The Cardio-VASCULAR System

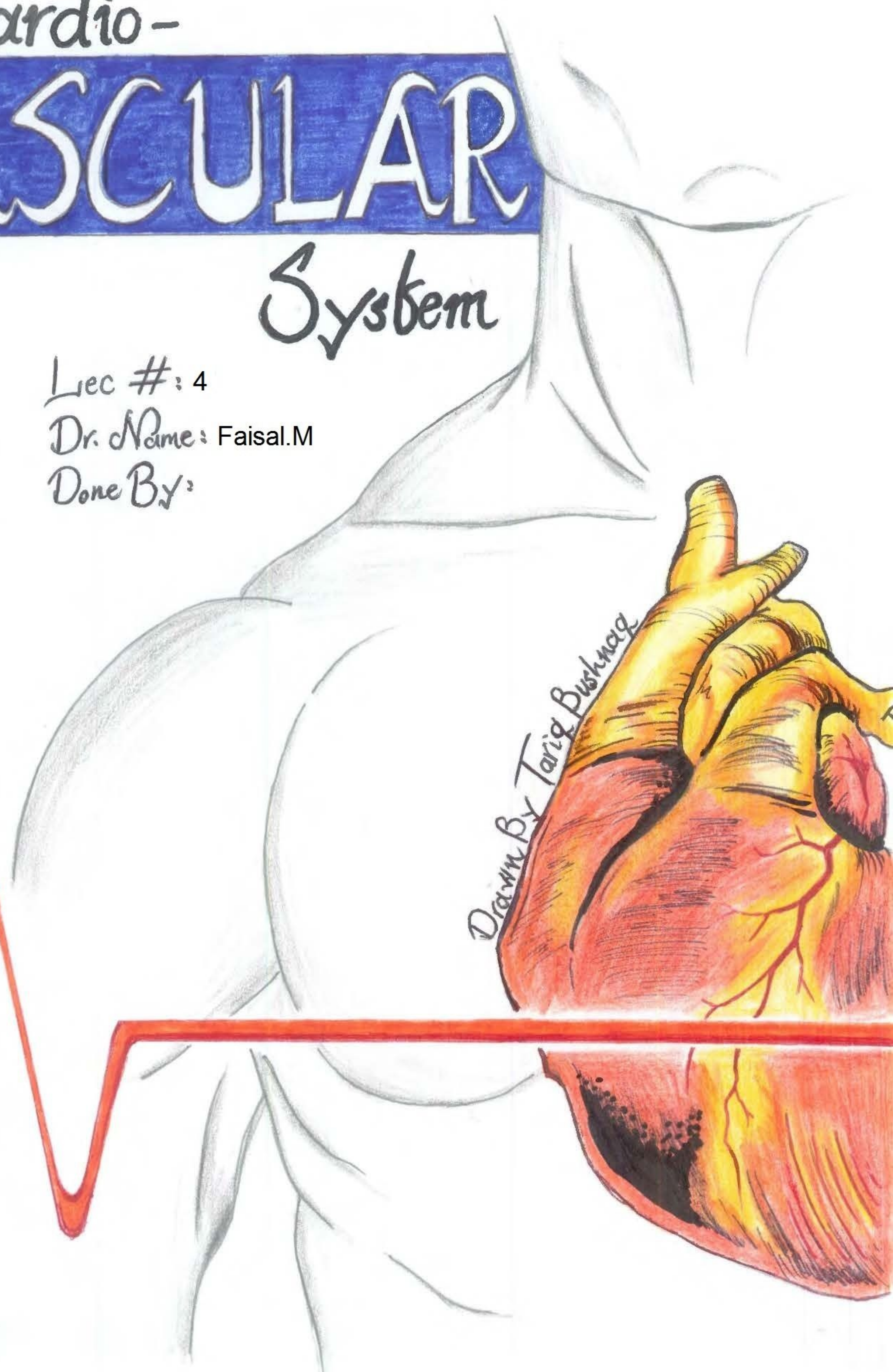
- ○ Anatomy
- ○ Histology
- ○ Pathology
- ○ Pharmacology
- ● Physiology
- ○ Microbiology

Lec #: 4

Dr. Name: Faisal.M

Done By:

- ○ Handout
- ○ Sheet
- ● Slide



Electrocardiography – Normal 6

Faisal I. Mohammed, MD, PhD

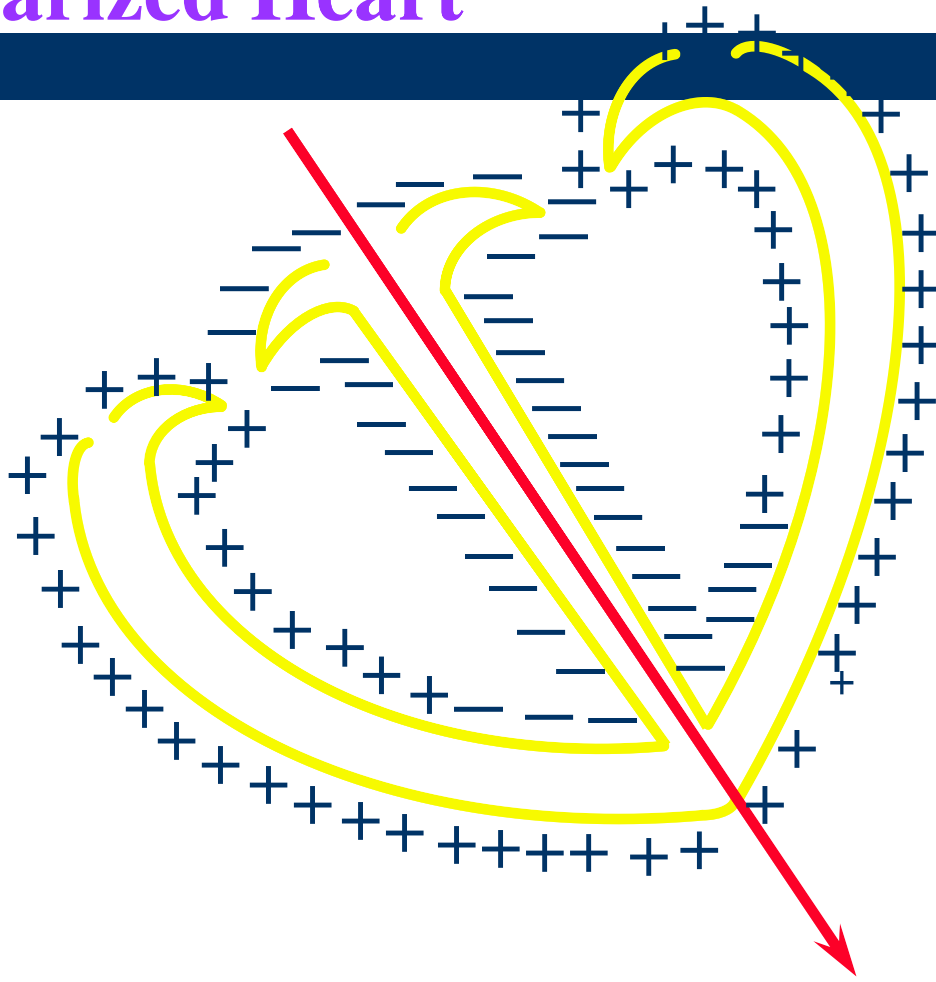
Objectives

- Recognize the normal ECG tracing
- Calculate the heart rate
- Determine the rhythm
- Calculate the length of intervals and determine the segments deflections
- Draw the Hexagonal axis of the ECG
- Find the mean electrical axis of QRS (Ventricular depolarization)

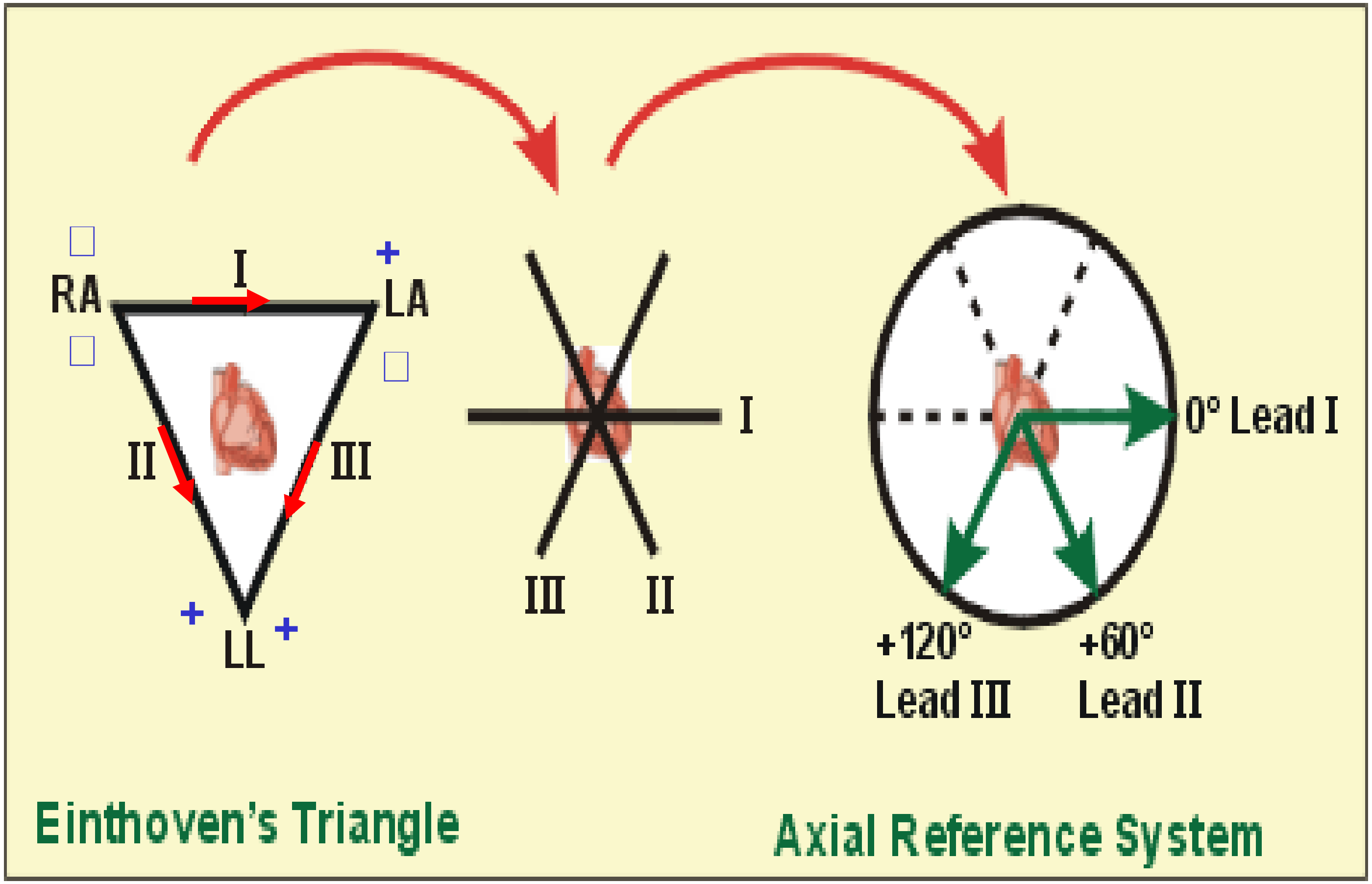
Principles of Vectorial Analysis of EKG's

