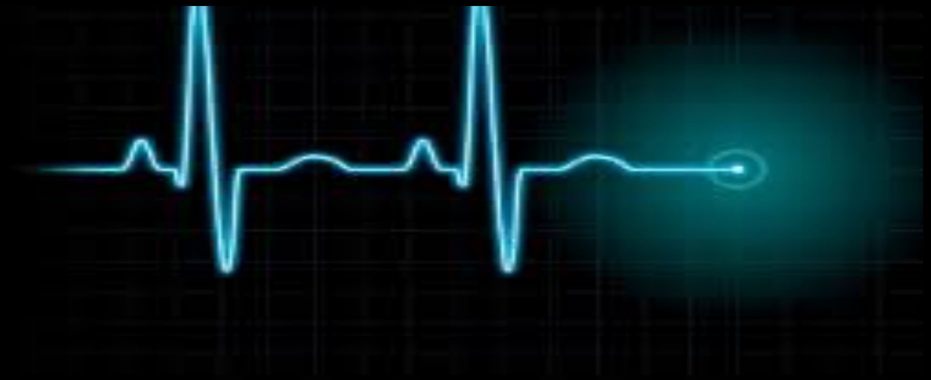
ECG

Dr. Taj

(Trying to make sense of a wrigley line)



Dr. Taj

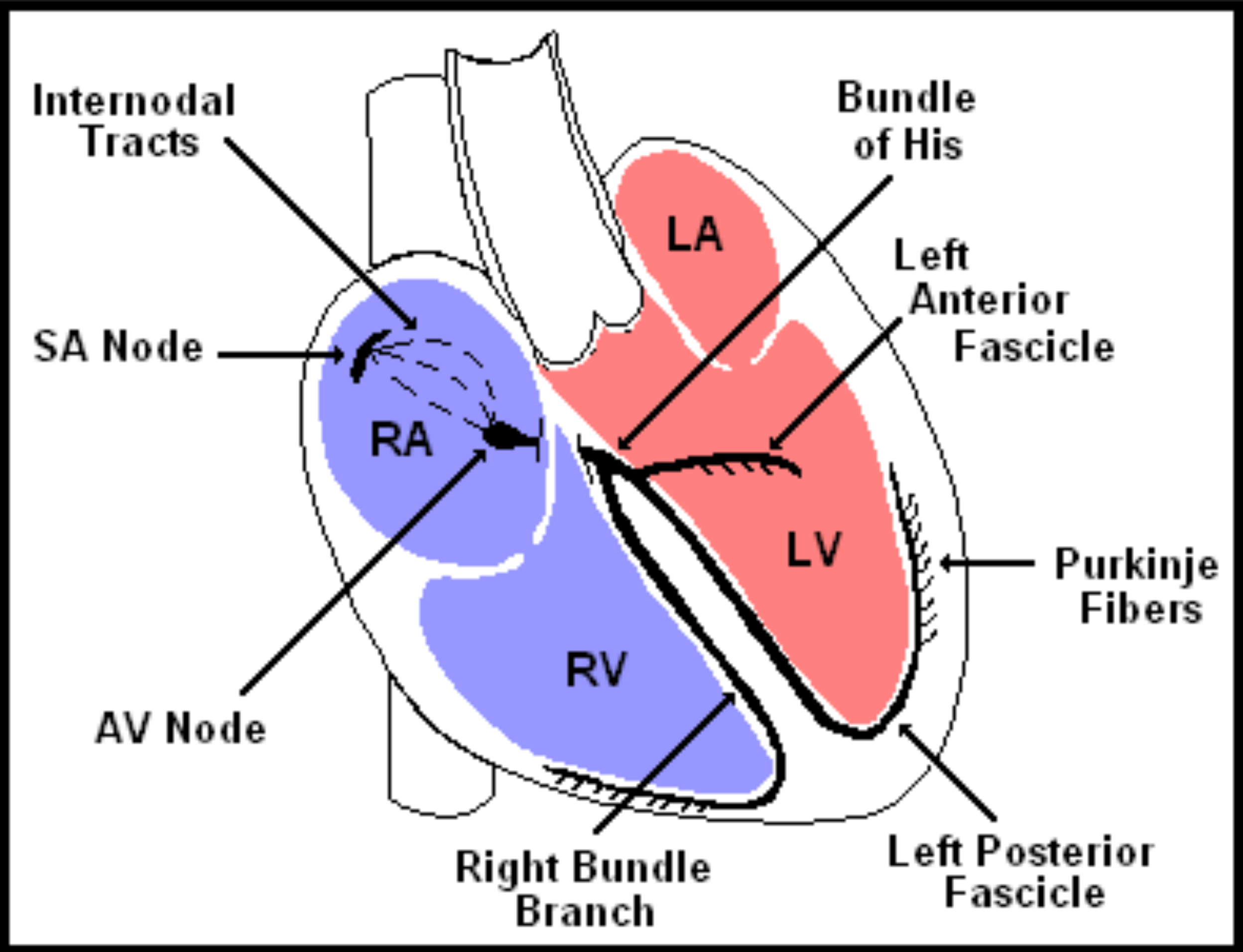
If life doesn’t have its ups and downs

YOU ARE DEAD

OUTLINE

1. Review of the conduction system
2. ECG waveforms and intervals
3. ECG leads
4. Determining heart rate
5. Determining heart axis
6. Determining heart rhythm
7. MI findings (Basic)

THE NORMAL CONDUCTION SYSTEM



WHAT IS AN ECG?

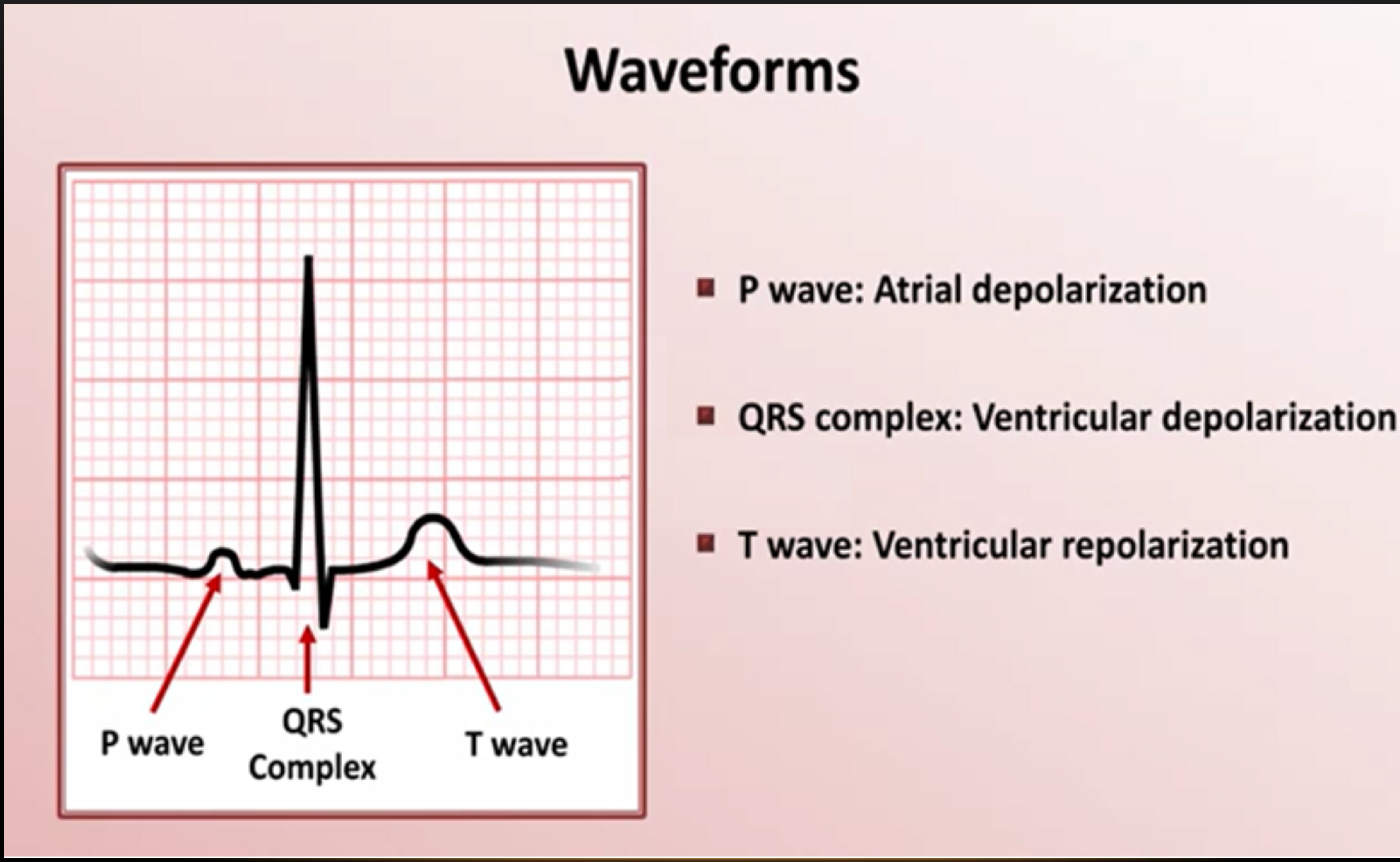
The electrocardiogram (ECG) is a representation of the sum of all the electrical events of the cardiac cycle.

