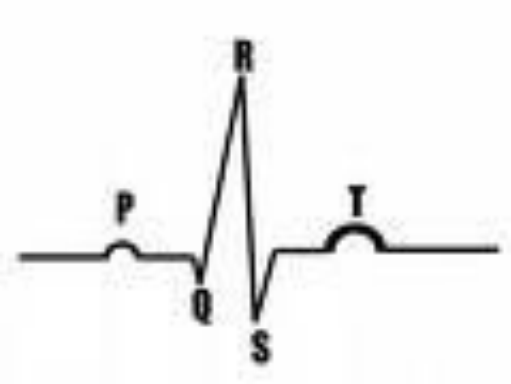

12 Lead ECG Interpretation

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No disclosures relevant to this presentation.

Disclosures

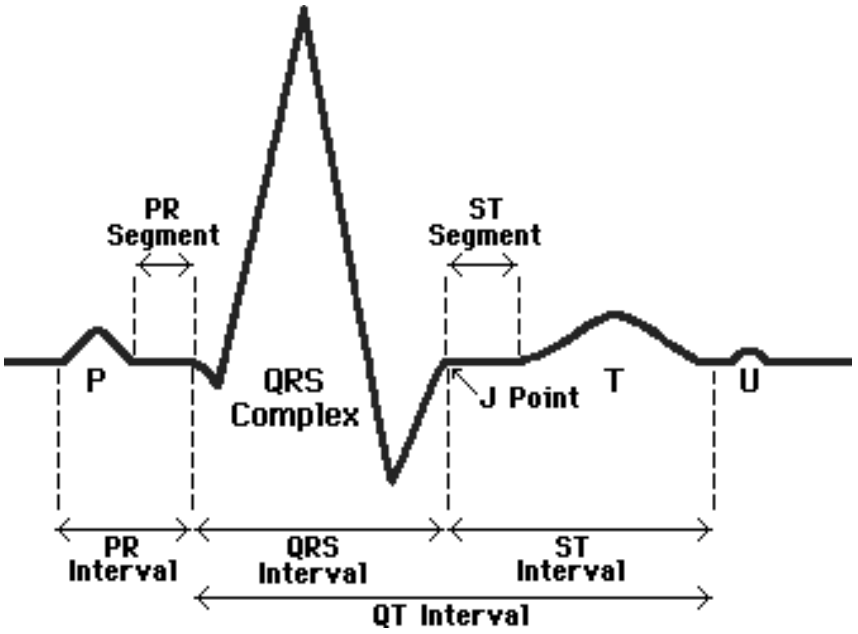
- No disclosures relevant to this content.

Objectives For Workshop

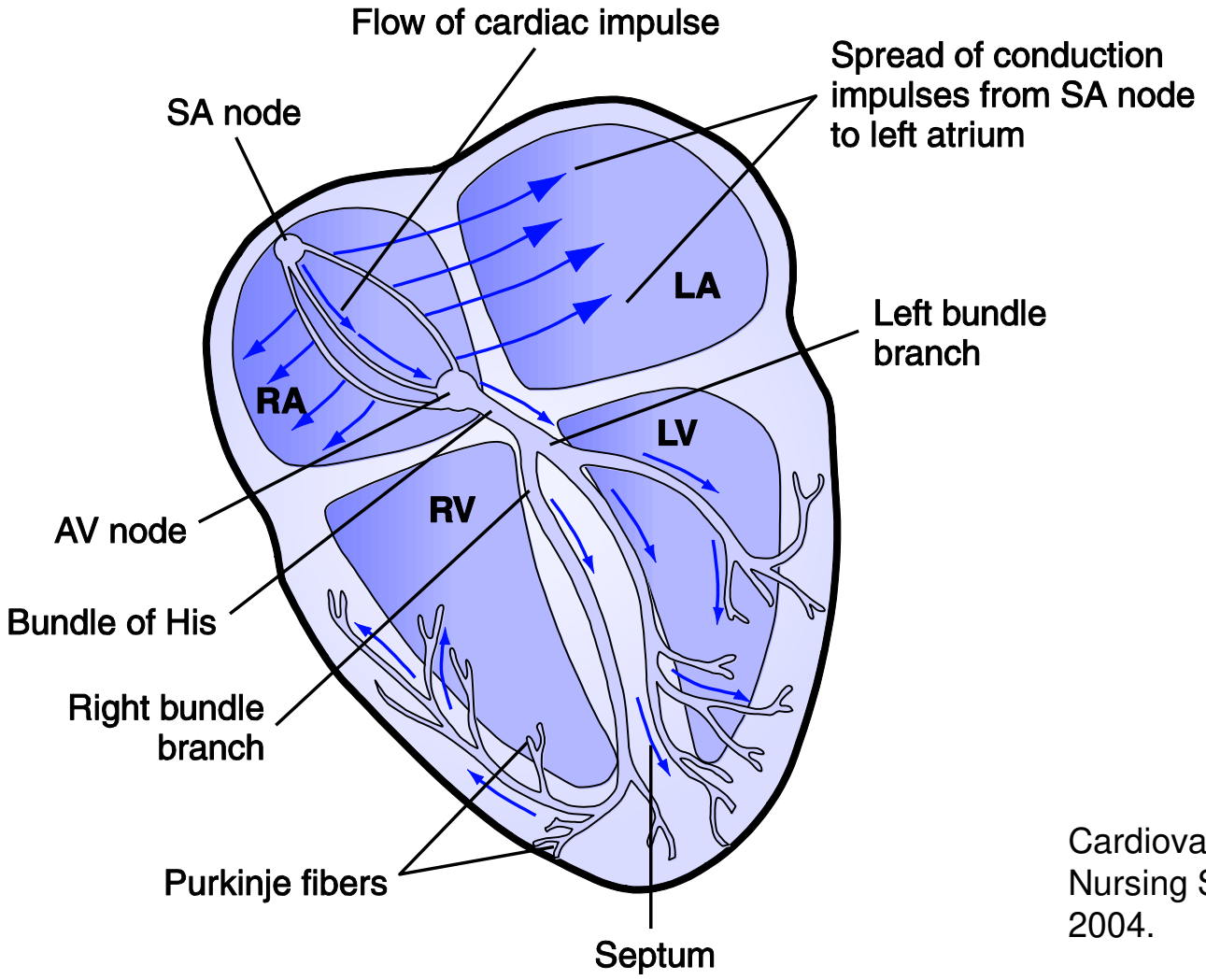
- Review the principles behind the 12 views on the electrocardiogram (ECG) & how they align with frontal, augmented, & precordial leads.
- Interpret axis deviation, if present, on the 12 Lead ECG.
- Identify possible pathological events that explain abnormalities on the 12 Lead ECG.
- Utilize a systematic approach for interpreting 12 Lead ECGs with the use of case studies.

Systematic Interpretation of 12 Lead ECGs

- Step 1: determine rate, intervals & rhythm
  - Lead II or V1 best
  - Rhythm strip helpful



Conduction System of the Heart



Cardiovascular Nursing Secrets, 2004.

AV, Atrioventricular; LA, left atrium; LV, left ventricle; RA, right atrium; RV, right ventricle; SA, sinoatrial.