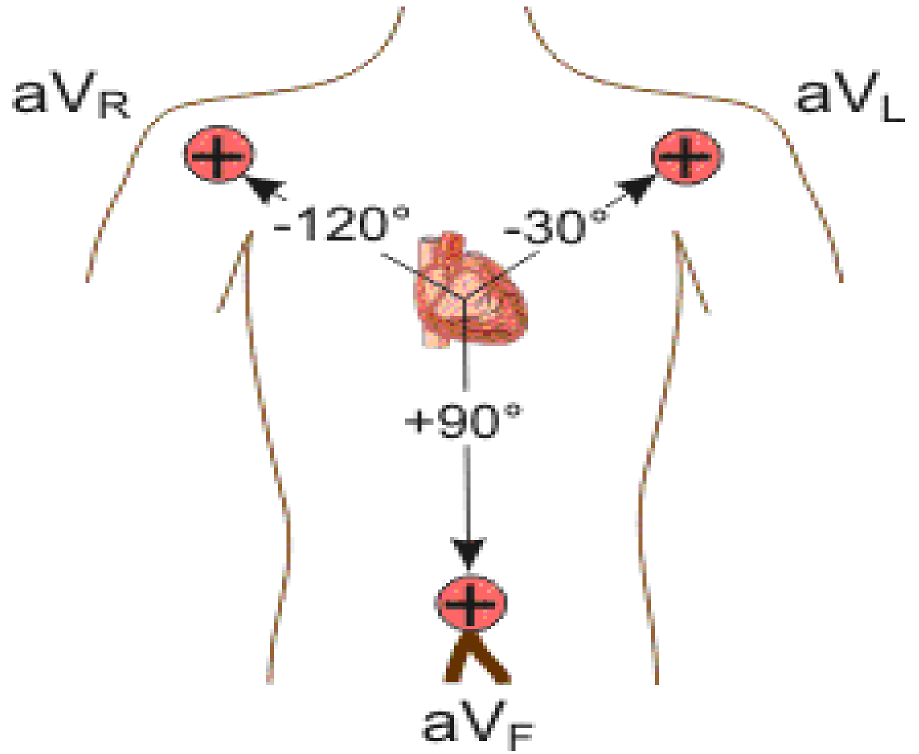
- The current in the heart flows from the area of depolarization to the polarized areas, and the electrical potential generated can be represented by a vector, with the *arrowhead pointing in the positive direction*.
- The length of the vector is *proportional to the voltage of the potential*.
- The generated potential at any instance can be represented by an *instantaneous mean vector*.
- The normal mean QRS vector is 60º (-30◦ - 110◦)

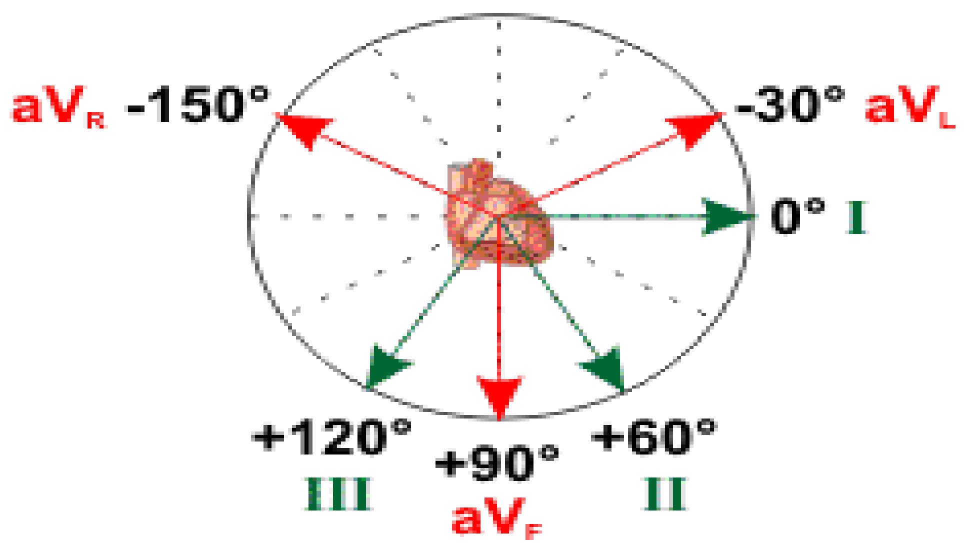
Mean Vector Through the Partially Depolarized Heart