Each event has a distinctive waveform, the study of which can lead to greater insight into a patient’s cardiac pathophysiology.

WHAT TYPES OF INFORMATION CAN WE OBTAIN FROM AN ECG?

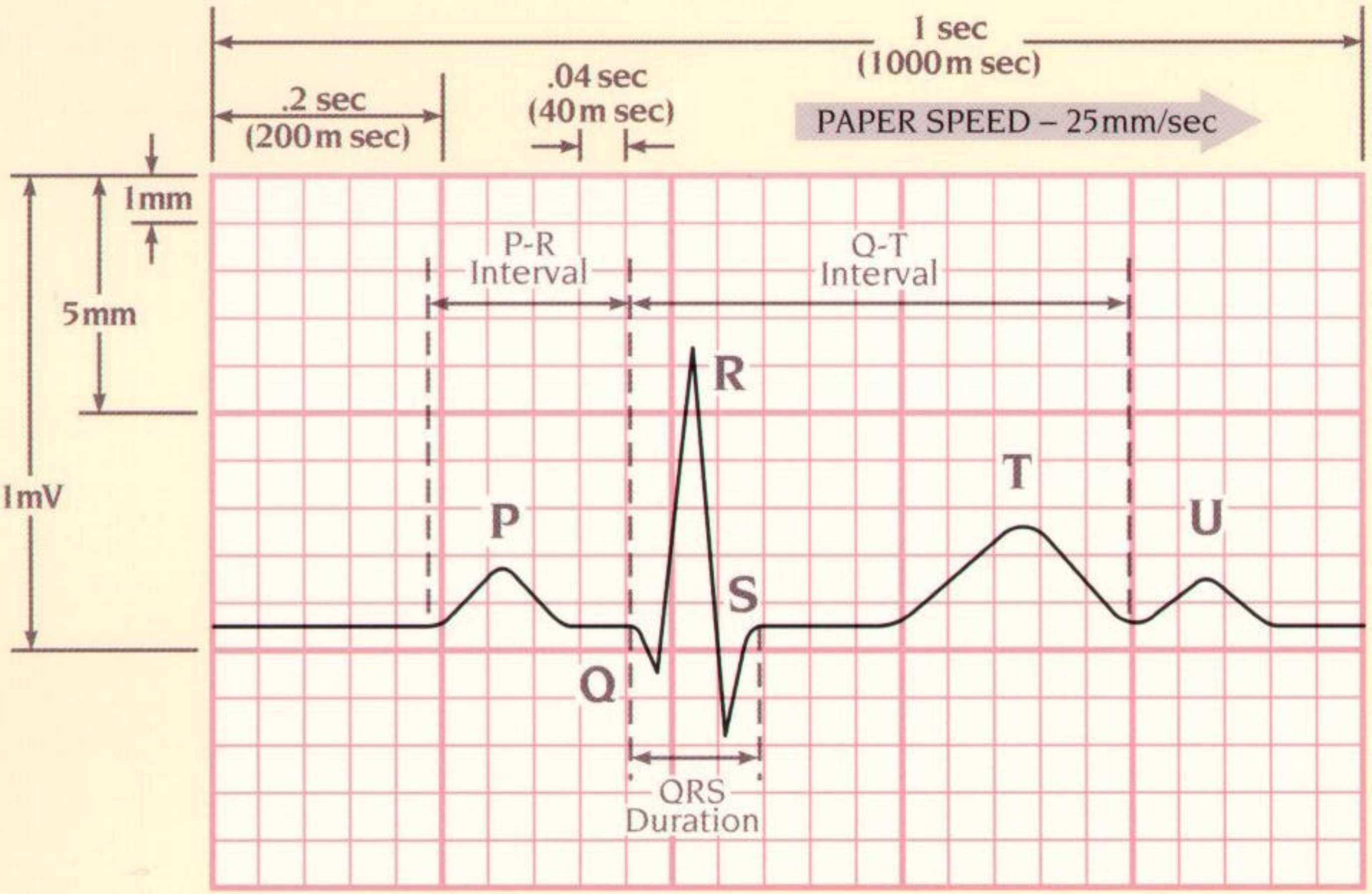
- Heart rate
- Heart Rhythem
- Myopathies
- Electrolyte disturbances (i.e. hyperkalemia, hypokalemia)
- Drug toxicity (i.e. digoxin and drugs which prolong the QT interval)

ECG WAVE FORMS



Functionally, **U waves** represent the last phase of ventricular repolarization specially that of the papillary muscles. **Prominent U waves are** characteristic of hypokalemia.

