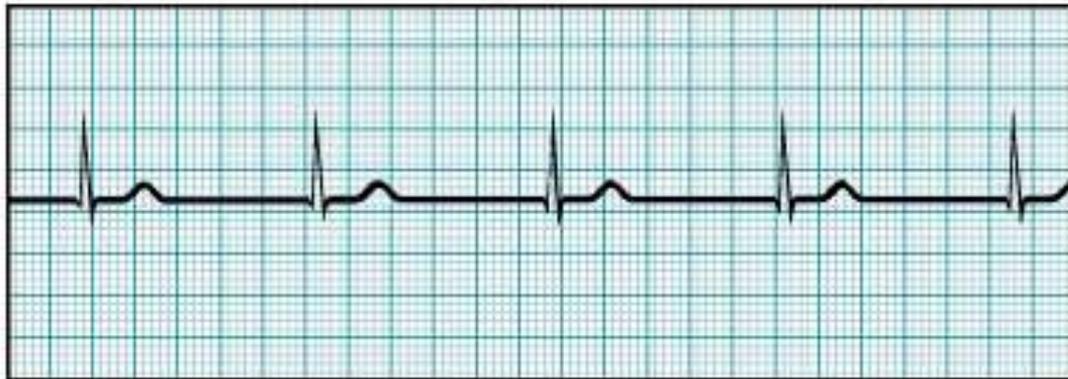


- **Etiology:** SA node is depolarizing slower than normal, impulse is conducted normally (i.e. normal PR and QRS interval) rate is slower than 60/beats per minute

# ECGs, Normal and Abnormal



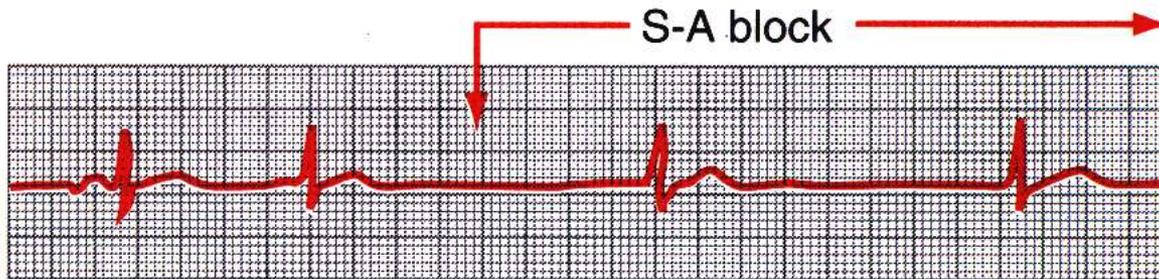
(a) Sinus rhythm (normal)



(b) Nodal rhythm – no SA node activity

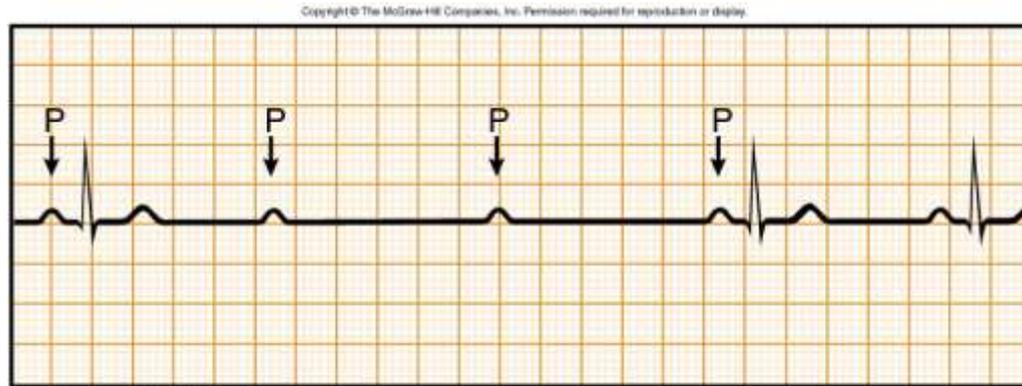
# Sinoatrial Block

- ❖ In rare instances impulses from S-A node are blocked.
- ❖ This causes cessation of P waves.
- ❖ New pacemaker is region of heart with the fastest discharge rate, usually the A-V node.