Einthoven's triangle and law

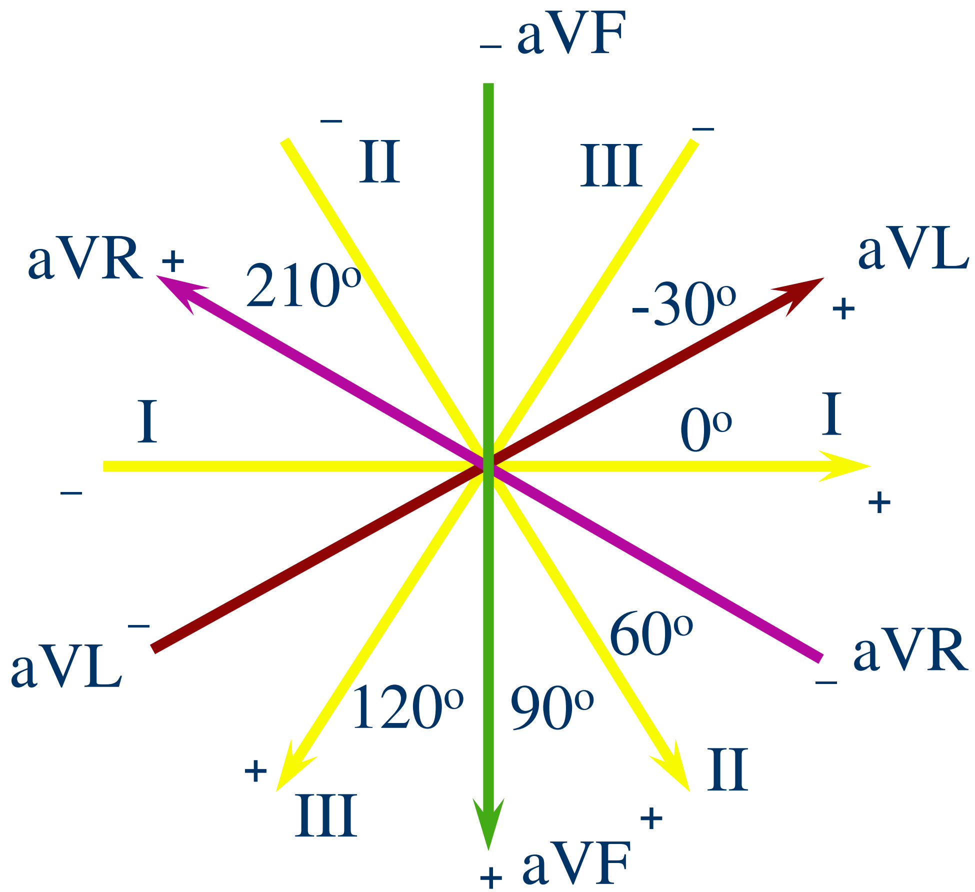



aV_R
aV_L
-120°
-30°
+90°
aV_F

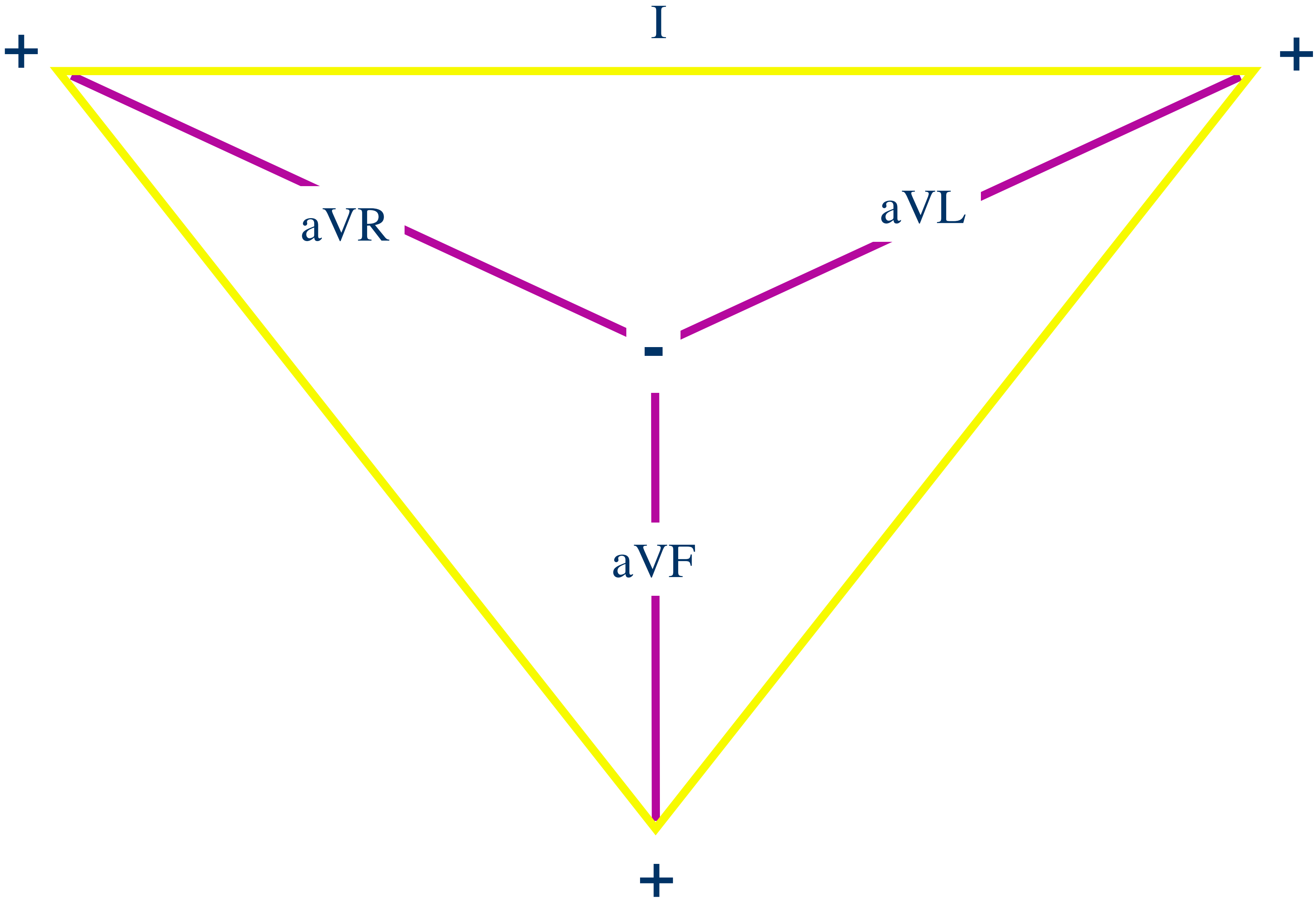

aV_R -150°
-30° aV_L
0° I
+120°
III
+90°
aV_F
+60°
II

Principles of Vectorial Analysis of EKG's (cont'd)

Axes of the Three Bipolar and Augmented Leads



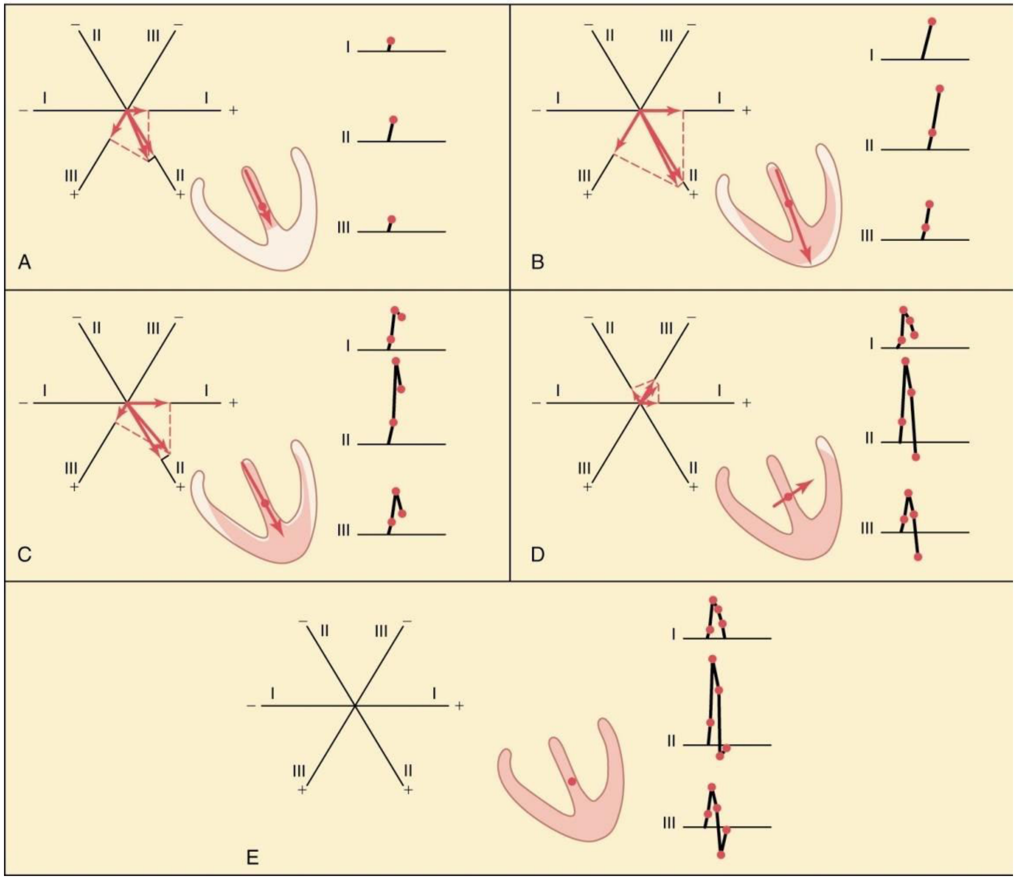
Axes of the Unipolar Limb Leads



Principles of Vectorial Analysis of EKG's (cont'd)

- *The axis of lead I is zero degrees* because the electrodes lie in the horizontal direction on each of the arms.
- *The axis of lead II is +60 degrees* because the right arm connects to the torso in the top right corner, and left leg connects to the torso in the bottom left corner.
- *The axis of lead III is 120 degrees.*

Principles of Vectorial Analysis of EKG's (cont'd)

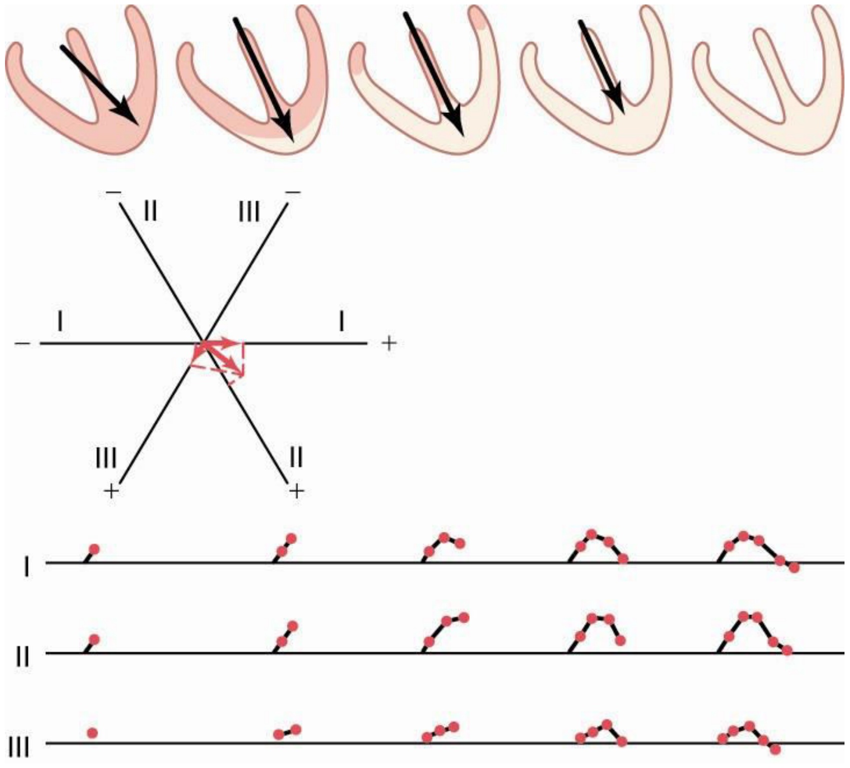


Principles of Vectorial Analysis of EKG's (cont'd)

- In figure B, the depolarization vector is large because half of the ventricle is depolarized.
- Lead II should be largest voltage when compared to I and III when the mean vector is 60^o.
- In figure C, left side is slower to depolarize.
- In figure D, the last part to depolarize is near the left base of the heart which gives a negative vector (S wave).
- Q wave is present if the left side of the septum depolarizes first.

The T Wave (Ventricular Repolarization)

- First area to repolarize is near the apex of the heart.
- Last areas, in general, to depolarize are the first to repolarize.
- Repolarized areas will have a + charge first; therefore, a + net vector occurs and a positive T wave

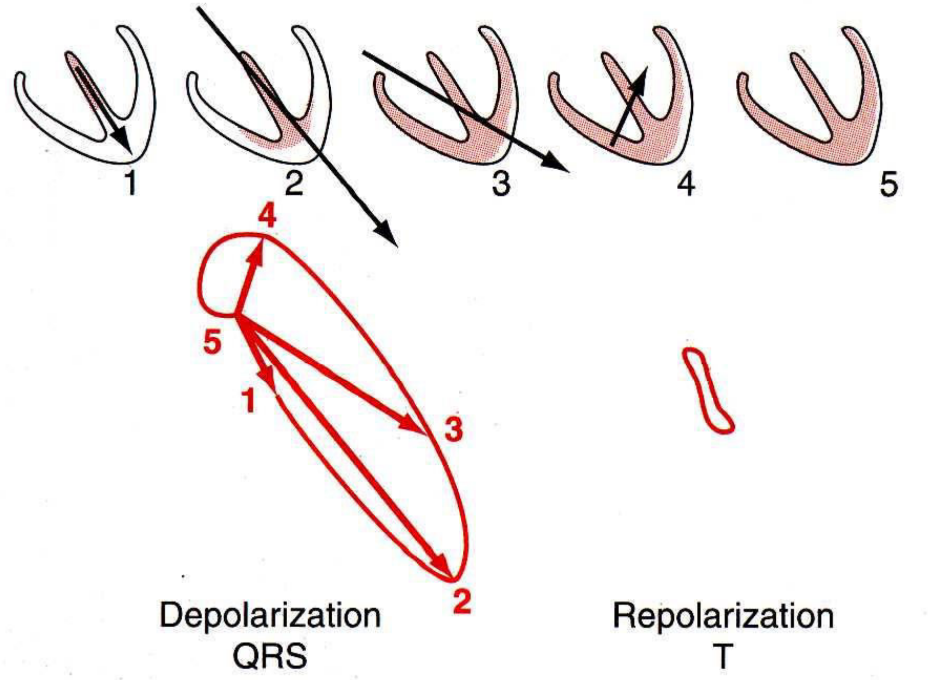


Atrial Depolarization (P-Wave) and Atrial Repolarization (Atrial T Wave)

- Atrial depolarization begins at sinus node and spreads toward A-V node.
- This should give a + vector in leads I, II, and III.
- Atrial repolarization can't be seen because it is masked by QRS complex.
- Atrial depolarization is slower than in ventricles, so first area to depolarize is also the first to repolarize. This gives a negative atrial repolarization wave in leads I, II, and III

