

(X.) Electrocardiography

Electrocardiography (ECG)

Definition:

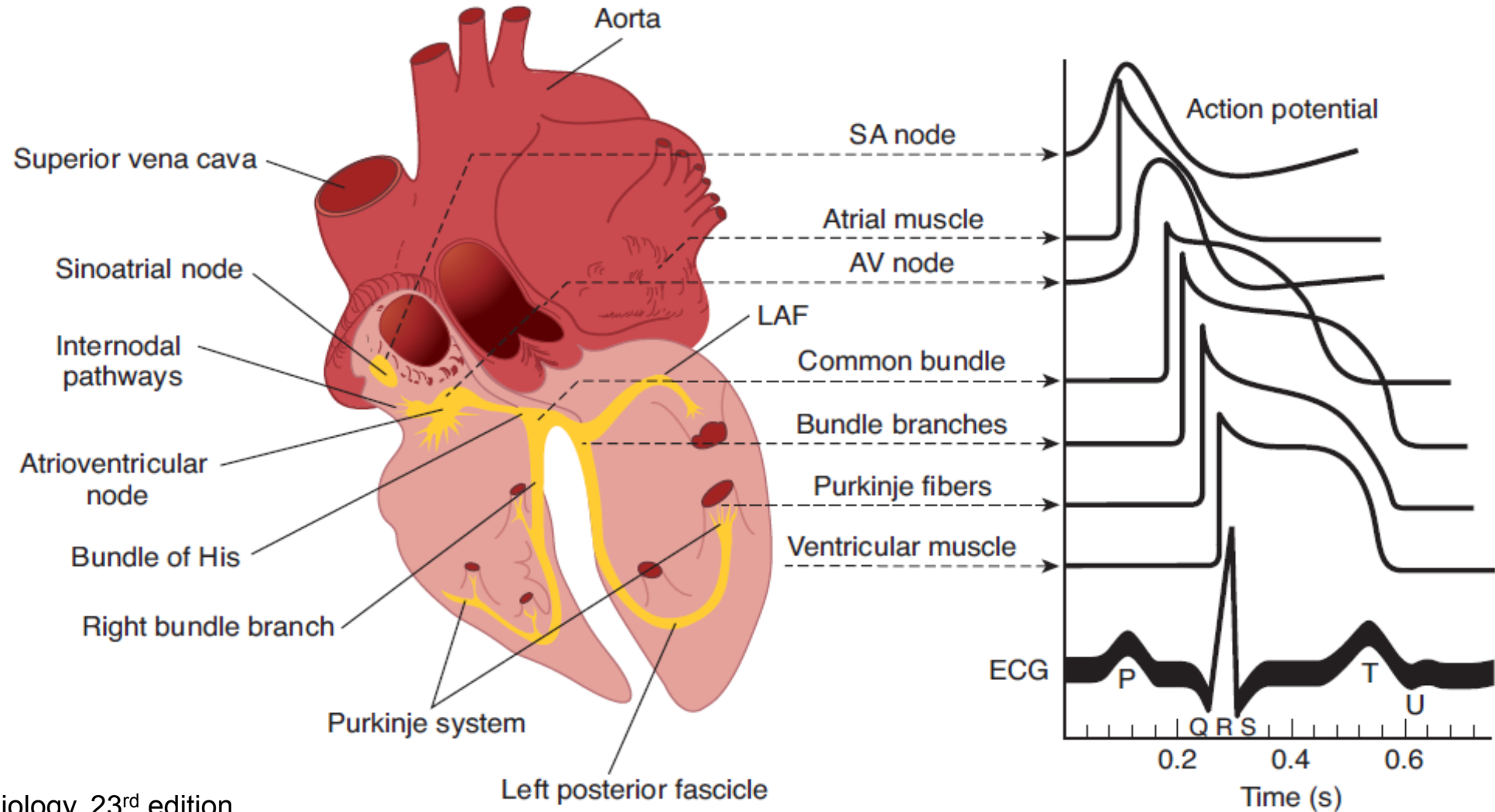
Recording of changes of electric potential differences arisen from cardiac electric activity by electrodes placed on patient's body surface.