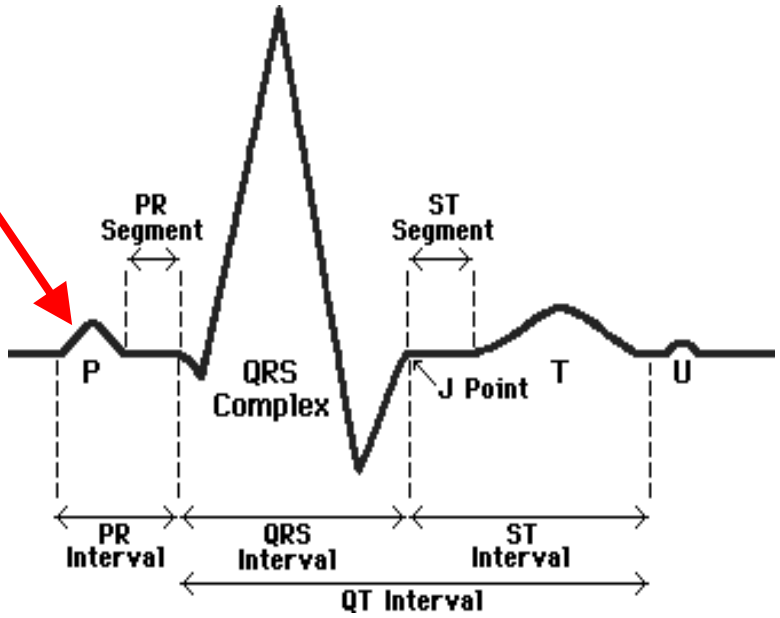
Basic Elements of the ECG

"P wave":

- atrial depolarization (right; then left)
- small, rounded, returns to baseline
- *Usually* upright ("positive") in most leads

"**PR interval**":

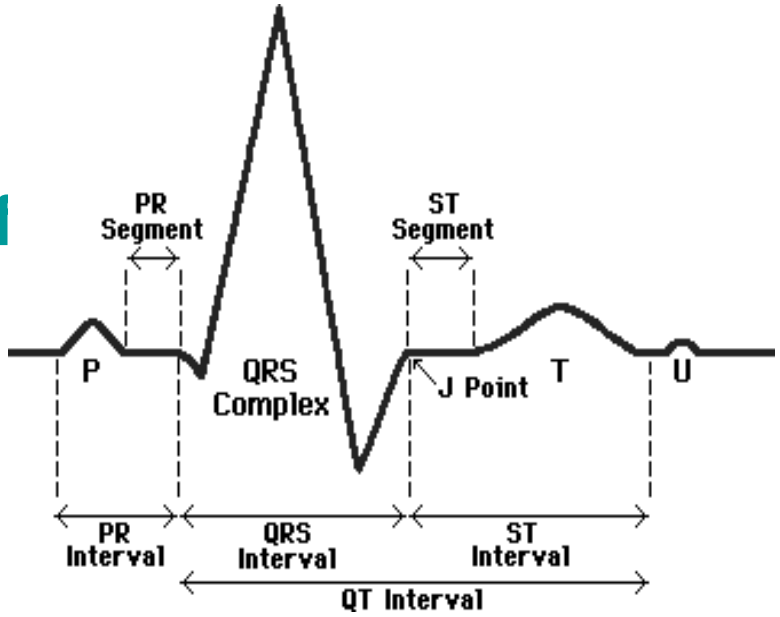
- usually **.12 - .20 seconds** (3-5 small squares).
- Measures the **time** from the start of the atrial depolarization to the start of ventricular depolarization.



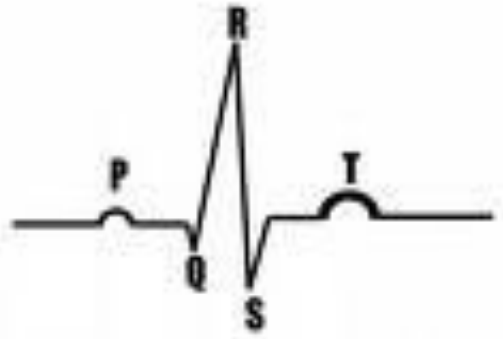
Basic Elements of the ECG

"**QRS complex**": usually < 0.12 **seconds**. [<.10 theoretically]

- Ventricular depolarization beginning with the **bundle of HIS**, **bundle branches**, & **Purkinje fibers**, then out to the ventricular myocardium (starting with the septum).
- Usually **Q wave negative**, **R wave positive**, and **S wave is negative**.
- Many variations



Basic Elements of the EC



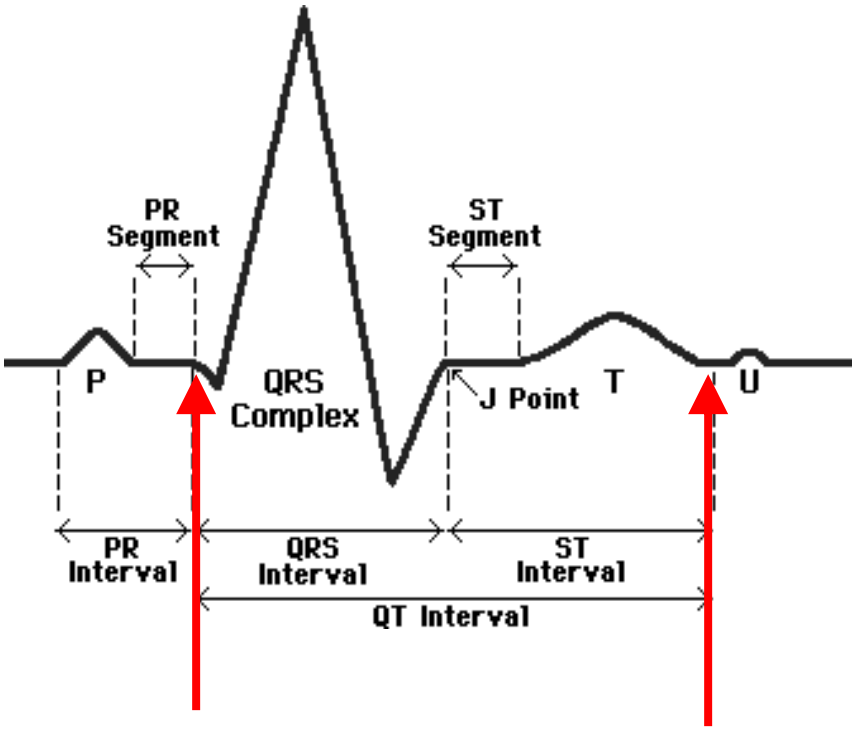
"T wave"

- Represents ventricular repolarization
- Usually rounded.
- Usually upright (positive), may be inverted or biphasic.
- Many variations; some due to electrolyte changes or medications.

Basic Elements of the ECG

"QT Interval": the area between the beginning of the QRS complex & the end of the T wave.

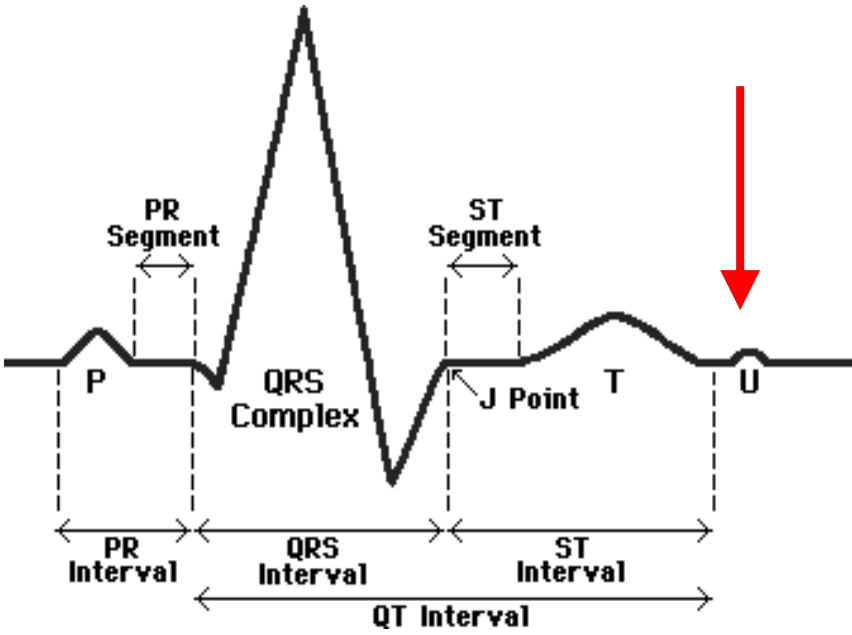
- Usually **<.40 seconds** (0.34-.42 sec) (10 small squares).
- **Corrected QT interval (QTc)**:
  - **Meaning of QTc:** QT interval is inversely related to heart rate; The faster the HR the shorter the QTc. The slower the HR the longer the QTc. Prolonged QTc can place someone at risk for V Tach.
  - **Usual measurement**: Men should be < .47 sec; women should be < .48 sec. A QTc interval >0.50 sec is considered dangerous.
- Measures the **time** from the start of the ventricular depolarization to the end of the refractory period.



