Ministry of Health of Ukraine
Kharkiv National Medical University

THE MAIN ECG SYNDROMES OF THE MYOCARDIUM DAMAGE (ISCHEMIA, INJURY, NECROSIS). ECG IN MYOCARDIAL INFARCTION.

Methodical instructions for students

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Coronary (Ischemic) Heart Disease

The term coronary heart disease includes such diseases as angina pectoris, myocardial infarction, and coronary cardiosclerosis.

The most frequent cause of the **angina pectoris** is atherosclerosis of the heart coronary arteries. Its main clinical symptoms are attacks of retrosternal pain due to acute but transient disorder in the coronary circulation.

Myocardial infarction is formation of a necrotic focus in the heart muscle due to upset coronary circulation.

Cardiosclerosis is the disease of the myocardium caused by developing fibroid elements in the heart muscle. Atherosclerotic and myocarditic cardioscleroses are distinguished. The later may result from any myocarditis. Atherosclerotic cardiosclerosis is the result of atherosclerosis of the coronary arteries. Myocardial infarction that ends in the formation of scars becomes the cause of focal post-infarction cardiosclerosis.

ECG signs of the coronary heart disease

If the coronary artery is occluded the involved heart muscle progresses in sequence through three stages of damage toward infarction. Each stage is associated with electrical changes.

Ischemia develops in conditions when the insufficient amount of blood is delivered to the heart muscle through the coronary arteries, and the myocardium does not receive the necessary amount of oxygen. Ischemic damage of the myocardium alters the sequence of ventricular activation and affects the repolarization or the recovery

process of the heart. These changes alter the electrical field of the heart, resulting in T wave modifications. Ischemia is recognized by symmetrically inverted T wave. Ischemia is a reversible process unassociated with histological changes (Fig. 4.73).

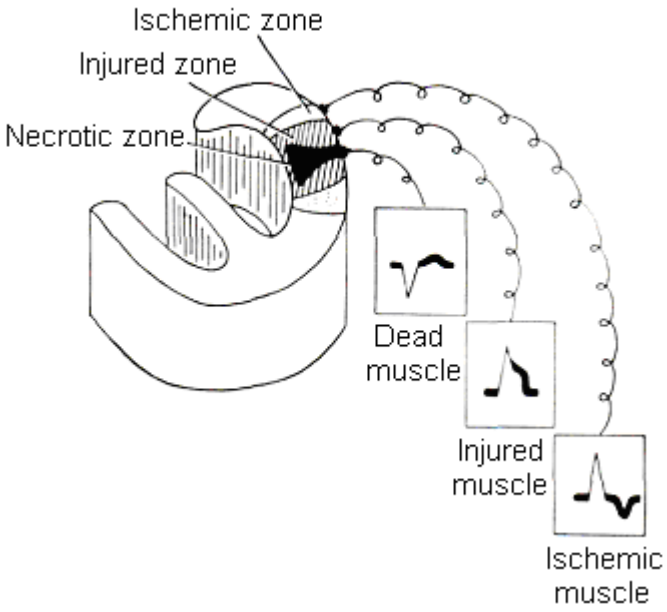


Fig. 4.73. Ischemic, injured, and infracted zones with their respective electrical patterns.

Injury is recognized by ST segment elevation. These changes are caused by persisted ischemia, which lead to more significant alteration of the repolarization processes. The injury patterns are also reversible.

If a deficient blood supply persists injured muscle progresses to necrosis.

Necrosis or infarction. With infarction, "a dead zone" appears and become electrically inactive. Dead or necrotic muscle tissue is inexcitable and incapable of producing an action potential. Such tissue acts as a passive conductor of the potential forces generated in viable areas of the myocardium. In the event of myocardial death, a Q wave appears and the R wave deflection decreases in amplitude or disappears. The depth of the Q wave is directly proportional to the relative thickness of the dead zone, and the height of the R wave is directly proportional to the amount of living

tissue that escapes death. Surrounding the area of acute infarction are zones of injured muscle and ischemic muscle. These adjacent zones are transient, and either eventual progression to the stage of necrosis or recovery occurs, depending on the collateral circulation.

