13

Electrical Axis

Fast & Easy ECGs – A Self-Paced Learning Program

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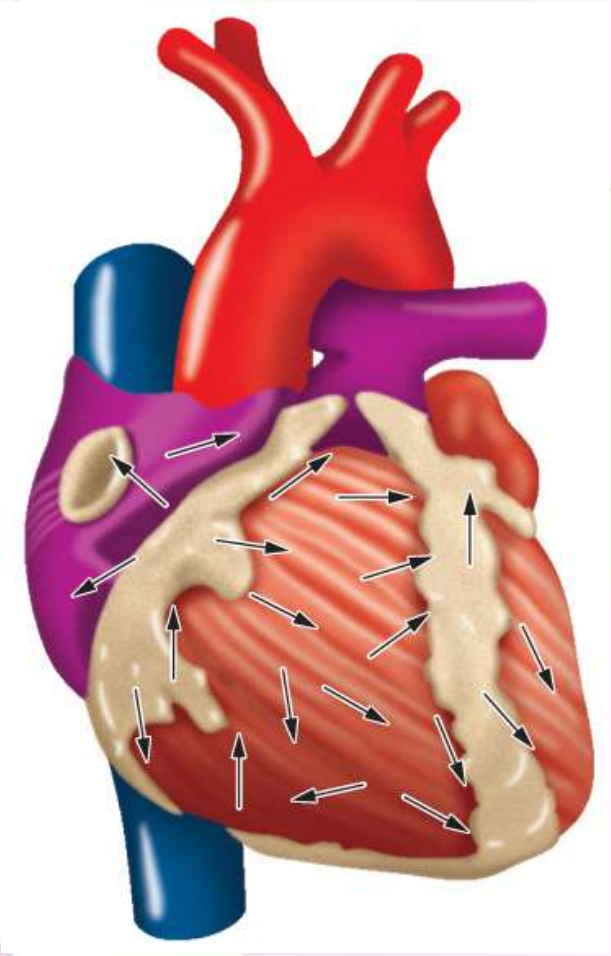
Electrical Axis

- 12-lead ECG can measure the axis of the electrical flow of energy during the cardiac cycle

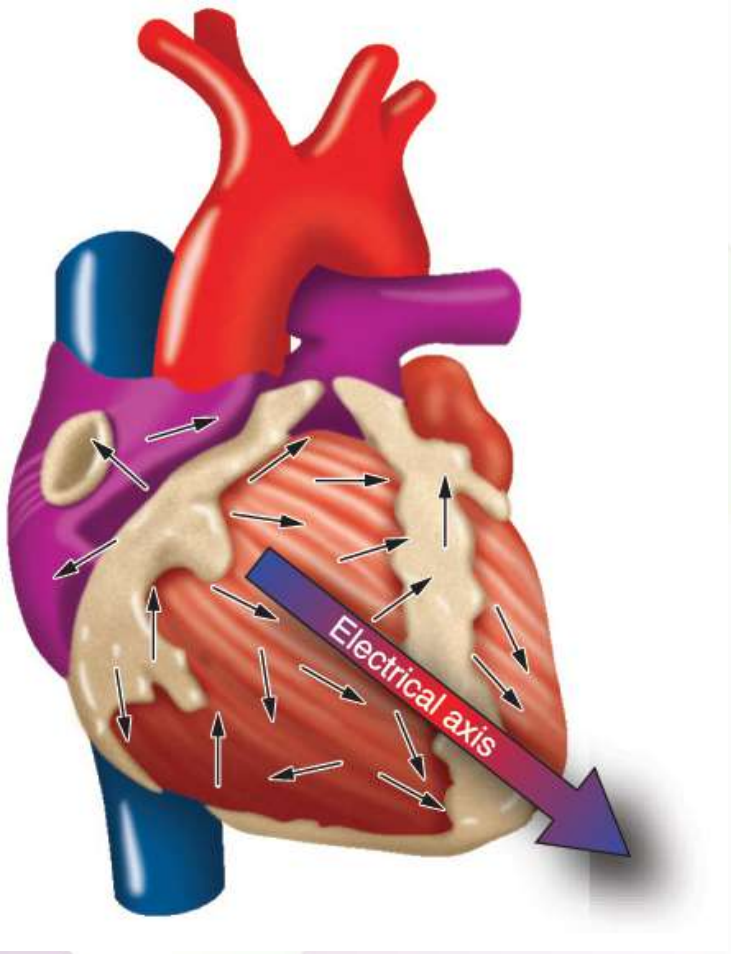
Instantaneous Vectors

- Cardiac cell depolarization and repolarization produces many small electrical currents
  - Sum of these currents called *instantaneous vectors*
  - Average of instantaneous vectors called the *mean vector*