Vectorcardiogram

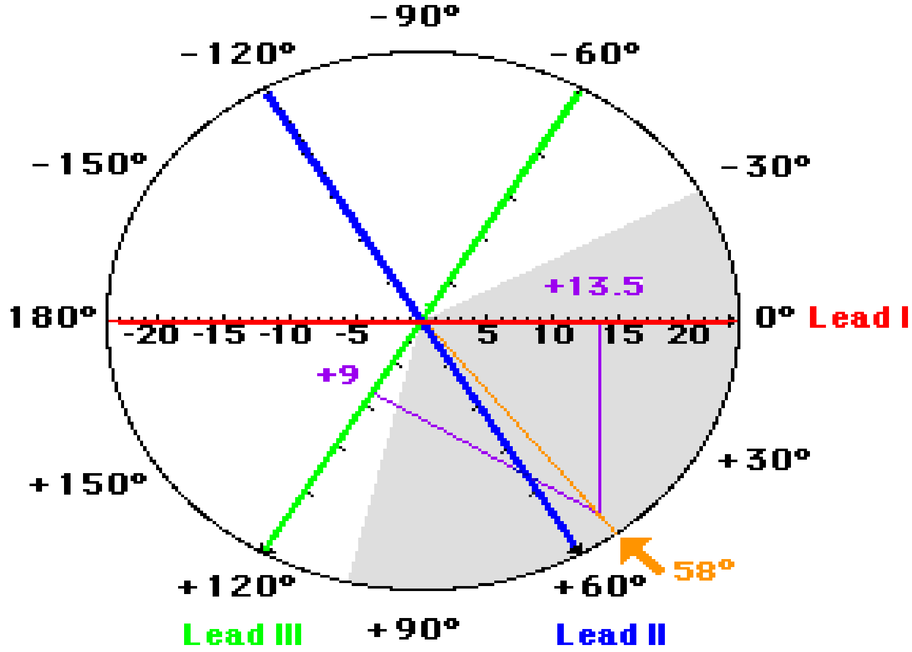
- This traces vectors throughout cardiac cycle.
- When half of the ventricle is depolarized, vector is largest.

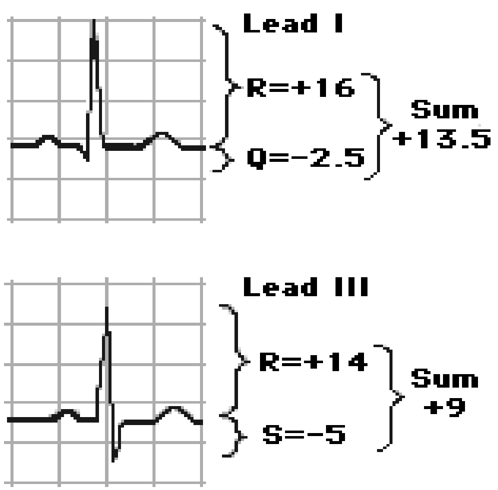


- Note zero reference point, number 5, is point of full depolarization

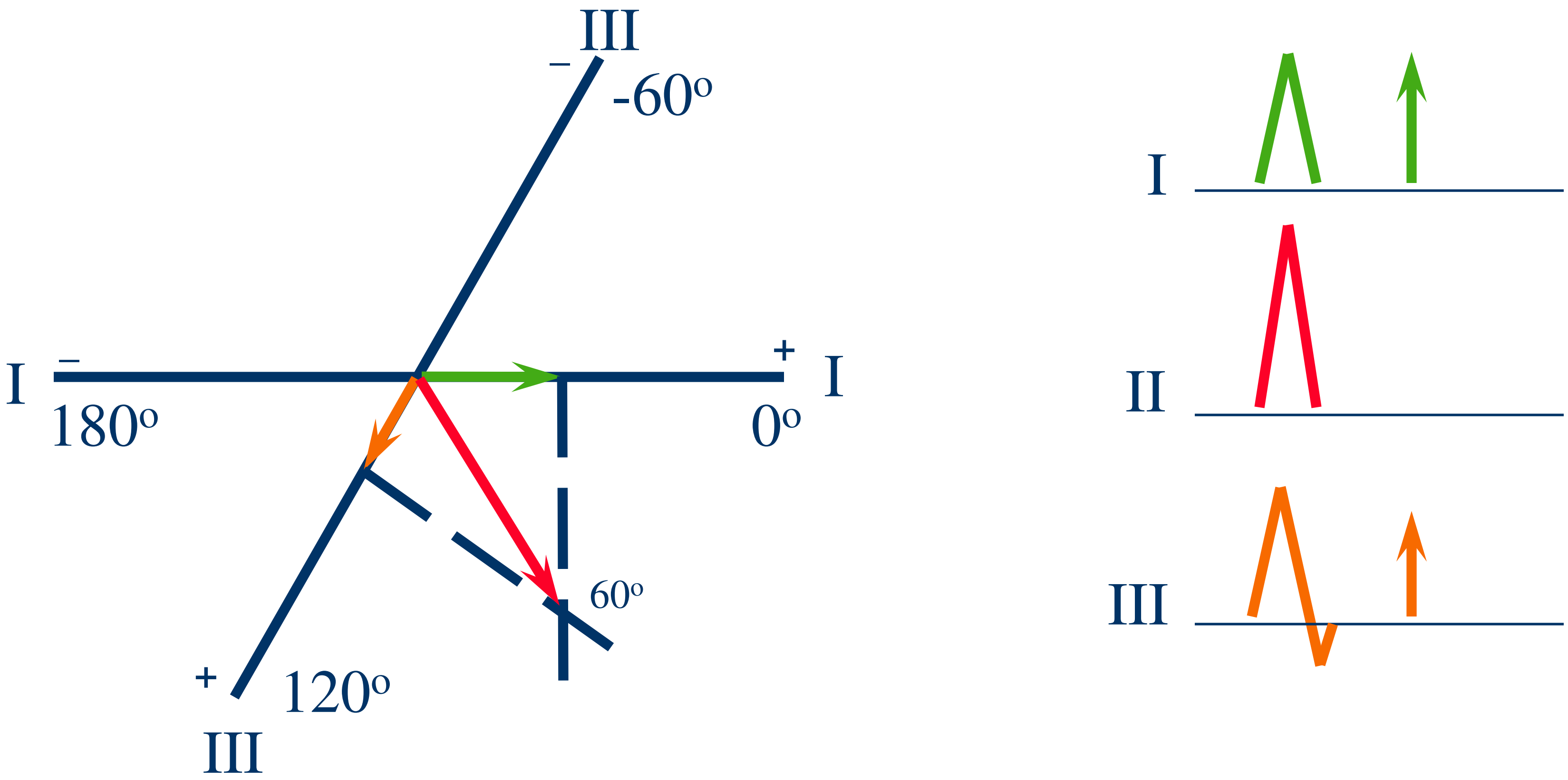
Determining Mean Electrical Axis

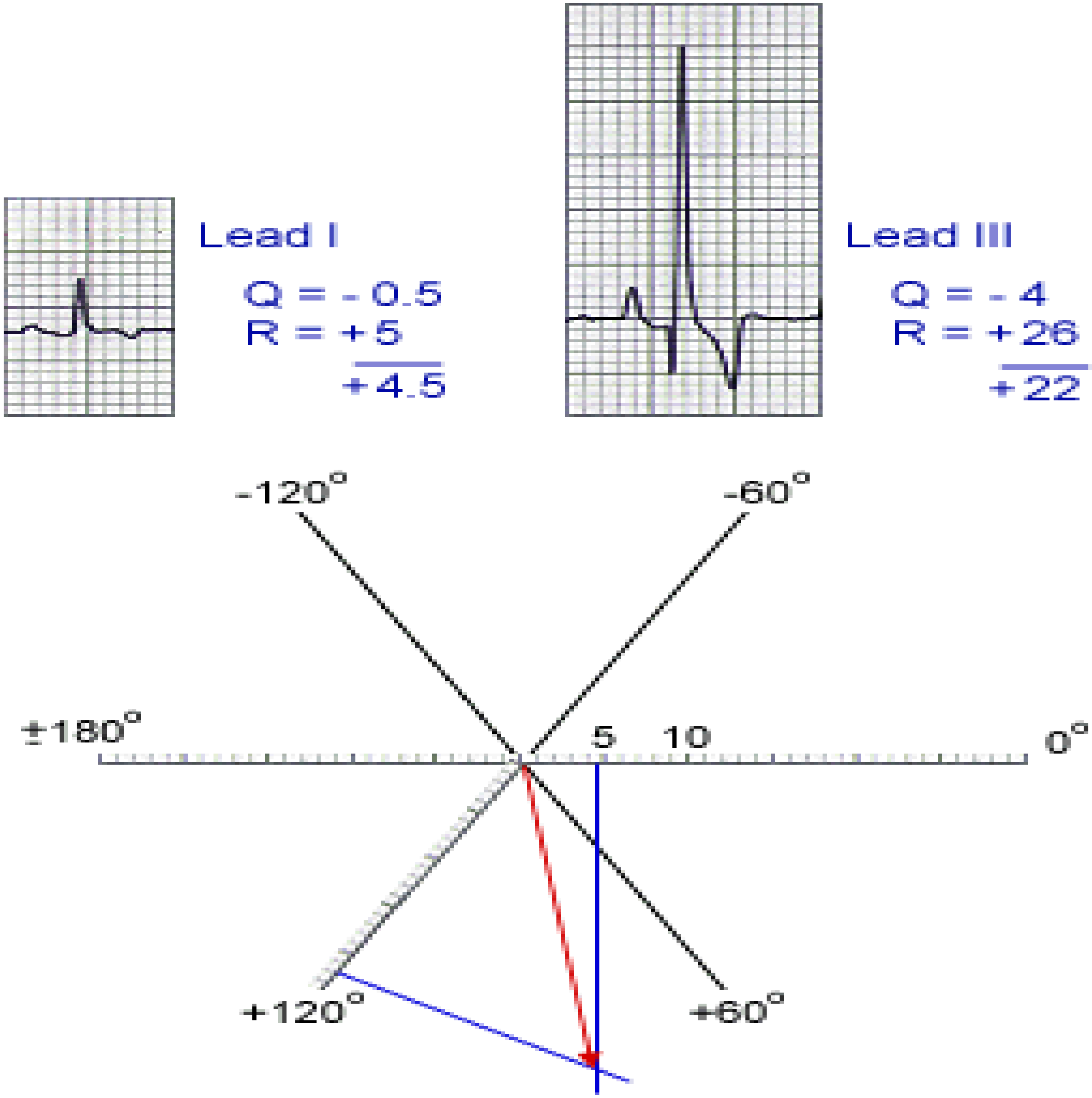
- Use 2 different leads
- Measure the sum of the height and the negative depth of the QRS complex
- Measure that vaule in mm onto the axis of the lead and draw perpendicular lines
- The intersection is at the angle of the mean axis.