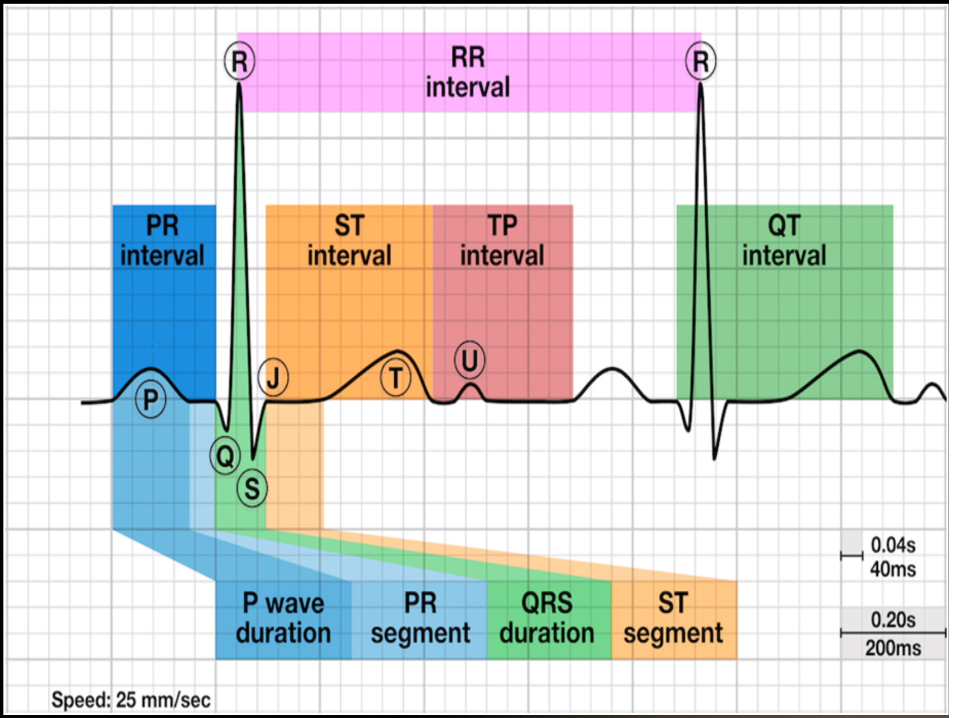
WAVEFORMS, INTERVALS AND SEGMENTS

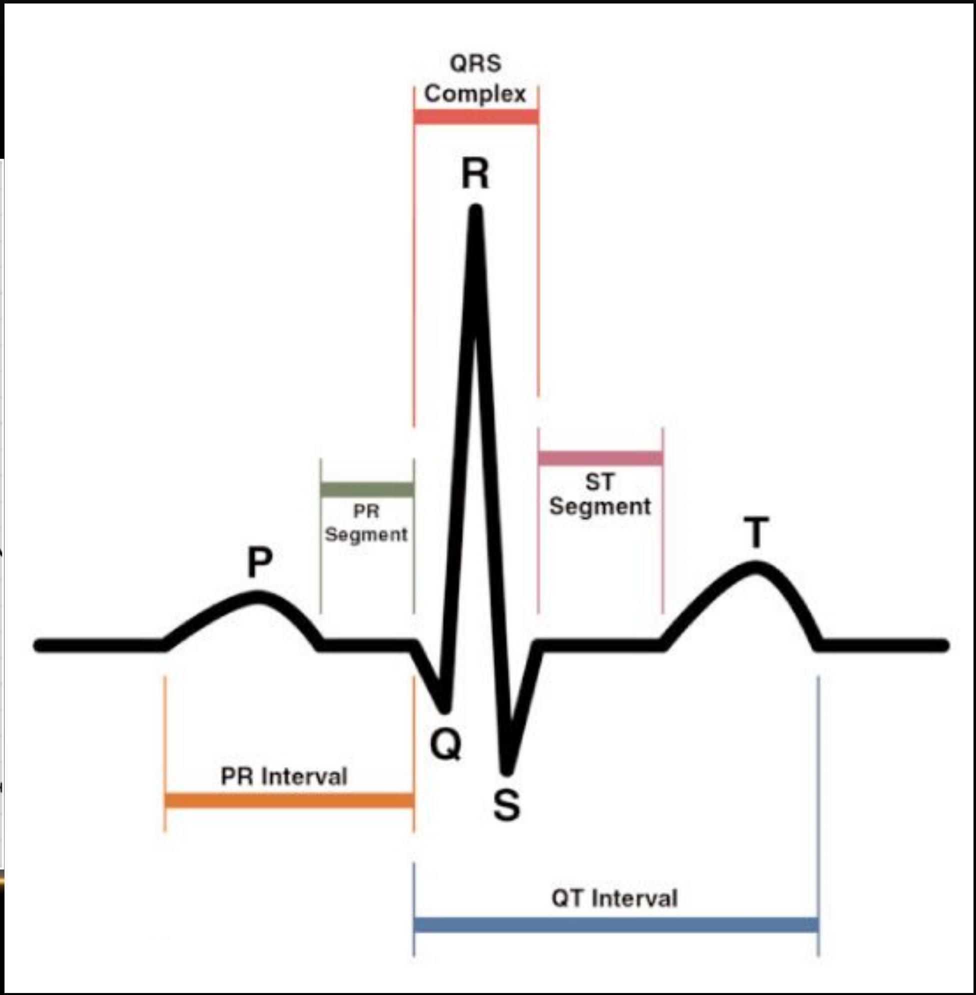


VERTICAL AXIS	
	1 Small Square = 1mm (0.1mV)
	1 Large Square = 5mm (0.5mV)
	2 Large Squares = 1mV

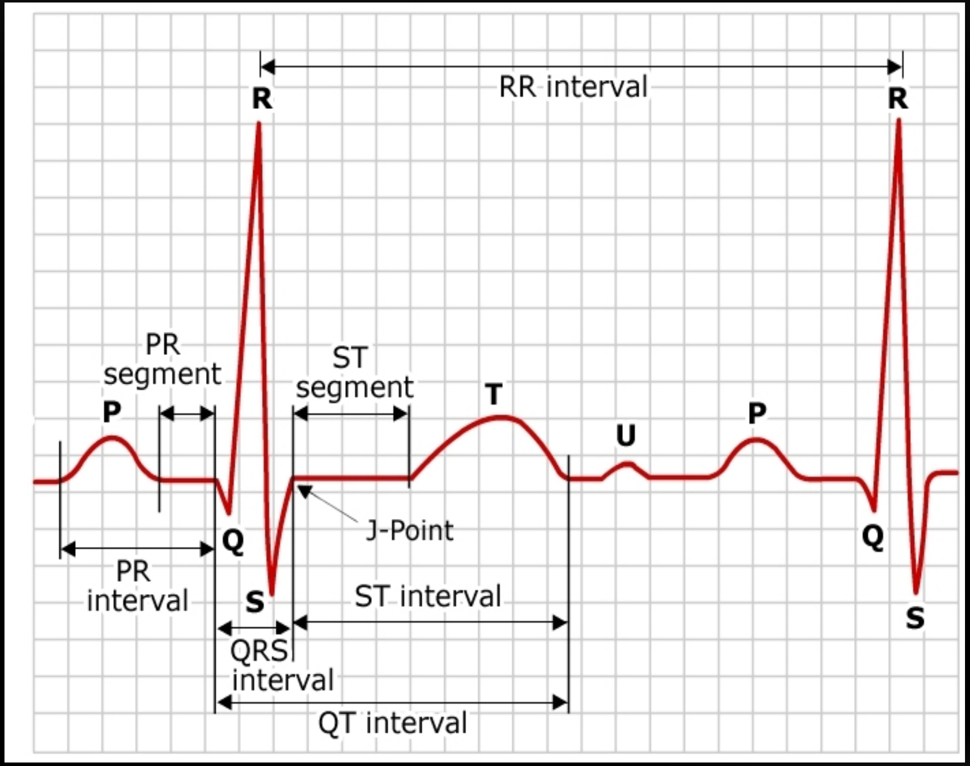
HORIZONTAL AXIS	
	1 Small Square = .04 sec (40 m sec)
	1 Large Square = .2 sec (200 m sec)
	5 Large Squares = 1 sec (1000 m sec)

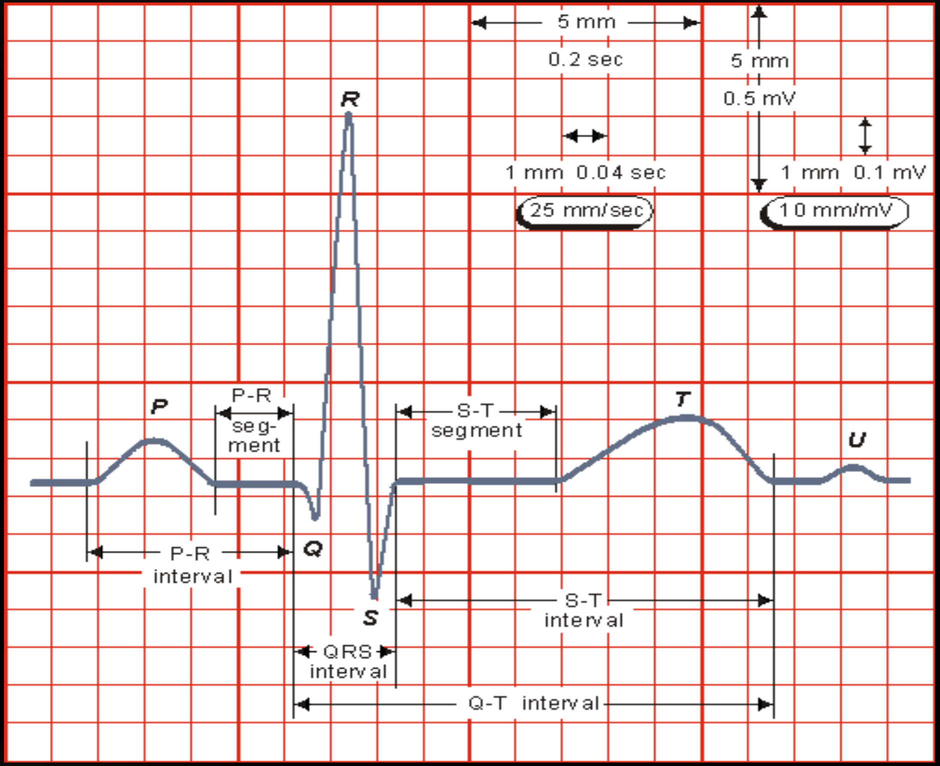
WAVEFORMS, INTERVALS AND SEGMENTS





WAVEFORMS, INTERVALS AND SEGMENTS Cont…





WAVEFORMS, INTERVALS AND SEGMENTS

Interval is a part of the ECG and a segment is a part of an interval.