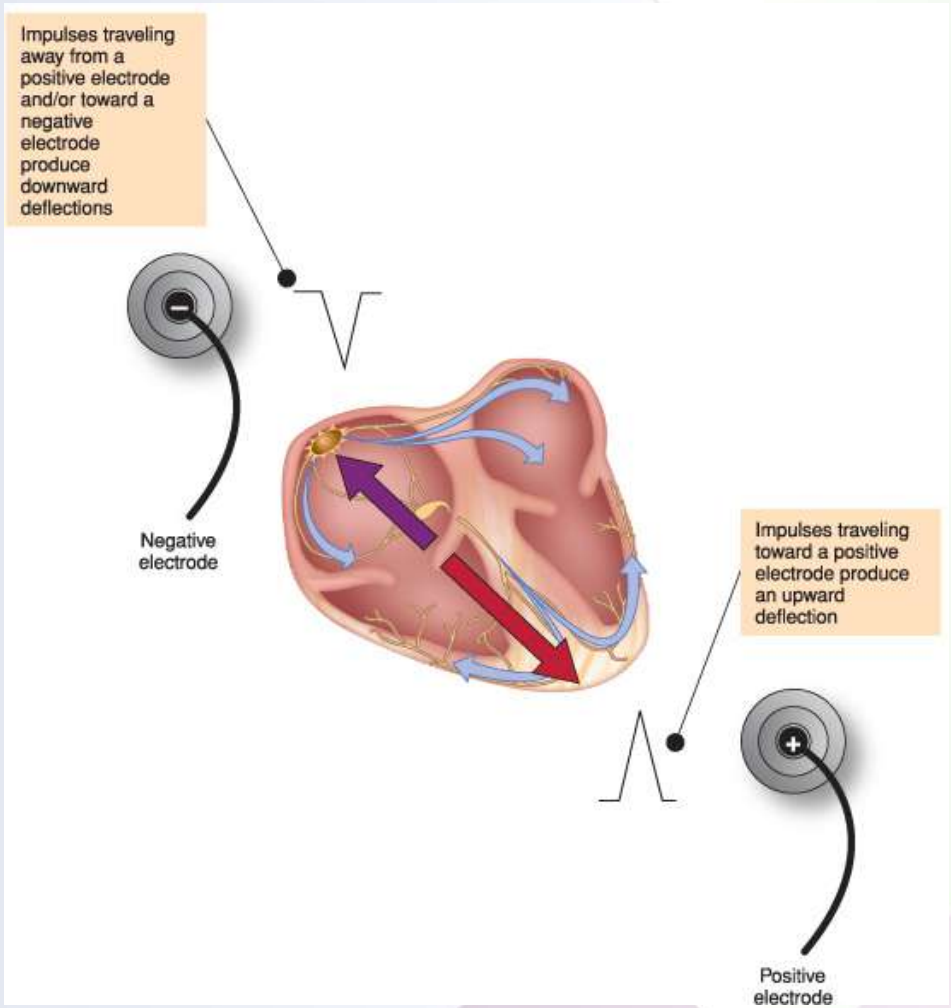


Mean Electrical Axis

- Direction of the mean vector called the *mean electrical axis*
- Axis is defined in the frontal plane only