An ***electric potential*** is the amount of electric potential energy that a unitary point electric charge would have if located at any point in space, and is equal to the work done by an electric field in carrying a unit positive charge from infinity to that point

Voltage is electric potential difference - the difference in electric potential energy between two points per unit electric charge. It is measured in units of *volts (V)*

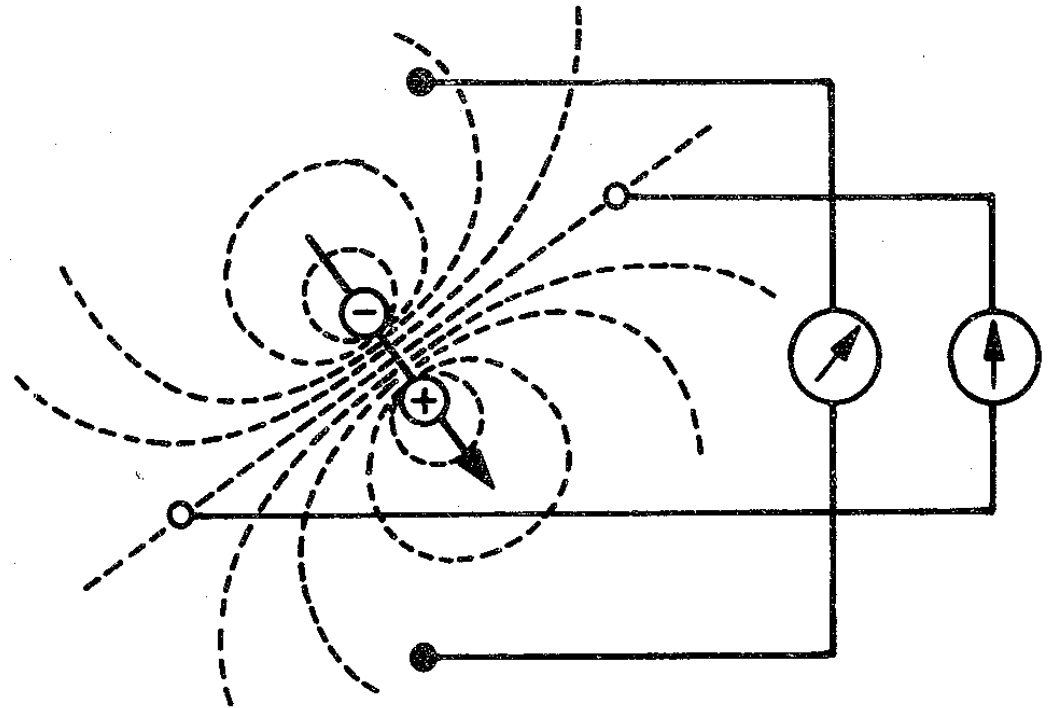
Conduction system of the heart

Cardiac muscle automaticity



ECG signal

- Summation of electric potential changes
- Cardiac vector



ECG lead

Standard 12-leads ECG

ECG lead - conductive connection of 2 electrodes; record of electric potential differences between 2 electrodes in course of time

Classification of ECG leads:

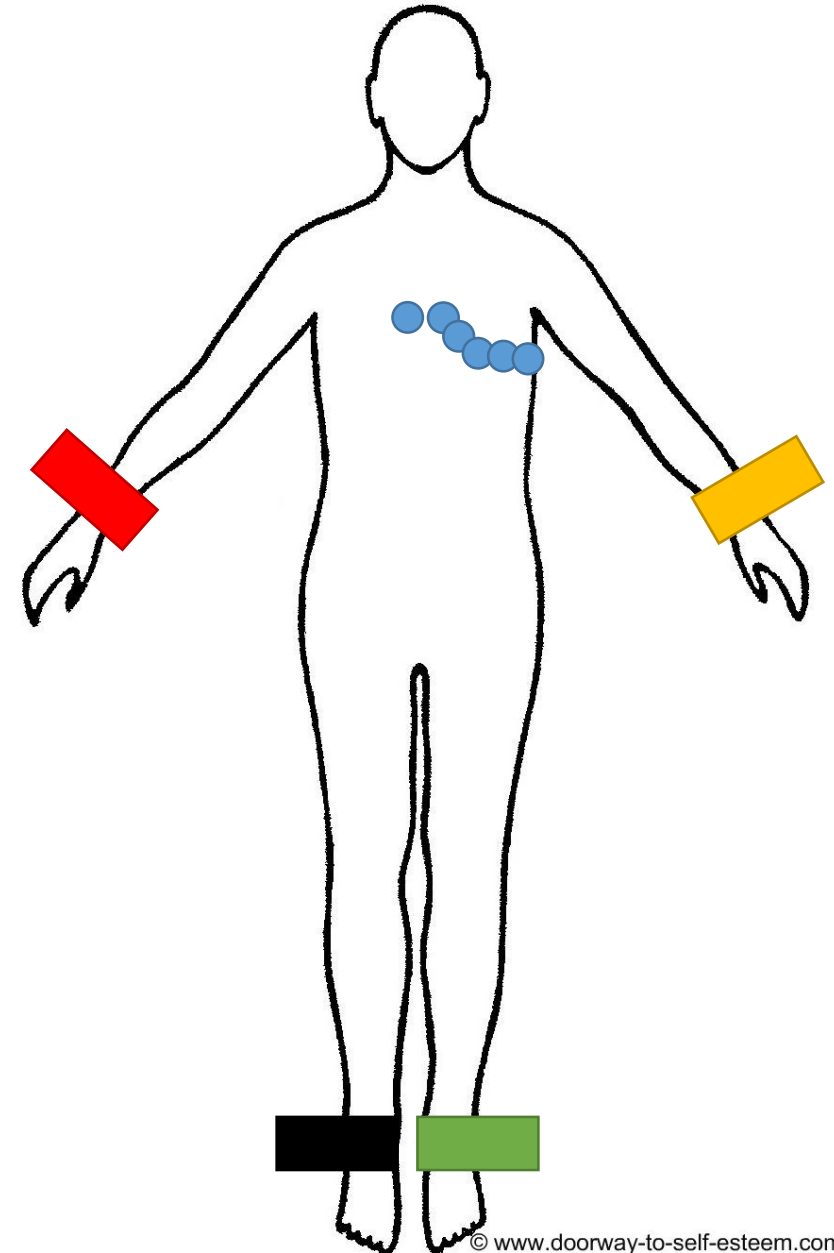
- According to the position (and in agreement with historical development)
 - Standard limb leads: I, II, III
 - Augmented limb leads: aVR, aVL, aVF
 - Chest leads: V_1 - V_6
- According to polarity
 - Unipolar: aVR, aVL, aVF, V_1 - V_6
 - Bipolar: I, II, III

Possibilities of ECG recording

- Standard 12-leads ECG
- Modified position of electrodes
- 24-hours ECG monitoring
 - = ECG Holter monitoring
- ECG telemetric card
- Implantable ECG monitor