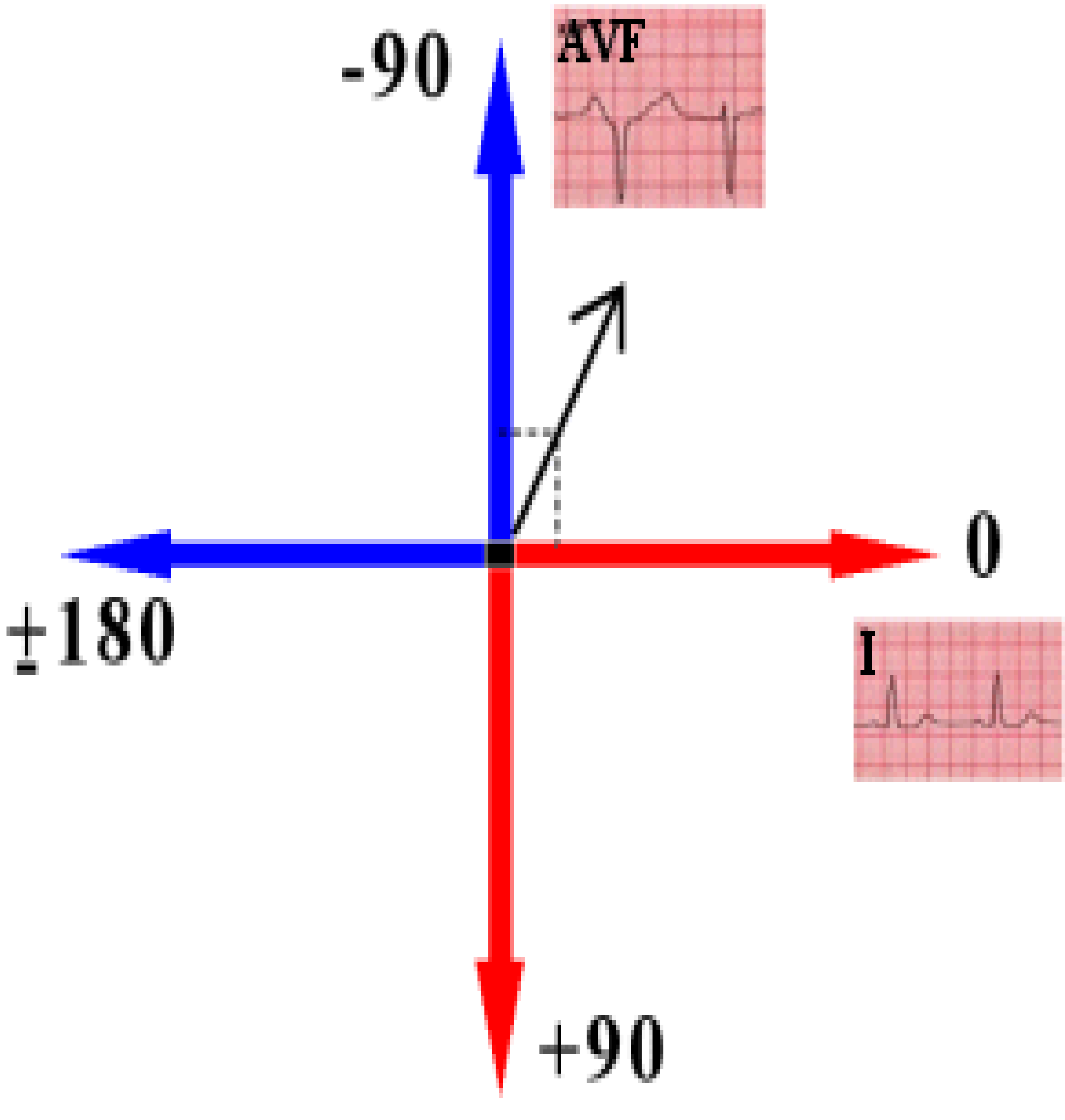


Plot of the Mean Electrical Axis of the Heart from Two Electrocardiographic Leads

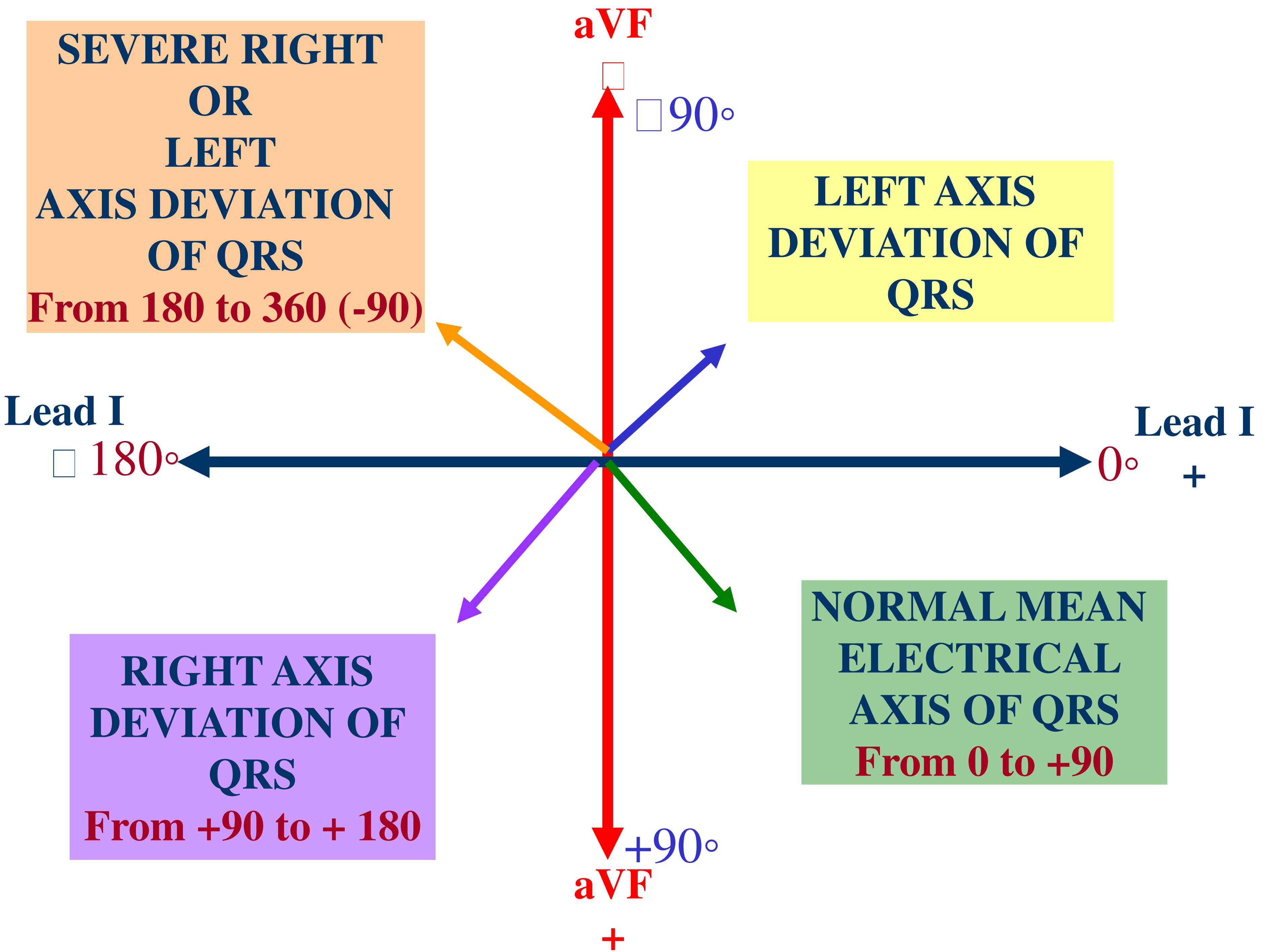




Lead I
Q = - 0.5
R = + 5
+ 4.5
Lead III
Q = - 4
R = + 26
+ 22
-120°
-60°
±180°
5
10
0°
+120°
+60°