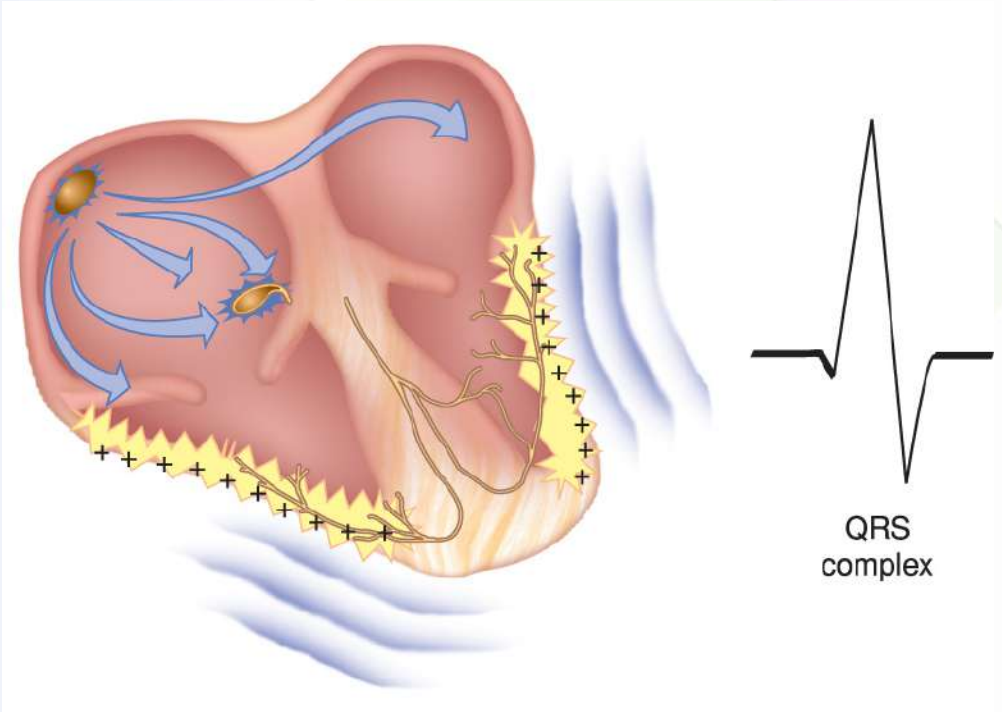


ECG Deflection



QRS Axis

- The most important most frequently determined axis

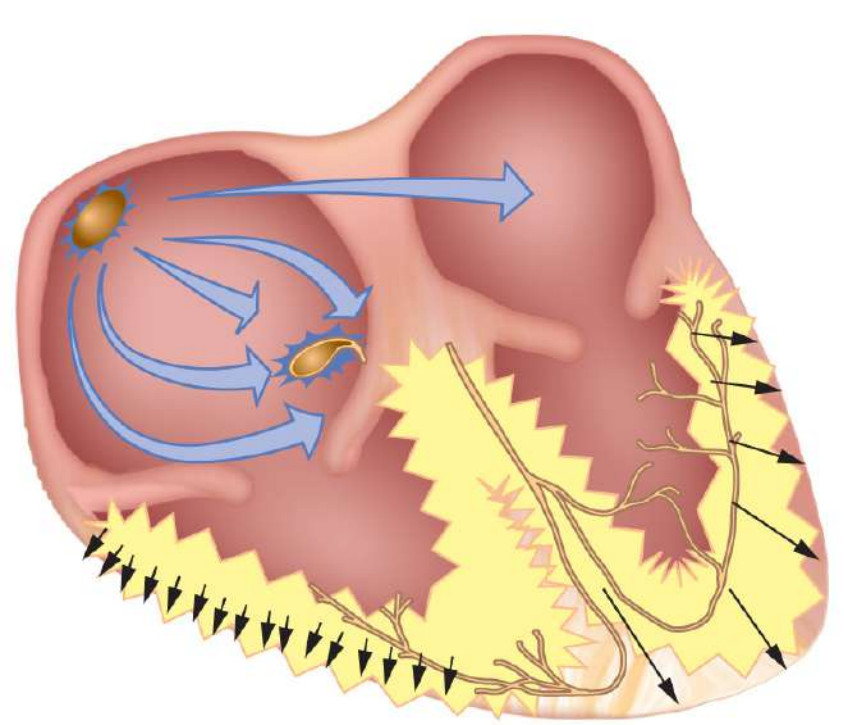


Ventricular Depolarization and Mean QRS Axis

- Interventricular septum depolarization represents the first cardiac vector associated with ventricular depolarization
- A sequence of vectors is produced as the Purkinje fibers carry the impulse from the endocardial lining of the RV and LV through the ventricular wall toward the epicardium

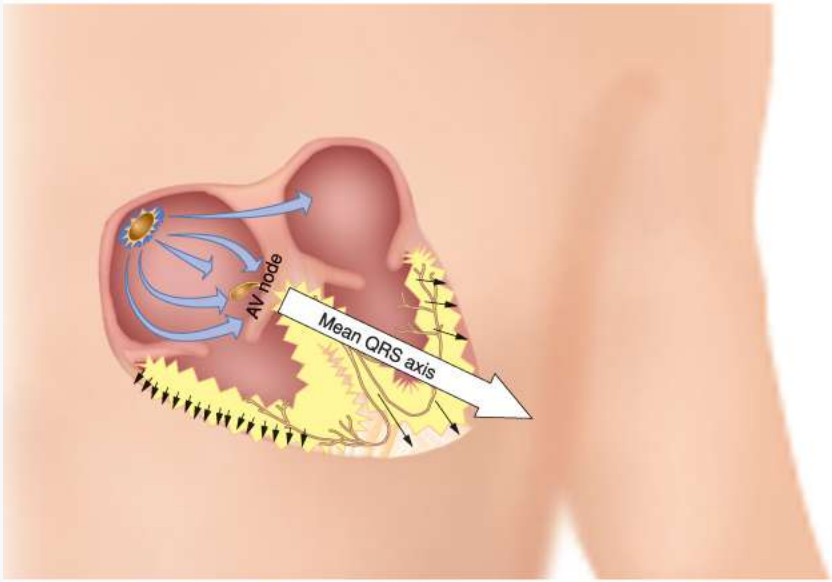
Ventricular Depolarization and Mean QRS Axis

- Completion of right ventricular activation occurs first
- The thinner wall of the RV transmits impulse quicker than the thicker wall of LV



Mean QRS Axis

- The small depolarization vectors of the thicker LV are larger
- Therefore, the *mean QRS axis* points more to the left

