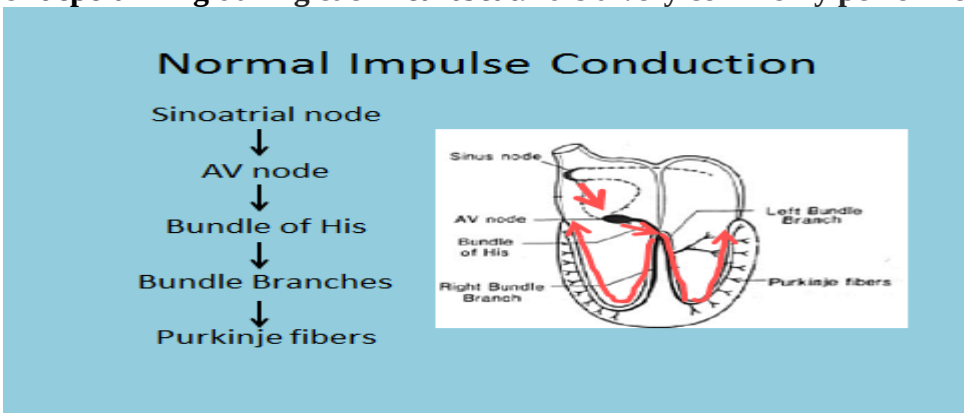
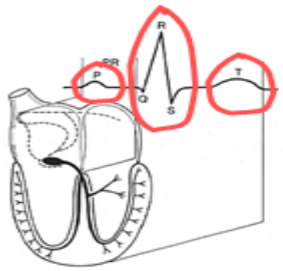
L33 Electrocardiography (ECG)

Electrocardiography (ECG) is the process of recording the electrical activity of the heart over a period of time using electrodes placed on the skin. These electrodes detect the tiny electrical changes on the skin that arise from the heart muscle's electrophysiology pattern of depolarizing during each heartbeat. It is a very commonly performed cardiology test.



The "PQRST"

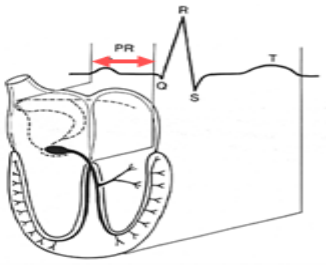


- P wave - Atrial depolarization
- QRS - Ventricular depolarization
- T wave - Ventricular repolarization

The PR Interval

Atrial depolarization
+
delay in AV junction
(AV node/Bundle of His)

(delay allows time for the atria to contract before the ventricles contract)



What an ECG traces looks like

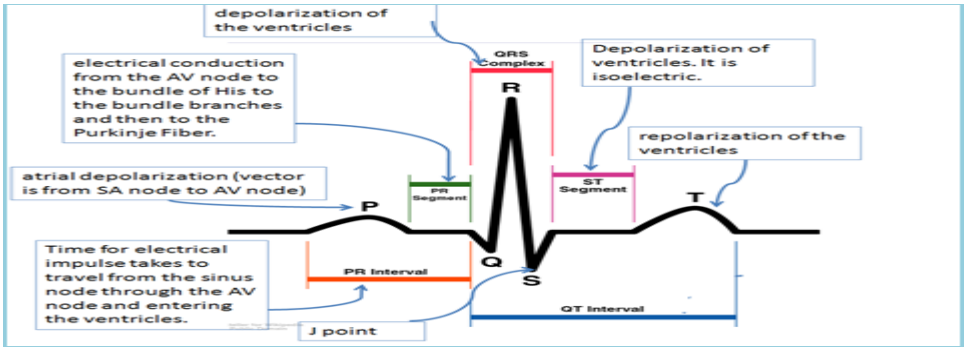
P wave: atrial depolarization

QRS complex: (<120ms)(12sec)

1. **Q wave: first downward (negative) deflection (not always present) ~ septal depolarization**
2. **R wave: upward (positive) deflection**