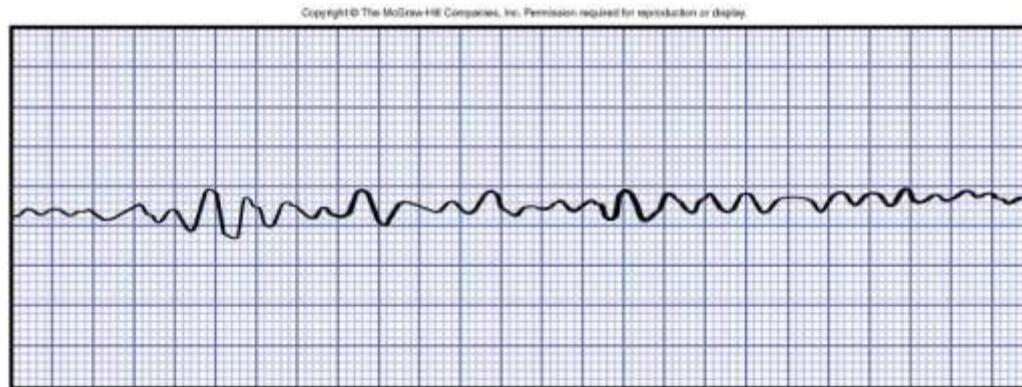
Note: no P waves and slow rate

# ECGs, Abnormal



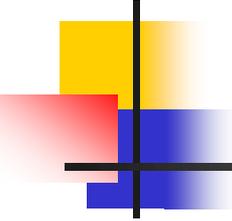
(c) Heart block

**Arrhythmia: conduction failure at AV node**



(e) Ventricular fibrillation

**No pumping action occurs**

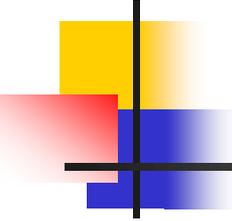


# Atrioventricular Block

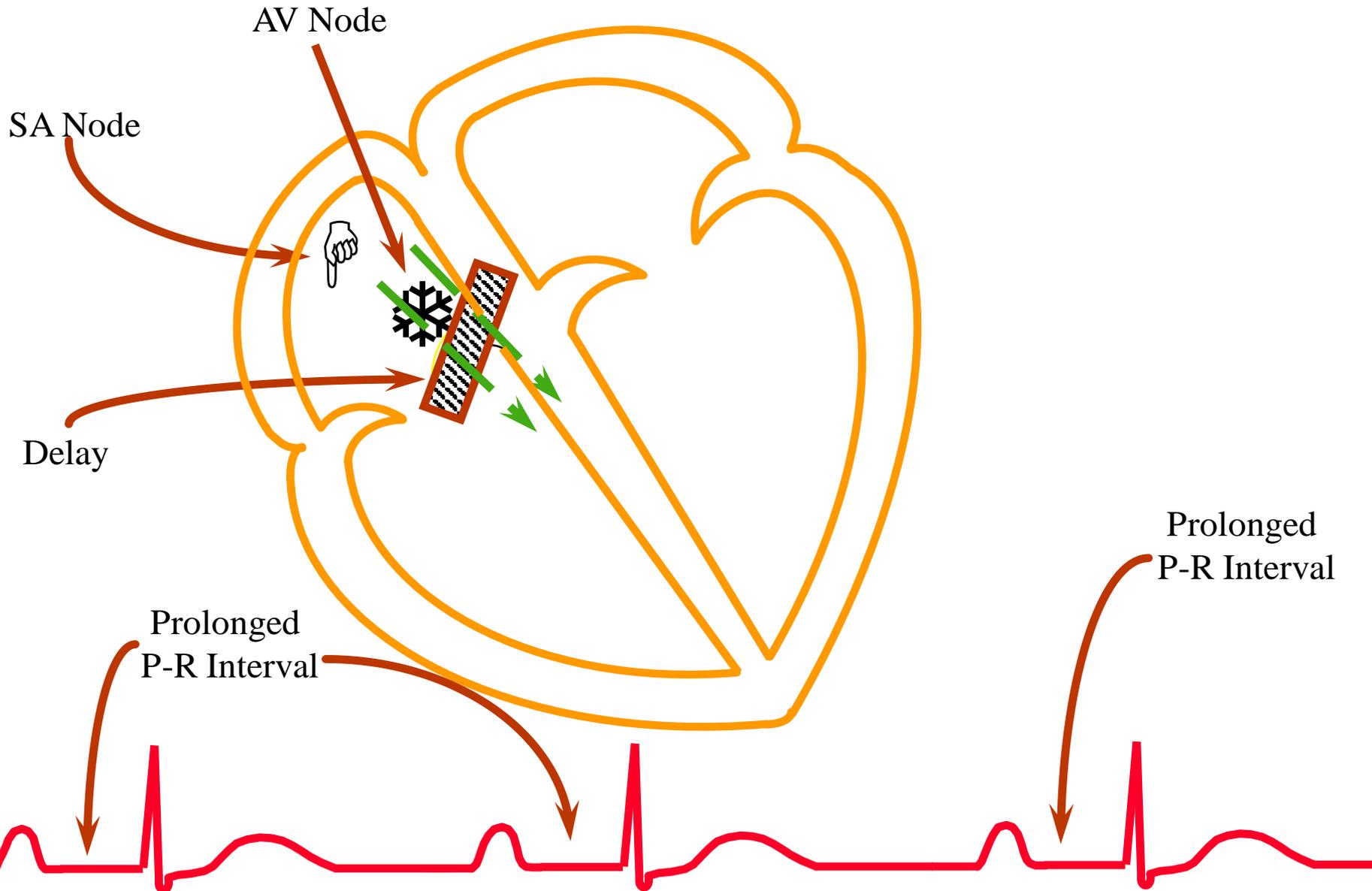
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- ✓ **Impulses through A-V node and A-V bundle (bundle of His) are slowed down or blocked due to :**
  - ✓ (1) Ischemia of A-V nodal or A-V bundle fibers (can be caused by coronary ischemia)
  - ✓ (2) Compression of A-V bundle (by scar tissue or calcified tissue)
  - ✓ (3) A-V nodal or A-V bundle inflammation
  - ✓ (4) Excessive vagal stimulation

# Incomplete Heart Block: First Degree Block

- 
- 
- ❖ Normal P-R interval is 0.16 sec
  - ❖ If P-R interval is  $> 0.20$  sec, first degree block is present (but P-R interval seldom increases above 0.35 to 0.45 sec)

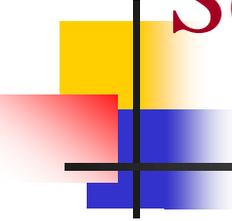
# First Degree Heart Block



# 1st Degree AV Block



- **Etiology:** Prolonged conduction delay in the AV node or Bundle of His.