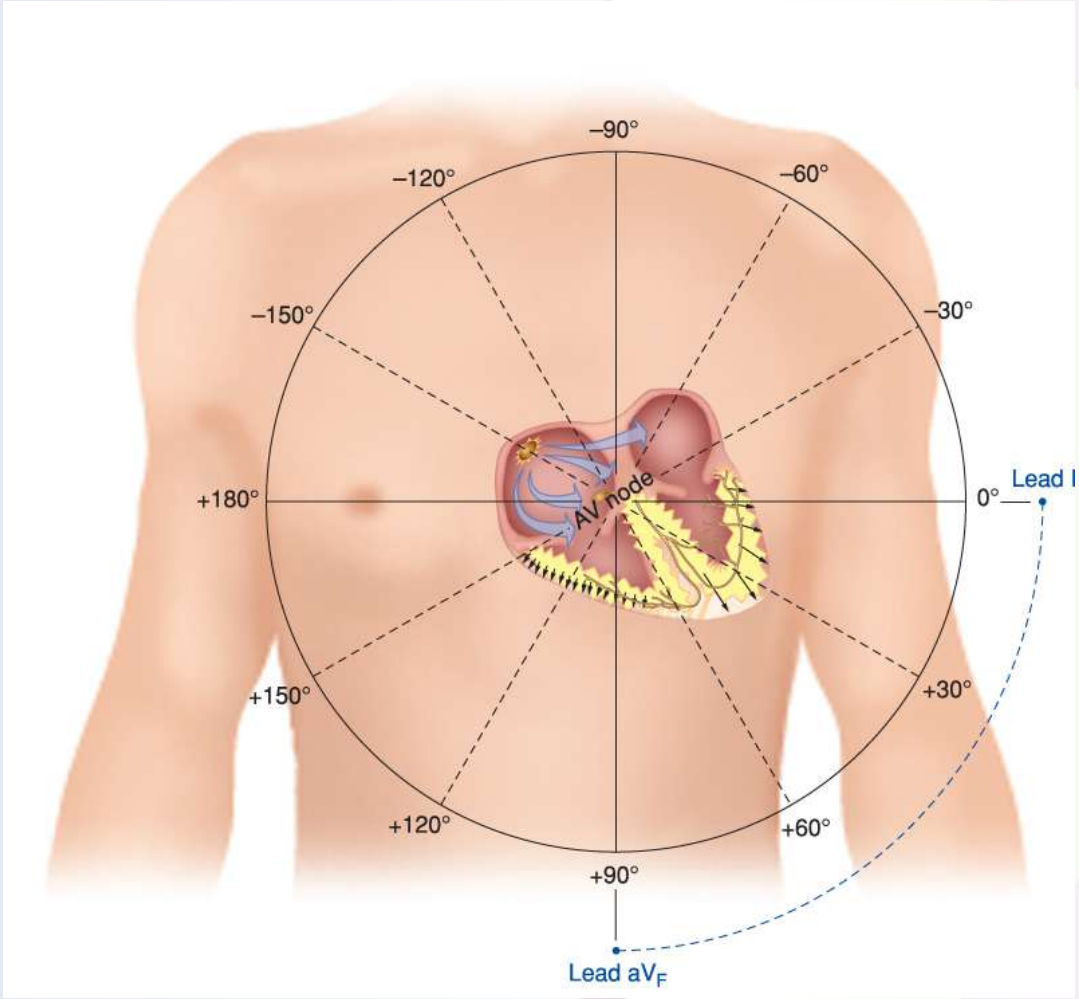


Position of the Mean QRS Axis

- Limb leads provide information about the frontal plane and are used to determine the position of the mean QRS axis
- Described in degrees within an imaginary circle drawn over the patient's chest

