



# **PARACLINICAL EXPLORATIONS IN CARDIOLOGY**

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## **Biological evaluation: laboratory tests, serum biomarkers**

- The patient with cardiovascular disturbances has to pass some current and routine blood tests and some specific probes that are individual for every patient's case. There are no specific blood tests for cardiovascular affections.
- There are biomarkers useful in assessing cardiovascular disease.

# **Biomarker**

- **Biomarker is defined as a characteristic that can be measured, assessed objectively, it is an indicator of normal biological processes, of those pathological or a pharmacological response to a therapeutic intervention.**
- **Biomarker may be a component of biological products (blood, urine, tissue), or can be obtained by recording (ECG) - or imaging (echocardiography, CT, etc.).**
- **The accuracy of a biomarker is expressed by sensitivity (ability to detect true positive cases) and specificity (the power to identify real cases negative) as a biomarker helps the clinician performing the optimal evaluation of the patient.**

# **Types of potential serological biomarkers present in cardiovascular disease:**

- Myocytes injury (damage) markers
- Inflammation markers
- Oxidative stress markers
- Myocytes stress markers
- Extracellular matrix remodeling markers
- Neuro-hormones

# EXAMPLES

- for myocytes injury markers: troponin I and T, creatine kinase MB, myosin light chain kinase, cardiac fatty acids bound to protein;
- for inflammation markers : C-reactive protein, tumor necrosis factor alpha, interleukins, Fas (APO I);
- for oxidative stress markers: oxidized low-density lipoproteins, myeloperoxidases, malondialdehyde,
- for neurohormonal markers: norepinephrine, epinephrine, angiotensin II, renin, aldosterone, arginine vasopressin, endothelin;
- for myocytes stress markers: B natriuretic peptide (BNP), NTpro-BNP, pro adrenomedullin;
- for extracellular matrix remodeling markers : metalloproteinases collagen proteins.

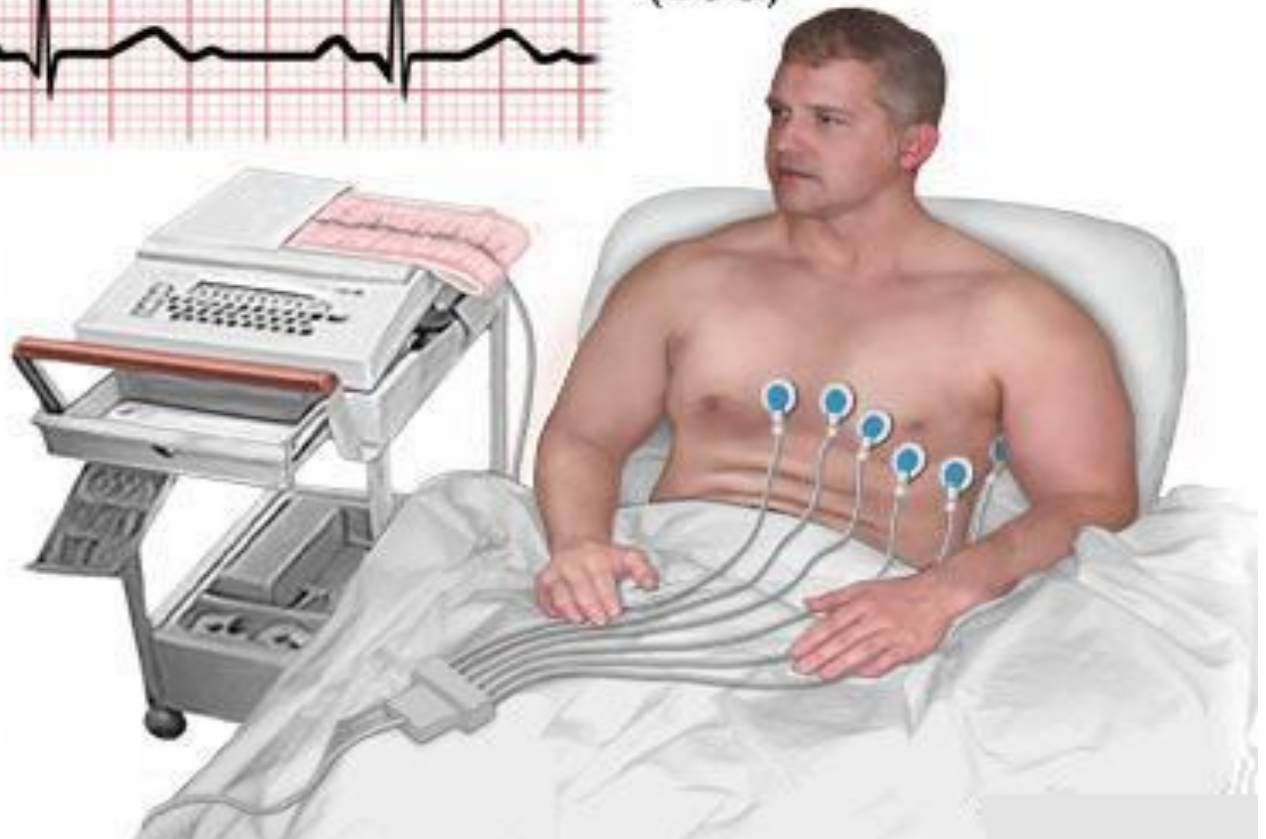
# Electrocardiography

- Resting electrocardiogram is a paraclinical investigation most commonly used in cardiology exam.
- Her performance implications provide information diagnostic and prognostic therapeutic essential especially in the management of patients with:
  - acute coronary syndromes
  - or arrhythmia management
  - electrical anomalies with genetic substrate.
- The resting electrocardiogram is part of the screening assessment for people who want to practice competitive sports and those who work with high-risk activities.