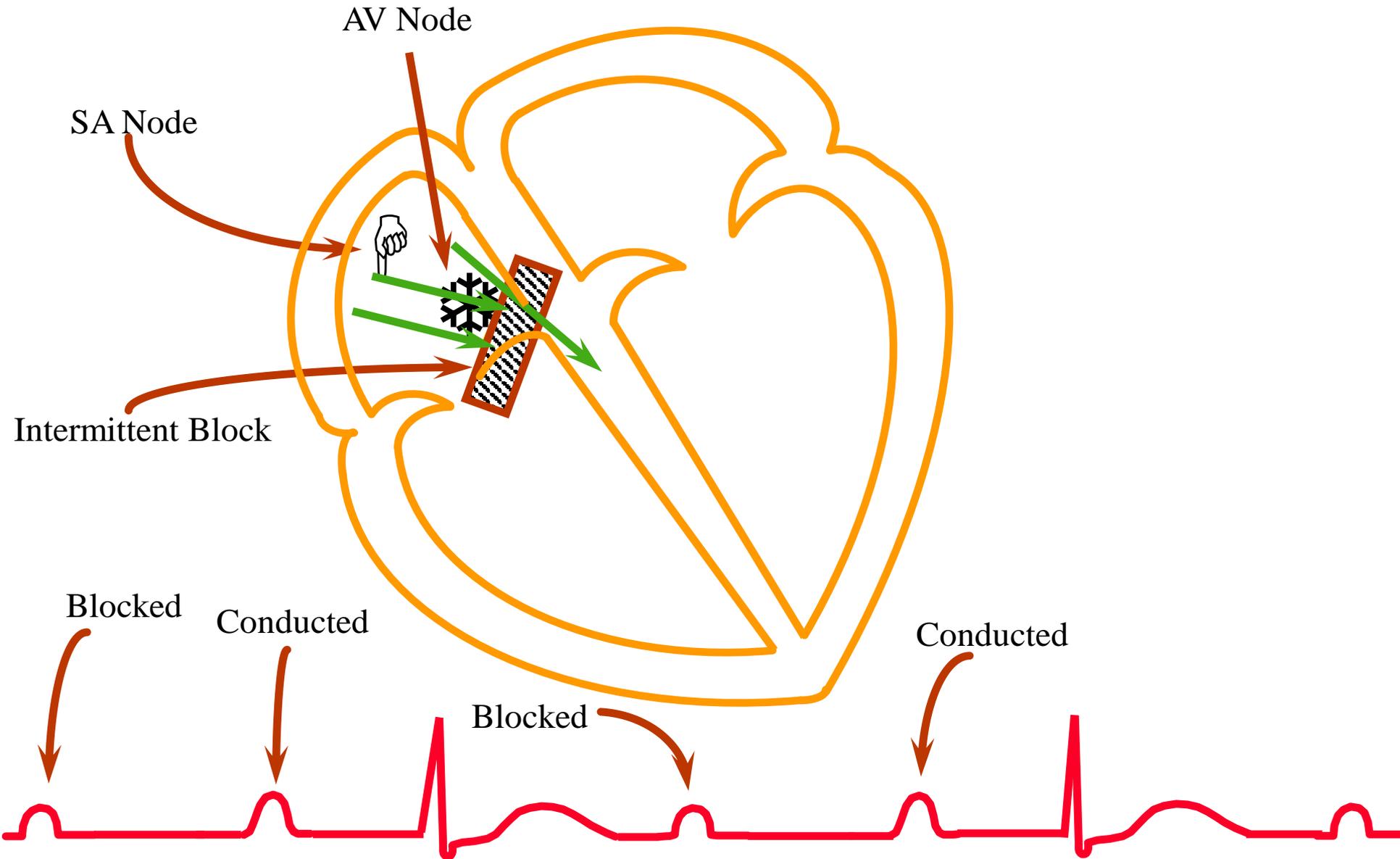


# Second Degree Incomplete Block

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- P-R interval increases to 0.25 - 0.45 sec
- Some impulses pass through the A-V node and some do not thus causing “dropped beats”.
- Atria beat faster than ventricles.

# Second Degree Heart Block



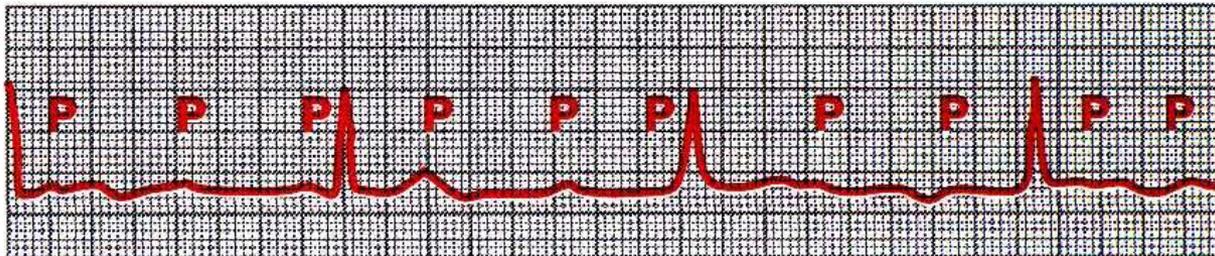
# 2nd Degree AV Block,



- **Etiology:** Each successive atrial impulse encounters a longer and longer delay in the AV node until one impulse (usually the 3rd or 4th) fails to make it through the AV node.

# Third Degree Complete Block

- ☞ Total block through the A-V node or A-V bundle
- ☞ P waves are completely dissociated from QRST complexes
- ☞ Ventricles escape and A-V nodal rhythm ensues

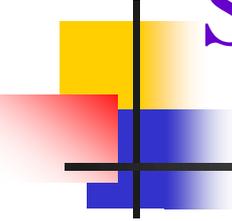


HR = 37

# 3rd Degree AV Block



- **Etiology:** There is complete block of conduction in the AV junction, so the atria and ventricles form impulses independently of each other. Without impulses from the atria, the ventricles own intrinsic pacemaker beats at around 15 - 40 beats/minute.



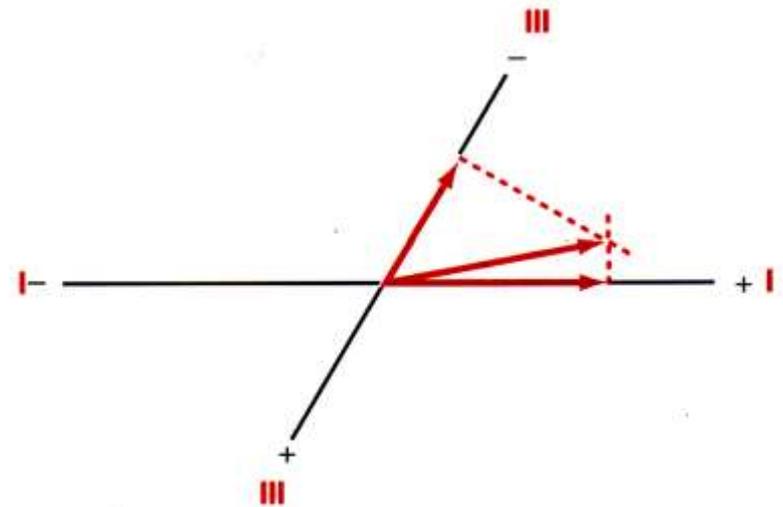
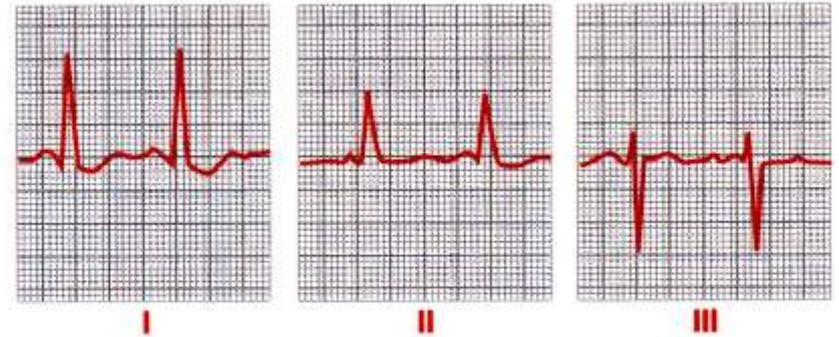
# Stokes-Adams Syndrome

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- Complete A-V block comes and goes.
- Ventricles stop contracting for 5-30 sec because of overdrive suppression meaning they are used to atrial drive.
- Patient faints because of poor cerebral blood flow
- Then, ventricular escape occurs with A-V nodal or A-V bundle rhythm (15-40 beats /min).
- Artificial pacemakers connected to right ventricle are provided for these patients.