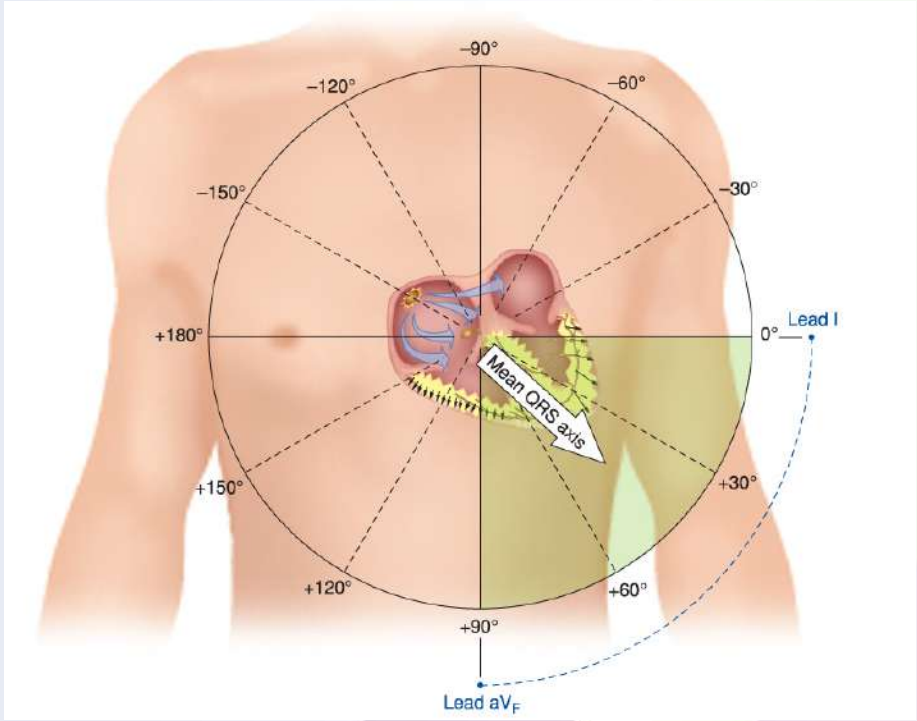
Position of the Mean QRS Axis

- AV node is center of circle
- Intersection of all lines divides circle into equal, 30-degree segments
- Lead I starts at +0 degrees and is located at the three o'clock position
- Lead aV_F starts at +90 degrees and is located at the six o'clock position


–90°
–120°
–60°
–150°
–30°
+180°
0°
Lead I
AV node
+150°
+30°
+120°
+60°
+90°
Lead aV$_F$

Position of the Mean QRS Axis

- Mean QRS axis normally points downward and to patient's left (between 0 and +90 degrees)

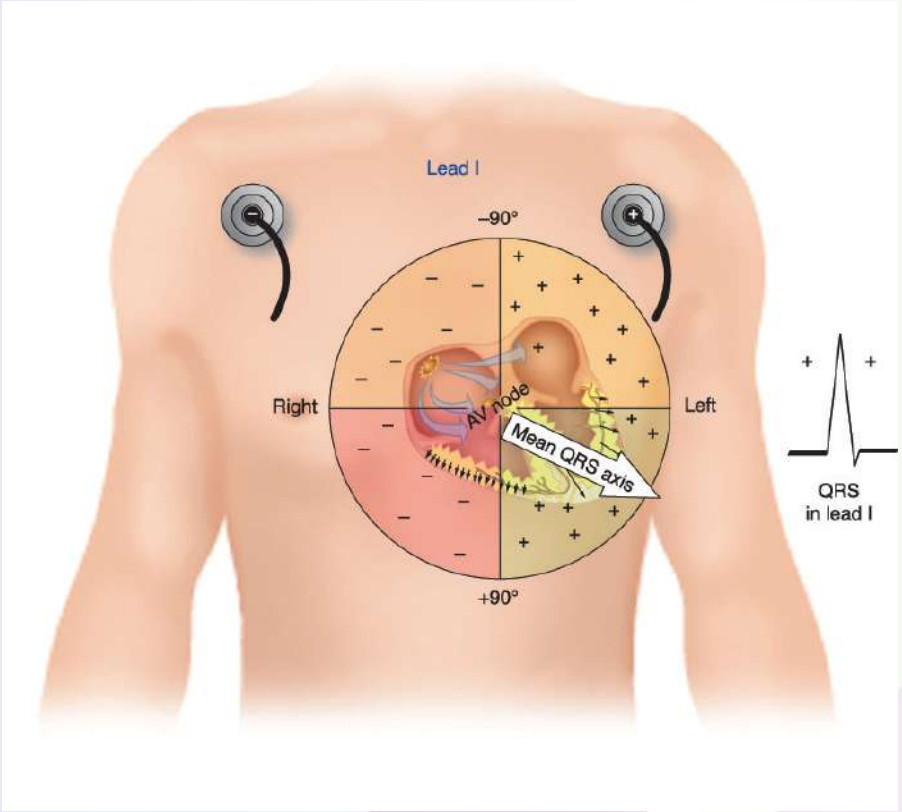


Determining Electrical Axis

- Use leads I and aV_F
  - The two leads that can best detect variations in the heart's electrical axis

