



**Department of Anesthesia  
Techniques**

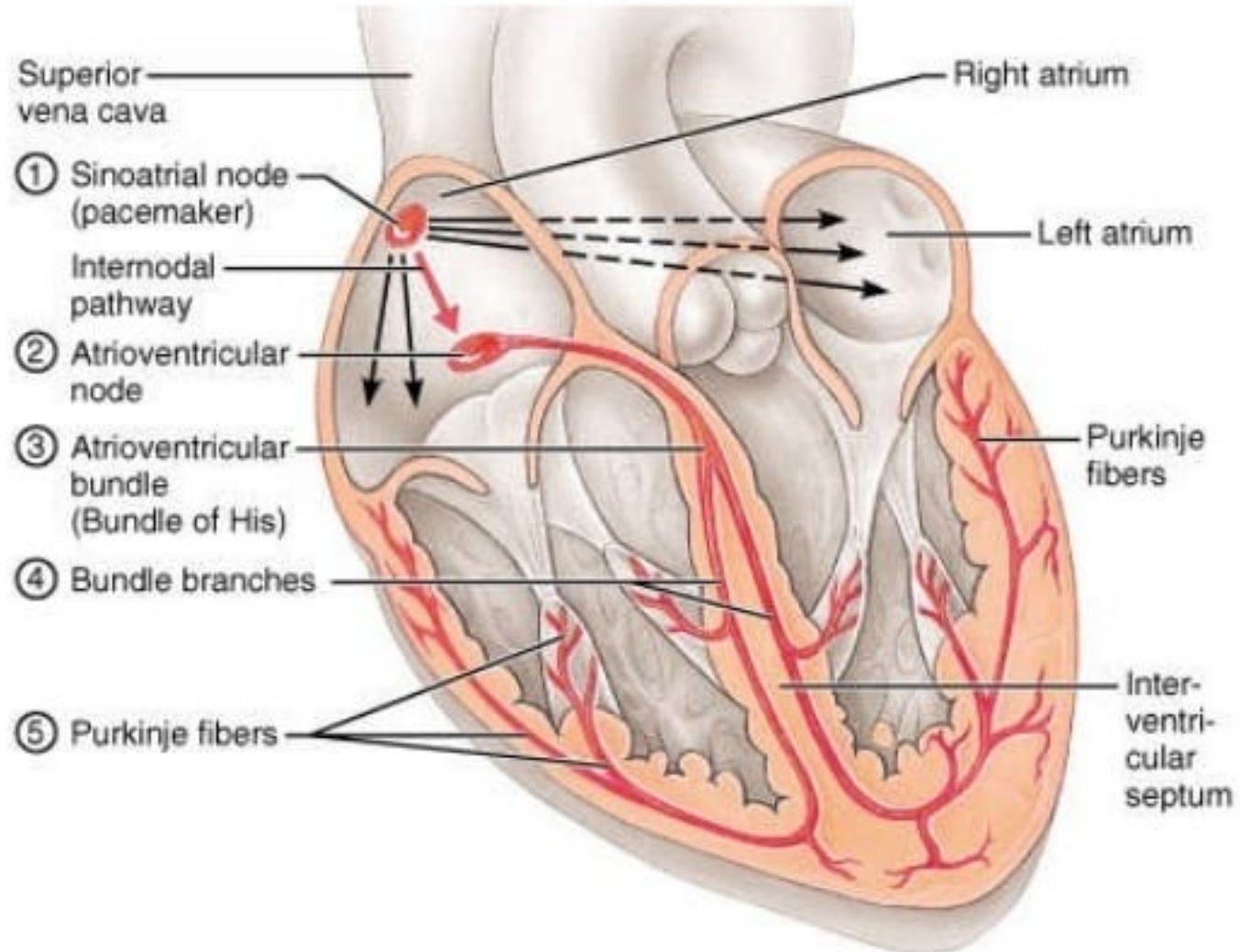
# Electrocardiogram



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# Conducting System

- Network of specialized tissue that stimulates contraction
- Modified cardiac myocytes
- The heart can contract without any innervation



# The Cardiac Conduction System

The impulse conduction system of the heart consists of four structures:

1. The sinoatrial node (SA node)
2. The atrioventricular node (AV node)
3. The atrioventricular bundle (AV bundle)
4. The Purkinje fibers

The cardiac muscle fibers that compose these structures are specialized for impulse **conduction**, rather than the normal specialization of muscle fibers for **contraction**.

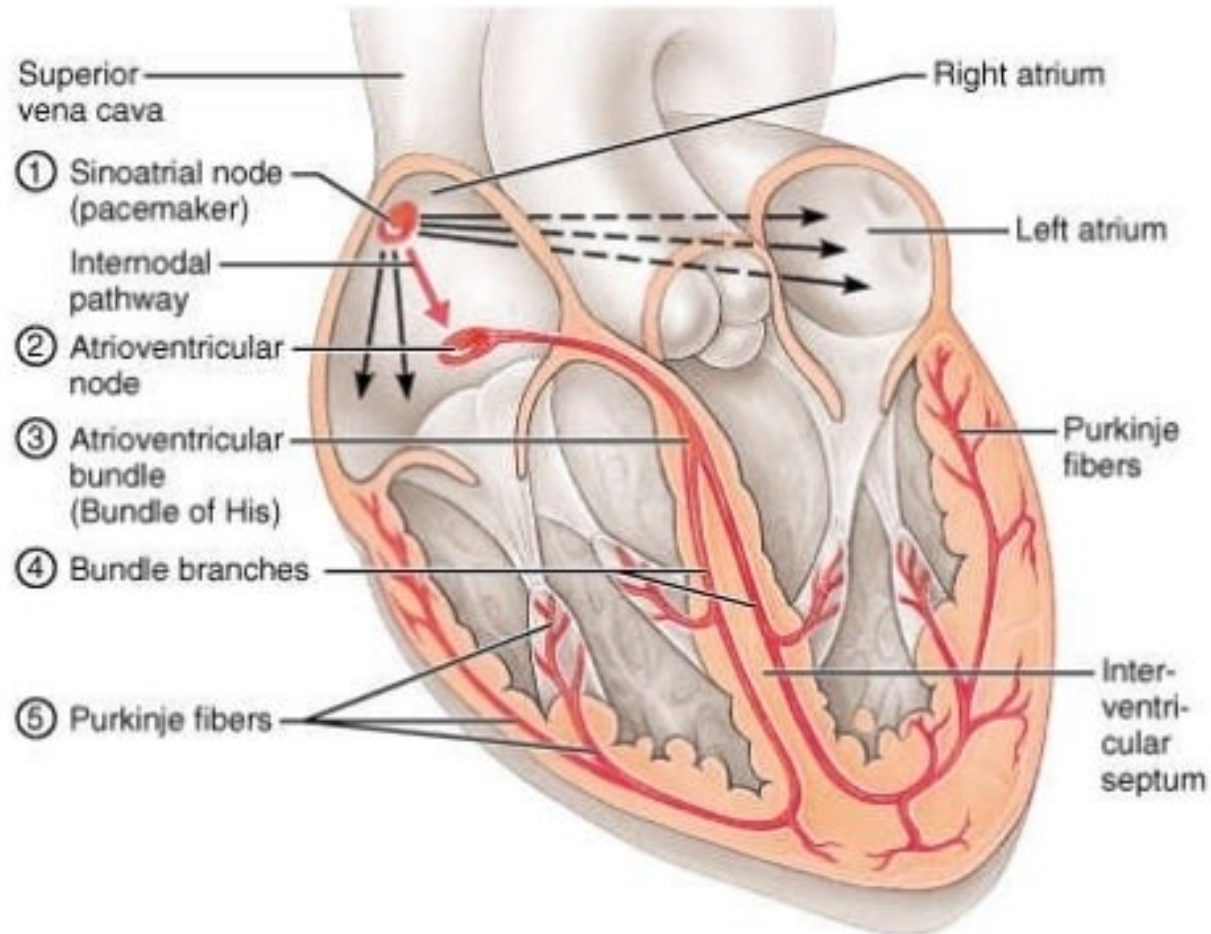
# The sinoatrial node

The SA node is located in the wall of the right atrium near the S.V.C. opening. The specialized muscle fibers that make up this structure are unique in that they can continually and rhythmically send impulses (signals to contract) without any stimulation from the nervous system. This means that the SA node is said to be “self exciting”.