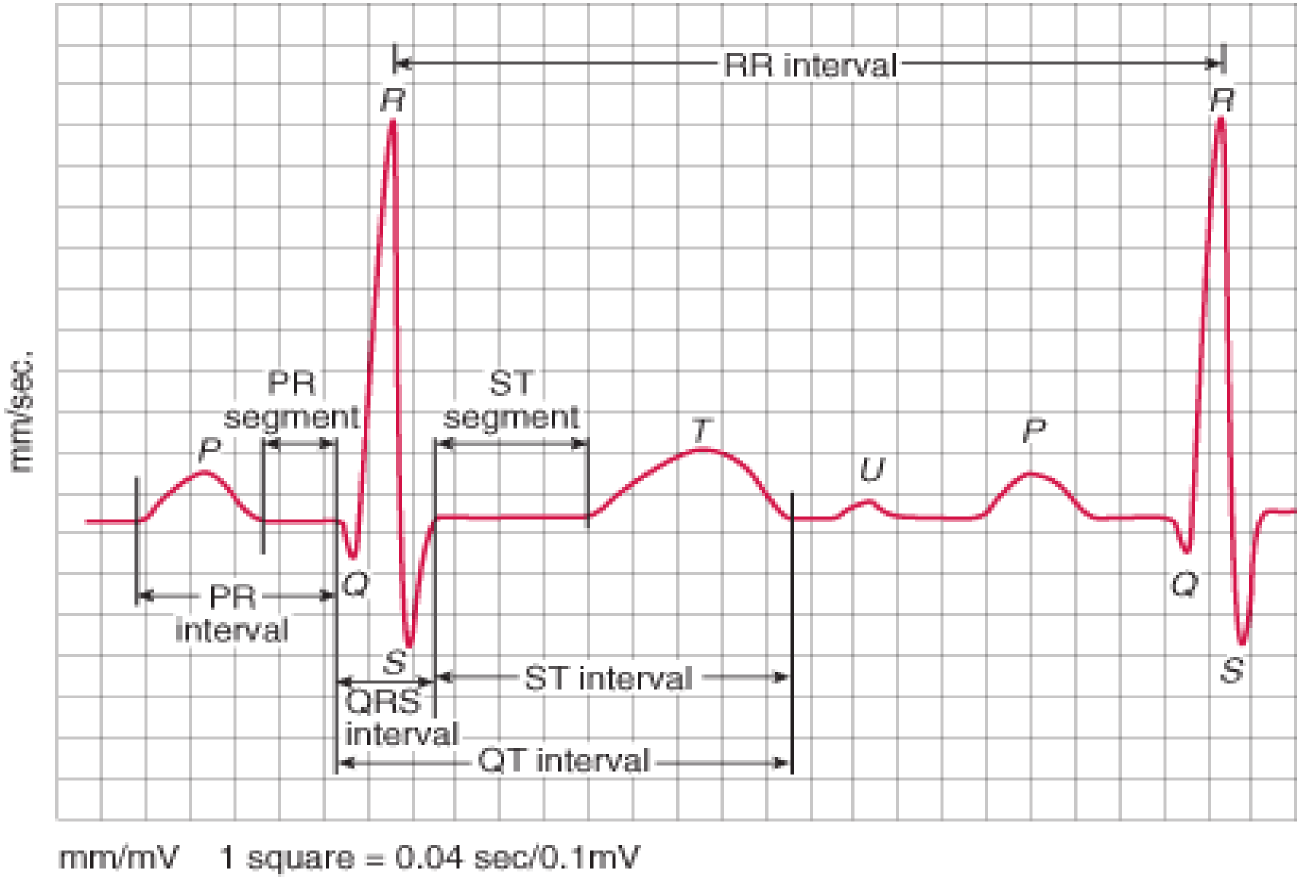
-90
AVF
0
±180
I
+90


aVF
□
□90◦
SEVERE RIGHT OR LEFT AXIS DEVIATION OF QRS
From 180 to 360 (-90)
LEFT AXIS DEVIATION OF QRS
Lead I
□ 180◦
Lead I
0◦
+
NORMAL MEAN ELECTRICAL AXIS OF QRS
From 0 to +90
RIGHT AXIS DEVIATION OF QRS
From +90 to + 180
+90◦
aVF
+

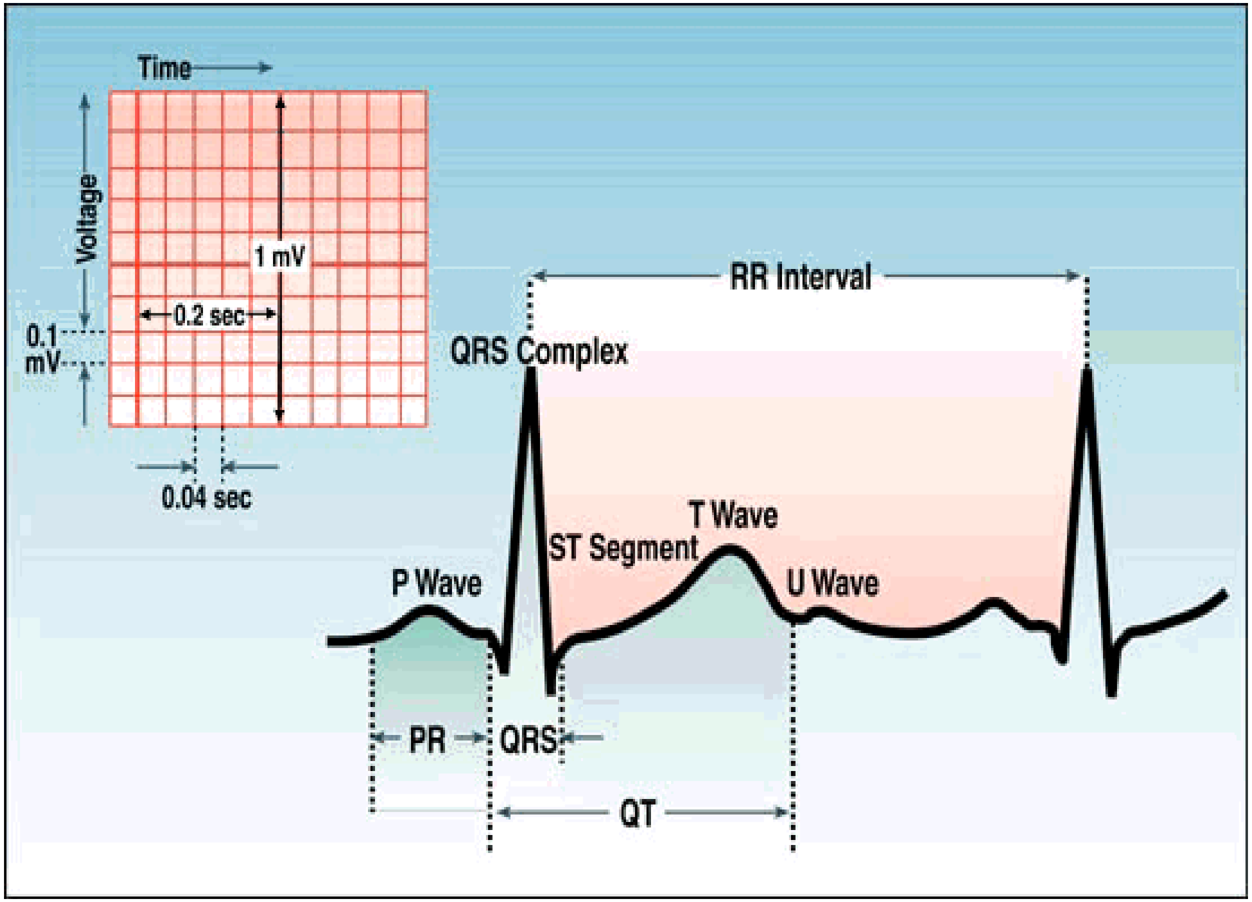
Heart Rate Calculation

- R-R interval = 0.83 sec
- Heart rate = $\frac{60\ \text{sec}}{\text{min}} / \frac{0.83\ \text{sec}}{\text{beat}}$ = 72 beats/min

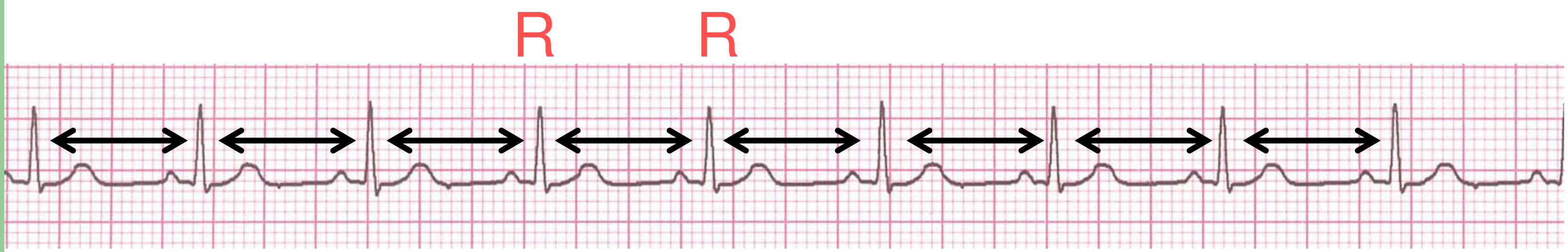
ECG Calculations



ECG Calculations



Determine regularity

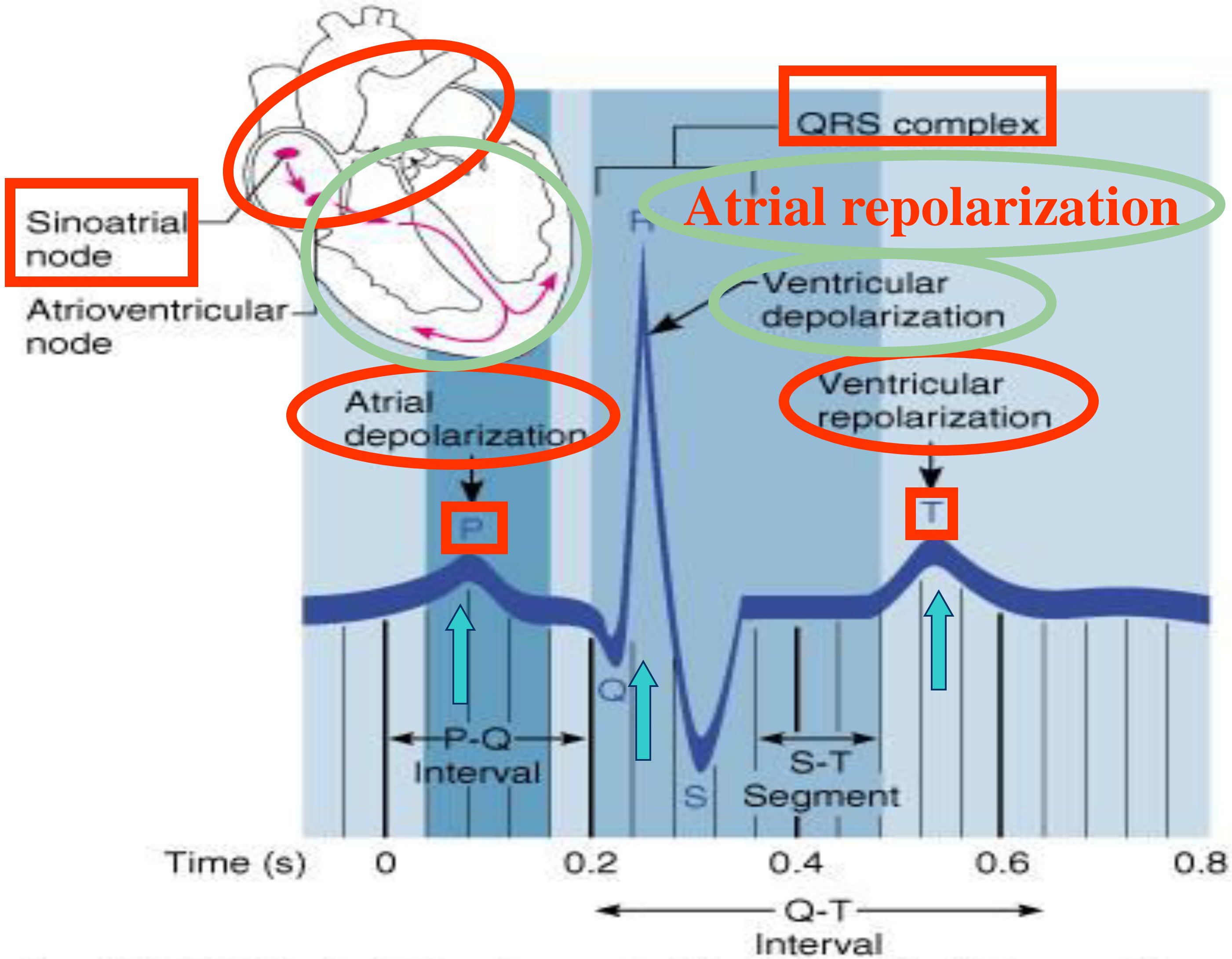


- Look at the R-R distances (using a caliper or markings on a pen or paper).
- Regular (are they equidistant apart)? Occasionally irregular? Regularly irregular? Irregularly irregular? Interpretation?