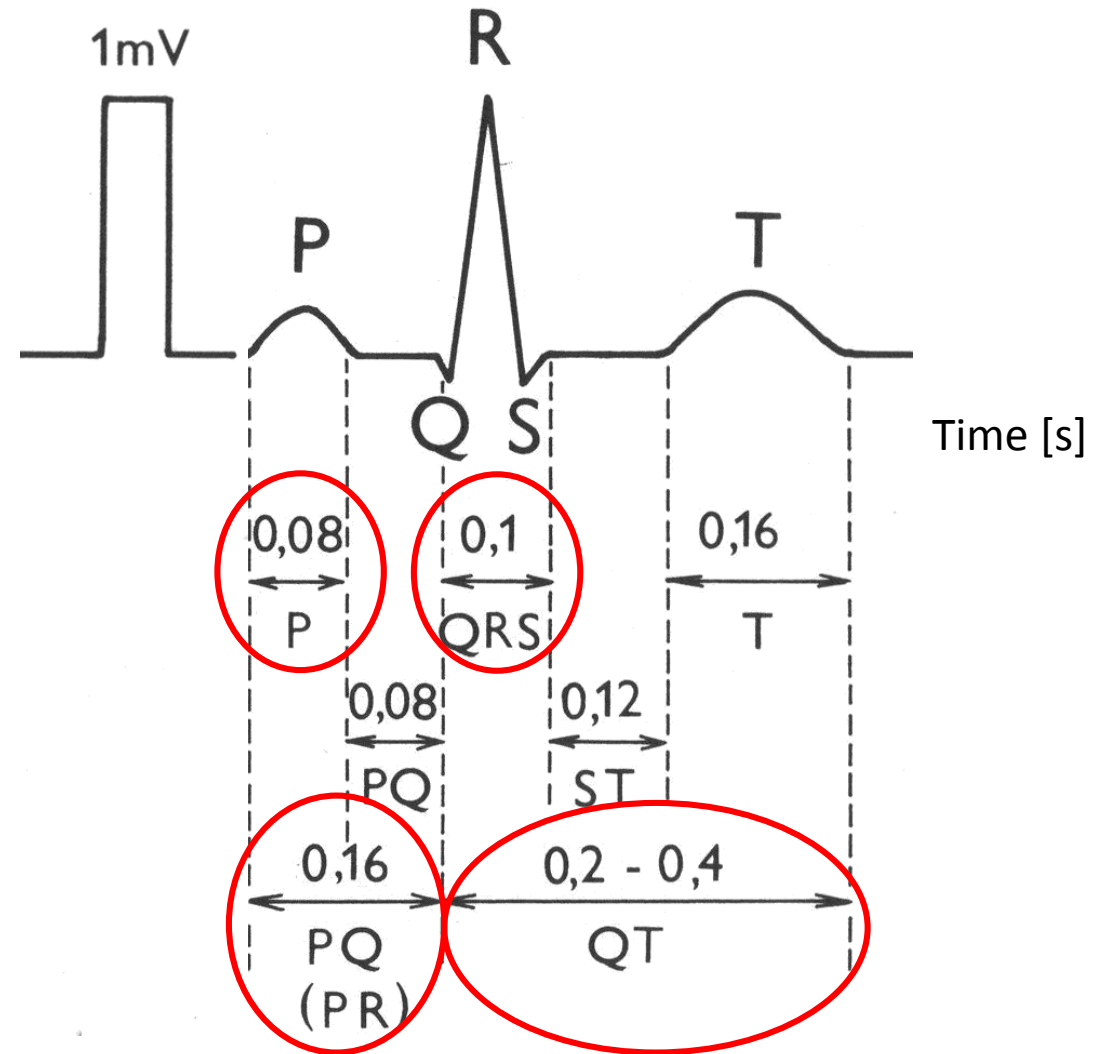
Rules for ECG recording

- Convention of electrodes position
- Examined person lie on his/her back, breathe freely



Electrocardiogram

- Voltage changes in course of time
- Y axis: voltage [mV]
- X axis: time [s]
- Speed of paper feeding:
 - 25 mm/s: 1 mm = 0.04 s = 40 ms
 - 50 mm/s: 1 mm = 0.02 s = 20 ms