Diagnostic electrocardiographic signs of myocardial infarction

1. Decreased R wave amplitude or its absence in the leads facing the necrotic myocardium. ($R_I + R_{II} + R_{III}$) : 3 = less than 5 mm.
2. Deep and wide Q wave, deeper than ¼ of the R wave amplitude, and wider than 0.03 second.
3. Pathological T wave – high ischemic or inverted (++, +-, --, -+).
4. ST segment changes.
5. Discordance of ST segment and T wave in opposite leads. That is, ST elevation in the lead I and depression in the lead III; T wave upright in the lead I and inverted in the lead III. Concordance of ST segment and T wave in opposite leads is an ECG sign of the angina pectoris.

Evolution of myocardial infarction

The clinical myocardial injury pattern does not remain stationary, but changes. Evolutionary ECG alterations take place over a period of hours, days, weeks, month, or even

years. The series of changes has been arbitrarily separated into stages (Fig. 4.74).

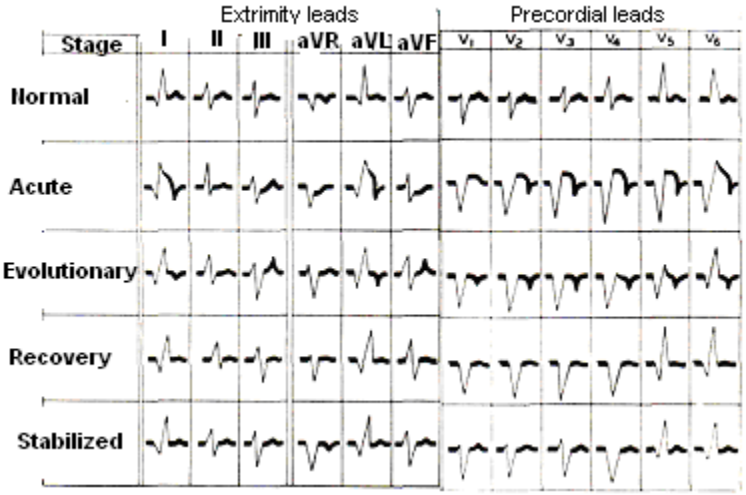


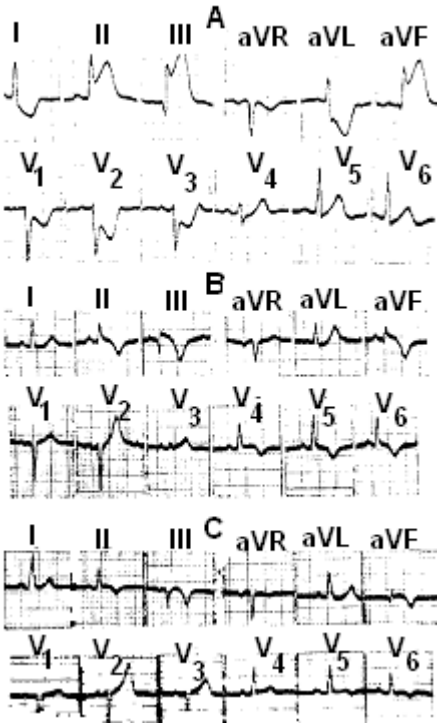
Fig 4.74. Evolution of myocardial infarction.

Stages of the myocardial infarction

Stage 1 – *acute*: abnormal Q wave, elevated ST segment, and inverted T wave.
Stage 2 – *evolutionary*: deep Q wave, ST segment isoelectric, and inverted symmetrical T wave.
Stage 3 – *recovery*: deep Q wave, ST isoelectric, and T wave returning to normal.
Stage 4 – *stabilized*: T waves normal, only evidence of old infarction is the deep Q wave.

Location of the myocardial infarction

Leads I, II, aVL – anterior infarction.
Leads III, II, aVF – posterior infarction.
V_1, V_2 – septal infarction.
V_3, V_4 – apical infarction.
V_5, V_6 - lateral infarction.



A, 12 hours after onset of pain. Markedly elevated S-T segment in leads II, III, and aVF; depressed ST in I, aVL, and V_1 through V_4.

B, 24 hours later. Less marked ST changes; deeply inverted T waves; Q wave in II, III, and aVF; ST elevation from V_4 to V_6, and T wave inversion in these leads demonstrate lateral wall involvement with the infarction. The tall, peaked T wave in lead V_2 probably represents posterior ischemia.