PR Interval:	From the start of the P wave to the start of the QRS complex 0.12 - 0.20 sec
PR Segment:	From the end of the P wave to the start of the QRS complex
J Point:	The junction between the QRS complex and the ST segment
QT Interval:	From the start of the QRS complex to the end of the T wave ≤ 0.40 sec (0.4 – 0.44)
QRS Interval:	From the start to the end of the QRS complex 0.06 - 0.10 sec
ST Segment:	From the end of the QRS complex (J point) to the start of the T wave

ECG LEADS

Leads are electrodes which measure the difference in electrical potential between either:

1. Two different points on the body (bipolar leads)
2. One point on the body and a virtual reference point with zero electrical potential, located in the center of the heart (unipolar leads)

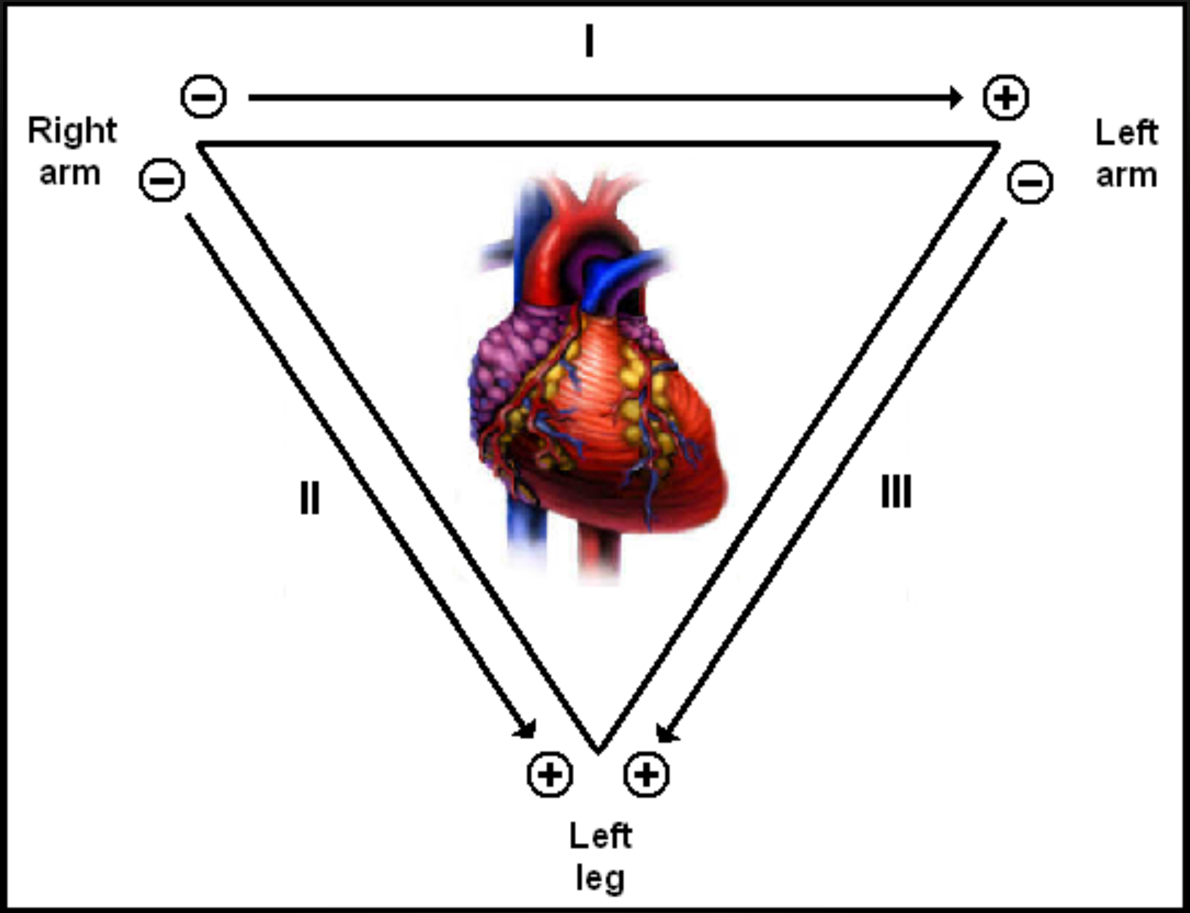
ECG LEADS

The standard ECG has 12 leads:

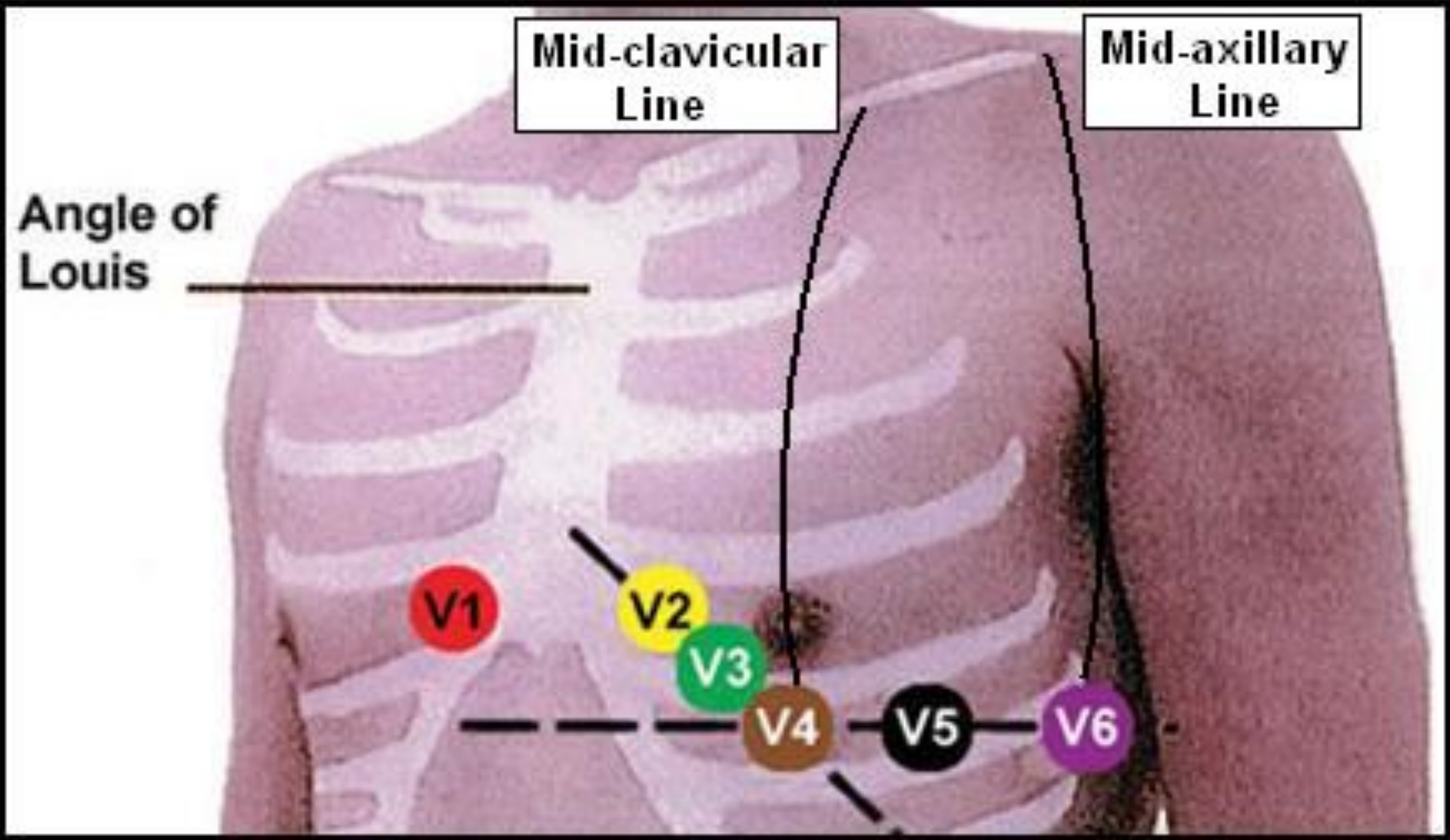
- 3 Standard Limb Leads
- 3 Augmented Limb Leads
- 6 Precordial (chest) Leads

The axis of a particular lead represents the viewpoint from which it looks at the heart.