Basic Elements of the ECG

"U wave":

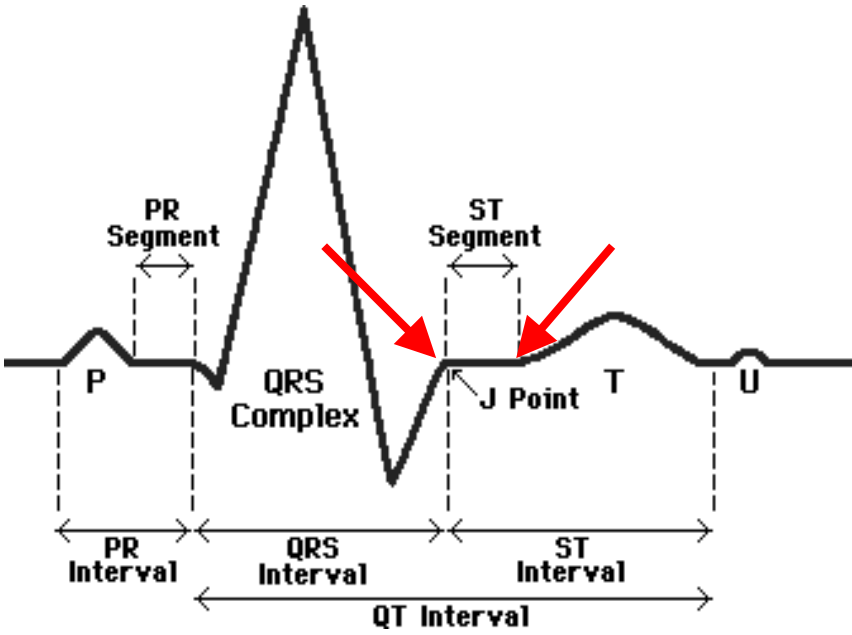
- Present in some people
- Follows the t wave
- Meaning: represents repolarization of the papillary muscles or Purkinje Fibers.
- May be prominent if hypokalemia, hypercalcemia, or digoxin toxicity occurs. Also may occur with congenitial long QT syndrome or if certain antiarrhythmics are given.



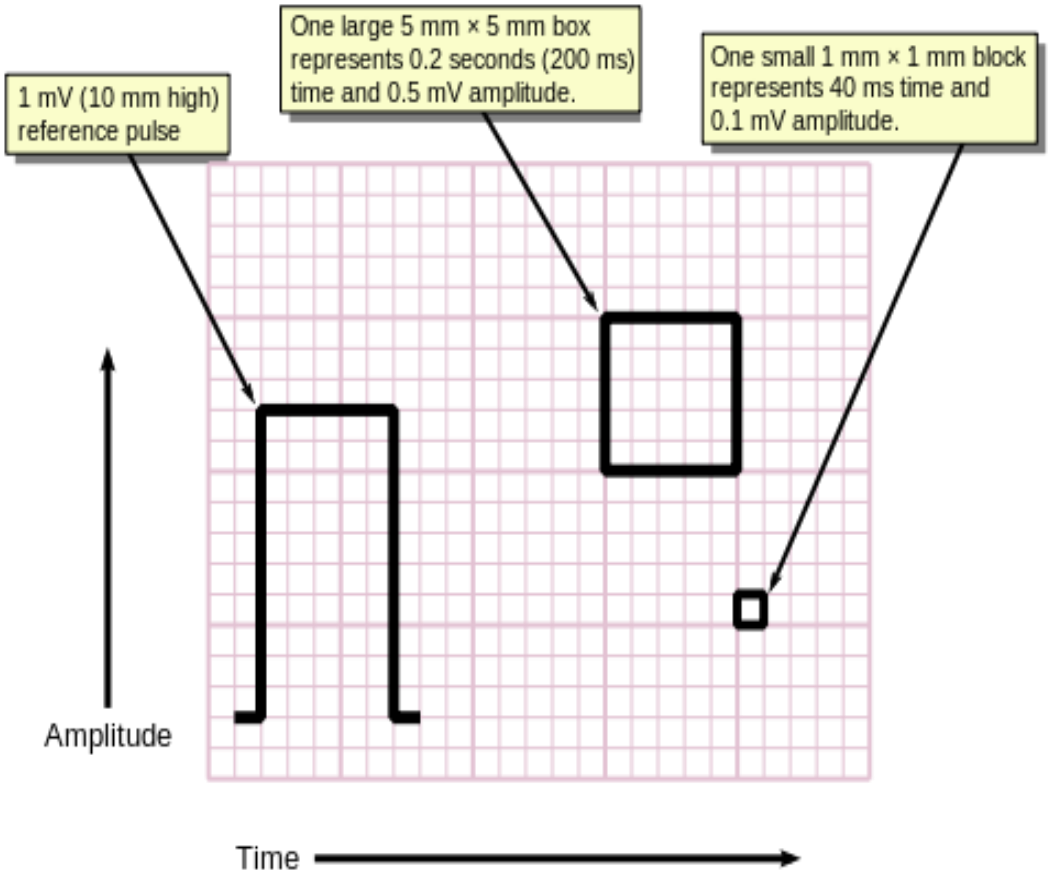
Basic Elements of the ECG

"ST segment": the area between where the QRS complex ends & the T wave begins.

- Records the end of ventricular depolarization and start of ventricular repolarization.
- Normally isoelectric; not varying > 1 mm above and 0.5 mm below the baseline.
- Abnormally ***may*** represent acute ischemic changes (coronary artery disease).
- Used more to interpret 12 Lead ECGs



The ECG Paper: Measuring Squares



- Horizontally (time)
  - One small box - 0.04 sec (or 40 ms)
  - One large box - 0.20 sec (or 200 ms)
- Vertically
  - One small box – 1 mm (or 0.1 mV)
  - One large box - 5 mm (or 0.5 mV)

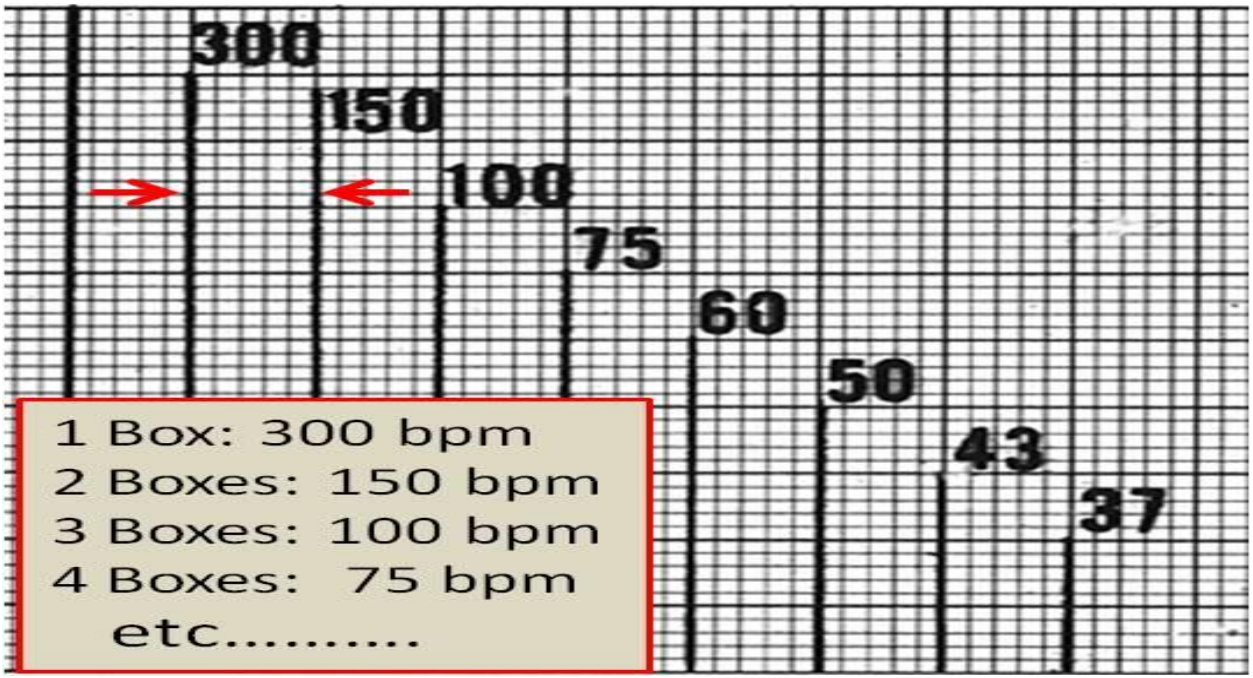
Source: https://commons.wikimedia.org/wiki/File:ECG_Paper_v2.svg

Calculating Heart Rate

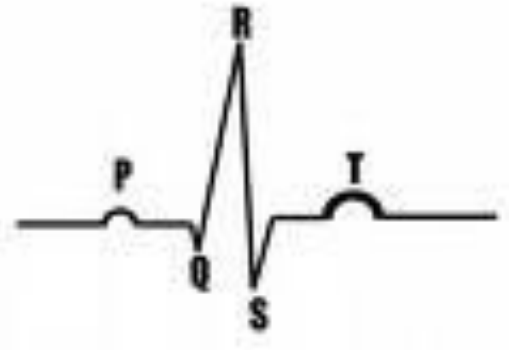
Step One: Find a R wave that lands on a bold line.