C, 5 days later, shows evolutionary changes.

Fig. 4.75. Acute posterior myocardial infarction.

1.2. What ECG interval is used to determine heart rate?
A. P-Q;
B. QRS;
C. QRST;
D. R-R;
E. P-P.
3. What registers R-R interval on ECG?
A. intraatrial conductivity;
B. intraventricular conduction;
C. atrioventricular conduction;
D. ventricular systole;
E. duration of cardiac cycle.
4. What is normal heart rate?
A. 30-40 for 1 minute;
B. 40-60 for 1 minute;
C. 60-80 C. for 1 minute;
D. 80-100 for 1 minute;
E. 90-110 for 1 minute.
5. What registers R wave on ECG?
A. Excitation of atria;
B. Excitation of ventricles;
C. atrial systole;
D. ventricular systole;
E. Excitation of Hiss bundle.
6. What conductavity registers complex QRS?
A. atrioventricular;
B. intraatrial;
C. Intraventricular;
D. The conductivity of the left Hiss bundle branch;
E. Conductivity on the right Hiss bundle branch.

7. What registers T wave on the ECG?
A. Excitation of atria;
B. Excitation of ventricles;
C. Reduction fibrillation;
D. Shifting of electrical axis of the heart;
E. ventricular repolarization.
8. In which lead wave P must always be negative?
A. I standard;
B. II standard;
C. III standard;
D. AVR;
E. AVF.
9. I standard registers mostly potential of:
A. Right atrium;
B. Right ventricle;
C. Anterior wall of the left ventricle;
D. Interventricular septum;
E. posterior wall of the left ventricle.
10. W standard allotment registers mostly potential:
A. Right atrium;
B. Right ventricle;
C. Anterior wall of the left ventricle;
D. Interventricular septum;
E. posterior wall of the left ventricle.
11. The normal duration of P wave is:
A 0,02-0,03 sec;
B. 0,03-0,04 sec;
C. 0,04-0,06 sec;
D. 0,06-010 sec;
E. 0,12-0,18 sec.
12. Which duration of QRS complex is normal?
A 0,02-0,05 sec;
B. 0,06-0,10 sec;
C. 0,16-0,20 sec;

D. 0,21-0,30 sec;
E. 0,30-0,40 sec.
13. Which limb potentials discharged during registration of I standard leads?
A. Upper extremity;
B. lower extremities;
C. The right hand and left foot;
D. Left arm and left leg;
E. Left hand and right leg.
14. Which limb potentials discharged during registration of II standard lead?
A. Upper extremity;
B. lower extremities;
C. The right hand and left foot;
D. Left arm and left leg;
E. Left hand and right leg.
15. Which limb potentials discharged during registration of III standard leads?
A. Upper extremity;
B. lower extremities;
C. The right hand and left foot;
D. Left arm and left leg;
E. Left hand and right leg.
16. How many chest electrodes must be used during ECG recording?
A. three;
B. twenty;
C. six;
D. ten;
E. twelve
17. What bioelectrical process reflects P wave?
A. Depolarization left ventricle;
B. Depolarization left atrium
C. Both atrial repolarization

D. Depolarization of both atria
E. depolarization of both ventricles
18. What bioelectrical process reflects a complex QRS?
A. Depolarization left ventricle;
B. Depolarization left atrium
C. Both atrial repolarization
D. Depolarization of both atria
E. Bepolarization of both ventricles
19. What bioelectrical process reflects T wave?
A. Left ventricular repolarization;
B. Left atrial repolarization
C. Both atrial repolarization
D. Depolarization of both ventricles
E. Repolarization both ventricles
20. Which characteristics of the Q wave are normal?
A.> 1/4 R, 0,04 sec;
B. <1/4 R, 0,04 sec;
C <1/4 R, 0,03 sec;
D. > 1/4 R, 0,03 sec;
E. = 1/4 R 0,02 sec.

Standards of answers: 12D. 3E. 4C. 5A. 6C. 7E. 8D. 9C. 10E. 11D. 12B. 13A. 14C. 15D. 16C. 17D. 18E. 19E. 20C.

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