STANDARD LIMB LEADS



PRECORDIAL LEADS



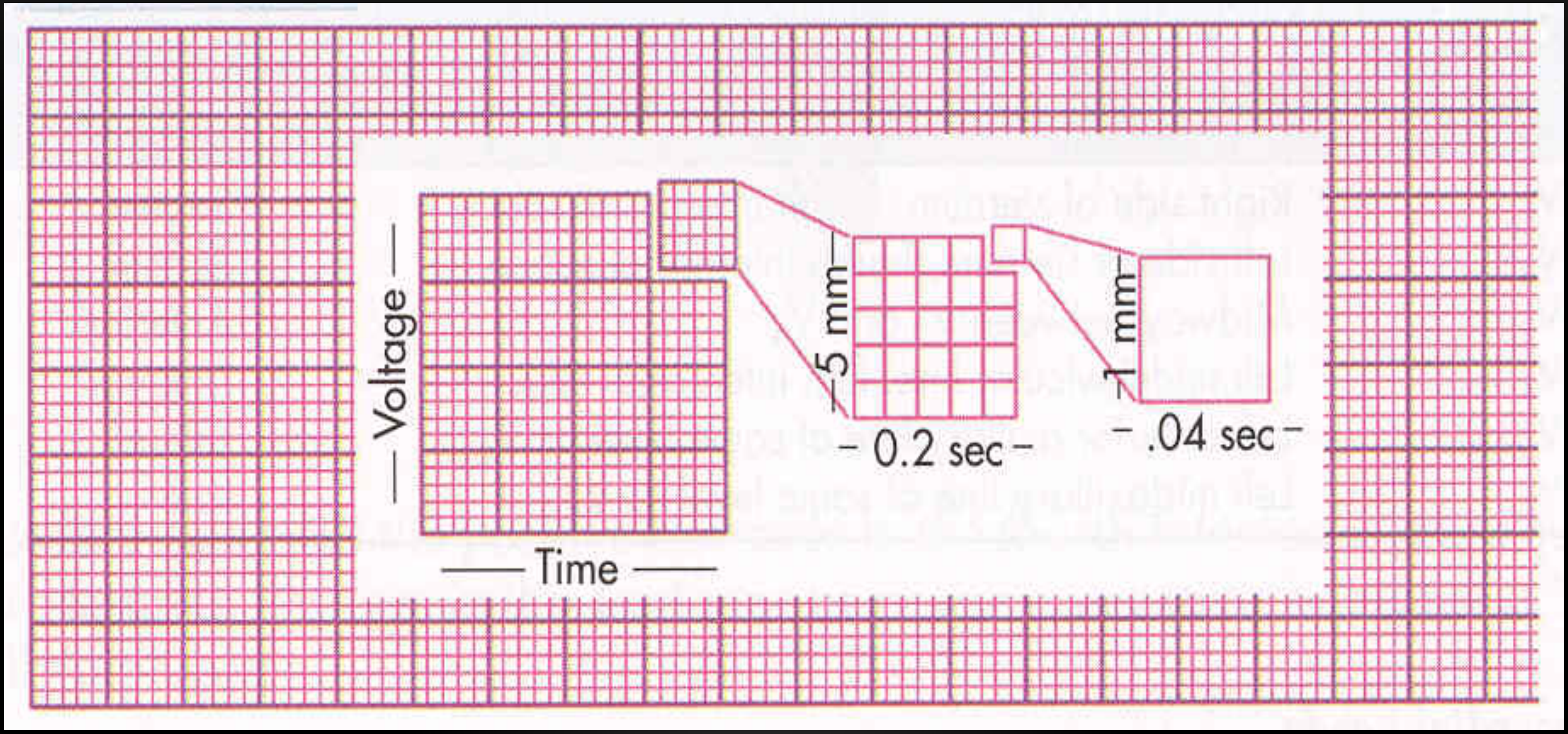
SUMMARY OF LEADS

	Limb Leads	Precordial Leads
Bipolar	I, II, III (standard limb leads)	-
Unipolar (V leads)	aVR, aVL, aVF (augmented limb leads)	V_1-V_6

RECORDING AN ECG

1. Explain procedure to patient, obtain consent and check for allergies.
2. Check cables are connected.
3. Ensure surface is clean and dry.
4. Ensure electrodes are in good contact with skin.
5. Enter patient data.
6. Wait until the tracing is free from artifact.
7. Request that patient lies still.
8. Push button to start tracing.

CALIBRATION OF ECG PAPER



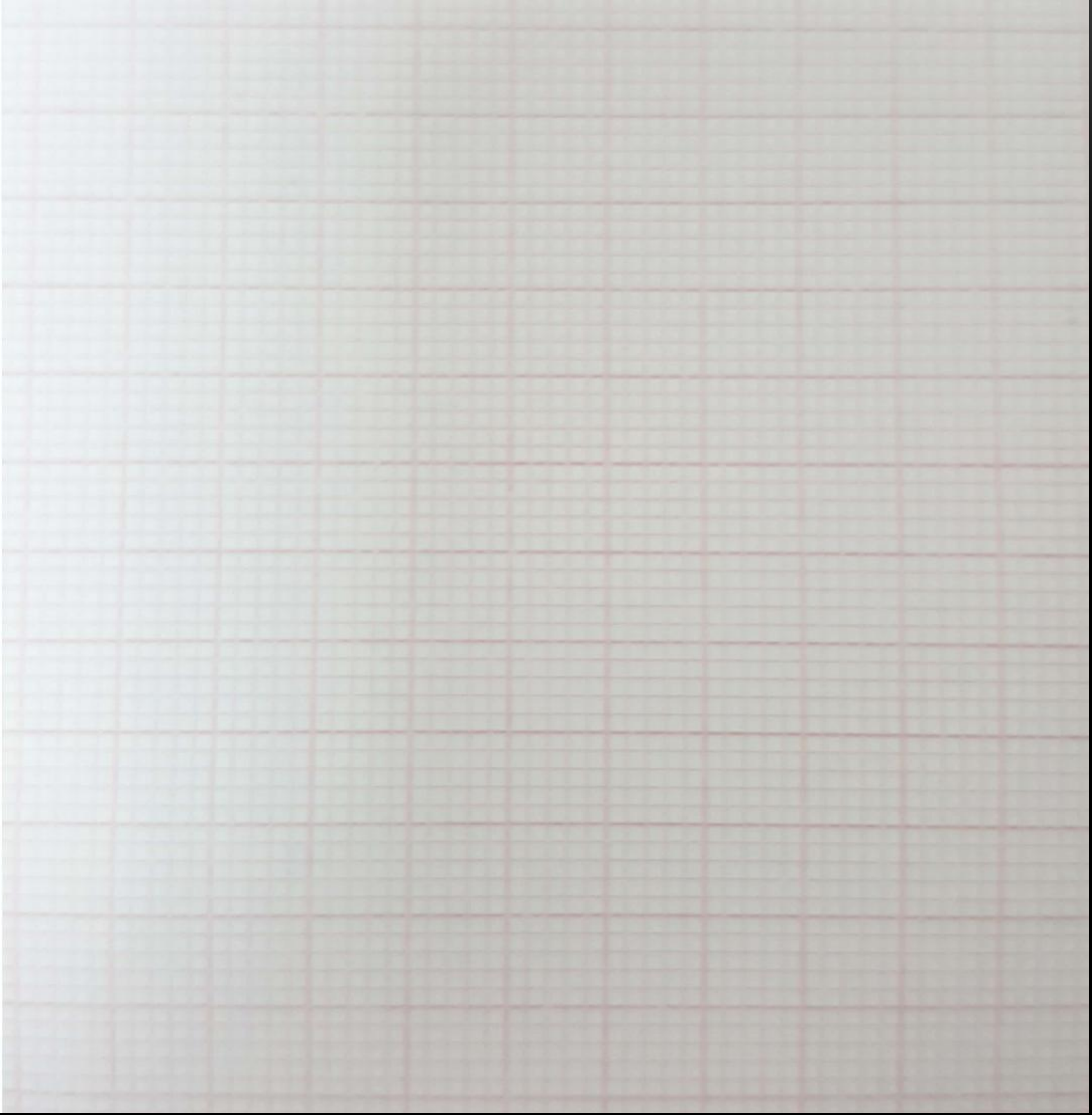
DETERMINING THE HEART RATE
WITH A **REGULAR** RHYTHEM.