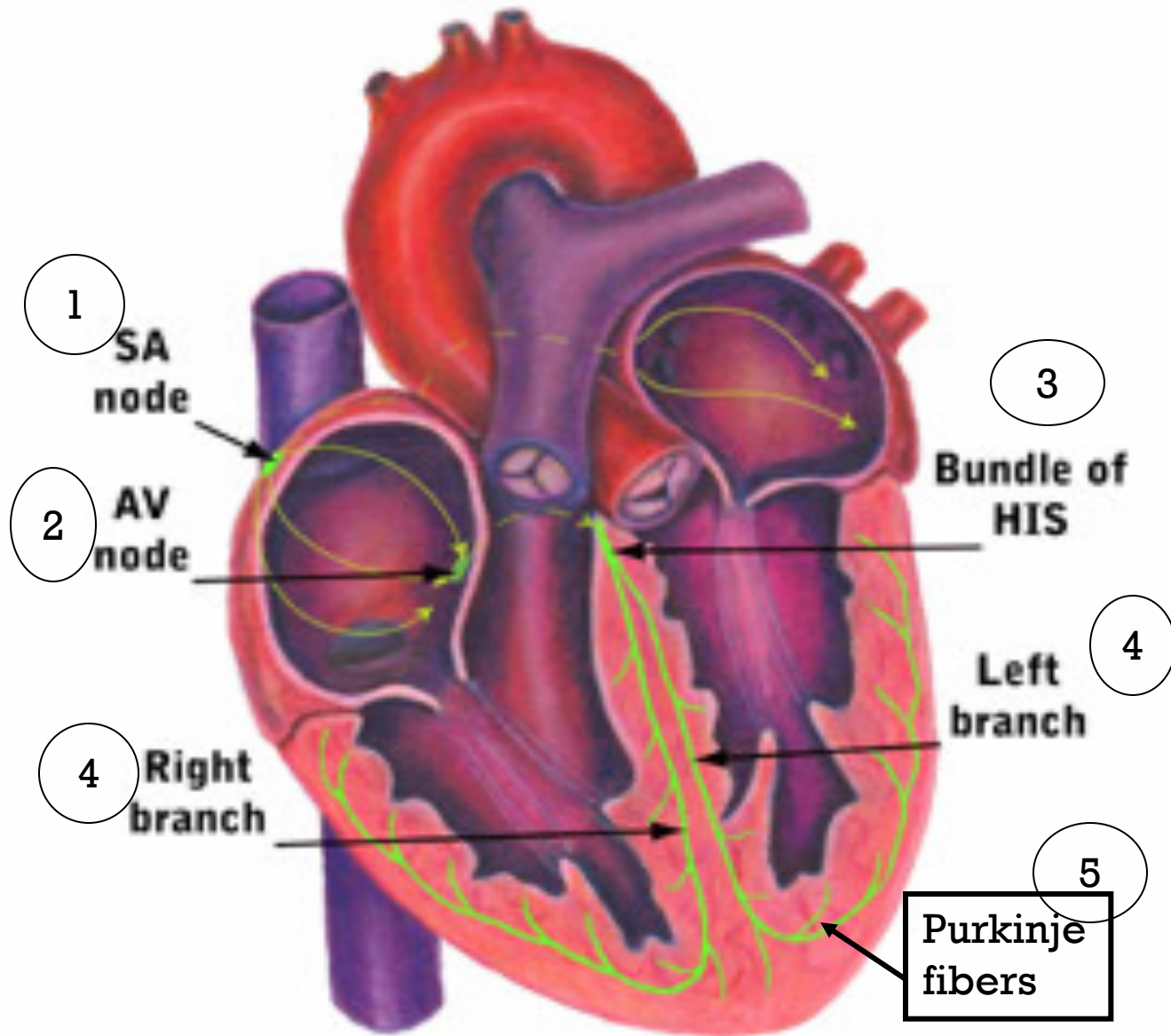
This is also why the SA node is said to be the “pacemaker” of the heart

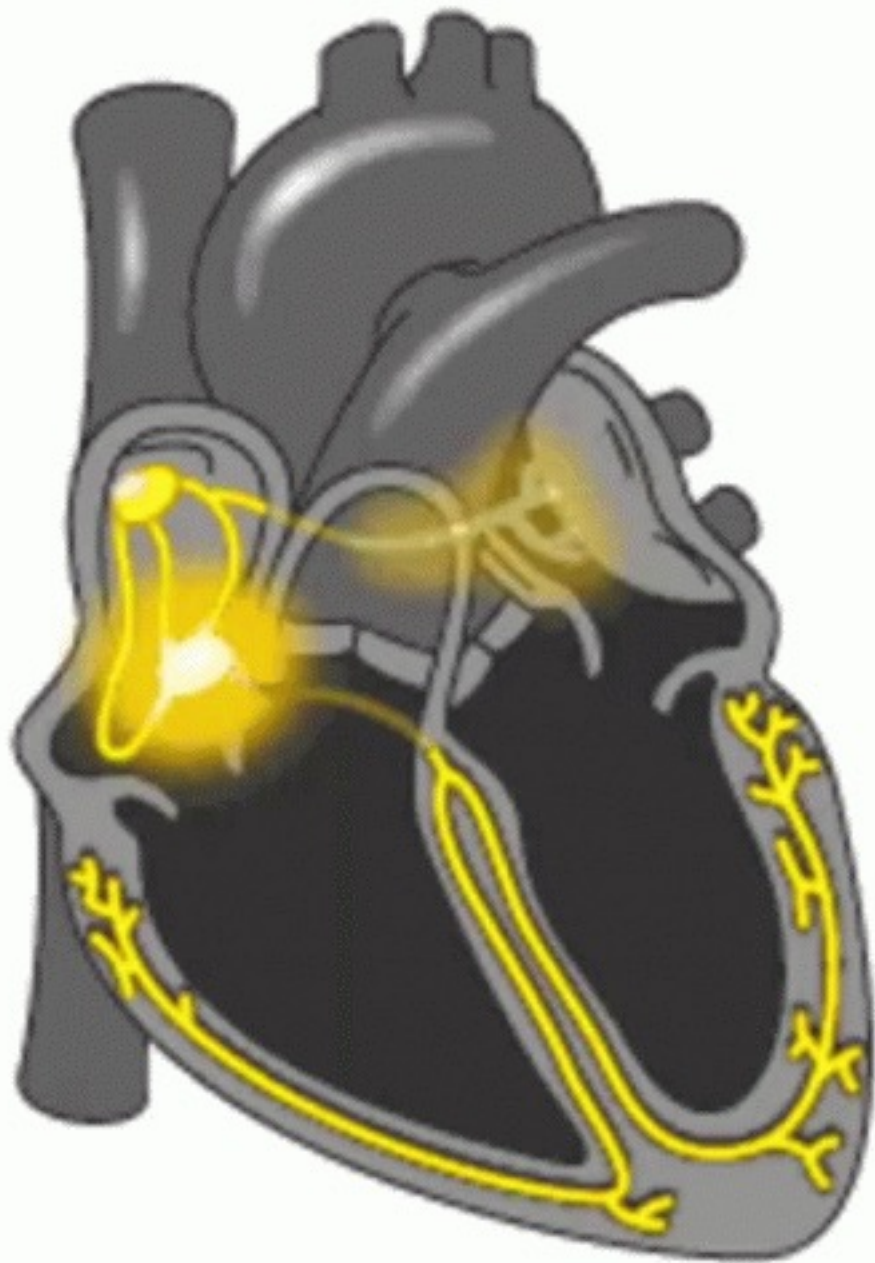
Impulses from the SA node are then conducted **across the atria from right to left**. The impulse does not however pass directly to the ventricles.