# Factors Causing Electrical Axis deviation

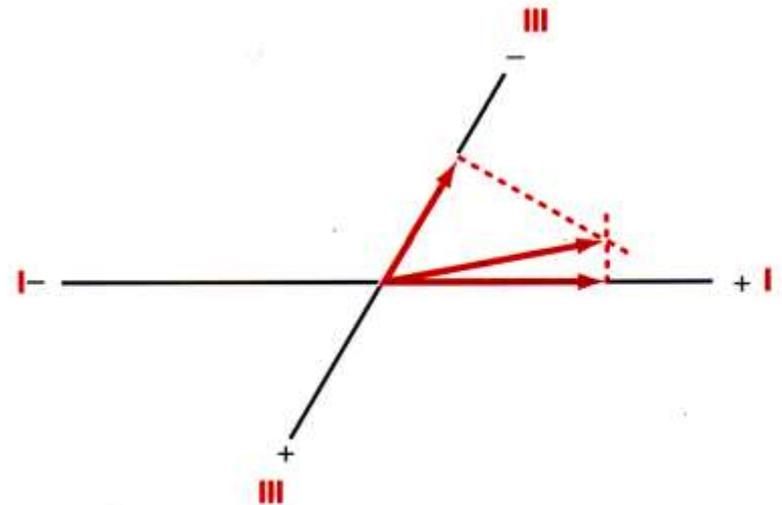
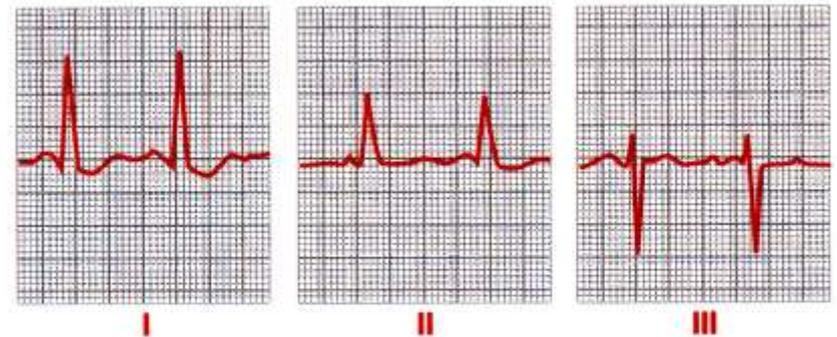
- Changes in heart position: left shift caused by expiration, lying down and excess abdominal fat, short and obese.
- Right shift caused by thin and tall person



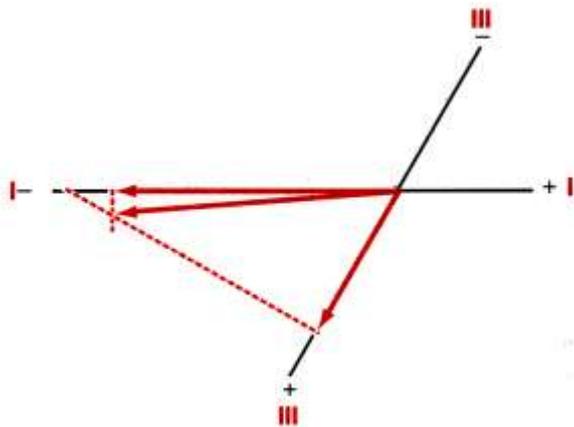
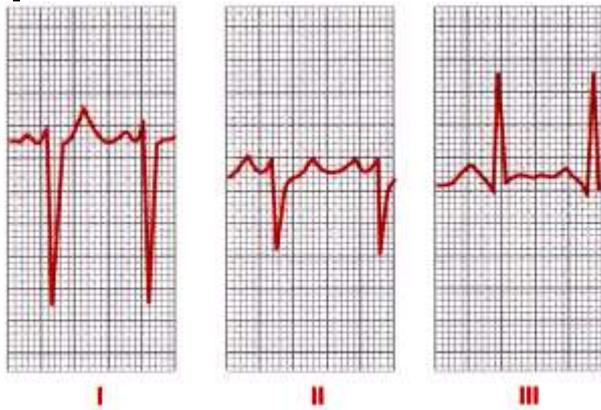
# Factors Causing Electrical Axis Deviation

...cont'd

- Hypertrophy of left ventricle (left axis shift) caused by hypertension, aortic stenosis or aortic regurgitation causes slightly prolonged QRS and high voltage.



# Factors Causing Electrical Axis Deviation (cont'd)

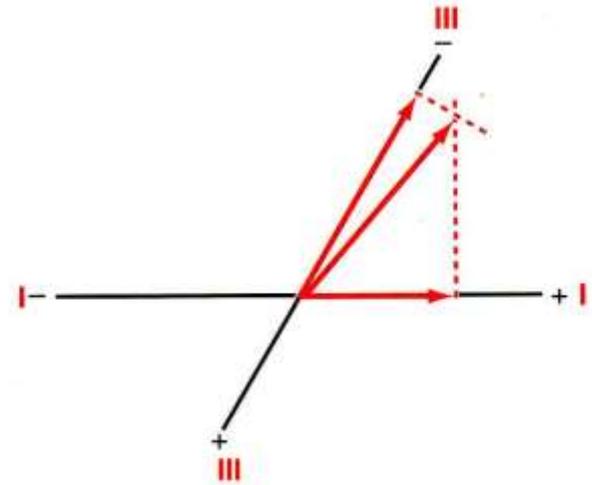
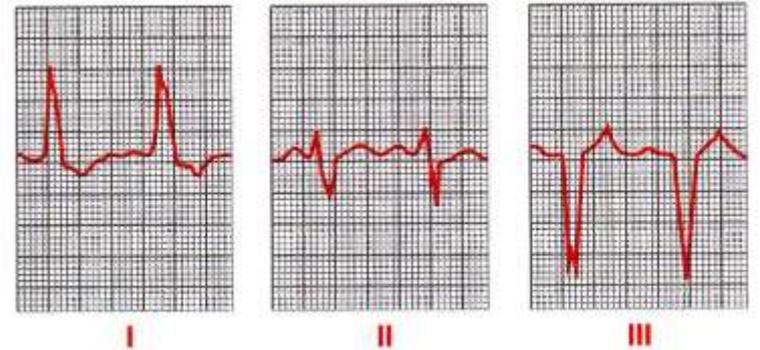


- Hypertrophy of right ventricle (right axis shift) caused by pulmonary hypertension, pulmonary valve stenosis, interventricular septal defect. All cause slightly prolonged QRS and high voltage.