Regular

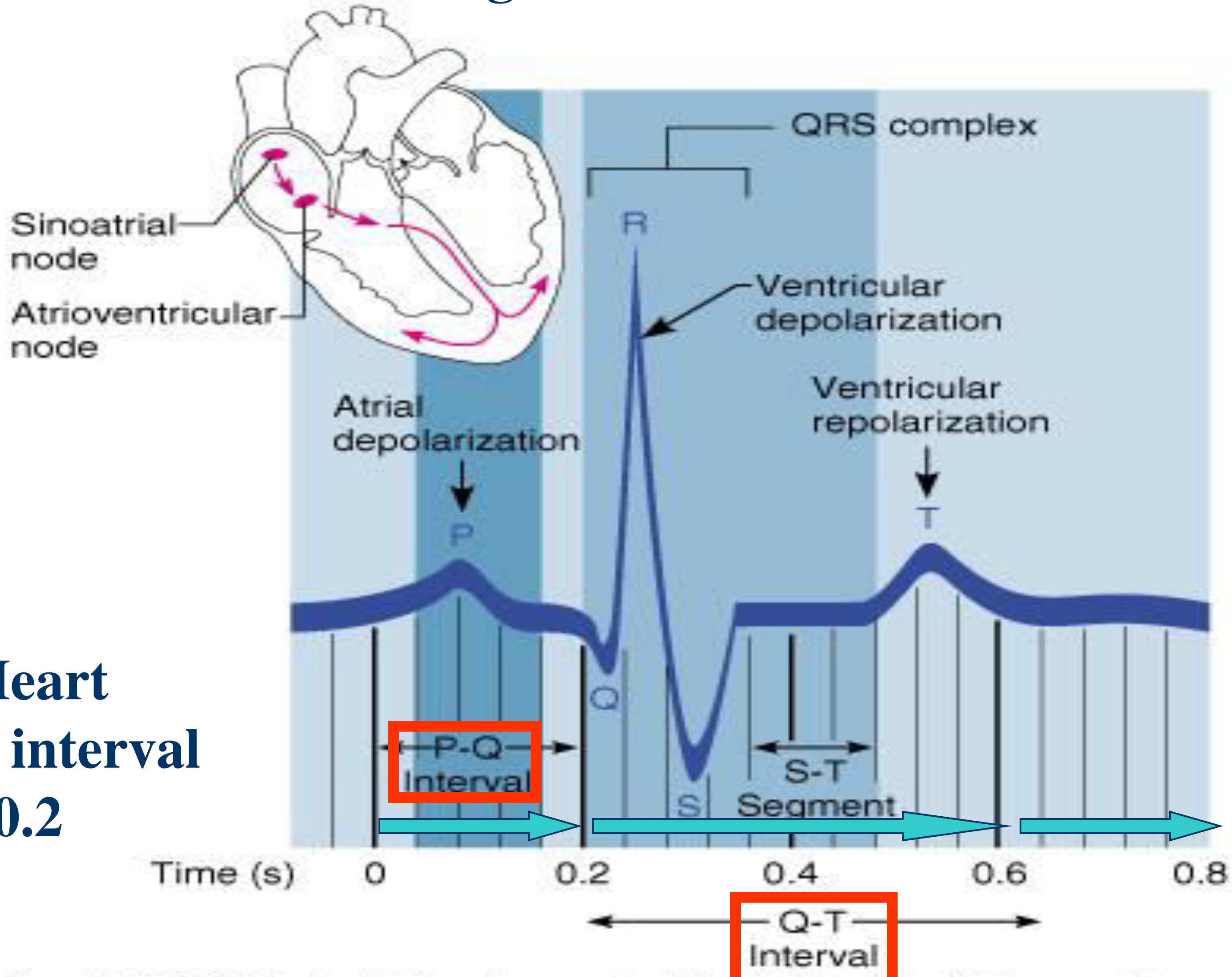
ECG Deflection Waves

(Pacemaker)