Step Two: Memorize the sequence:
300 - 150 - 100 - 75 - 60 – 50

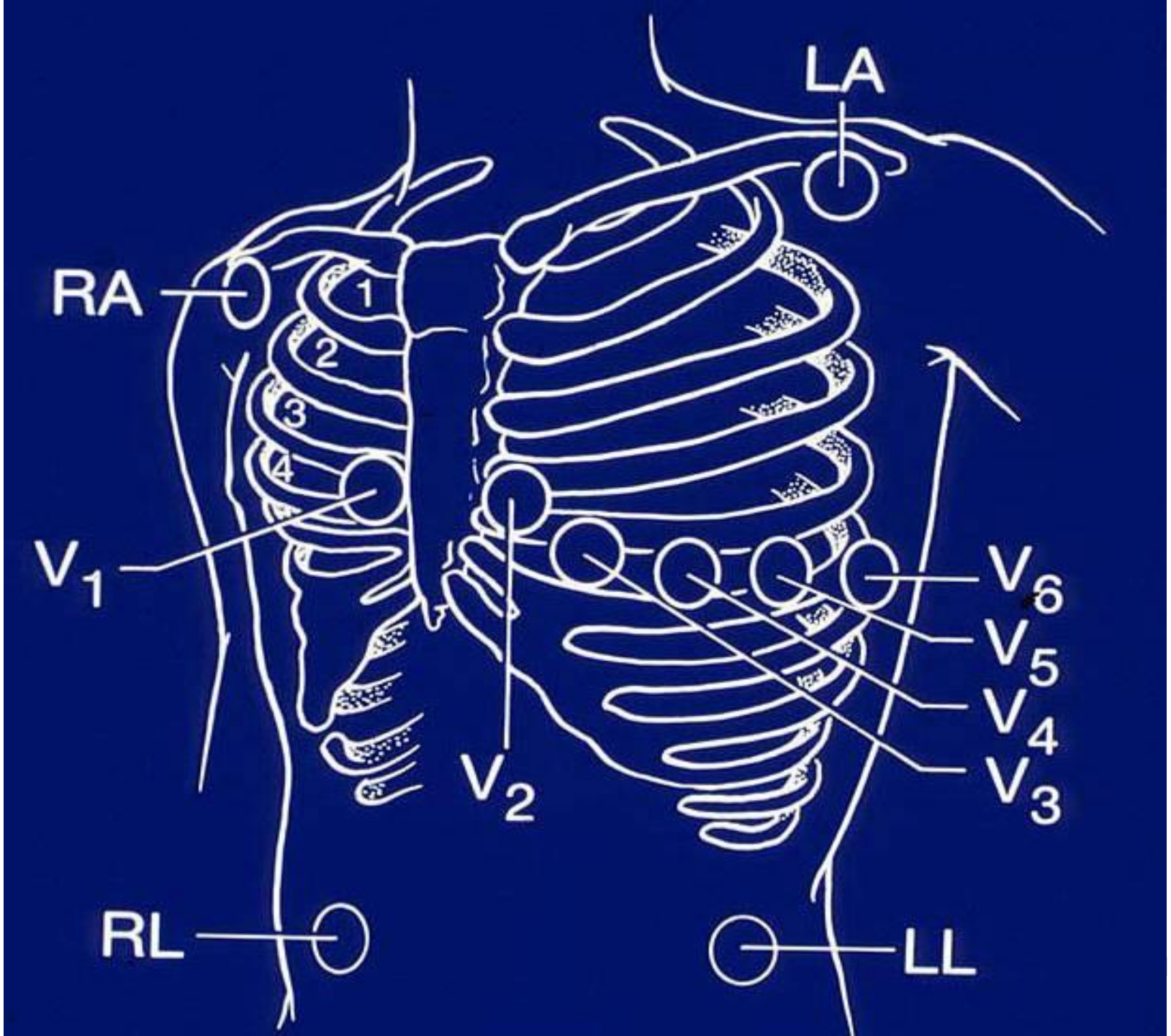
Step Three:
Find the next R wave & guestimate the rate



Source: http://ecg.utah.edu/lesson/3

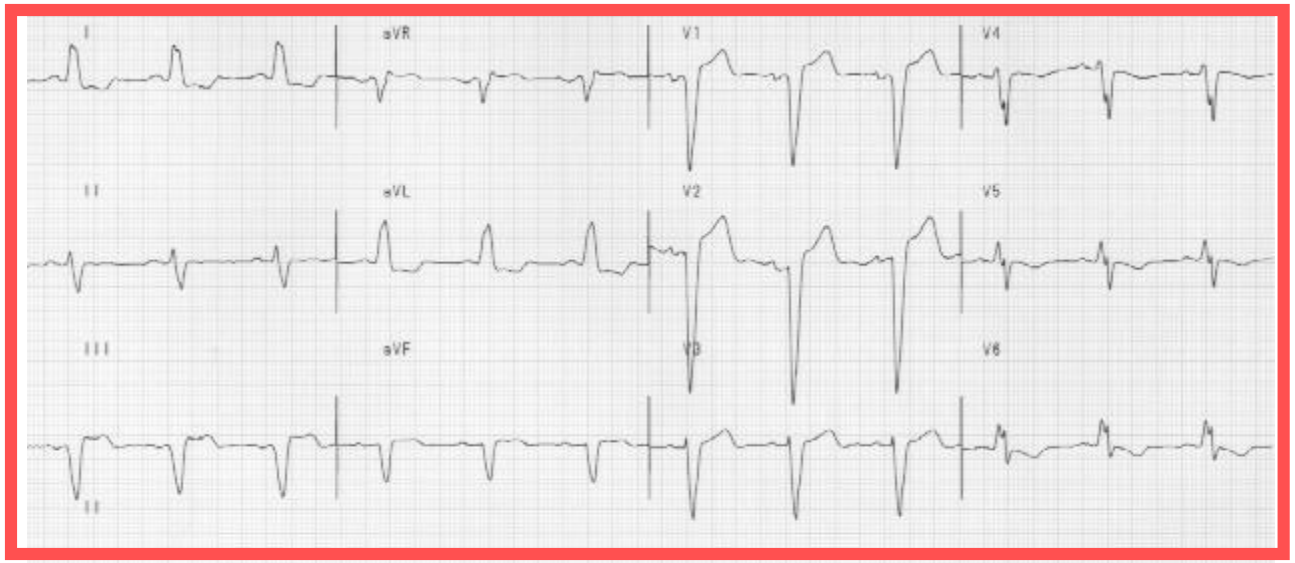


Normal Configurations of the 12 Lead ECG

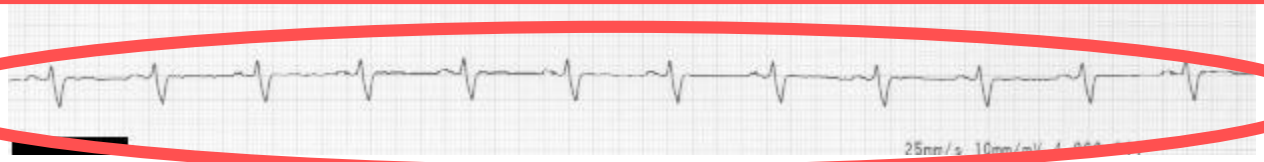

LA
RA
1
2
3
4
V1
V2
V6
V5
V4
V3
RL
LL

12 Lead ECG & Rhythm Strip

A standard 12 Lead ECG contains the 12 different views plus a rhythm strip at the bottom.