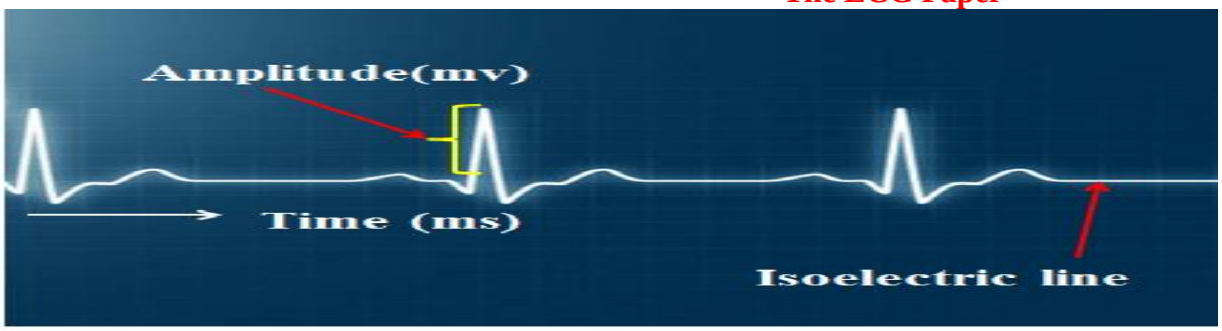
3. ◘ **S wave: downward (negative) deflection following an R wave**

T wave: ventricular repolarization (a positive deflection, since repolarization is in opposite direction)
PR interval: (120-200ms) (12-20 sec)time between beginning of P wave and beginning of QRS complex
ST segment: time between QRS complex and start of T wave (plateau phase of cardiac muscle)
QT interval: ~400ms - time between beginning of QRS complex and end of T wave



In a clinical examination ,six transverse plane ECGs are usually made in addition to the six frontal plans ECGs.
For the transverse plane measurement the negative terminal of the ECG recorder is attached to an indifferent electrode at the center point of three resistors connected to RA,LL, and LA

The ECG Paper

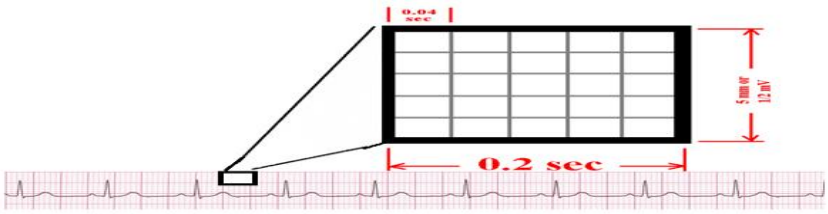


An ECG is printed on paper covered with a grid of squares.
The baseline: it is the line that would be perfectly straight and horizontal if not for those vertical deflections. This is called the isoelectric line
The "height" of an ECG wave is called its amplitude. represent the "strength" of the electricity at a given time
While the horizontal parts (i.e. the X-axis) of an ECG measure time.
The isoelectric line is considered to have amplitude of zero. Anything above the isoelectric line is positive; below the line is negative

- **Horizontally**
  - **One small box - 0.04 s**
  - **One large box - 0.20 s**
  - **One large box - 0.5 mV**

Vertically
- One large box - 0.5 mV

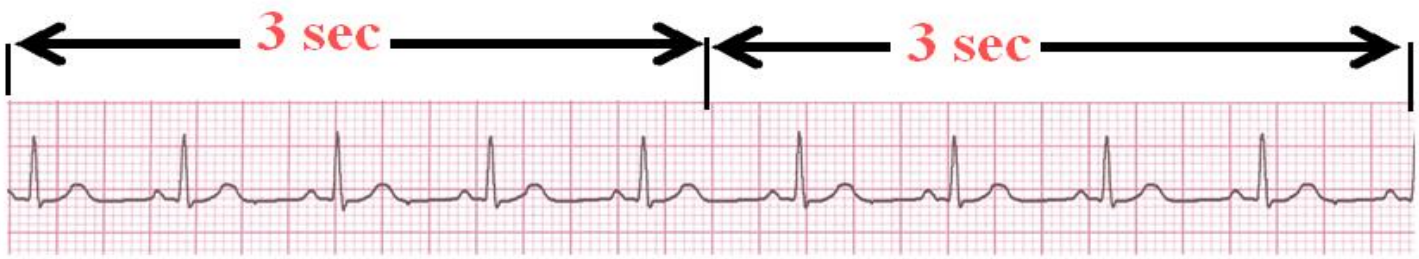
- **Notice that five small squares on the paper form a larger square.**
- **The width of a single small square on ECG paper represents 0.04 seconds.**
- **To successfully interpret ECGs, you must have this value committed to memory**



ECG Rhythm calculation and Interpretation

The ECG Paper (count)

- **Step 1: Calculate rate.**
- **Step 2: Determine regularity.**
- **Step 3: Assess the P waves.**
- **Step 4: Determine PR interval.**
- **Step 5: Determine QRS duration.**