When both the right and left atria are completely depolarized, they contract **simultaneously**.

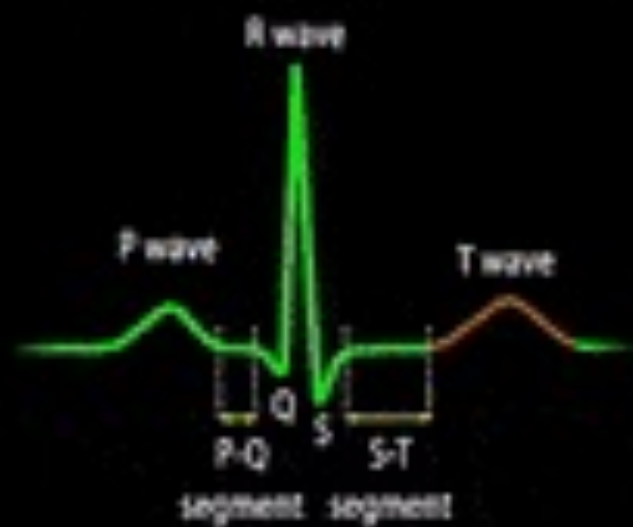


# Cardiac Conduction System





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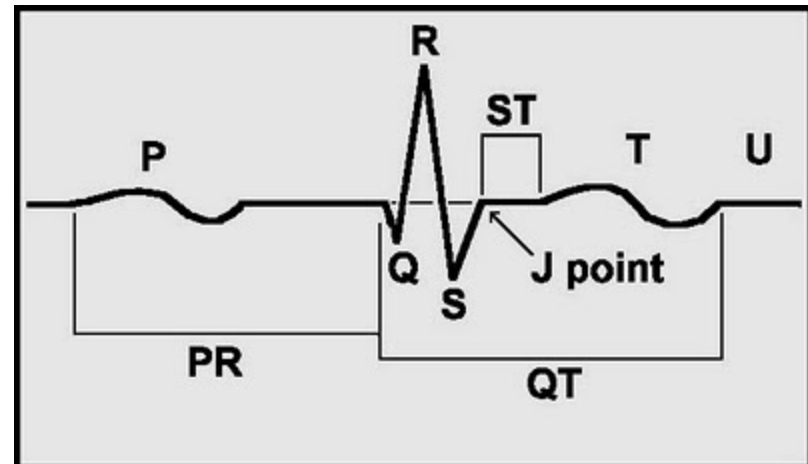
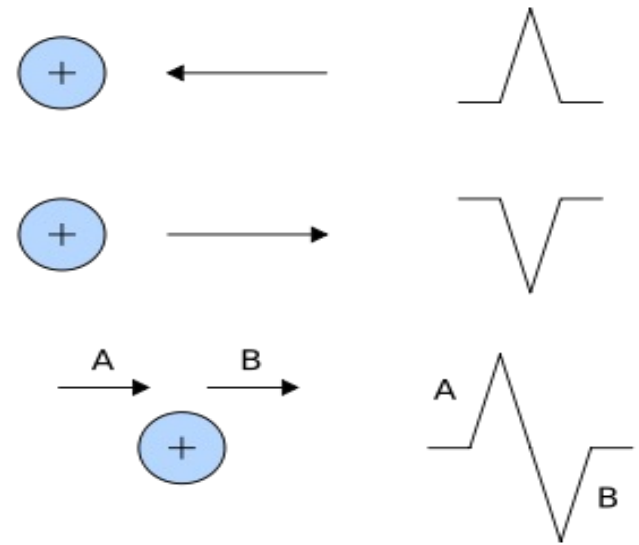


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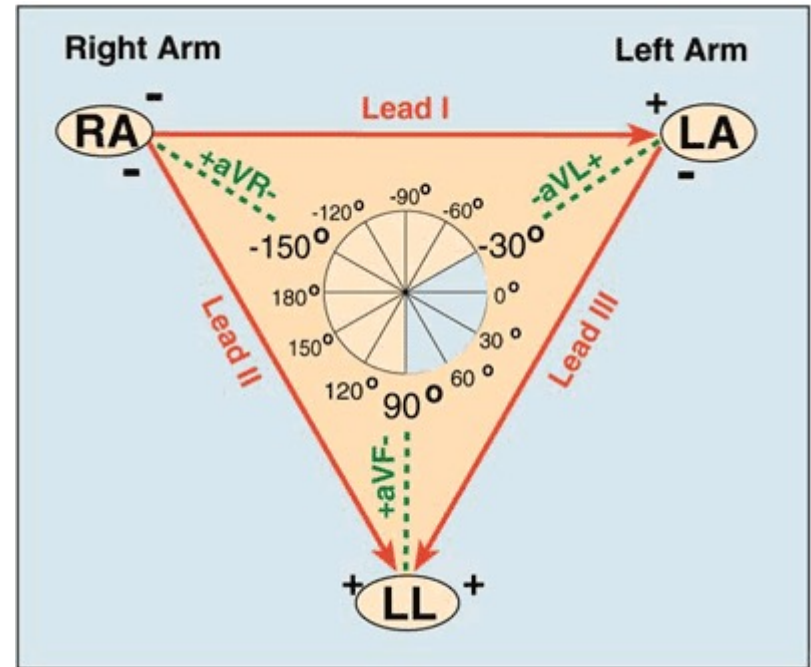
# Monitoring Basics

- Impulse toward positive is an up swing; away from positive is down.
- J point, or “junction point”, is located at junction of S wave and start of ST segment.