# Factors Causing Electrical Axis

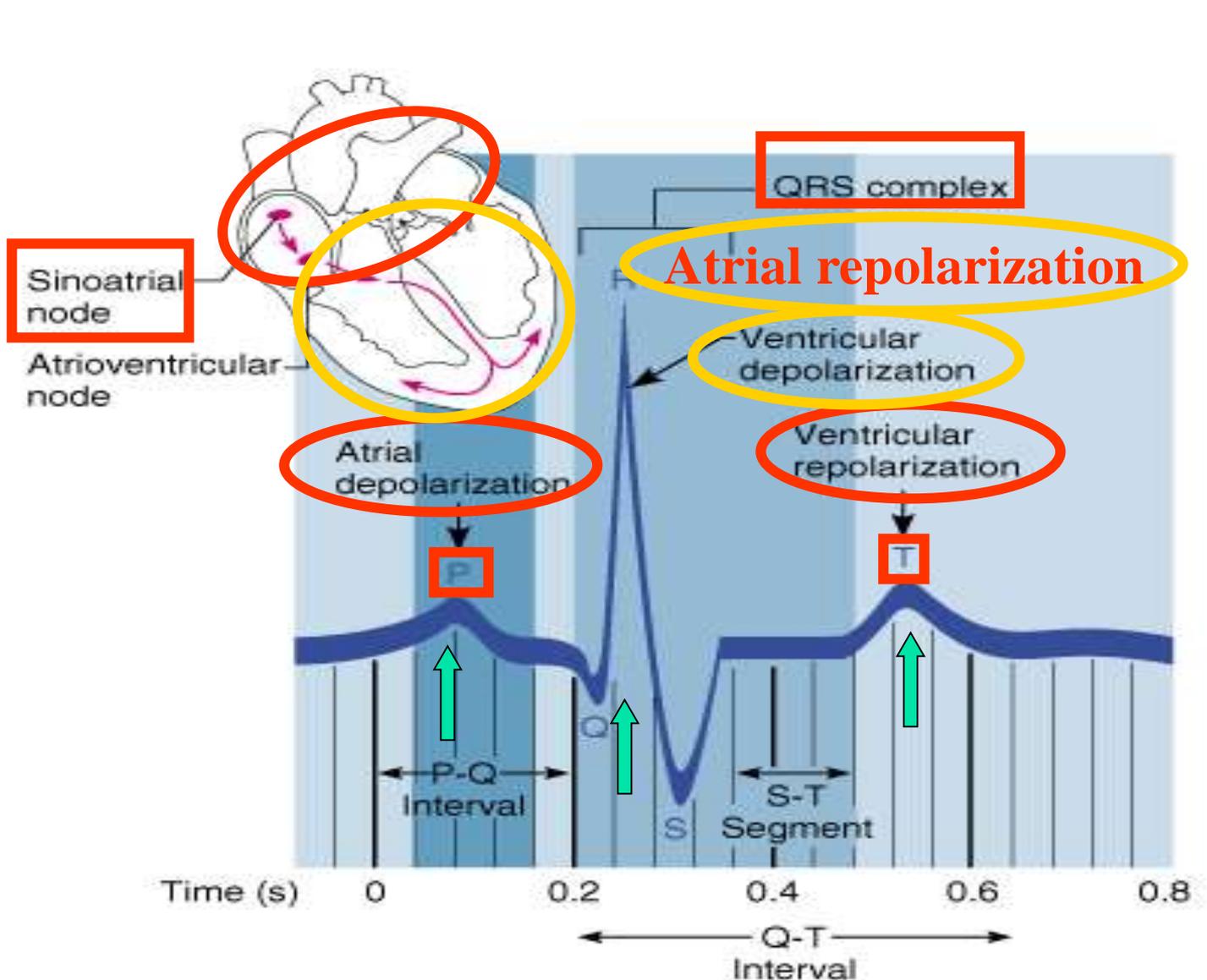
## Deviation ...cont'd

- Bundle branch block-**Left** bundle branch block causes **left** axis shift because **right** ventricle depolarizes much faster than **left** ventricle. QRS complex is prolonged. By the same token **Right** bundle branch block causes **right** axis deviation.



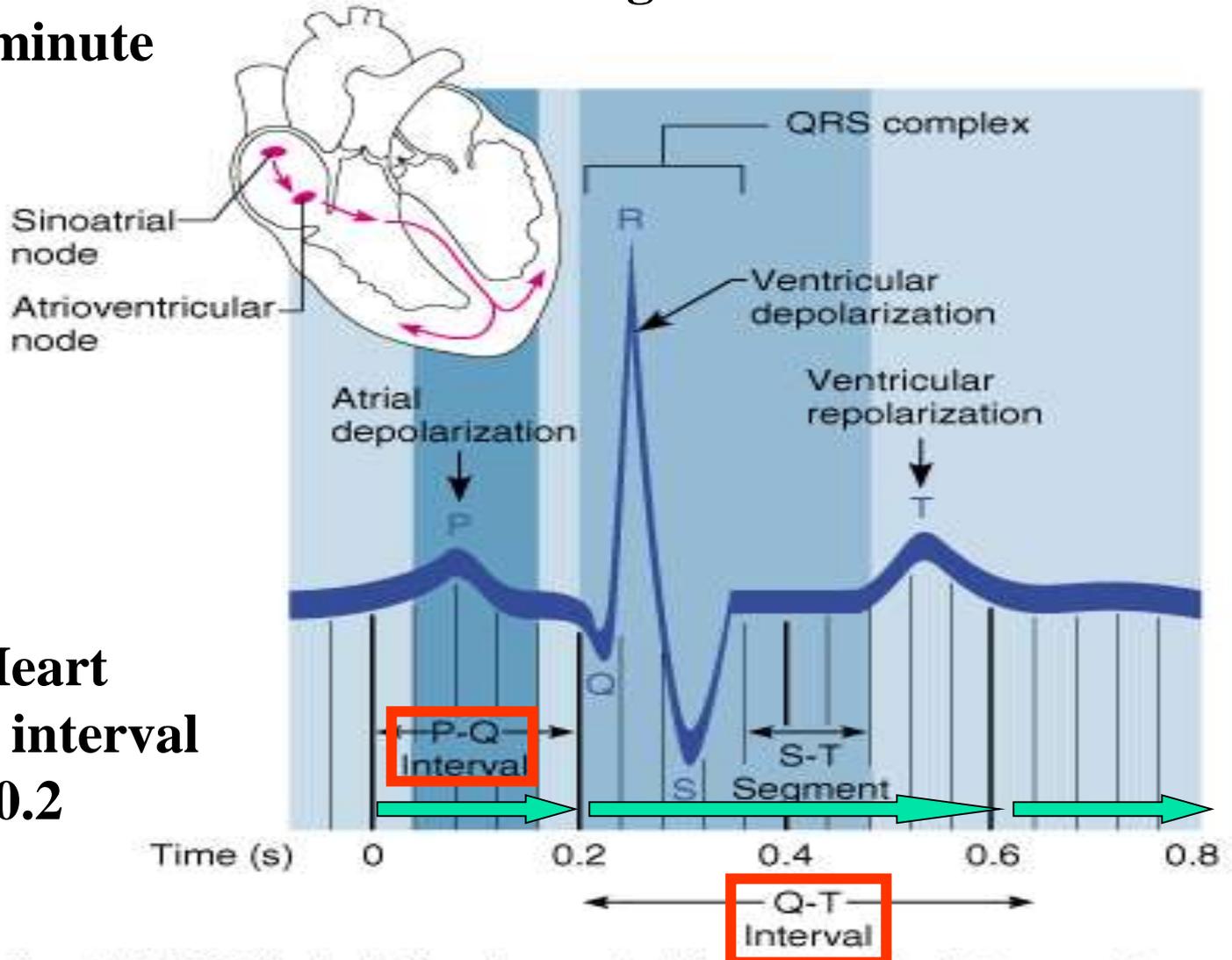
# ECG Deflection Waves

(Pacemaker)