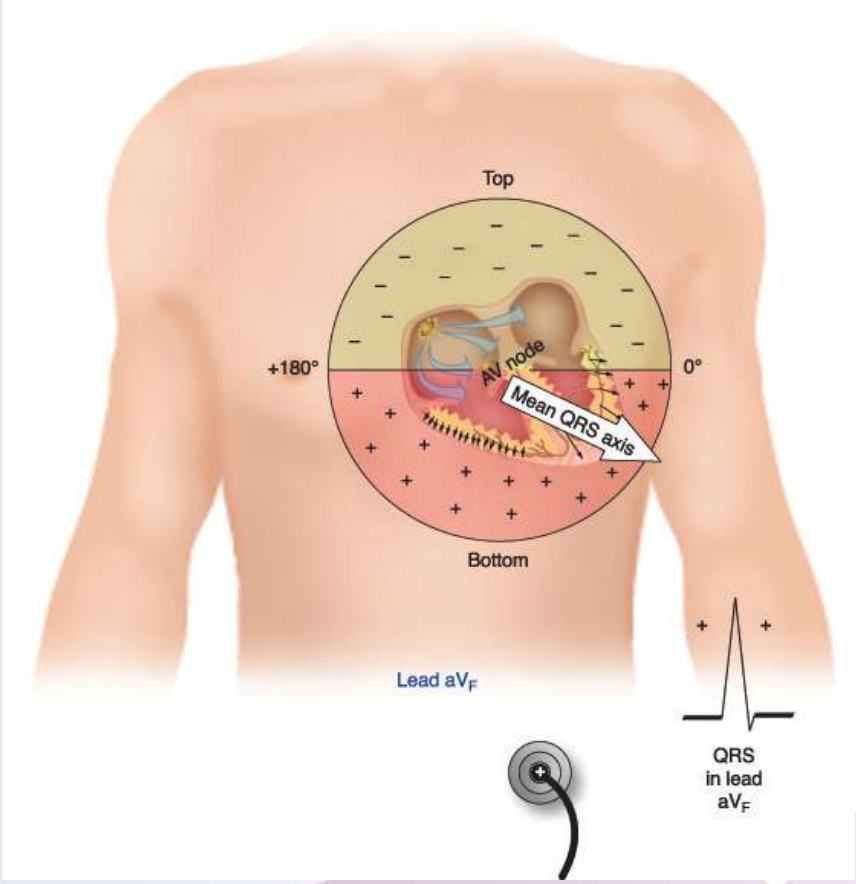
Determining Electrical Axis

- If the mean QRS vector directed anywhere between -90º and +90º, positive QRS complex in lead I