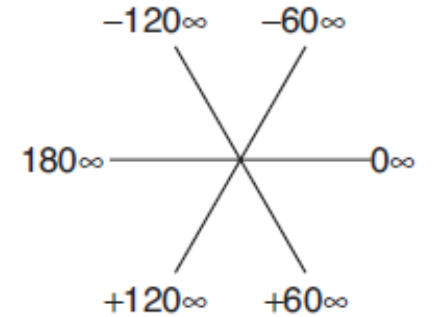
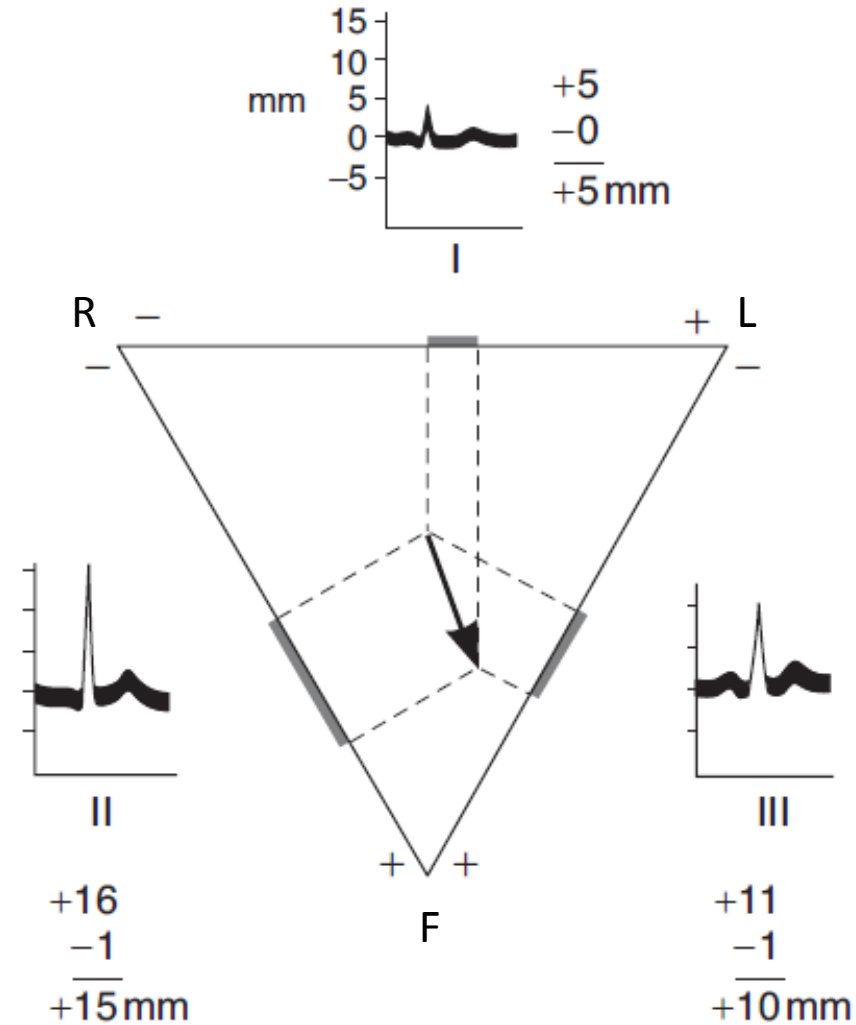
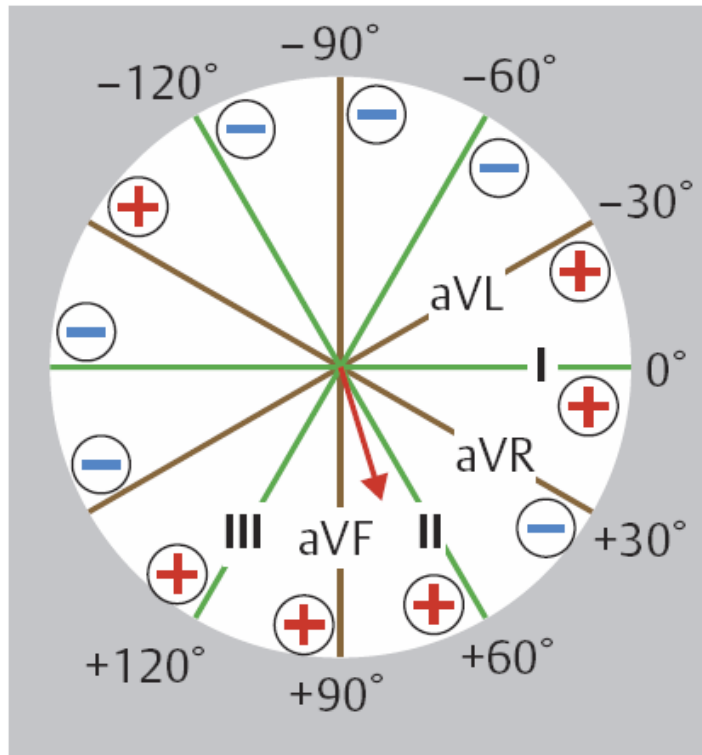