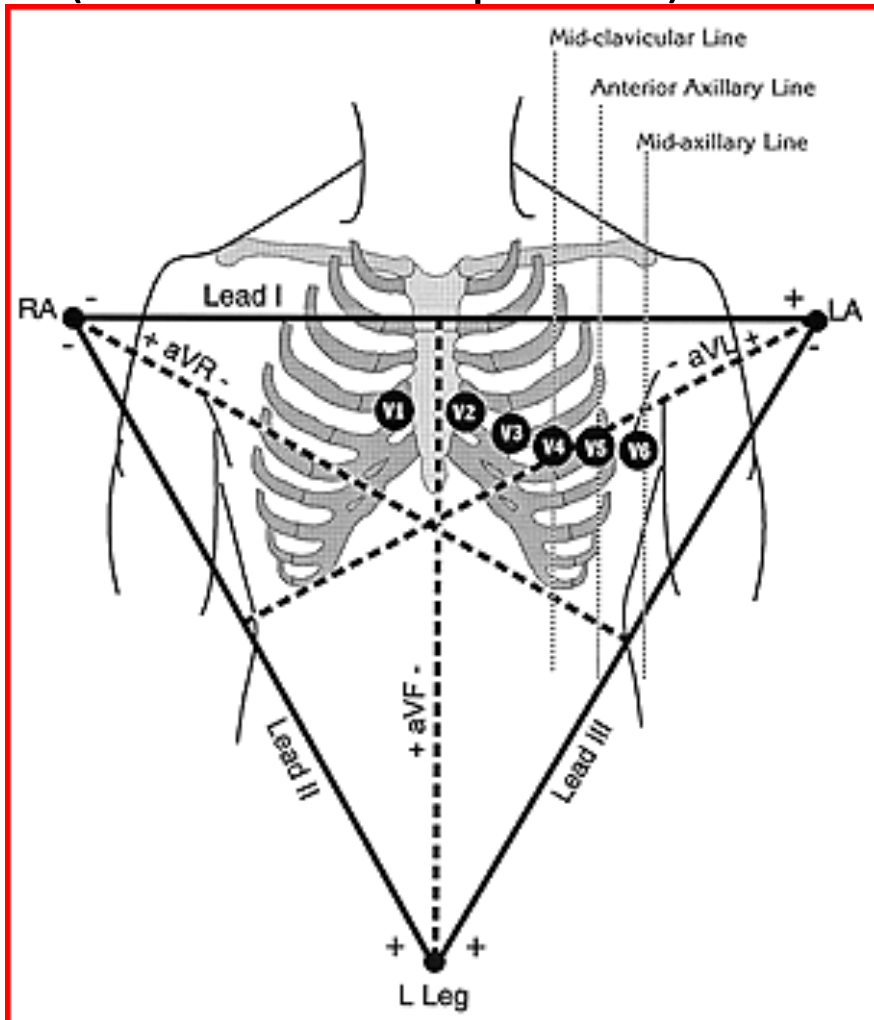


# Bipolar and Augmented Leads Placement

- Bipolar leads read from negative to positive.
- Bipolar leads are Lead I, II, and III also referred to as the limb leads.
- Augmented leads read from center to specific + lead and are unipolar.
- Augmented leads are aVR, aVL, and aVF.



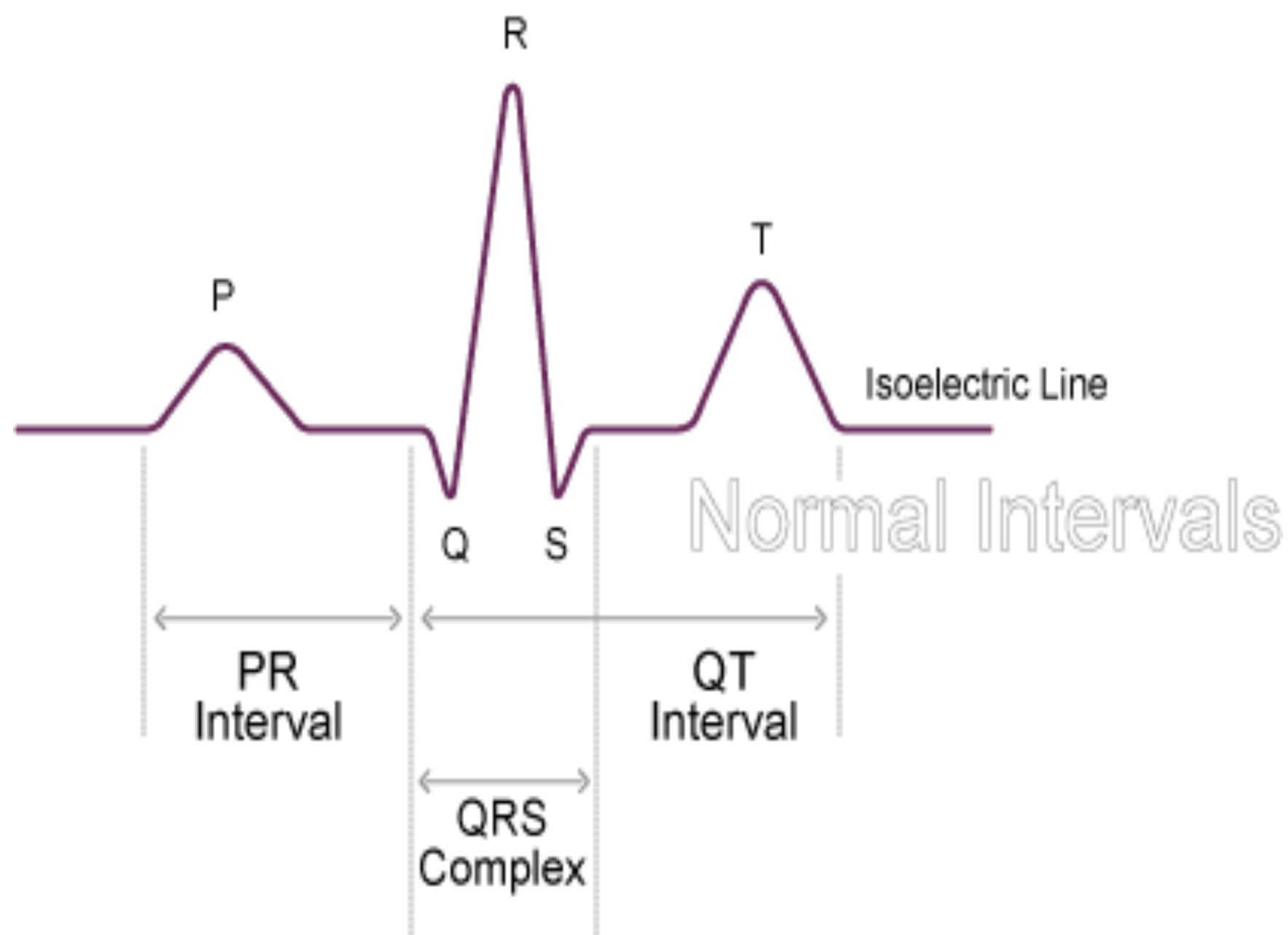
# Precordial Lead placement (Horizontal plane)



- Unipolar leads, reading from center to outward.
- **V1: right sternal boarder 4<sup>th</sup> intercostal space**
- V2: left sternal border 4<sup>th</sup> intercostal space**
- V3: halfway between V2 and V4**
- V4: left 5<sup>th</sup> intercostal space, mid-clavicular line**
- V5: horizontal to V4, anterior axillary line**
- V6: horizontal to V5, mid-axillary line**