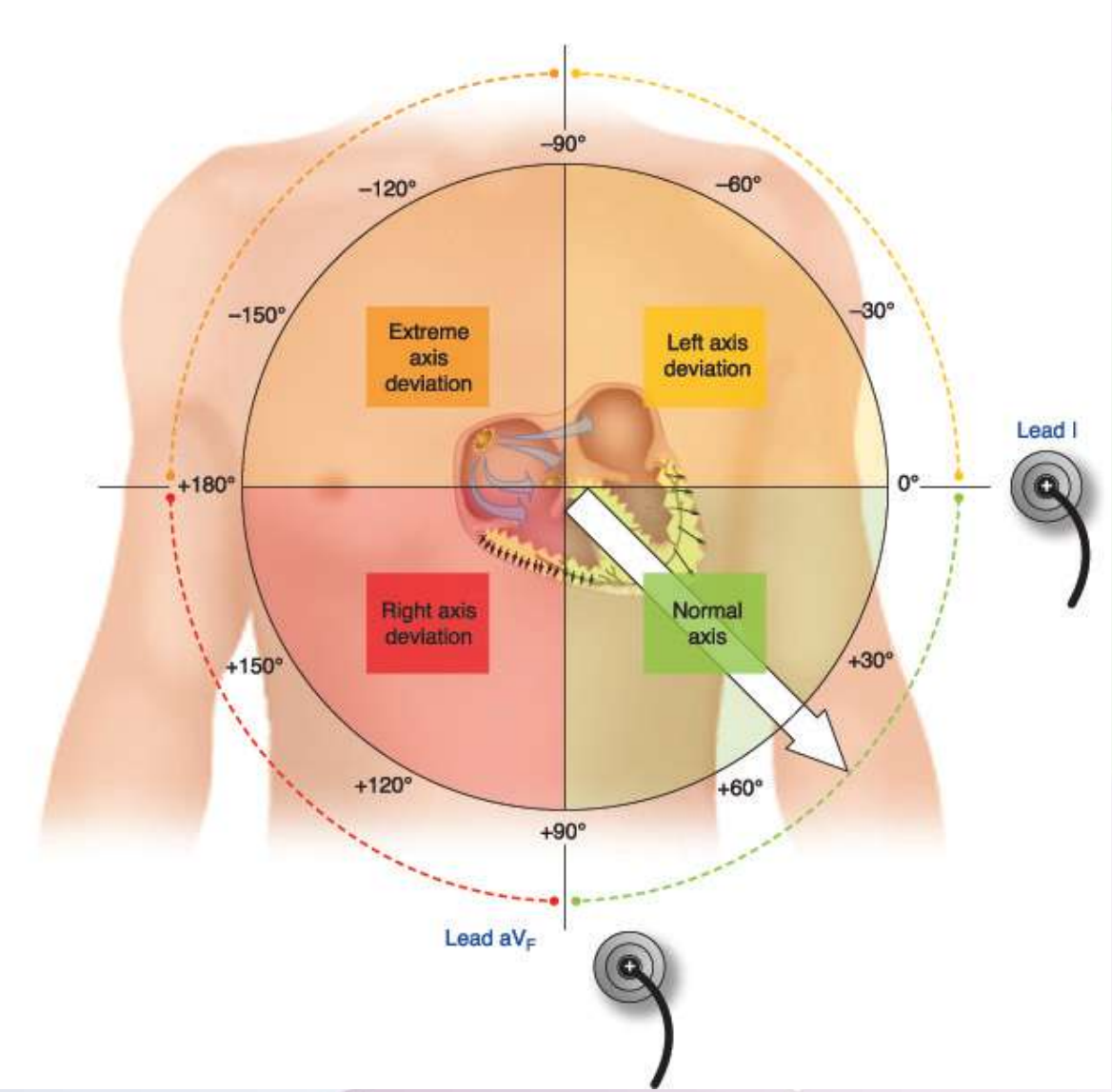


Determining Electrical Axis

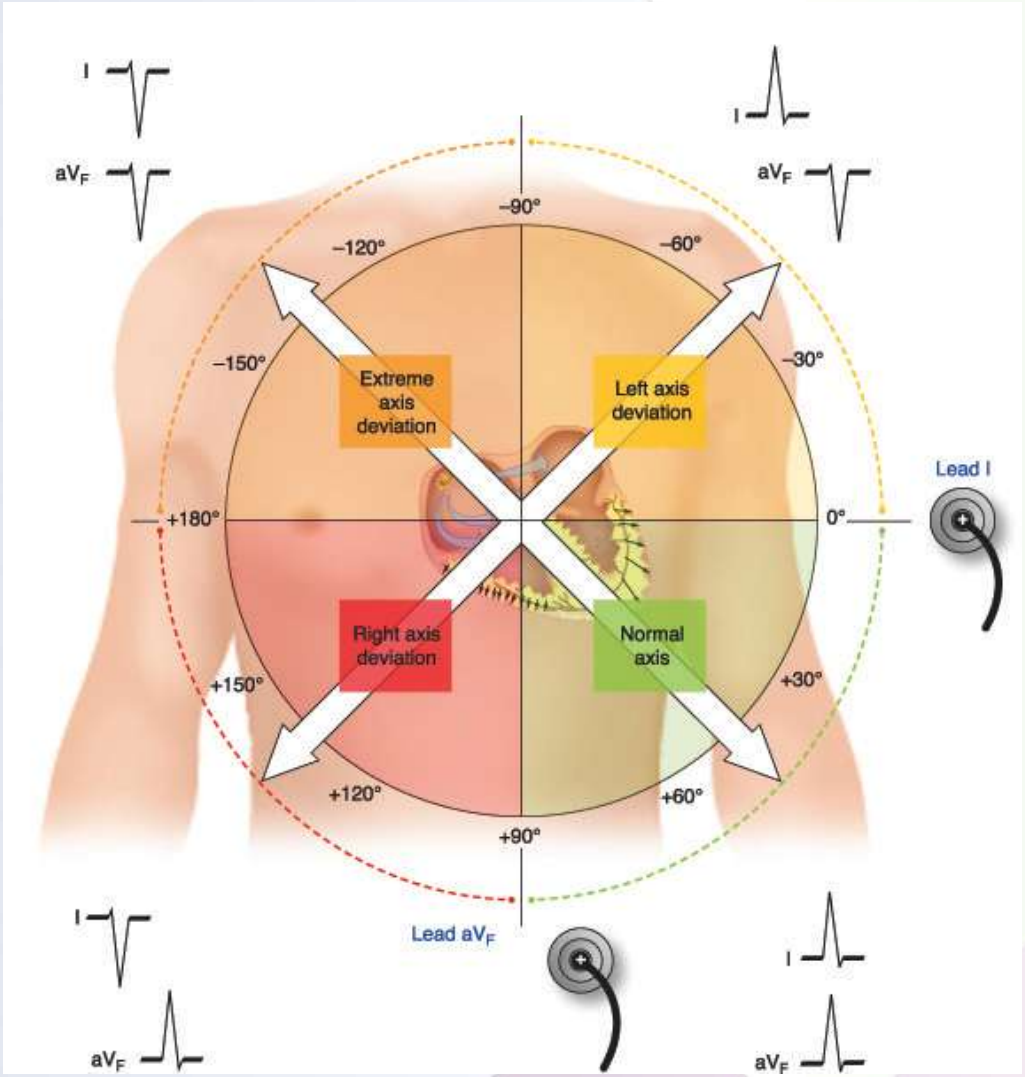
- If mean QRS vector directed between 0º and +180º, positive QRS complex in lead aV_F