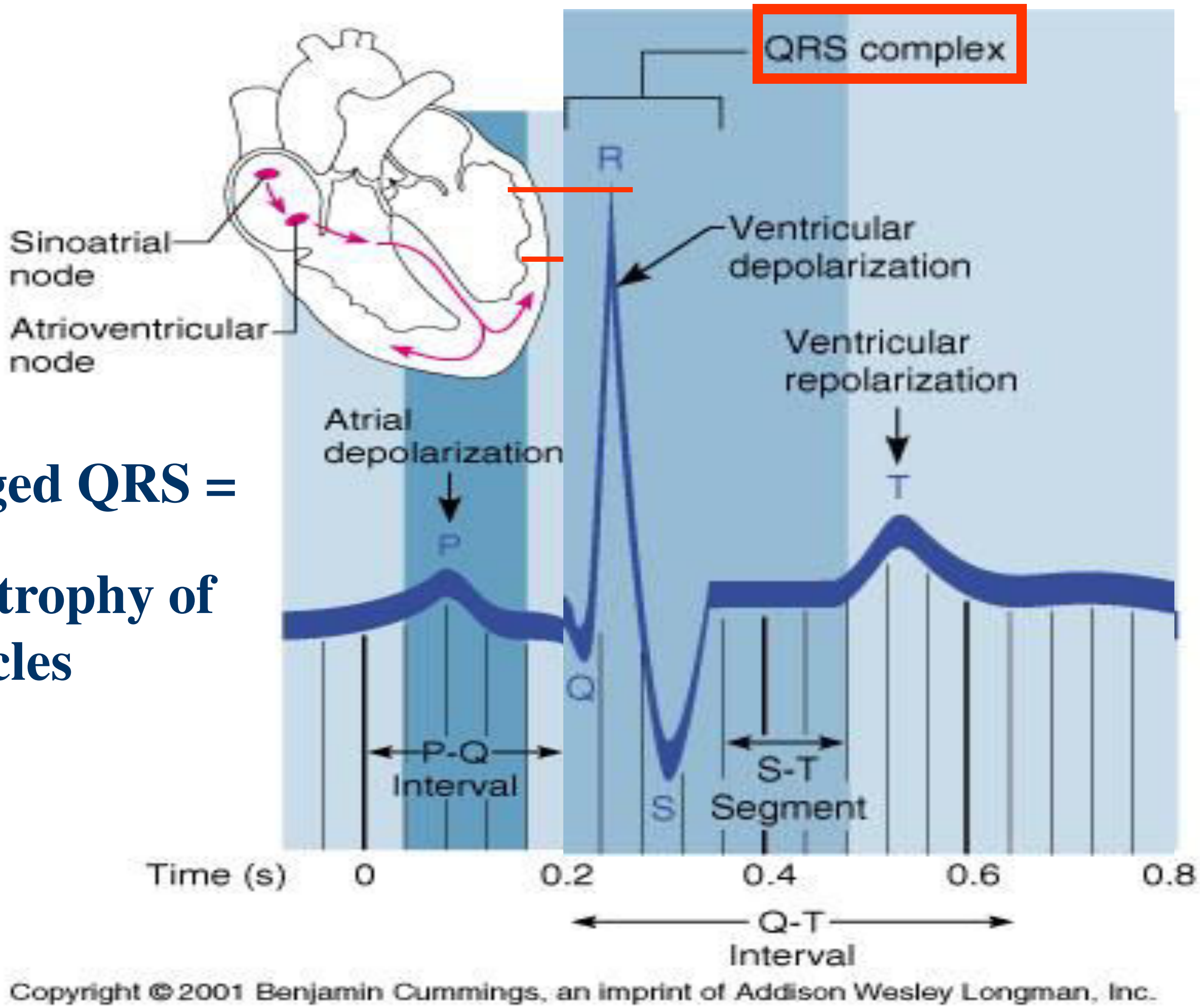
ECG Deflection Waves

60 seconds ÷ 0.8 seconds = resting heart rate of 75 beats/minute



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

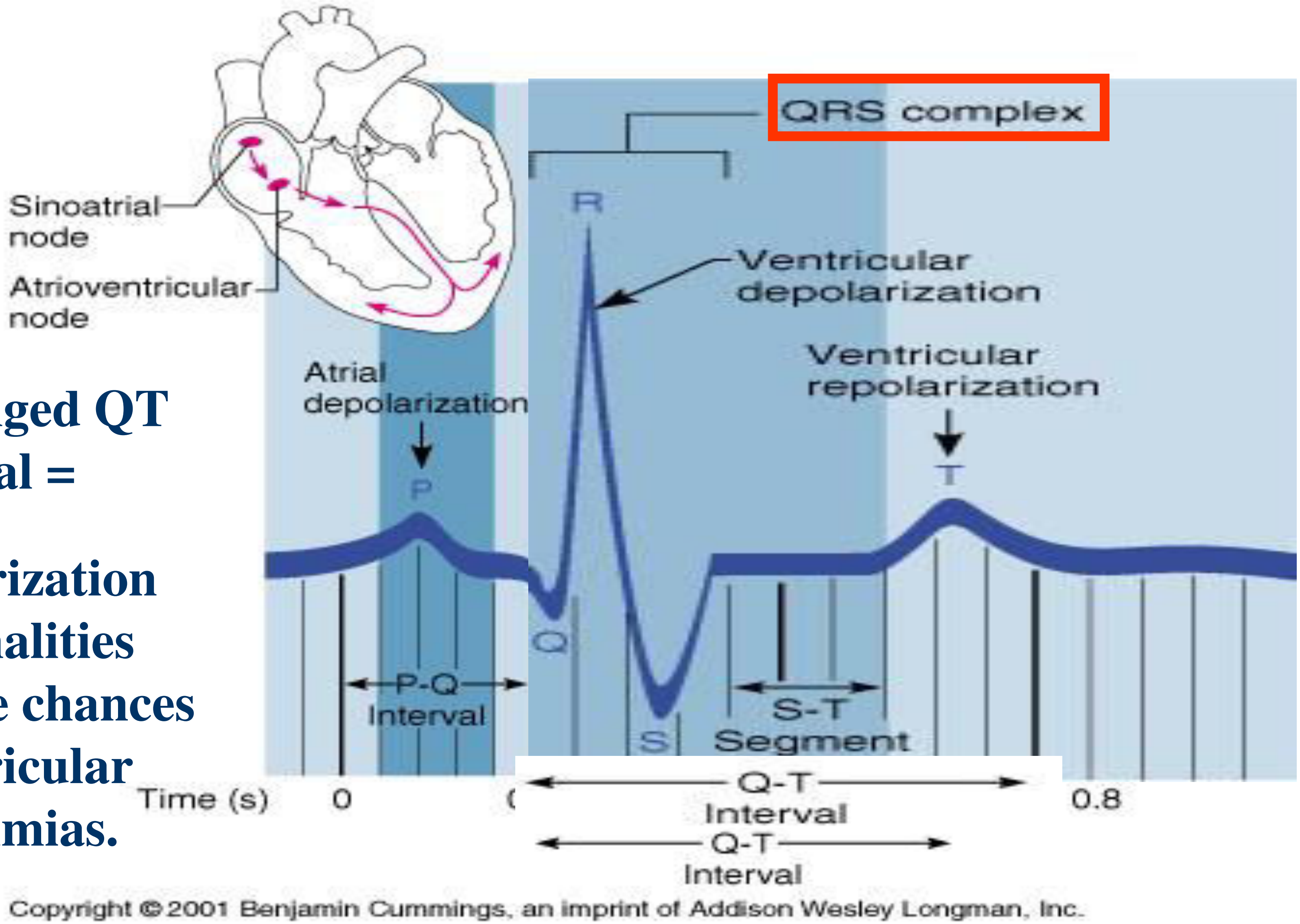
ECG Deflection Wave Irregularities



Enlarged QRS =

Hypertrophy of ventricles

ECG Deflection Wave Irregularities



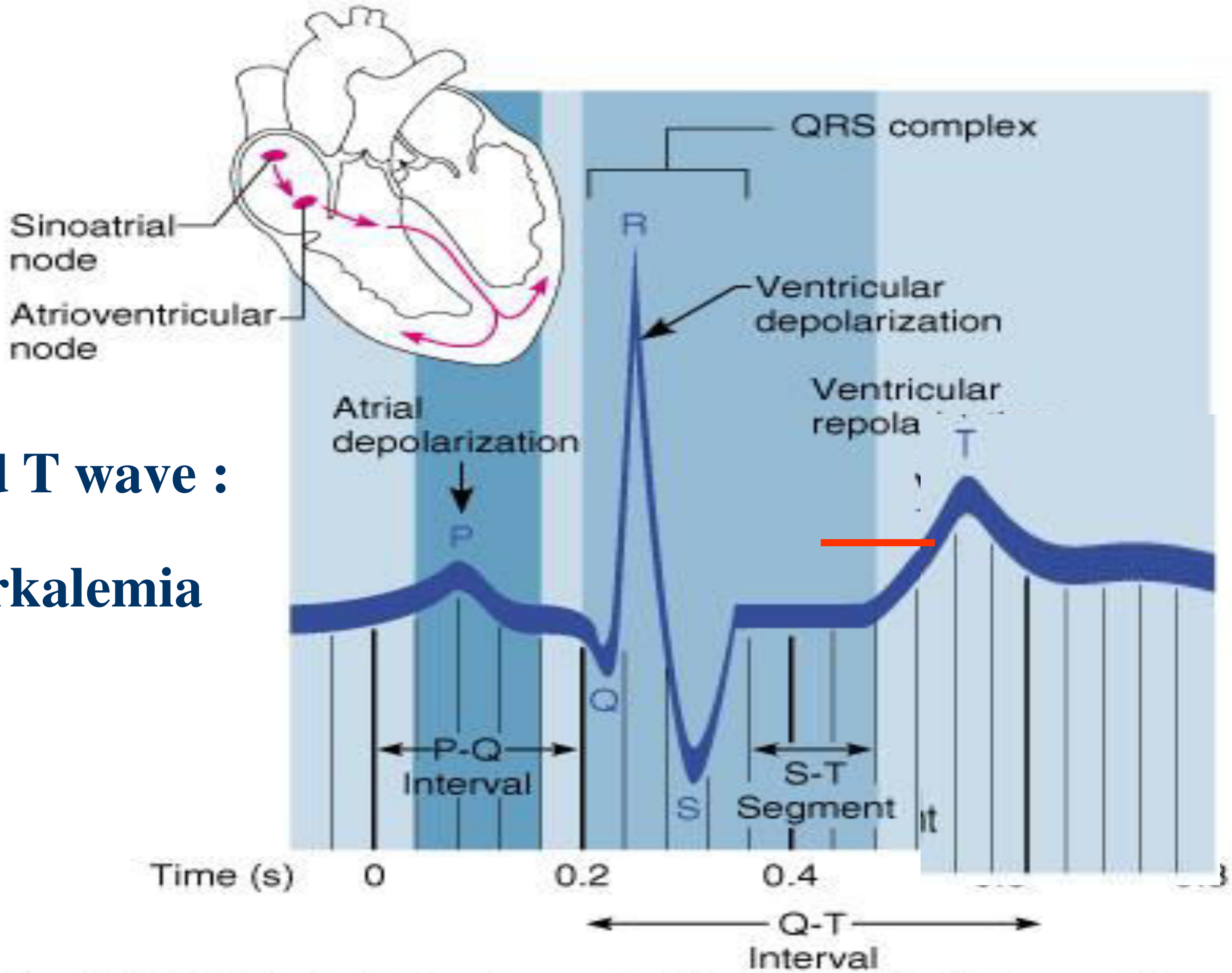
Prolonged QT Interval =

Repolarization abnormalities increase chances of ventricular arrhythmias.

ECG Deflection Wave Irregularities

Elevated T wave :

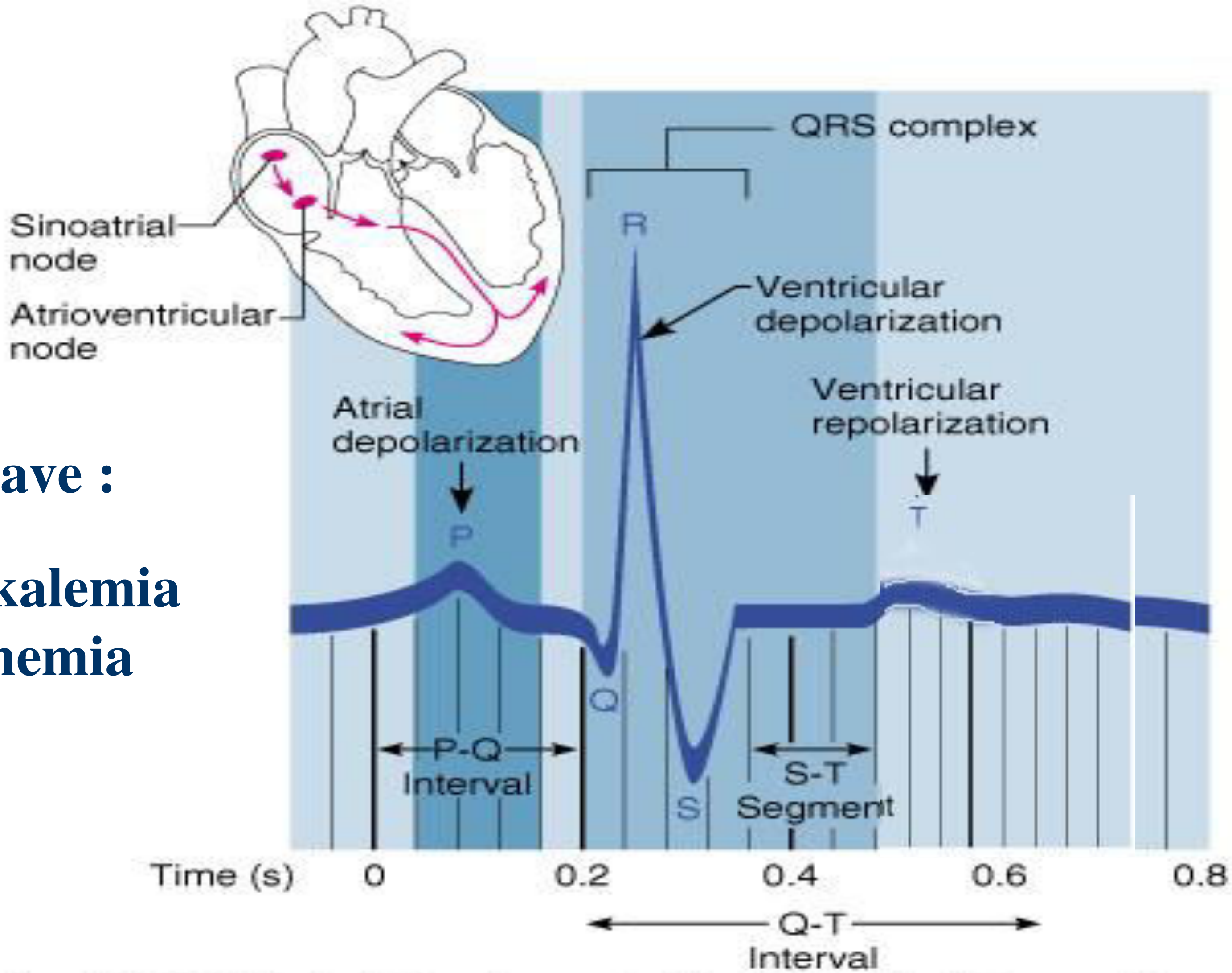
Hyperkalemia



ECG Deflection Wave Irregularities

Flat T wave :

Hypokalemia or ischemia



Thank You