# ECG Waveforms

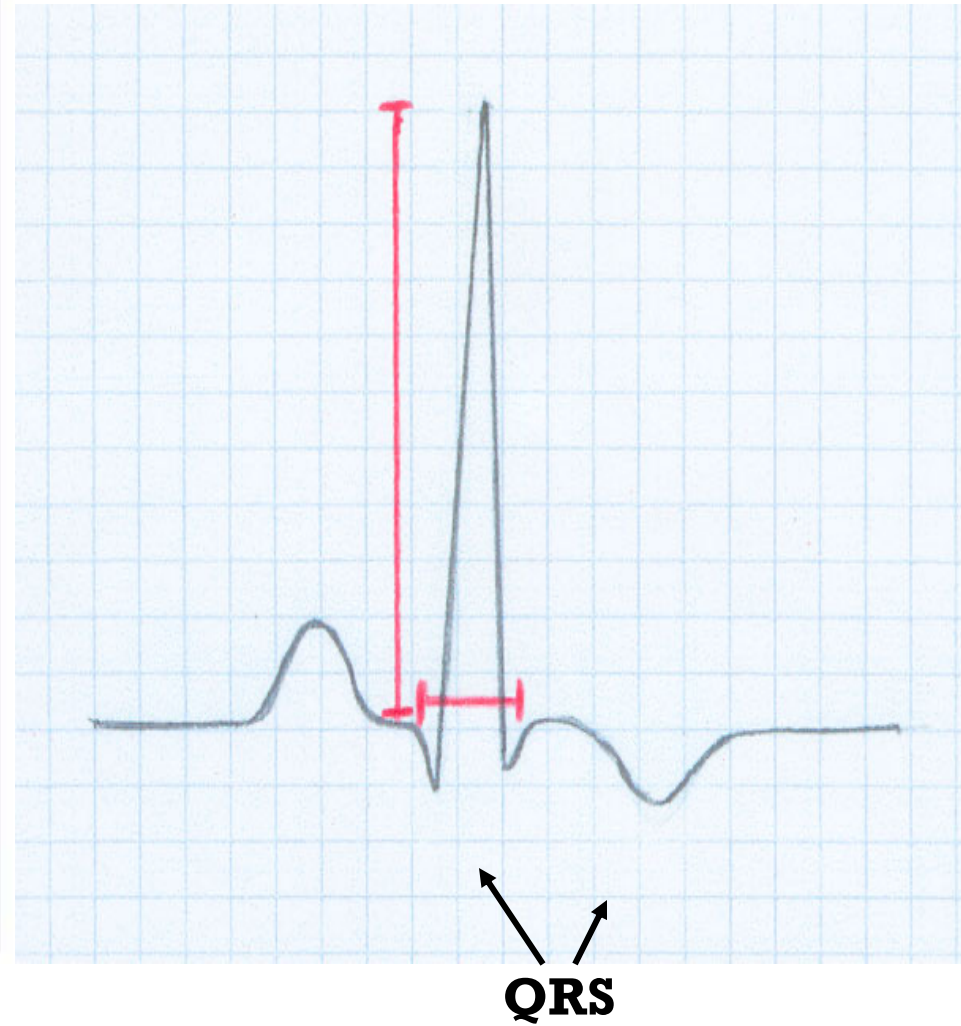
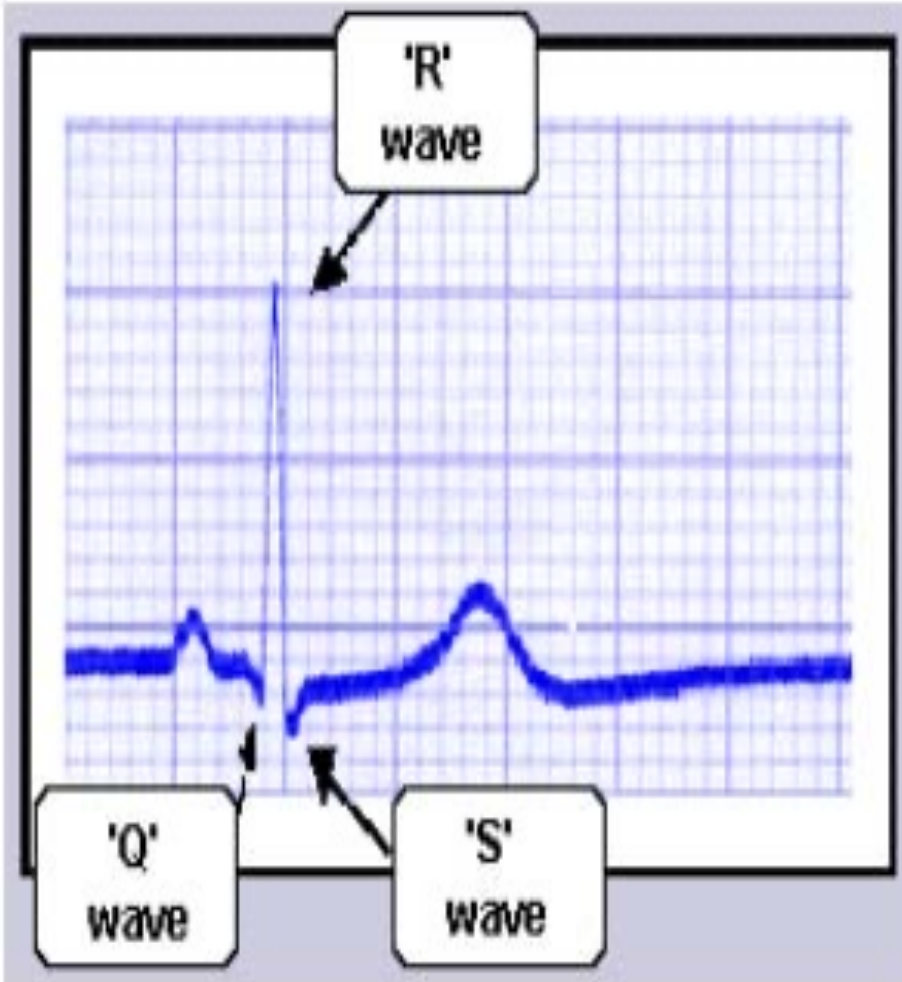
- P wave represents atrial stimulation
  - P wave is rounded and upright
- PR interval
  - PR interval is the time it takes for an impulse to travel from the SA node toward the ventricles
  - Includes delay time in the AV node
- Normal PR interval is 0.12 – 0.20 seconds



# ECG Wave Forms

- **QRS complex**
- Represents **ventricular depolarization**
  - Consists of the Q, R, and S waves
  - Larger than the P wave because ventricular depolarization involves a larger muscle mass than atrial depolarization
- Palpation of a pulse is generated by ventricular depolarization (seen as the QRS complex)
- Normal timing usually considered between 0.06 and 0.11 seconds