Determining Electrical Axis

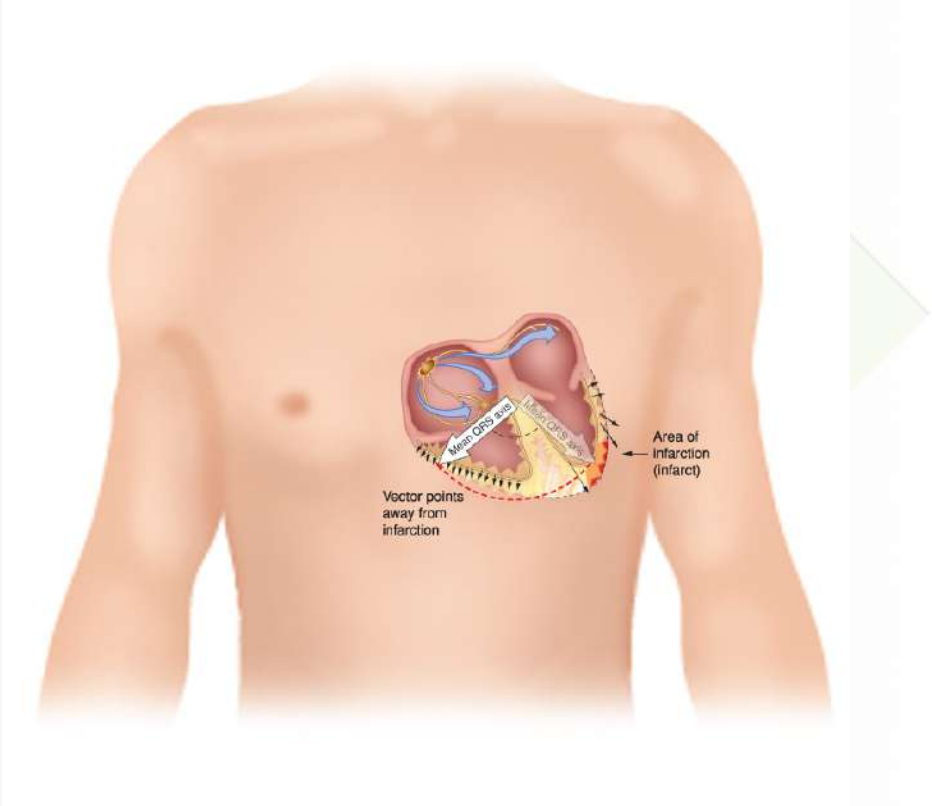


Determining Electrical Axis



Determining Electrical Axis

- Location of axis influenced by:
  - Heart's position in the chest
  - Heart size
  - Patient's body size
  - Conduction pathways
  - Force of electrical impulses being generated



Practice Makes Perfect

- Determine if the mean QRS is normal or if there is axis deviation

Practice Makes Perfect

- Determine if the mean QRS is normal or if there is axis deviation

Practice Makes Perfect

- Determine if the mean QRS is normal or if there is axis deviation

Practice Makes Perfect

- Determine if the mean QRS is normal or if there is axis deviation

Summary

- The mean or average of all the instantaneous vectors which the ECG detects is called the mean vector.
- The direction of the mean vector is called the mean electrical axis.
- When the electrical current traveling through the heart is moving toward a positive ECG electrode on a person's chest or extremity the ECG machine records it as a positive or upright waveform.

Summary

- The mean of all vectors that result from ventricular depolarization is called the QRS axis.
- Completion of right ventricle activation occurs first as the thinner wall of the right ventricle transmits the impulse in a fraction of the time it takes the impulse to travel through the thick lateral wall of the left ventricle.
- Sum of all the small vectors of ventricular depolarization is called the mean QRS vector.

Summary

- Because the small depolarization vectors of the thicker left ventricle are larger, the mean QRS axis points more to the left.
- The limb leads are used to determine the position (axis) of the mean QRS vector which is described in degrees within an imaginary circle drawn over the patient's chest.
- Lead I starts at +0 degrees and is located at the three o'clock position.
- Lead aV_F starts at +90 degrees and is located at the six o'clock position.

Summary

- The mean QRS axis normally points downward and to the patient's left, between 0 and +90 degrees.
- An axis between +90 and +180 degrees indicates right axis deviation, and one between 0 and -90 degrees indicates left axis deviation.
- An axis deviation between -180 and -90 degrees indicates extreme axis deviation and is called an indeterminate axis.

Summary

- Leads I and aV_F can be used to quickly determine whether the mean QRS axis on any ECG is normal.
- If the QRS complex is positive in leads I and aV_F, the QRS axis must be normal.

Summary

- If the QRS complex is upright in lead I and negative in lead aV_F then left axis deviation exists.
- If the QRS complex is negative in lead I and positive in lead aV_F then right axis deviation exists.
- If the QRS complex is negative in both leads extreme right axis deviation exists.