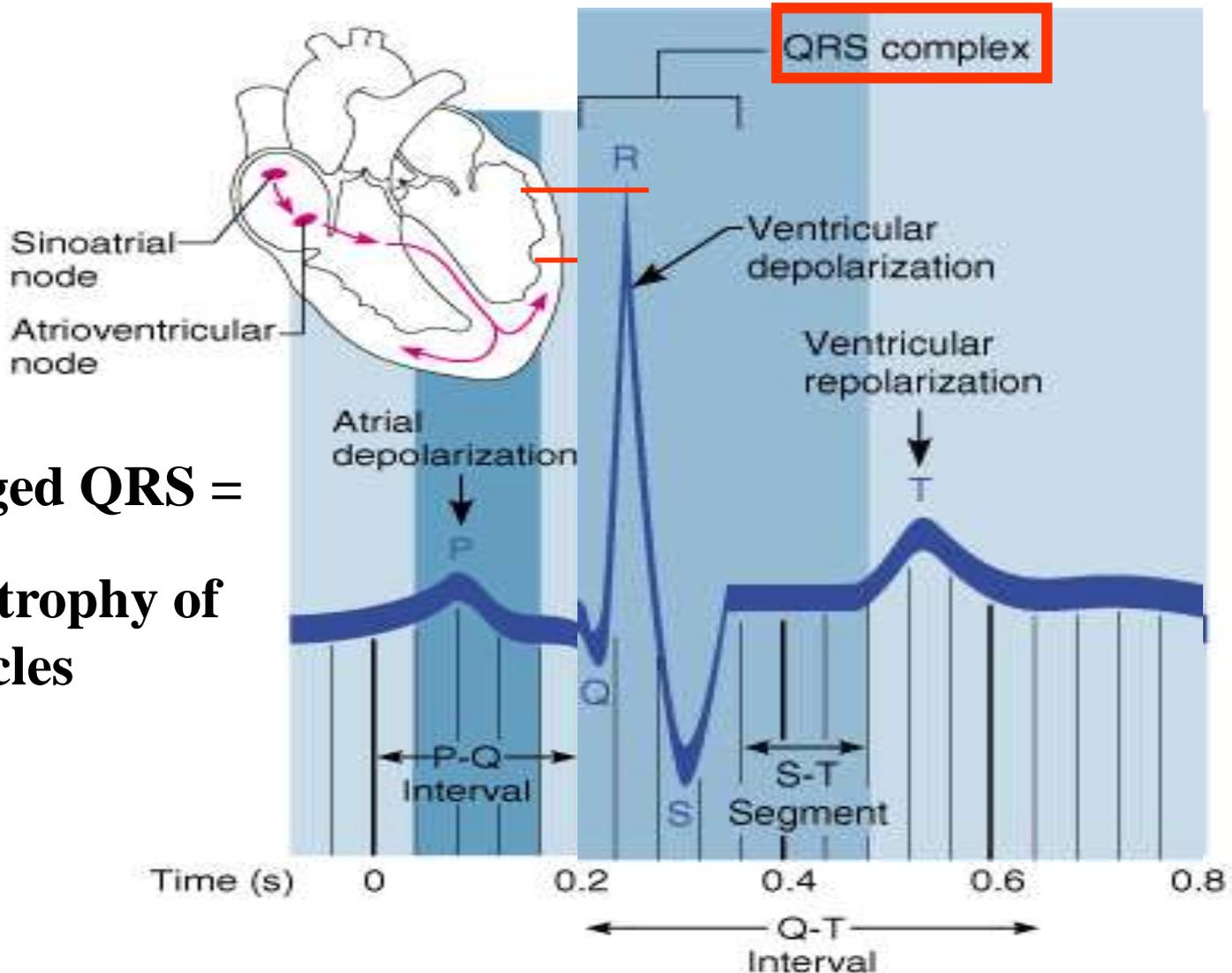
# ECG Deflection Waves

60 seconds  $\div$  0.8 seconds = resting heart rate of 75 beats/minute

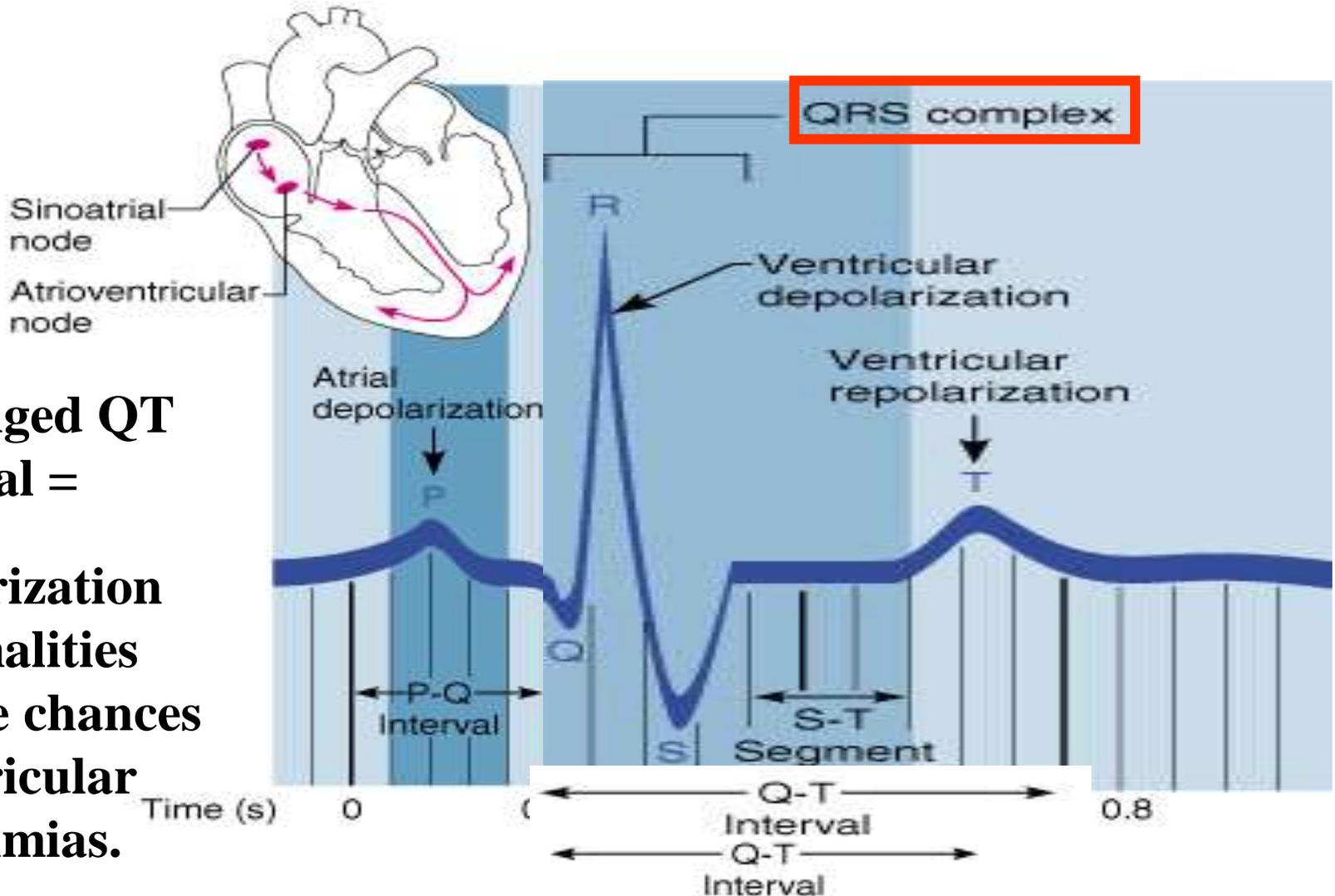


**1st Degree Heart Block = P-Q interval longer than 0.2 seconds.**

# ECG Deflection Wave irregularities



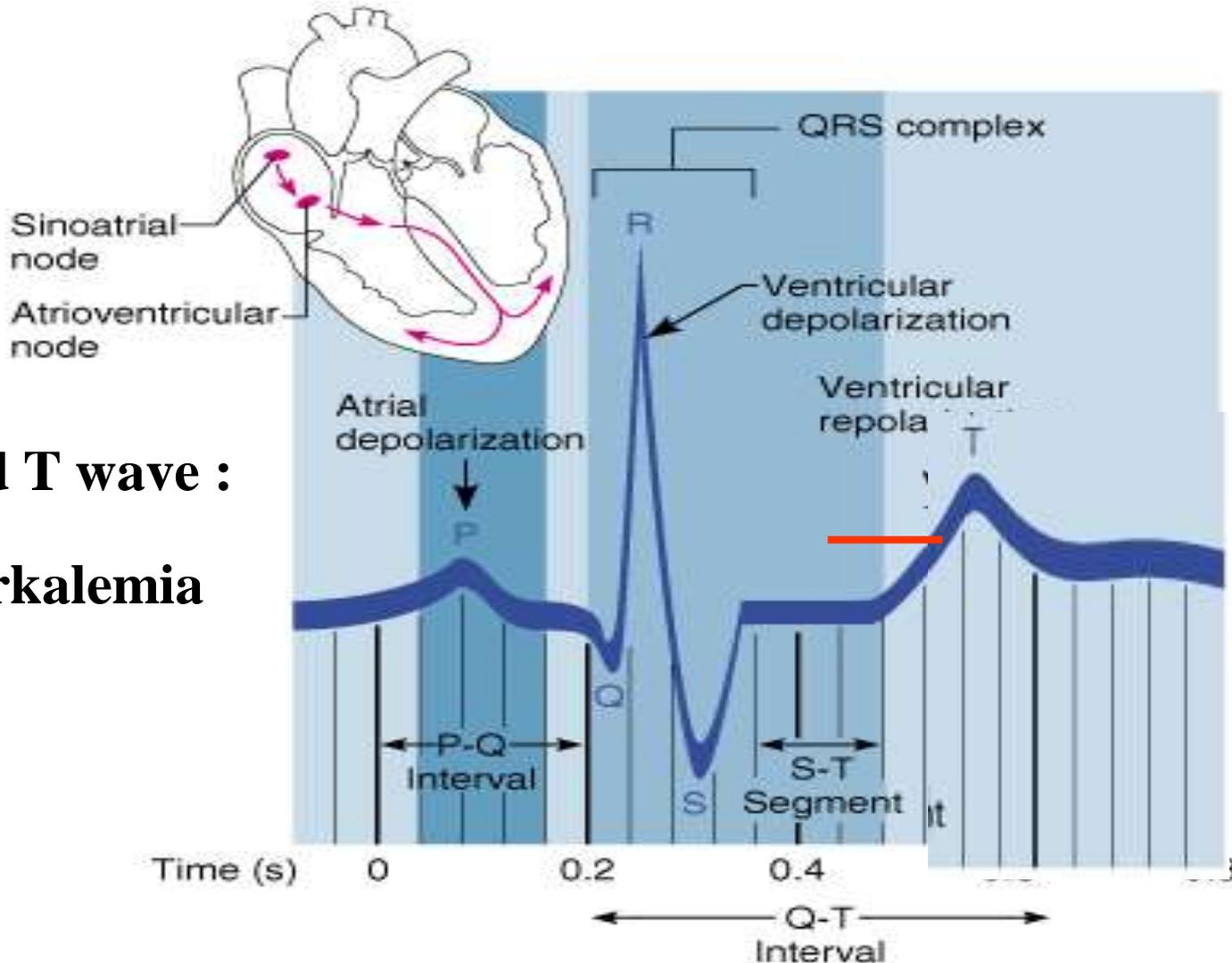
# ECG Deflection Wave Irregularities



**Prolonged QT Interval =**

**Repolarization abnormalities increase chances of ventricular arrhythmias.**

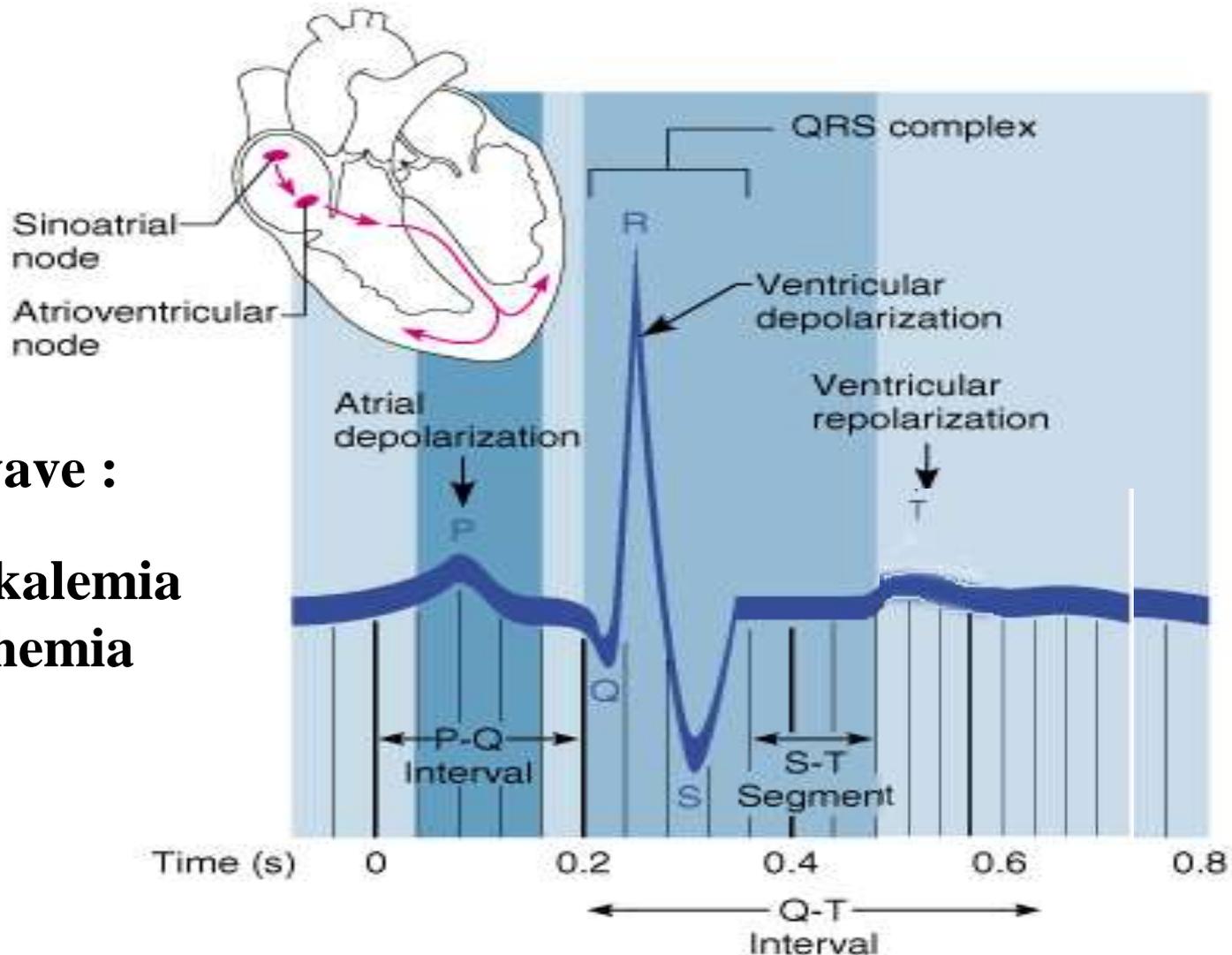