Take the number of “smallest boxes moved by the machine per minute” i.e. (1500) , and divide by the number of boxes between two adjacent “R”-”R” waves.

H.R. = 1500 / # of squares b/w 2 “R - R” waves

HEART RATE CALCULATION VISUALIZED

Lets see how ???



RULE OF 1500

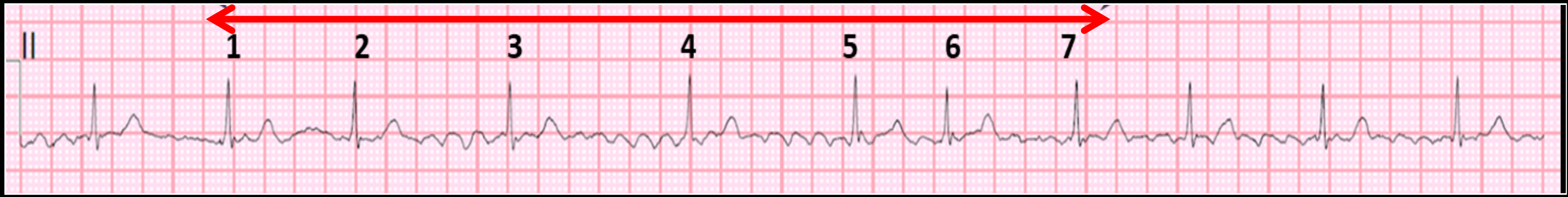
Take the number of “smallest boxes moved by the machine per minute” i.e. (1500) , and divide by the number of boxes between adjacent “R”-”R” waves.

H.R. = 1500 / # of squares b/w 2 “R - R” waves

DETERMINING THE HEART RATE
WITH A **IRREGULAR** RHYTHEM.

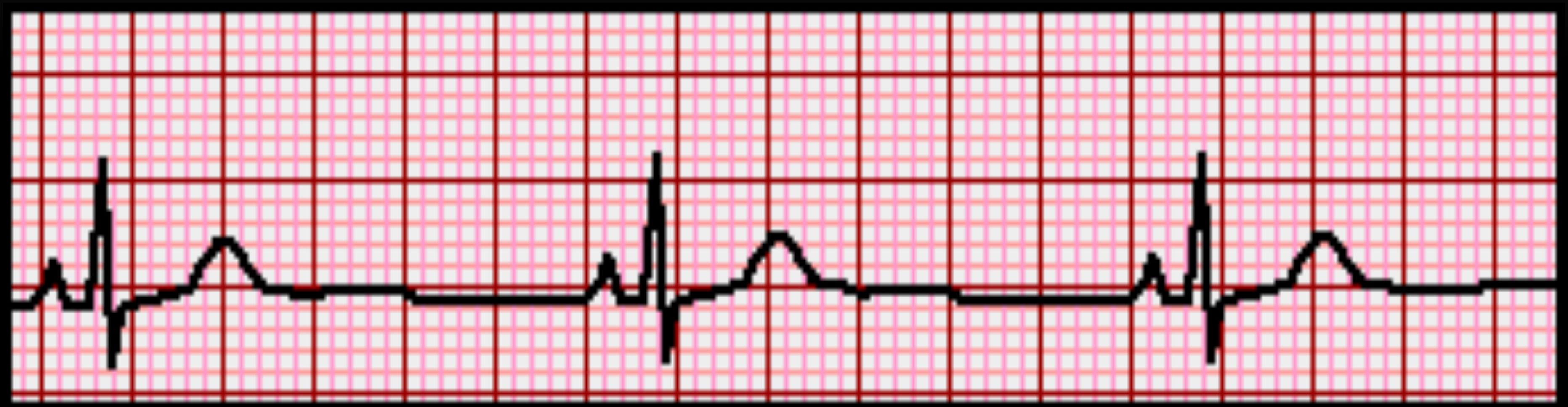
In this case, heart rate can be calculated by first, counting the number of QRS complexes in 30 large squares (which equals the number of QRS complexes in 6 seconds)

Then multiply the number of QRS complexes counted in 6 seconds by 10 to get the number of QRS complexes in one minute i.e. the heart rate



Number of QRS complexes in 6 sec i.e. (30 large squares) = 7
Number of QRS complexes in 1 min = 7 x 10 = 70 b/min

WHAT IS THE HEART RATE?



(1500 / 30) = 50 bpm

WHAT IS THE HEART RATE?

(1500 / ~18) = ~ 83 bpm

WHAT IS THE HEART RATE?

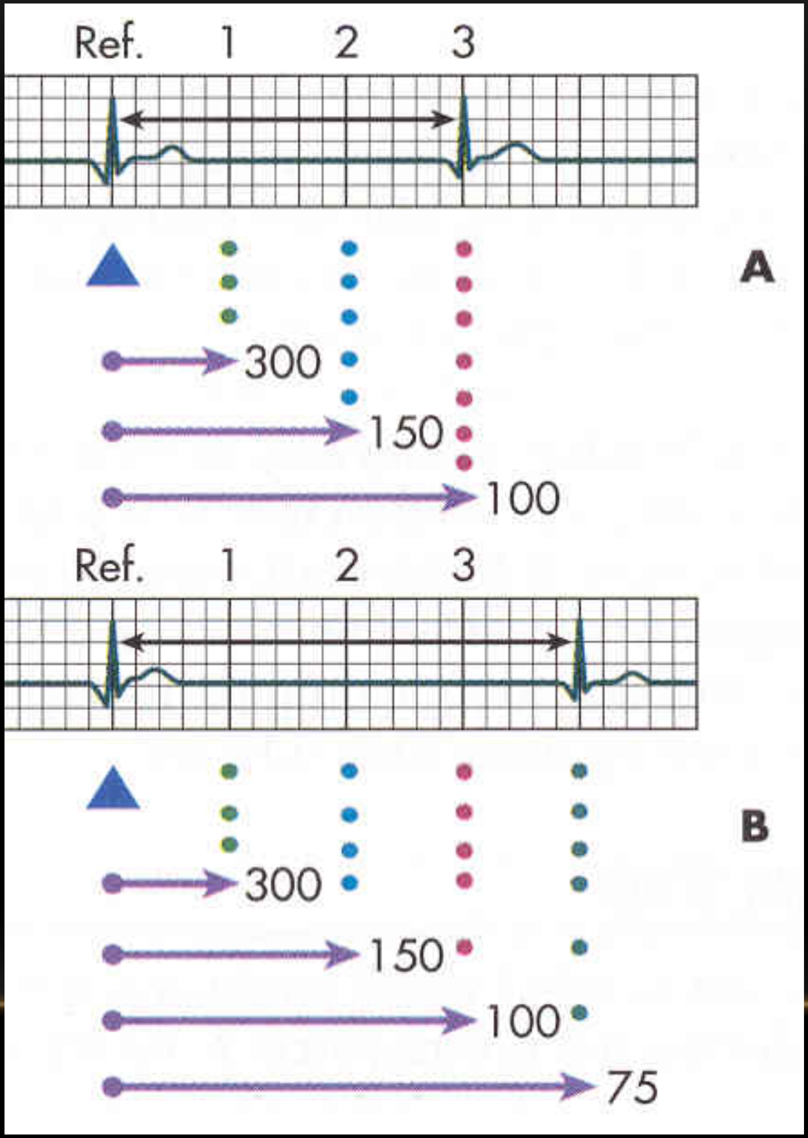
(1500 / 8) = 187 bpm

THE RULE OF 1500

It may be easiest to memorize the following table:

# of big boxes	Rate
1	300
2	150
3	100
4	75
5	60

THE RULE OF 300



RHYTHM

The Rhythem is defined as the time interrelationship between 2 (adjacent) “R” waves. Or it is the presence or absence of equal distance between two adjacent R waves.

