Myocardial Ischemia and Infarction

Fast & Easy ECGs – A Self-Paced Learning Program
Myocardial Oxygen Supply

- Because the heart’s oxygen and nutrient demand is extremely high it requires its own continuous blood supply.
Myocardial Oxygen Supply

- Coronary arteries deliver blood to myocardial cells
- Coronary veins return deoxygenated blood to RA via coronary sinus
- Can increase coronary blood flow through vasodilation to meet increased myocardial oxygen demands
Q Wave

- First part of QRS complex
- First downward deflection from baseline

[Diagram showing Q Wave characteristics]

- Amplitude is less than 25% of the amplitude of the R wave in that lead
- Duration is less than 0.04 seconds
ST Segment

• Flat line that follows the QRS complex and connects it to T wave
T Wave

- Slightly asymmetrical and oriented in the same direction as preceding QRS complex
Ischemia, Injury, and Infarction

- Occurs with interruption of coronary artery blood flow
- Often a progressive process
Myocardial Ischemia

• Results from decreased oxygen and nutrient delivery to myocardium
• Can be reversed if supply of oxygen and nutrients is restored
Myocardial Ischemia - Causes

• Atherosclerosis
• Vasospasm
• Thrombosis and embolism
• Decreased ventricular filling time
  – Tachycardia
• Decreased filling pressure in coronary arteries
  – Severe hypotension or aortic valve disease
Myocardial Injury

• Results if ischemia progresses unresolved or untreated
Myocardial Infarction

- Death of myocardial cells
ECG Indicators

- Inverted T wave
- Tall, peaked T wave
- Depressed ST segment
- Elevated ST segment
- Infarction
- ST segment changes
- Injury
- Ischemia

Q wave changes
Myocardial Ischemia

• Characteristic signs:
T Wave Inversion

- Occurs because ischemic tissue does not repolarize normally
T Wave Inversion

Enlarged view

Endocardium
Myocardium
Epicardium

Ischemia through full thickness of myocardium

$V_2$  $V_3$  $V_4$

T wave is symmetrical — meaning the right and left sides of the waveform are the same size
Peaked T Waves

- May be seen in early stages of acute myocardial infarction
- Within a short time (two hours) T waves invert
ST Segment Depression

- May or may not include T wave inversion
Flat ST Segment Depression

- Results from subendocardial infarction
ST Segment Elevation

- Earliest reliable sign that myocardial infarction has occurred
ST Segment Elevation

- Seen in:
  - Ventricular hypertrophy
  - Conduction abnormalities
  - Pulmonary embolism
  - Spontaneous pneumothorax
  - Intracranial hemorrhage
  - Hyperkalemia
  - Pericarditis
ST Segment Elevation - Pericarditis

With pericarditis

Elevated ST segment is flat or concave

ST segments and T waves are off the baseline, gradually angling back down to the next QRS complex
Pathologic Q Waves

- Indicate presence of irreversible myocardial damage or myocardial infarction
Pathologic Q Waves

• Develop because infarcted areas of heart become electrically silent (fail to depolarize) as they are functionally dead
Anterior Myocardial Infarction

- Involves anterior surface of LV
- Best identified in leads $V_1$, $V_2$, $V_3$, and $V_4$
Septal Infarction

- Leads $V_1$, $V_2$ and $V_3$ are over ventricular septum
- Ischemic changes seen in these leads, and possibly in the adjacent precordial leads, are often considered to be septal infarctions
Lateral Myocardial Infarction

- Involves left lateral heart wall
- ST segment elevation, T wave inversion, and the development of pathologic Q waves in leads I, aVL, V₅, V₆
Inferior Myocardial Infarction

- Involves inferior surface of the heart
- ST segment elevation, T wave inversion, and development of pathologic Q waves in leads II, III, aV_{F}

Posterior Myocardial Infarction

- Involve posterior surface of the heart
- Look for reciprocal changes in leads $V_1$ and $V_2$
Practice Makes Perfect

- Determine the likely location of the ischemia, injury or infarction

Identify the location where ischemia, injury, and/or infarction is likely present.
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Summary

• Coronary arteries deliver blood to the myocardial cells while the coronary veins return deoxygenated blood to the right atrium via the coronary sinus.

• By increasing coronary blood flow, mostly through vasodilation, the coronary arteries satisfy increased myocardial oxygen demands.
Summary

• The ST segment can be compared to the PR segment to evaluate ST segment depression or elevation.

• The Q wave is the first downward deflection from the baseline. It is not always present.

• The ST segment is the flat line that follows the QRS complex and connects it to the T wave.

• The T wave is slightly asymmetrical and oriented in the same direction as the preceding QRS complex.
Summary

- Myocardial ischemia, injury and death can occur with Interruption of coronary artery blood flow.

- Myocardial ischemia may cause the appearance of T waves and ST segments to change.

- A flat depression of the ST segment results from subendocardial infarction.
Summary

• ST segment elevation occurs with myocardial injury. It is the earliest reliable sign that myocardial infarction has occurred and tells us the myocardial infarction is acute.

• Pathologic Q waves indicate the presence of irreversible myocardial damage or myocardial infarction.

• Leads $V_1$, $V_2$, $V_3$, and $V_4$ provide the best view for identifying anterior myocardial infarction.
Summary

• Lateral infarction is identified by ECG changes such as ST segment elevation, T wave inversion, and the development of pathologic Q waves in leads I, aV_L, V_5 and V_6.

• Inferior infarction is determined by ECG changes such as ST segment elevation, T wave inversion, and the development of pathologic Q waves in Leads II, III, and aV_F.

• Posterior infarctions can be diagnosed by looking for reciprocal changes in leads V_1 and V_2.