# ECG Deflection Wave Irregularities



**Elevated T wave :**

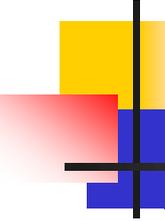
**Hyperkalemia**

# ECG Deflection Wave Irregularities



**Flat T wave :**

**Hypokalemia  
or ischemia**

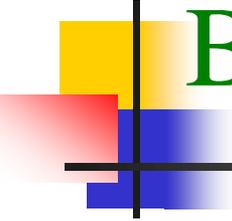


# Increased Voltages in Standard Bipolar Limb Leads

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- ❖ If sum of voltages of Leads I-III is greater than 4 mV, this is considered to be a high voltage EKG.
- ❖ Most often caused by increased ventricular muscle mass (hypertension, marathon runner).

# Decreased Voltages in Standard Bipolar Limb Leads



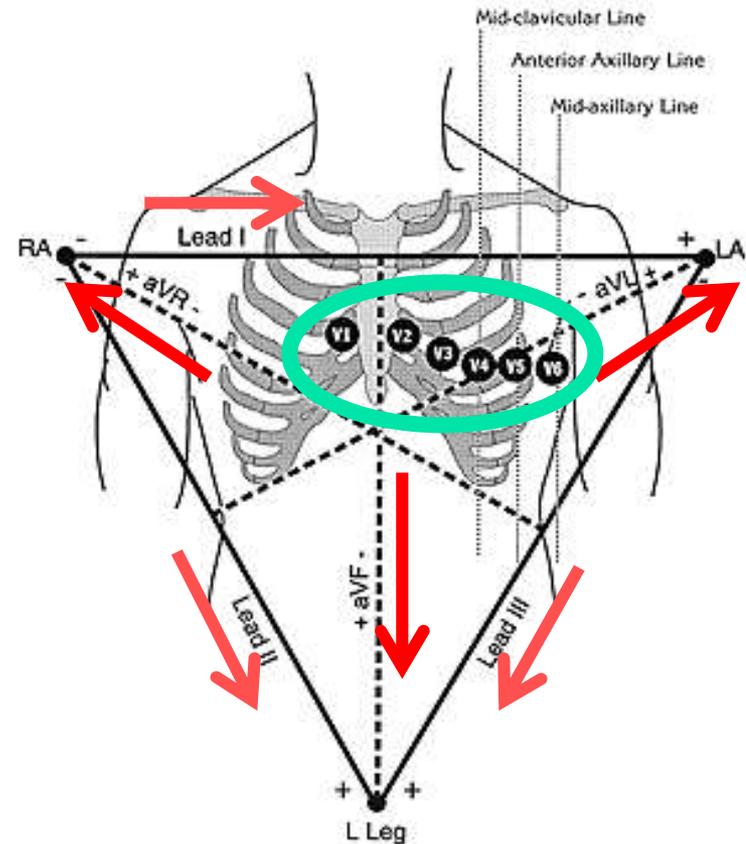
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- ☞ Cardiac muscle abnormalities (old infarcts causing decreased muscle mass, low voltage EKG, and prolonged QRS).
- ☞ Conditions surrounding heart (fluid in pericardium, pleural effusions, emphysema).

# The 12-Leads

The 12-leads include:

- 3 Limb leads  
(I, II, III)
- 3 Augmented leads  
(aVR, aVL, aVF)
- 6 Precordial leads  
(V<sub>1</sub>- V<sub>6</sub>)



# Thank You