The rhythm of the heart can be regular or irregular.

CARDIAC AXIS

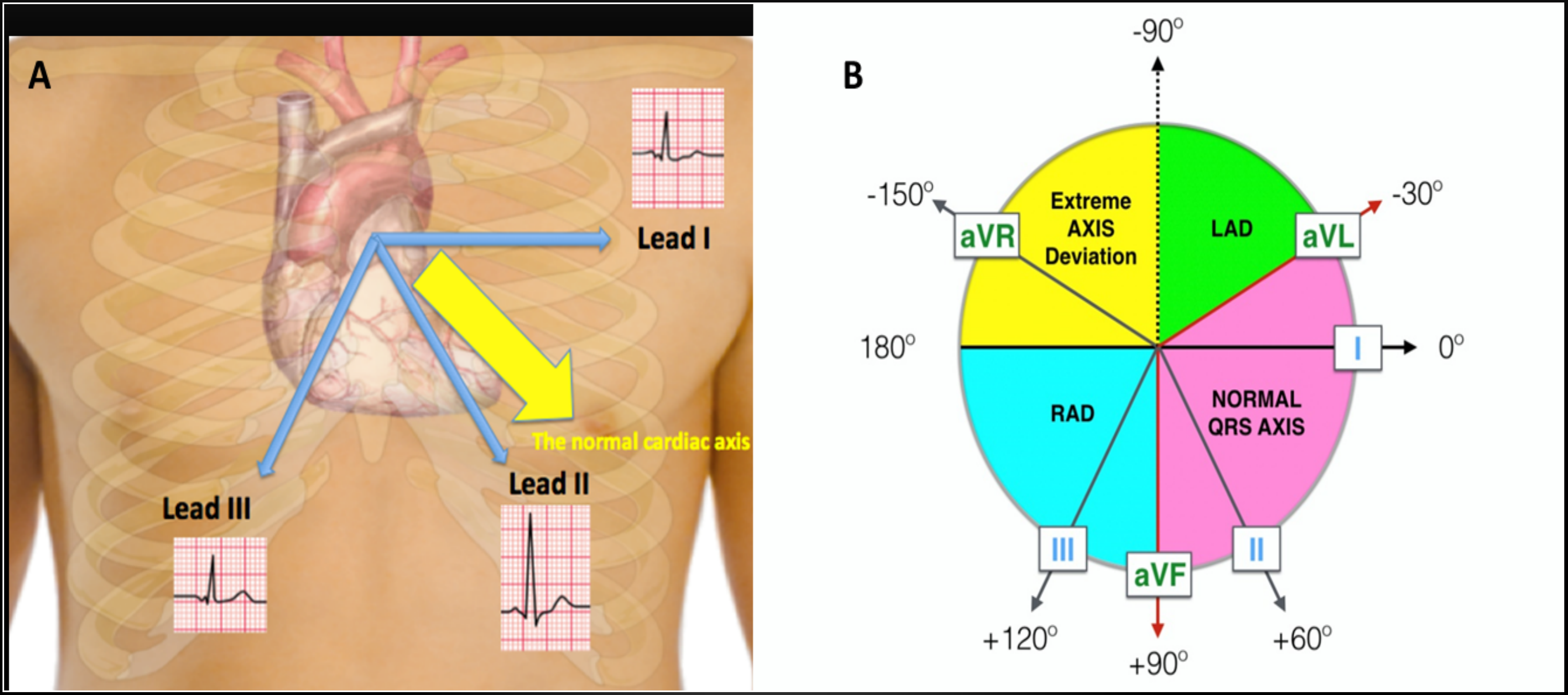
CALCULATION OF THE CARDIAC AXIS

The electrical axis is the average direction of the current flow in the heart during a cardiac cycle. The cardiac axis is expressed as an angle and is measured in degrees. The depolarization wave normally spreads through the ventricles in a direction from base of the heart to its apex.

The normal cardiac axis lies between -30^{o} to 90^{o}, Fig-22. Certain pathological conditions causes the cardiac axis to deviate to the left (between -30^{o} to -90^{o}) which is then called *left axis deviation* (LAD) while other pathological conditions causes it to shift to the right (90^{o} to 180^{o}) and it is called *right axis deviation* (RAD). Beyond these values, it will be extreme right/left axis deviation

CARDIAC AXIS

Normal Axis = -30 to +90 (Pink)



CARDIAC AXIS

There commonly used methods to determine the Cardiac Axis.

1. Rule of the thumb.
2. Triaxial Method,

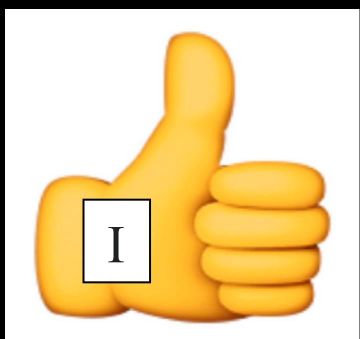
1. RULE OF THE THUMB.

Using this methods, Leads I and III are used.

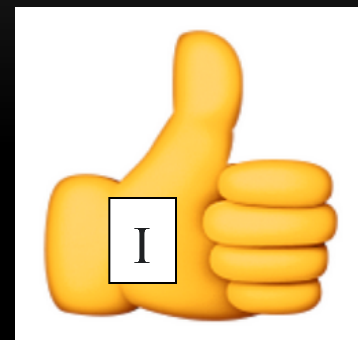
(But lead I and AVf can also be used)

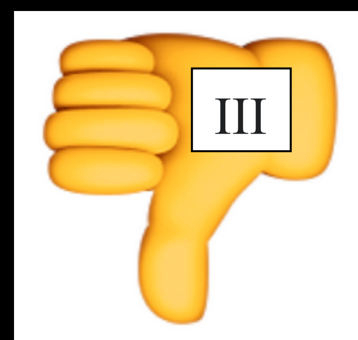
- Both +ve (Normal axis)
- I +ve and III –ve (Left axis deviation)
- I –ve and III +ve (Right axis deviation)