12-Lead ECG



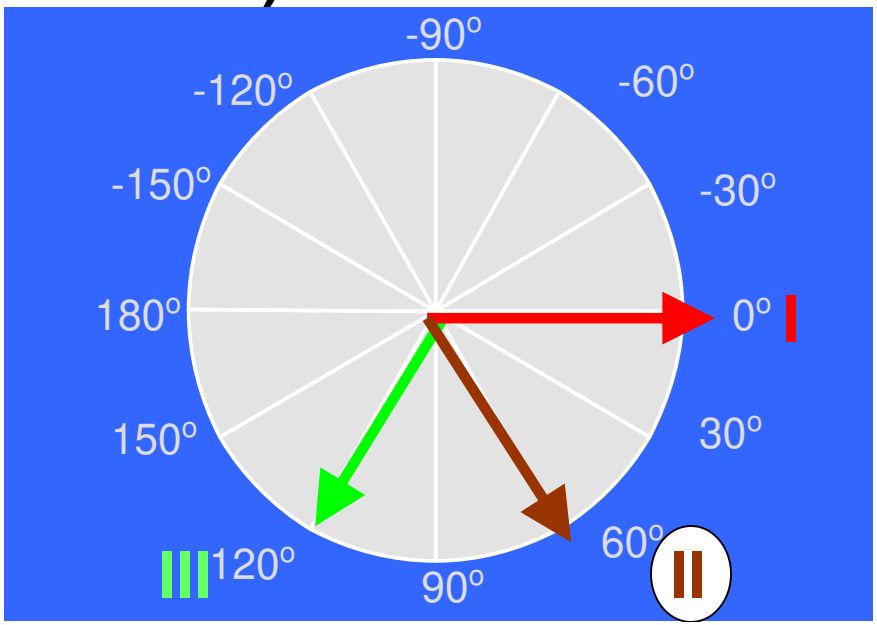
Rhythm Strip

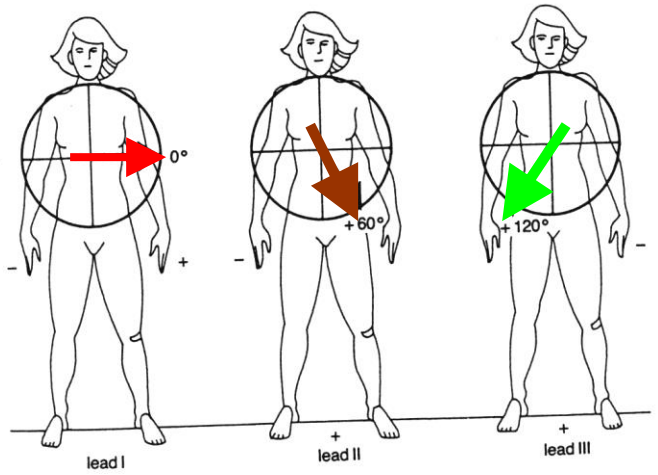
12 Views of the Heart

- **Frontal leads**: 6 leads viewing the heart in a *vertical plane* (from the front).
- Measures **forces moving up & down** and **left & right**.
- I, II, III (bipolar)
- aVR, aVL, aVF (unipolar; augmented leads generated from a single lead and a "ground" lead).

Standard limb leads (6) (Frontal Plane)

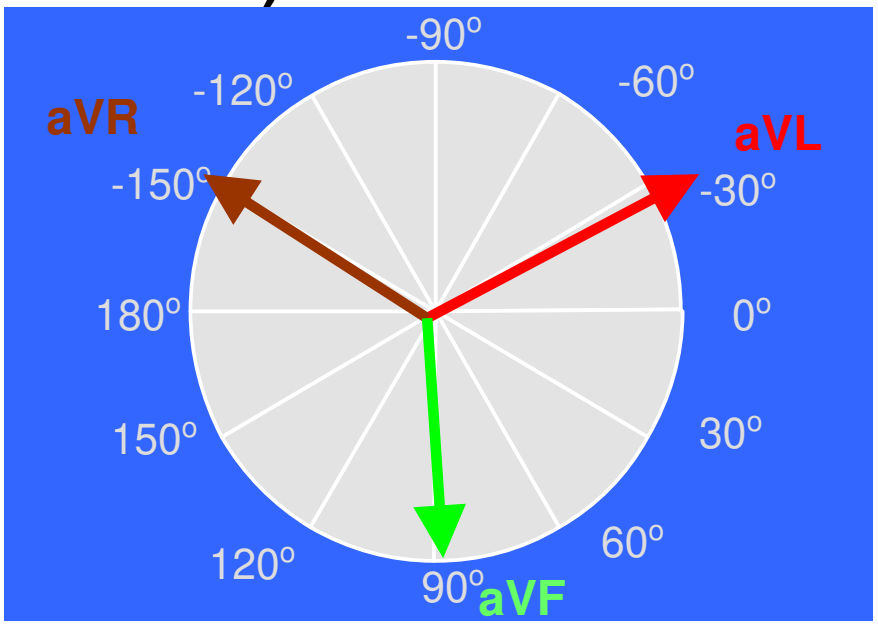
- **Lead I**: RA (-) to the LA (+). Positive lead pointing towards left arm (**0 degrees**).
- **Lead II**: RA (-) to LL (+). Positive lead pointing towards left leg (**60 degrees**).
- **Lead III**: LA (-) to RL(+) Positive lead pointing towards right leg (**120 degrees**).