Evaluation of ECG

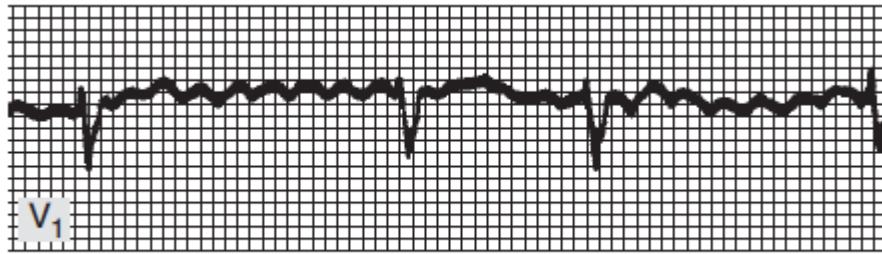


1. Rhythm
 - Regularity: regular/irregular
 - Origin: sinus (SA node) / other
2. Heart rate – according to RR interval duration
3. Duration of (in ms) P wave, PQ interval, QRS complex
4. Changes in ST: isoelectric / elevation / depression
5. QT interval length (in ms)
 - Bazett correction: $QT_c = QT / \sqrt{RR}$
6. Transitional zone (rS to Rs) in leads V_1 - V_6
7. Electrical axis of the heart (cardiac vector)

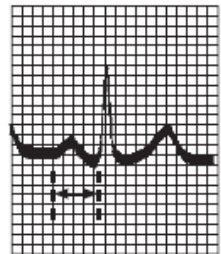
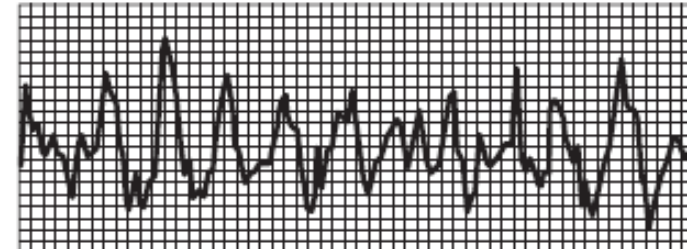
Electrical axis of the heart