Normal Axis

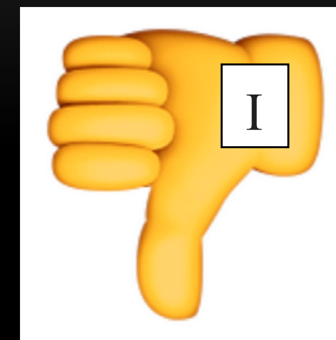


Left Axis

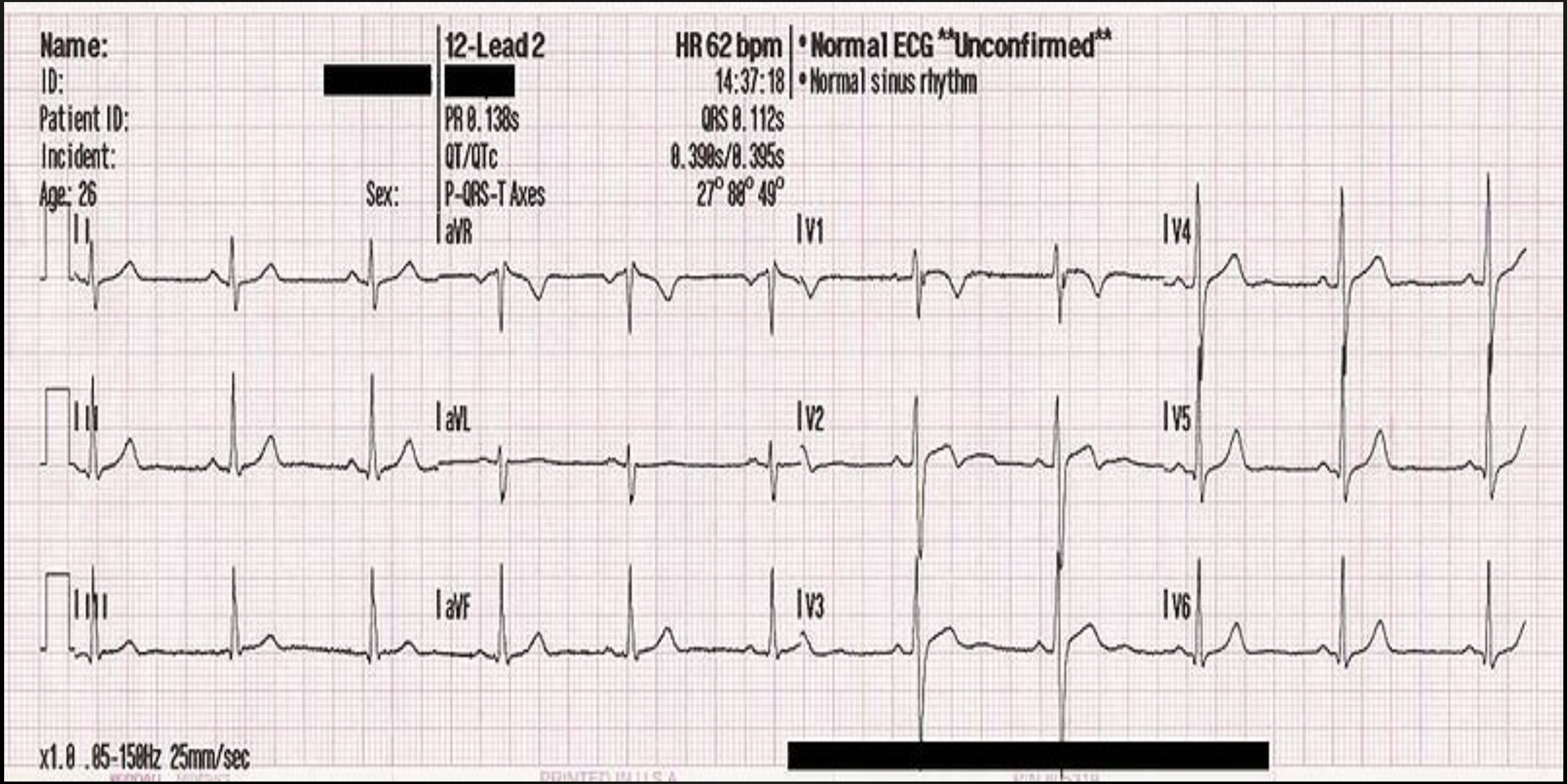




Right Axis



CALCULATING THE CARDIAC AXIS AN EXAMPLE



1. *Calculate the sum potential in each lead:*
   - Lead I = 5 – 4 = 1 (+ve).
   - Lead III = 12 – 1 = 11 (+ve).

CARDIAC AXIS CONT..

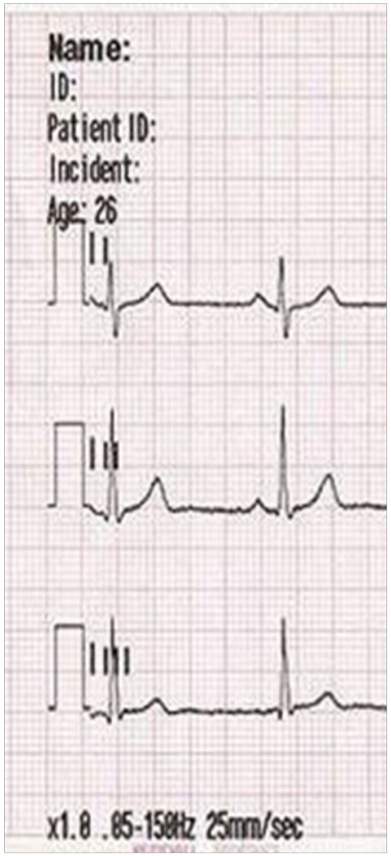
2. TRIAXIAL METHOD.

Use two limb leads, namely leads I and III. Looking at the QRS complexes in these leads, calculate the overall size and polarity of the QRS complex in each by subtracting the depth of S wave from the height of the R wave. Construct a vector diagram and draw arrows that represent the sum of size and polarity for each lead on the diagram.

- The cardiac axis lies between the two arrows. Drop a perpendicular line from the tip of each arrow. The point at which the two perpendicular lines meet, constitute the tip of the cardiac axis. Draw a line from that point to zero point and this will be the cardiac axis. (Fig in next slide)
- N.B. the height of the R wave and the depth of the S wave are both measured starting from the isoelectric line.

CARDIAC AXIS CONT..

Step 1
Look at leads I & III

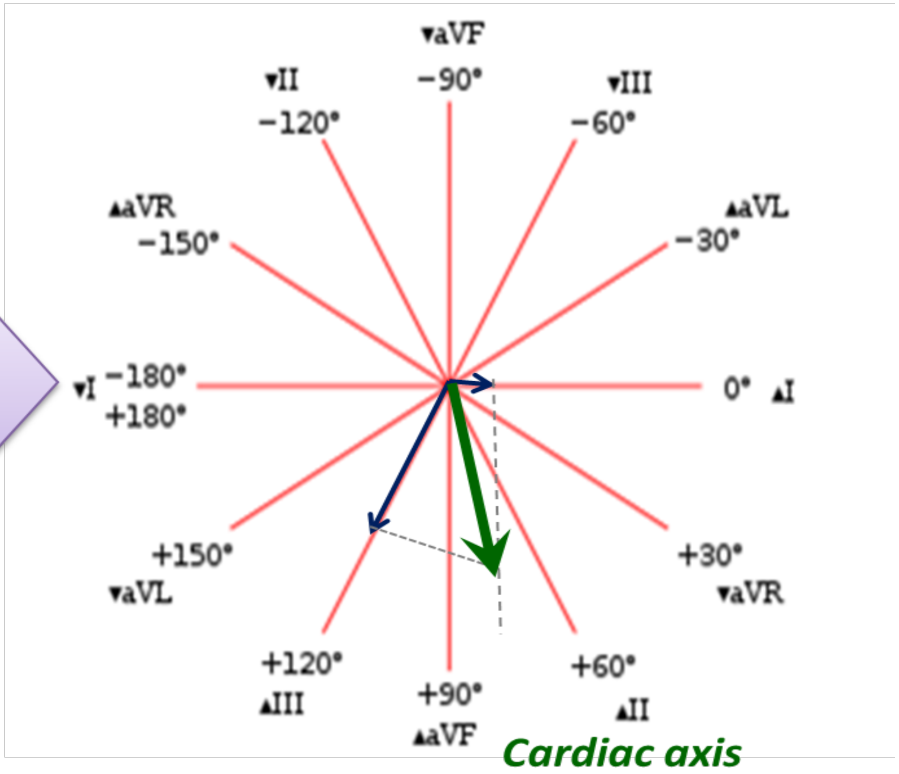


Step 2
Calculate the average size and polarity of QRS complex in each

R wave = +5
S wave = -4
Their sum= +1

R wave = +12
S wave = -1
Their sum= +11

Step 3
Plot on the hexaxial reference system



THANK YOU