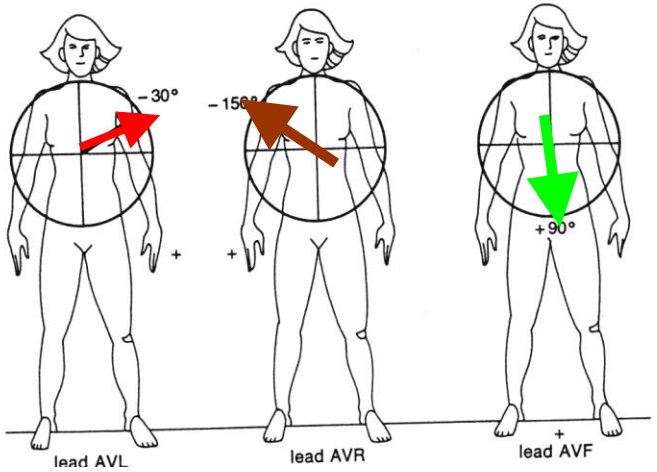


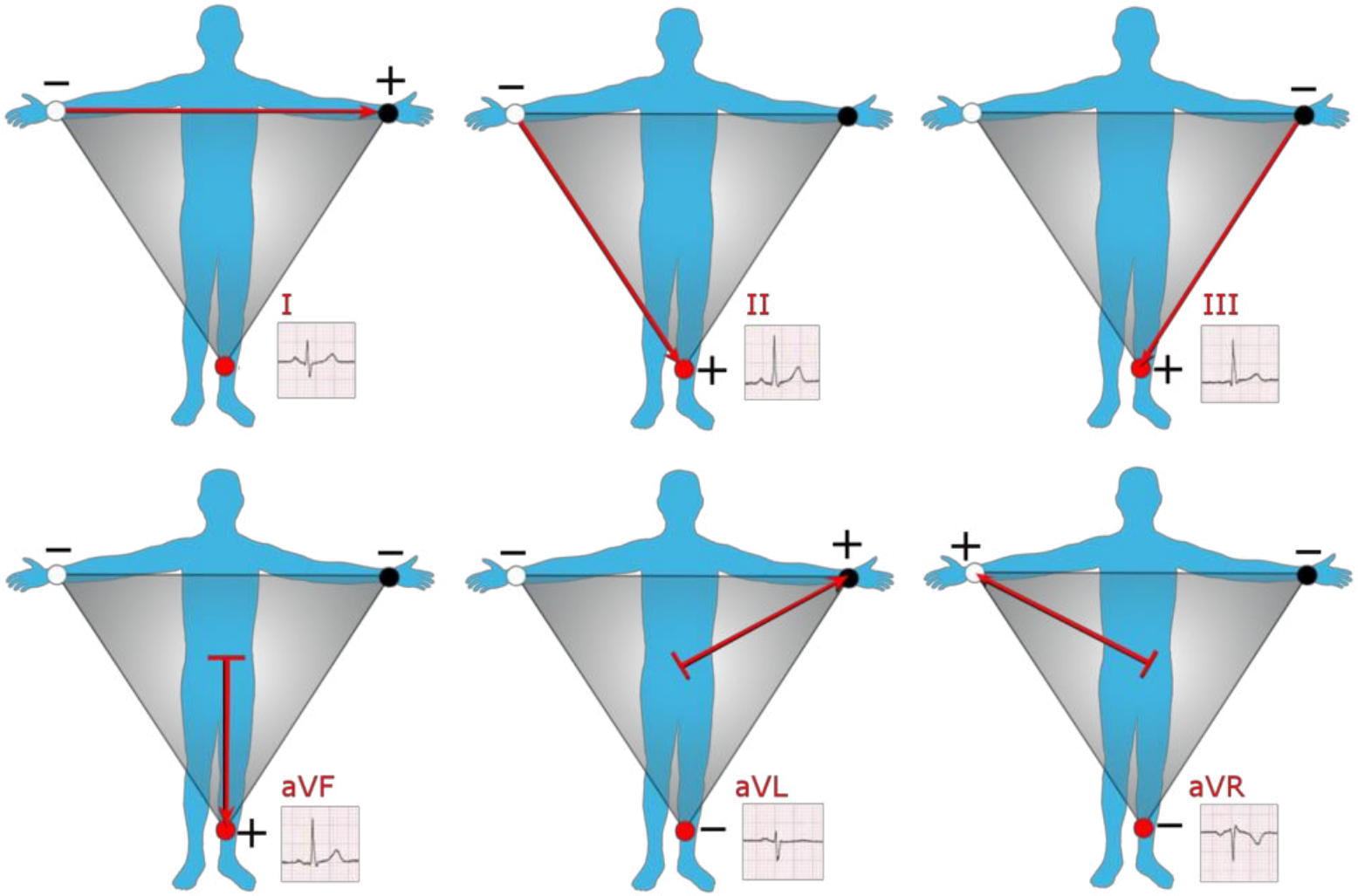


Augmented Limb Leads (Frontal Plane)

- **Lead aVL**: *left arm* positive; wave of depolarization towards it. (**-30 degrees**).
- **Lead aVR**: *right arm* positive; wave of depolarization towards it. (**-150 degrees**).
- **Lead aVF**: *feet* positive; so wave of depolarization towards them. (**+90 degrees**).



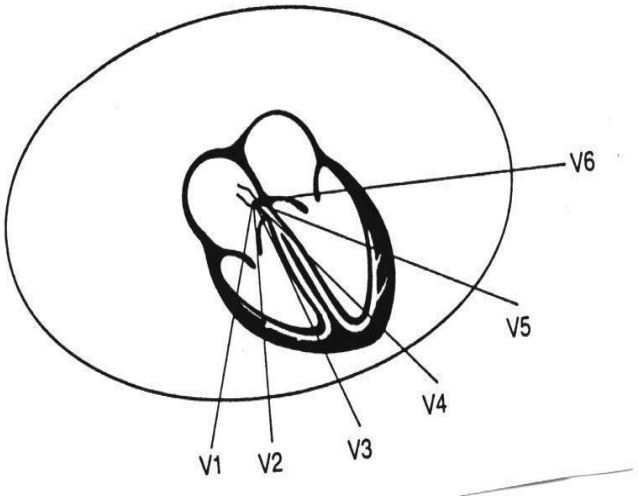




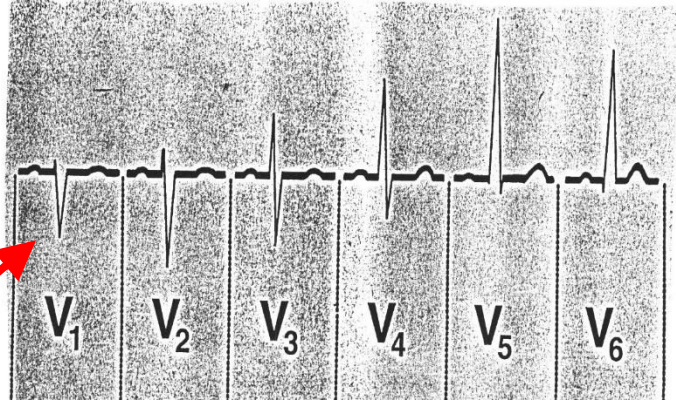
Courtesy of Dr. Nicholas Patchett. Available through creative commons via Wikipedia at: https://en.wikipedia.org/wiki/Electrocardiography#/media/File:Limb_leads_of_EKG.png

12 Views of the Heart

- **Precordial Leads**: 6 leads arranged across the chest in a *horizontal plane*.
- Measures forces moving **anteriorly and posteriorly** (slices through the heart).
- V1,V2, V3, V4, V5, & V6.



Six Precordial Leads (Chest Leads)

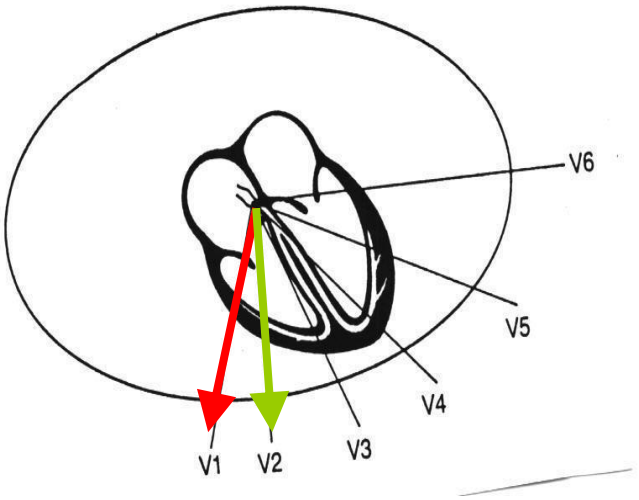


V1: 4th ICS to the right of the sternum

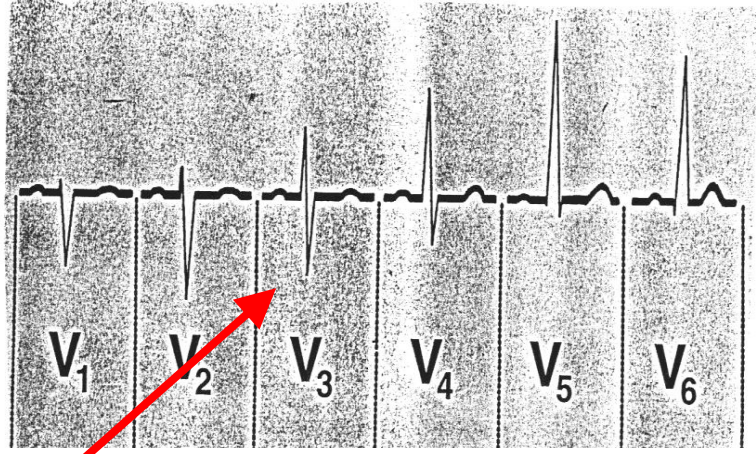
- Views the septum from the (L) bundle to the (R) ventricle= ***smallest R wave*** then moves away from the (L) ventricle = ***largest S wave***.

V2: 4th ICS to the left of the sternum;

- Similar to V1; primarily negative.