# QRS Complex



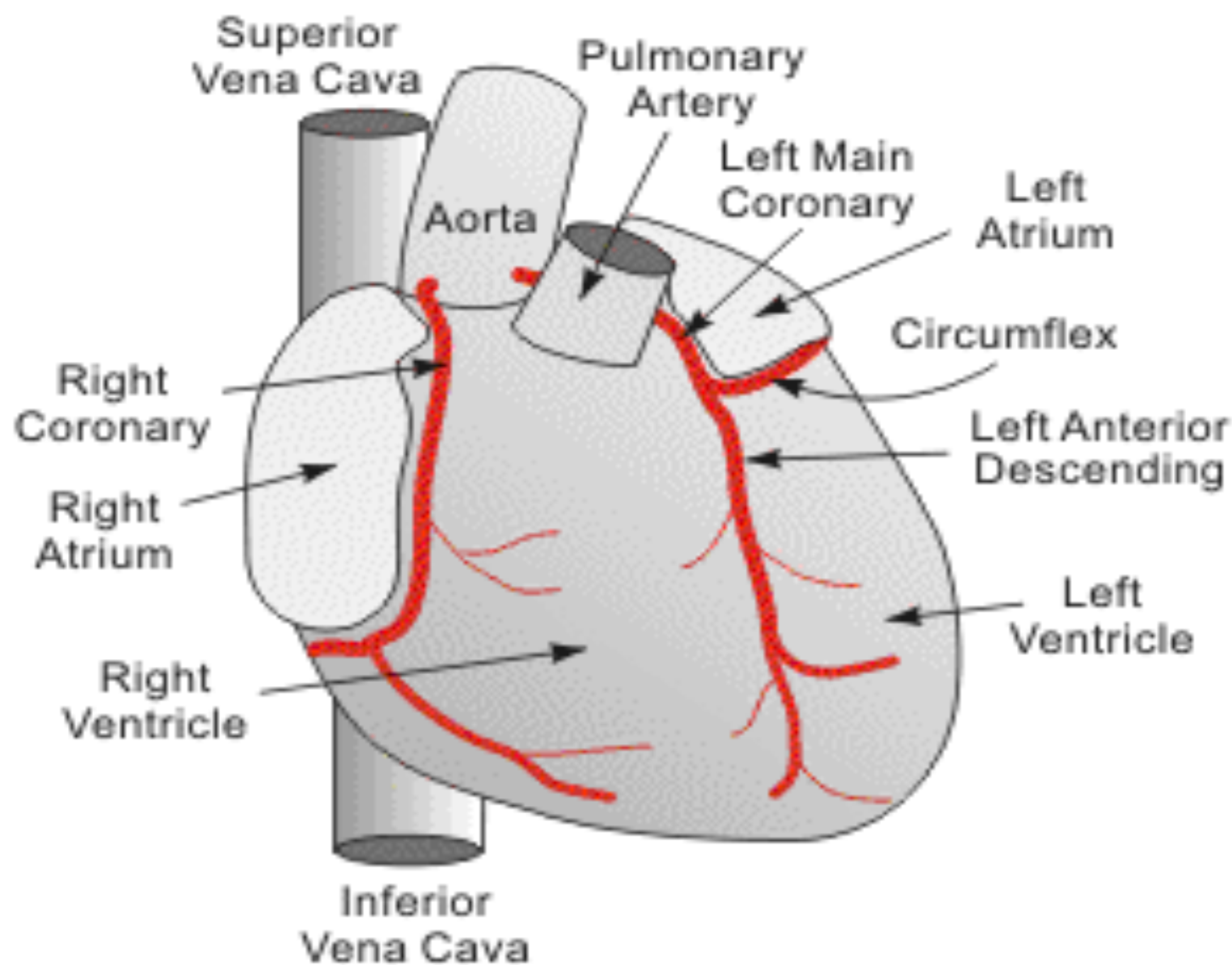
# ECG Wave Forms

- **T wave**
  - **Represents ventricular repolarization**
- Atria repolarize during ventricular depolarization so the small atrial T wave is hidden during the larger QRS complex



# Coronary Circulation

- Coronary arteries and veins
- Myocardium extracts the largest amount of oxygen as blood moves into general circulation
- Oxygen uptake by the myocardium can only improve by increasing blood flow through the coronary arteries
- If the coronary arteries are blocked, they must be reopened if circulation is going to be restored to that area of tissue supplied



## 12-Lead Electrodes (اقطاب كهرياء)

- A lead is a tracing of the electrical activity between 2 electrodes
- Leads view the heart from the front of the body
  - Top, bottom, right, and left side of heart
- Leads view the heart as if it were sliced in half horizontally
- Each lead has a positive and a negative electrode

## Standard 12-Lead ECG

- Six limb leads
  - Leads I, II, III, aVR, aVL, aVF
- Six chest leads (precordial leads)
  - V1, V2, V3, V4, V5, V6
- Information from 12 leads obtained from the attachment of only 10 electrodes

## View The Leads Provide

- **II, III, aVF – view inferior wall of heart**
- **V1 and V2 – view septal wall of heart**
- **V3 and V4 – view anterior wall of heart**
- **I, aVL, V5, V6 – view lateral wall of heart**

# Preparation for 12 Lead EKG

- Skin preparation
  - Hair removal
    - ✓ clip hair if necessary so electrodes adhere
  - Clean and dry skin surface
    - ✓ gently rub skin area with gauze pad
      - ◆ need to remove skin oils & dead skin

# Patient positioning

- Preferably flat
  - ✓ Heart rotates position as the patient position changes
- If patient is elevated, note that information on the ECG

# Precordial Chest Leads

V1 - 4<sup>th</sup> intercostal space, Rt of sternum

V2 - 4<sup>th</sup> intercostal space, Lt of sternum

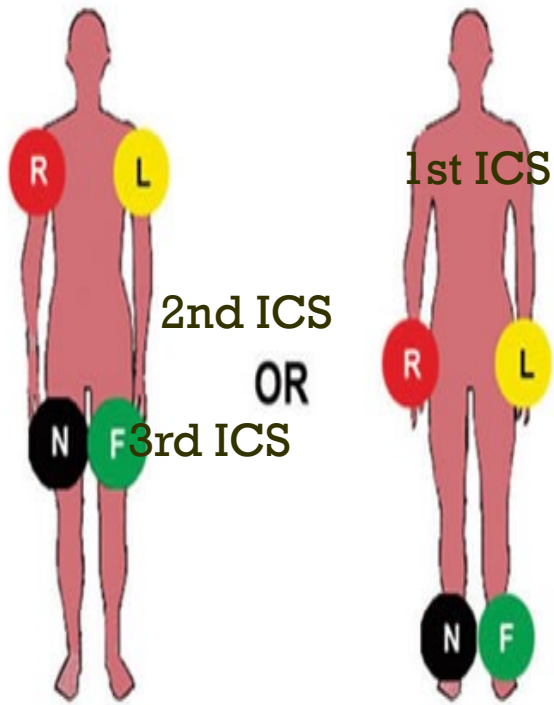
V4 - 5<sup>th</sup> intercostal space, midclavicular