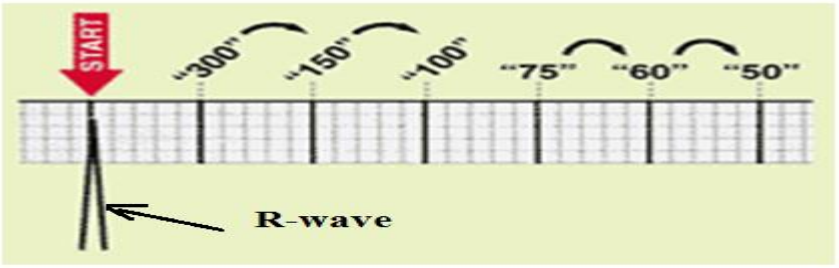
- **Every 3 seconds (15 large boxes) is marked by a vertical line.**
- **This helps when calculating the heart rate.**

NOTE: the following strips are not marked but all are 6 seconds long.

Step 1: Calculate Rate

- **Step 1: Calculate rate.**
- **Option 1**
  - **Count the number of R waves in a 6 second rhythm strip, then multiply by 10.**
  - **Reminder: all rhythm strips in the Modules are 6 seconds in length.**

  Interpretation? *9 x 10 = 90 bpm*
- **Option 2**
  - **Find a R wave that lands on a bold line.**
  - **Count the number of large boxes to the next R wave. If the second R wave is 1 large box away the rate is 300, 2 boxes - 150, 3 boxes - 100, 4 boxes - 75, etc. (count)**

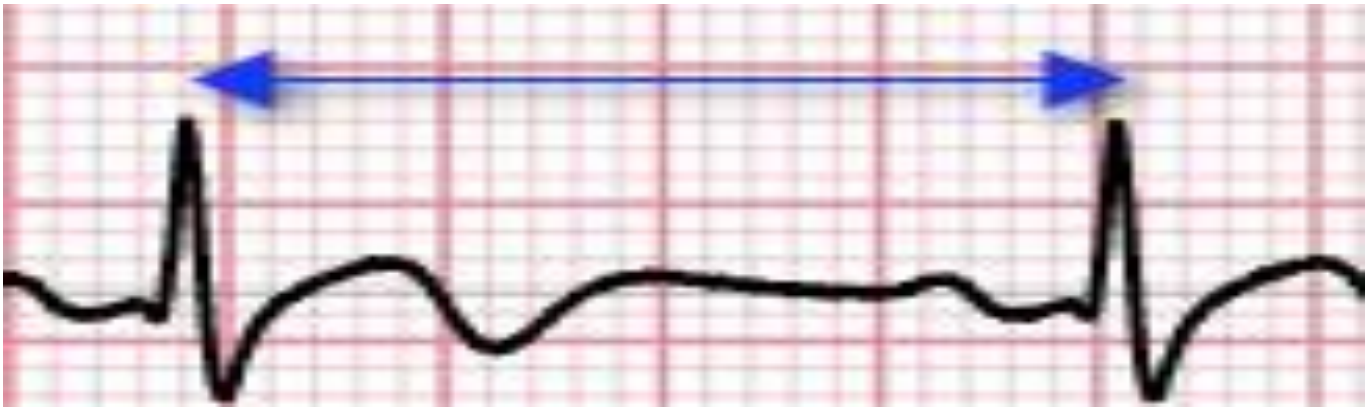


Option 3

The 3rd method uses small boxes. Count the number of small boxes for a typical R-R interval. Divide this number into 1500 to determine heart rate.

HR=1500/(no. of small boxes between R-R interval)

In this \image, the number of small boxes for the R-R interval is 21.5. The heart rate is 1500/21.5, which is 69.8 bpm.



- **Option 2 (cont)**

  - **Memorize the sequence:**
    300 - 150 - 100 - 75 - 60 - 50
    Interpretation? ***Approx. 1 box less than 100 = 95 bpm***

Step 2: 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***

Step 3: Assess the P waves

- **Are there P waves?**
- **Do the P waves all look alike?**
- **Do the P waves occur at a regular rate?**
- **Is there one P wave before each QRS?**
  Interpretation? Normal P waves with 1 P wave for every QRS

Step 4: Determine PR interval

- **Normal: 0.12 - 0.20 seconds.**
  (3 - 5 boxes)

Interpretation? 0.12 seconds

Step 5: QRS duration

- **Normal: 0.04 - 0.12 seconds.**
  (1 - 3 boxes)

Interpretation? *0.08 seconds*

Rhythm Summary

- **Rate** **90-95 bpm**
- **Regularity** **regular**
- **P waves** **normal**
- **PR interval** **0.12 s**
- **QRS duration** **0.08 s**

Interpretation? *Normal Sinus Rhythm*