Six Precordial Leads (Chest Leads)

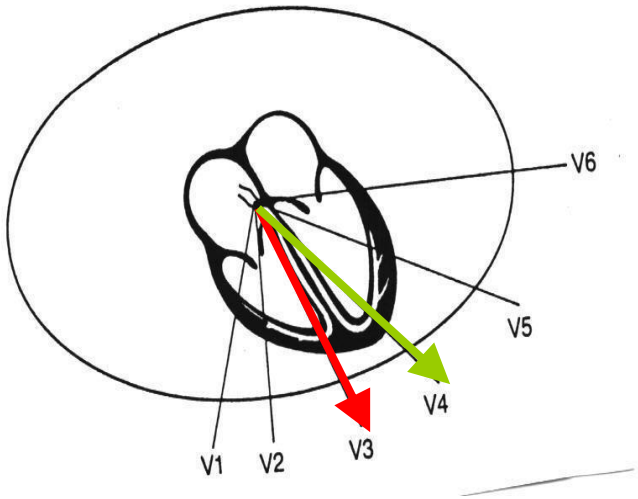


V3: between V2 and V4;

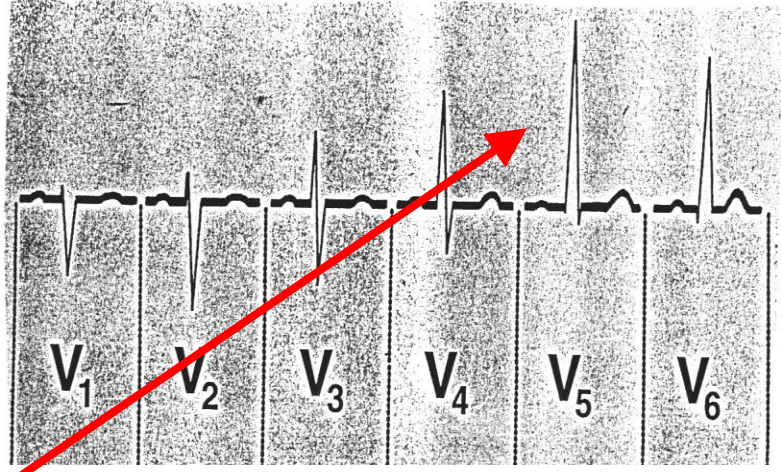
- views the wave of depolarization coming towards it (***large R wave***) and then moves through (L) ventricular wall (***deep S wave***); ***transitional lead***; *biphasic QRS*.

V4: 5th ICS in the midclavicular line;

- same as above;
- *transitional lead* similar to V3 only ***R wave is taller***.



Six Precordial Leads (Chest Leads)

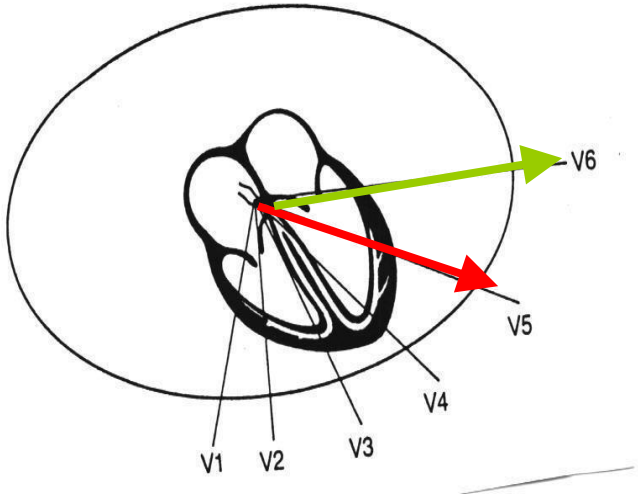


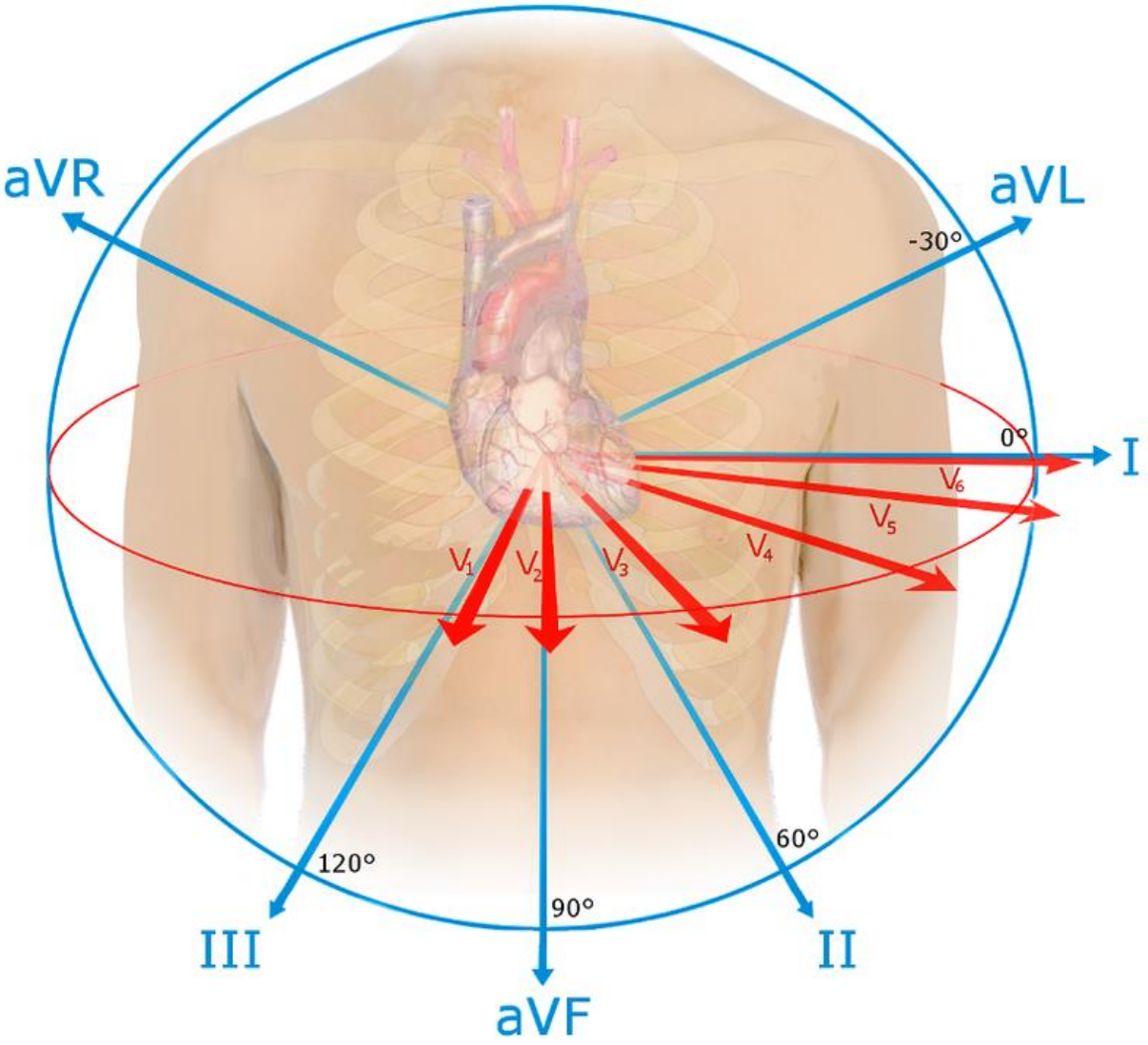
V5: between V4 and V6.;

- ***small q wave*** (since initially going away from the LV); wave goes down the septum towards the (L) ventricle = ***large R wave***.

V6: 5th ICS, midaxillary line;

- same as above;
- ***Tallest R wave (V5 or V6).***
- Progressively increasing R wave amplitude as wave moves down & towards (L) vent.