Application of ECG in diagnostics of arrhythmias

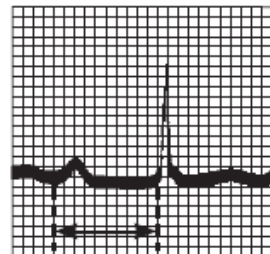


Atrial fibrillation



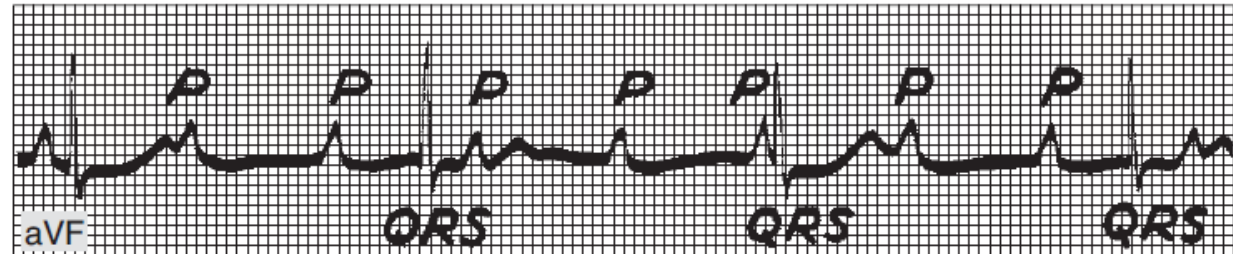
PR = 0.16 s

Normal complex



PR = 0.38 s

First-degree heart block



Complete heart block. Atrial rate, 107; ventricular rate, 43

Application of ECG in diagnostics of myocardial infarction (ischemia of the heart)

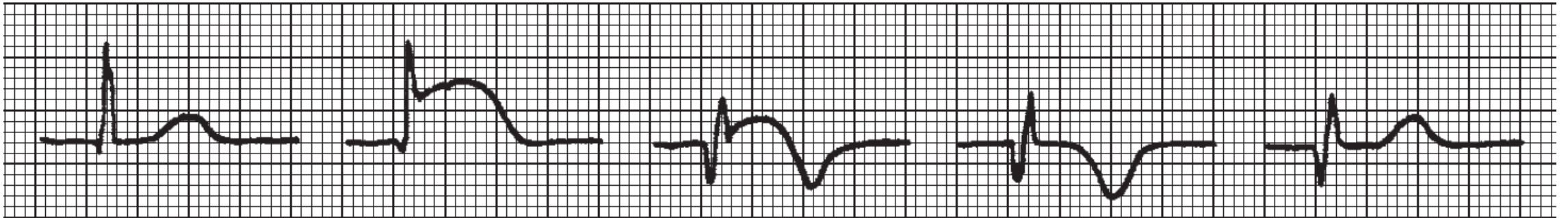
A

B

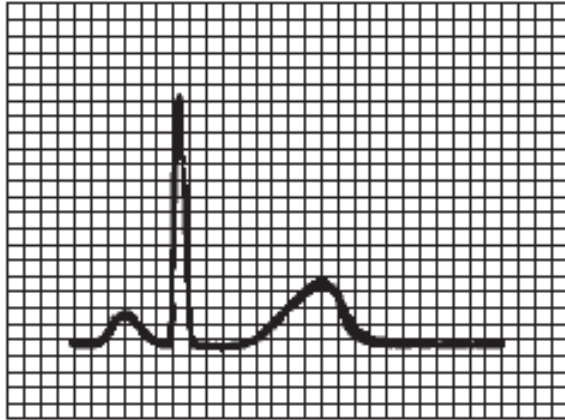
C

D

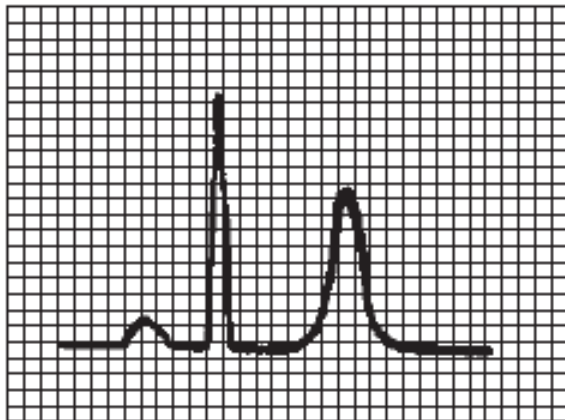
E



Application of ECG in diagnostics of hyperkalemia



Normal tracing (plasma K^+ 4–5.5 meq/L).



Hyperkalemia (plasma K^+ \pm 7.0 meq/L).