V3 - between V2 and V4, on 5<sup>th</sup> rib

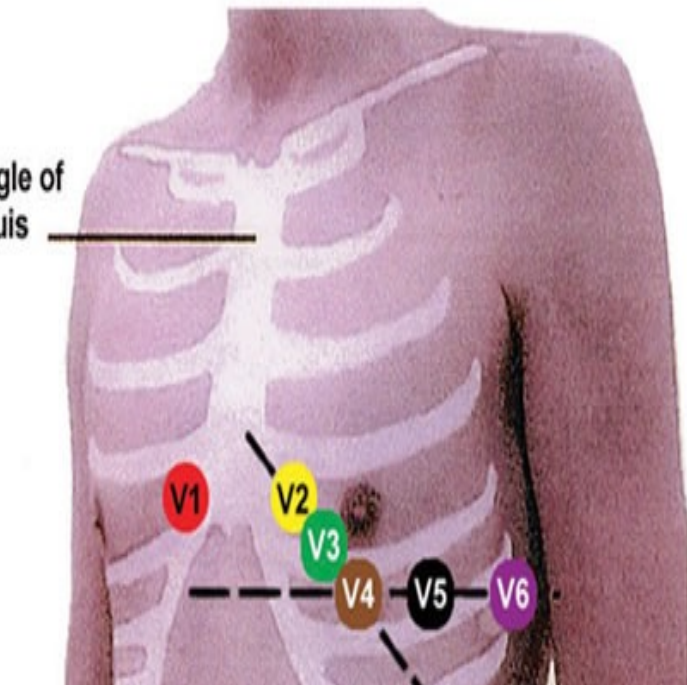
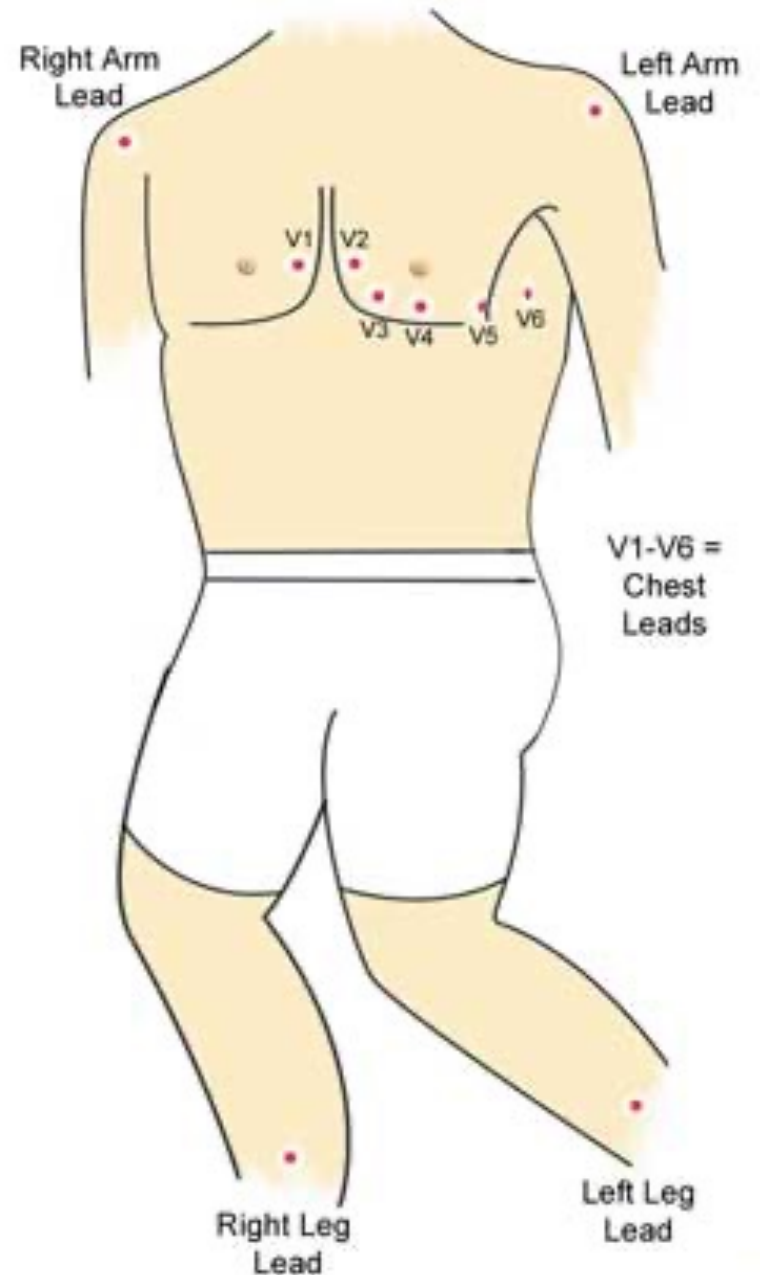
V5 - 5<sup>th</sup> intercostal space, anterior axillary line

V6 - 5<sup>th</sup> intercostal space, mid-axillary line



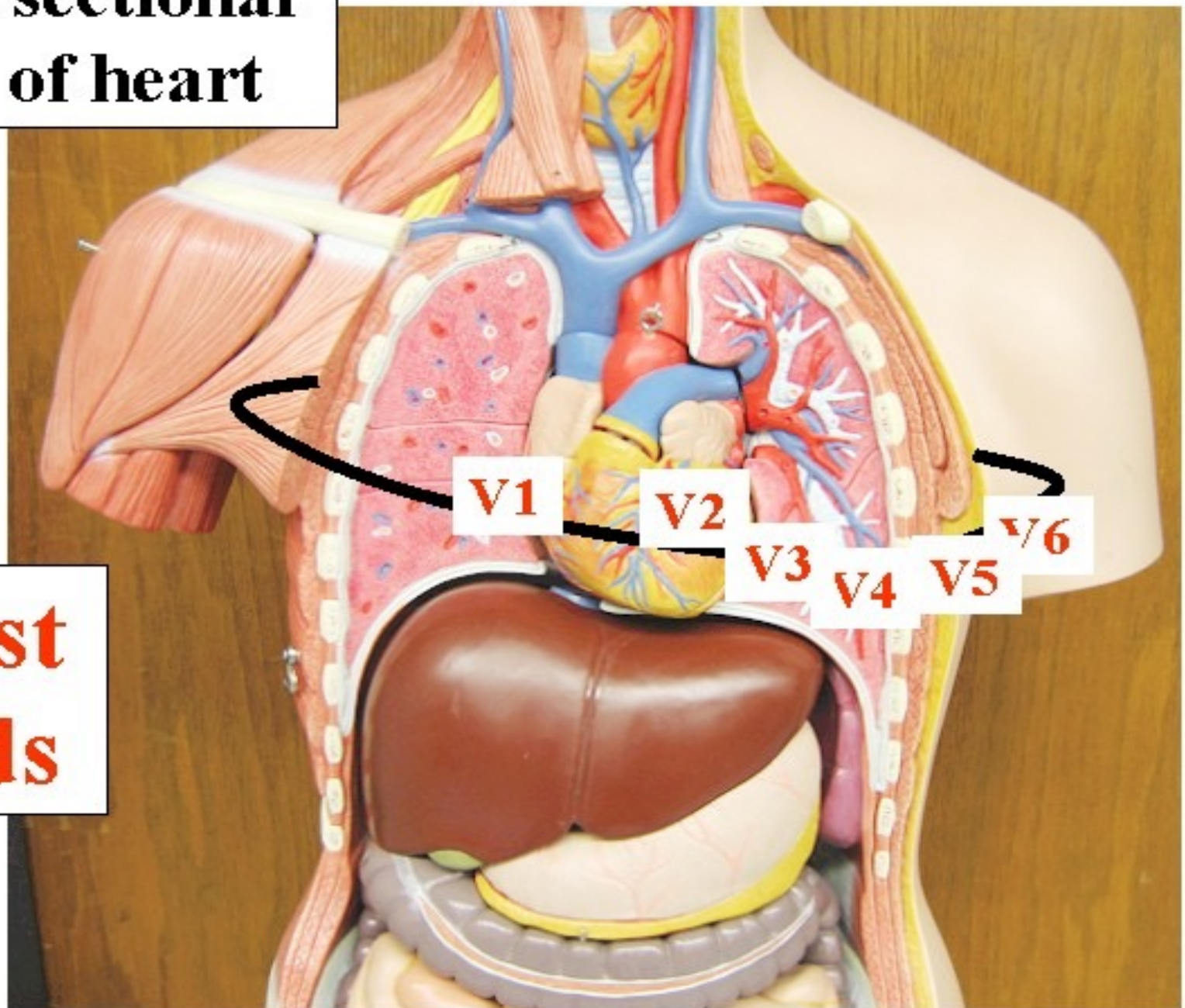


## ECG Lead Positions



# Cross sectional view of heart

Chest leads



# 12 Lead ECG Printout

- 12 lead format:

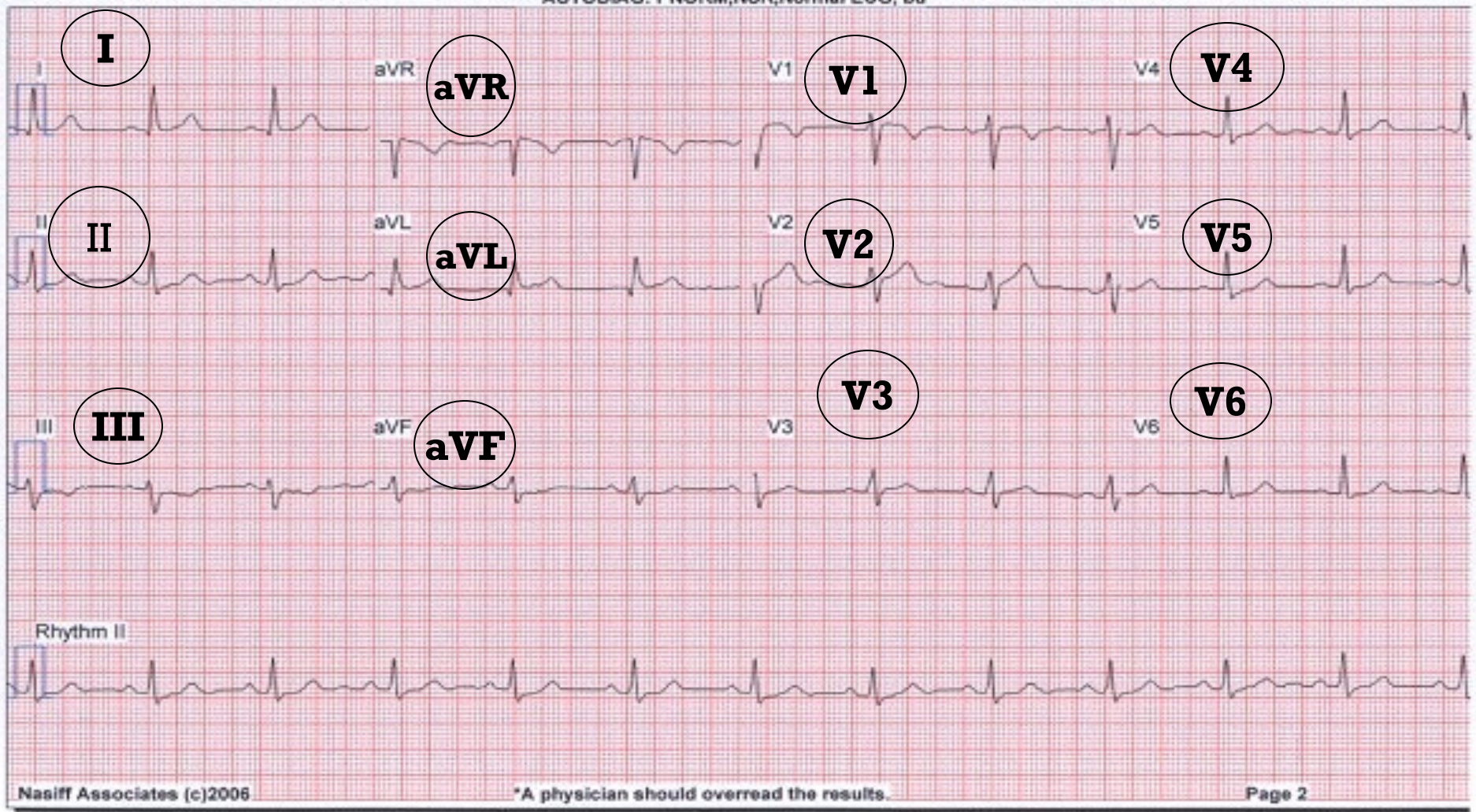
I	aVR	V1	V4
II	aVL	V2	V5
III	aVF	V3	V6

Machines can analyze data obtained but  
humans must interpret data

Age:39,Sex:F,Ht:5 6,Wt:170  
10mm/mV, 0.05-100Hz, 25mm/sec  
Medications:  
Meds (con't):  
Blood Pressure:

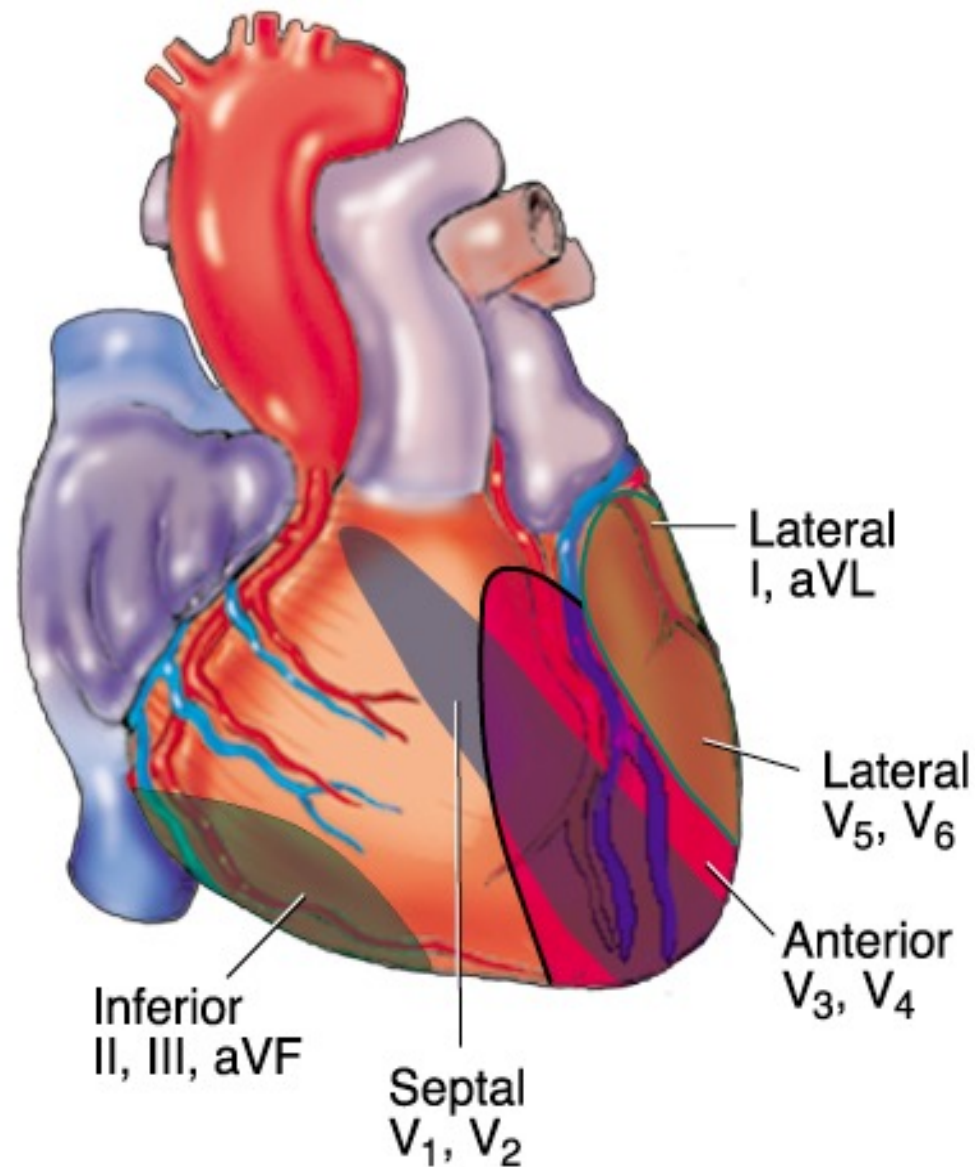
HR (bpm): 70 (lead II)  
R-R (ms): 857  
P dur (ms): 89  
PR int (ms): 176  
QRS dur (ms): 104  
P/R/T axis: 58/8/18  
QT/Qtc (ms): 424/438  
Referring:  
\*\*\* Confirmed by (required):  
\*\*\* AUTODIAG: PNORM,NSR,Normal ECG, bu

**Example of a complete  
12-lead EKG (ECG)**



# Contiguous(متجاورة) ECG Leads

- ECG changes are significant when they are seen in at least two *contiguous* leads
- Two leads are contiguous if they look at the same area of the heart or they are numerically consecutive chest leads



# 12-Lead Electrode Placement

**Positions of the electrodes:**

**right arm**