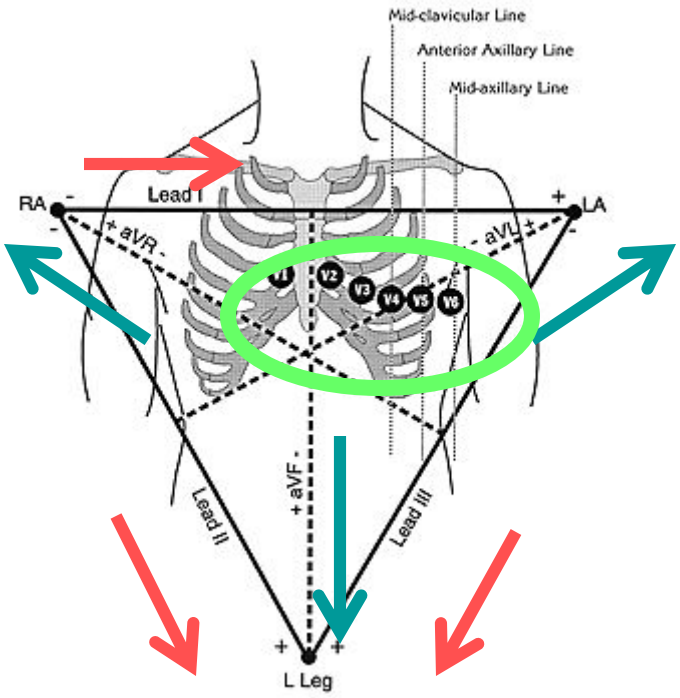


Courtesy of Dr. Nicholas Patchett. Available through creative commons via Wikipedia at: https://en.wikipedia.org/wiki/Electrocardiography#/media/File:EKG_leads.png

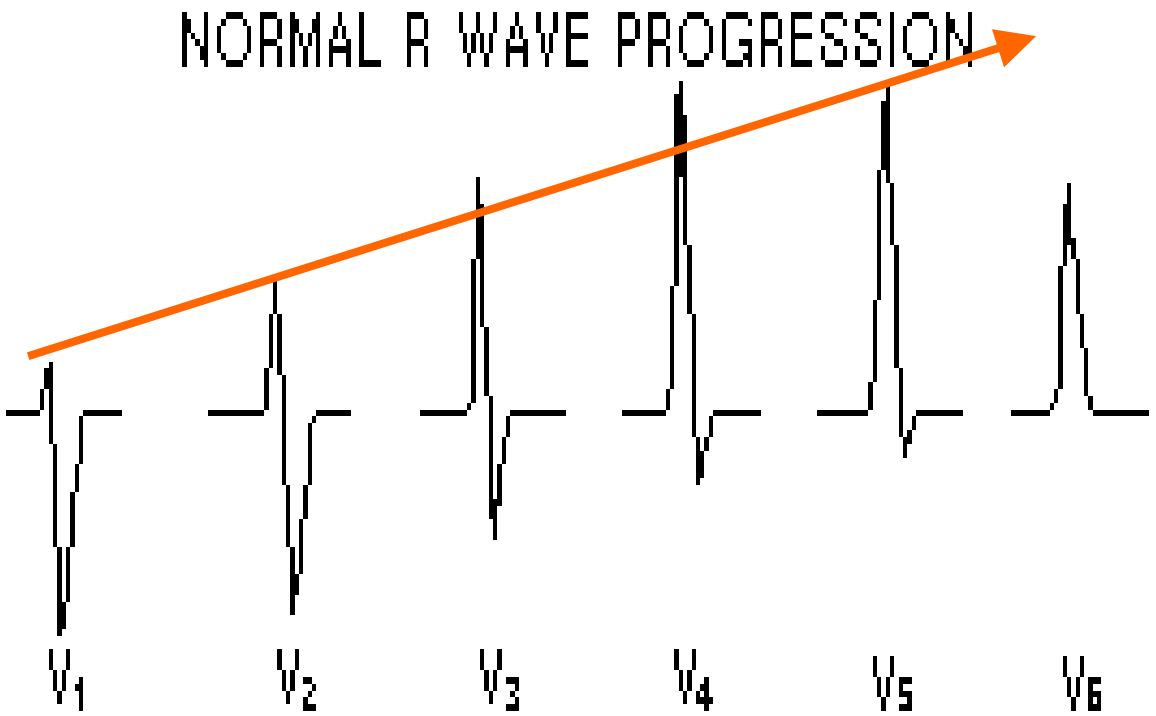
Putting All 12-Leads Together

The 12-leads include:

- **3 Limb leads**
  (I, II, III)
- **3 Augmented leads**
  (aVR, aVL, aVF)
- **6 Precordial leads**
  (V_1- V_6)



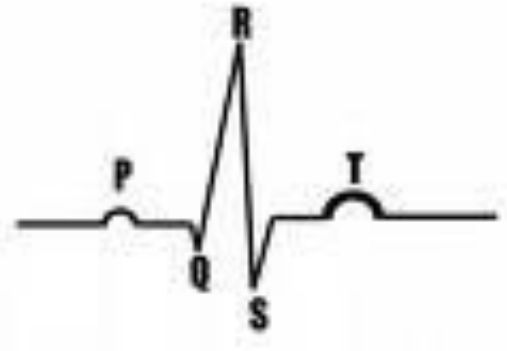
R Wave Progression



R wave height gradually increases to approximately V_4 and then decreases.

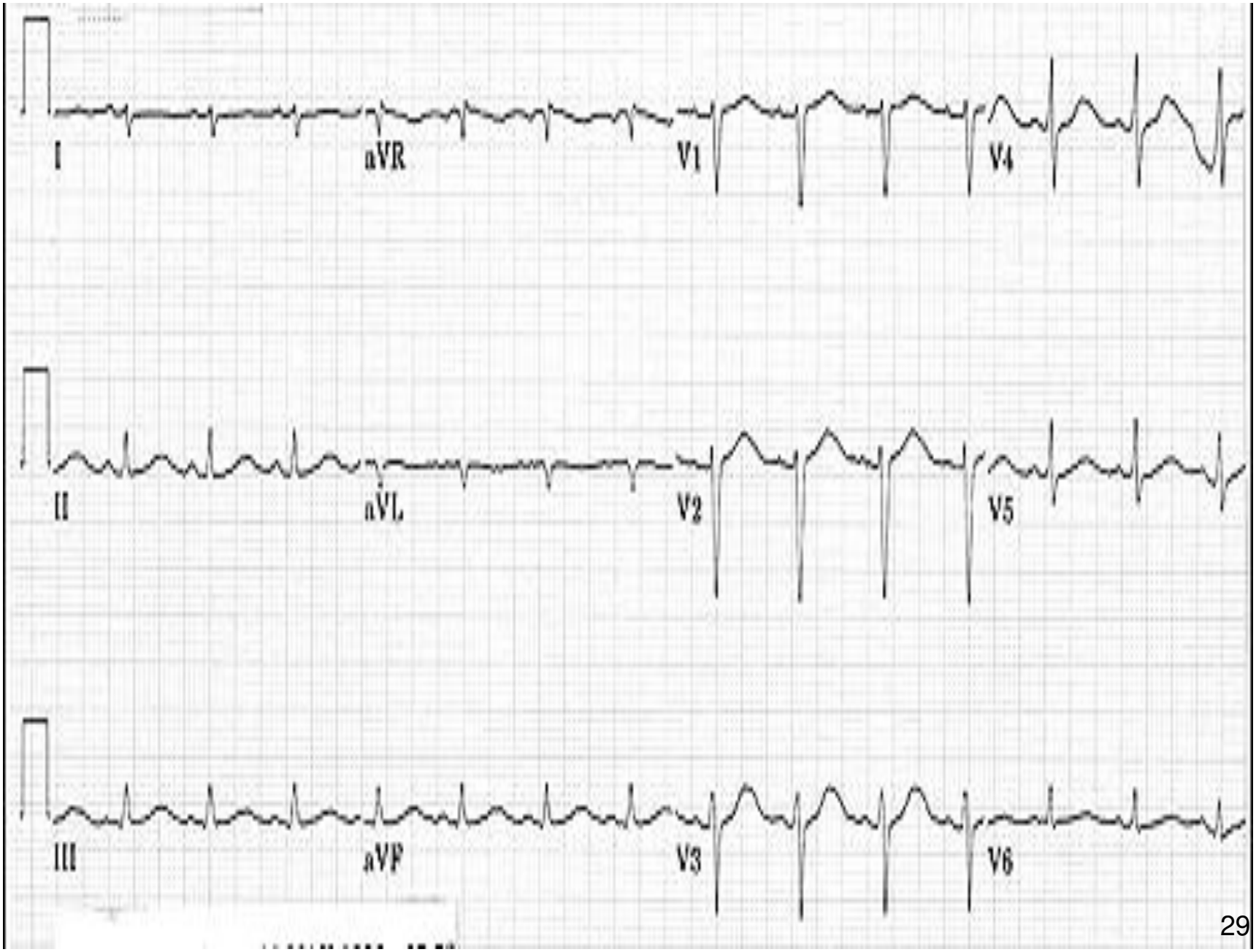
http://nps.freeservers.com/ekg.htm

Case 1 (next slide)



- Case 1:
  - Rate: _____
  - Intervals:_____
  - Underlying rhythm: _____

  - We will come back & do other steps (axis, etc) later


I
aVR
V1
V4
II
aVL
V2
V5
III
aVF
V3
V6