# EKG



Electrocardiogram  
(ECG)



# Electrocardiogram genesis

- Electrocardiogram reflects electrical activity of the heart through a succession hence the segments with the depolarization and repolarization substrate myocardial processes.
- In repose the inside of the myocyte is electronegative, repose potential is approximately -90mV.
- An electrical trigger on these channels followed by positive ions influx of sodium and calcium, cell depolarization and the appearance of "action potential".
- Potential differences in the levels of a single cell or a small group of cells does not generate sufficient current to be recorded by electrodes placed on the body surface.



# Electrocardiogram genesis

- Electrocardiographic path registration is a consequence activation of the majority of atrial respectively ventricular myocytes.
- Electric front that can be represented as a vector, moving from depolarized cells positively charged to those cells that are in repose. In normal myocardium depolarization and repolarization are opposite meanings:
  - depolarization - from subendocardium to subepicardium,
  - repolarization - from subepicardium to subendocardium.
- Conventionally, the direction vector depolarization is from negative to positive when the vector is moving towards the electrode explorer it will be recorded as a positive deflection, and if it is removed as a negative deflection.

# Electrocardiograma standard in 12 derivații

- Standard ECG consists of 12 leads obtained by placing electrodes on the two upper limbs, lower limbs 2 electrodes and 6 standard chest locations:
  - 6 derivatives limb: 3 standard DI, II, III,
    - 3 augmented or enhanced:  
aVR, aVL, aVF
  - 6 precordial leads: V1 - V6.
- The 12 derivatives form two planes perpendicular to each other. The first, called foreground, consists of six derivatives of limbs, and the second, the transverse plane, consists of precordial leads.
- Classically described as bipolar leads when using two active electrodes (the three standard limb derivatives) and unipolar or monopolar electrode active when (explorer) and the second is whether (placed at a constant potential).

# ECG recording quality

ECG recording quality can be influenced by a number of factors:

- Related to patient: muscle tremors, respiratory movements, obesity, chronic lung disease;
- Techniques - linked by the operator or equipment used: incorrect placement of electrodes, electrode reversing, the insufficient preparation of the skin and insufficient contact with the electrodes, excess gel, dextrocardia (when the operator is not known).
  - Limb electrode positions is traditionally the hands and the wrist or ankle with the patient in the supine position.
  - A common error is the positioning of chest electrodes V1 and V2 in intercostal spaces 2 and 3, leading to a decrease in initial R wave amplitude in these leads with 0.1 mV per interspace, poor R wave progression and appearance suggestive of myocardial above.
  - They also demonstrated that in patients with chronic obstructive pulmonary disease, due to low position of the diaphragm causes the electrodes V3 and V4 actually be located above the left ventricle, thus registering negative deflection that simulates previously infarction.

# Indications for performing standard 12-lead electrocardiogram in cardiology practice

- Patients in whom treatment may cause side effects that can be detected ECG
- Pacemaker implant patients
- Patients with stable chronic heart disease evaluated periodically
- Evaluation of patients with increased risk of heart disease
- Assess the response to cardio active medication
- Biological changes in clinical status or cardiac dysfunction suggesting occurrence
- patients > 40 years undergoing a routine exam
- Evaluating patients before stress test

# Electrocardiogram with signal mediation

- Allows analysis of the terminal portion of the P wave and QRS complex to detect low amplitude signals (1-25 MKV) and high frequency - atrial and ventricular late potentials (PTV) - which can not be detected on the usual surface electrocardiogram.
- The mechanism of occurrence of PTV consists of fragmentation depolarization by delaying certain areas of the myocardium, secondary structural heterogeneity induced by ischemia, fibrosis, postoperative scars etc. Clinical importance of splitting PTV is based on the fact that their presence provides electrophysiological substrate for initiation and maintenance of reentered ventricular arrhythmias.
- Principle of ECG with signal mediation consists of analysis and mediation of a large number of successive QRS complexes, with the same morphology and eliminating artifacts ("noise") that are not synchronized with the QRS complexes

# Ambulatory ECG monitoring

- Used in clinical practice cardiology for detection, documentation and characterization of cardiac electrical anomalies occurred during normal daily activities.

There are 2 types of ambulatory ECG monitors:

- -devices that allow continuous ECG recording over 24 or 48 hours, useful for capturing symptoms and ECG changes that have a high probability of occurrence in this period,
- -recording devices that allow type intermittent long periods of time (weeks, months), useful for sporadic events.
- Selection the type of device is individualized, depending on the specifics of individual patients.
- **Continuous ECG monitoring** is particularly useful in symptomatic patients with syncope, could not turn in time the recording device of intermittent type or in patients with intermittent symptoms occurring daily or almost daily (recurrent episodes of palpitations).
- **Intermittent ECG monitoring** is recommended in patients with sporadic symptoms or very short, able to activate the device so as to store in its memory ECG immediately preceding symptomatic episode.

# Ambulatory ECG monitoring

The main indications of ambulatory ECG monitoring:

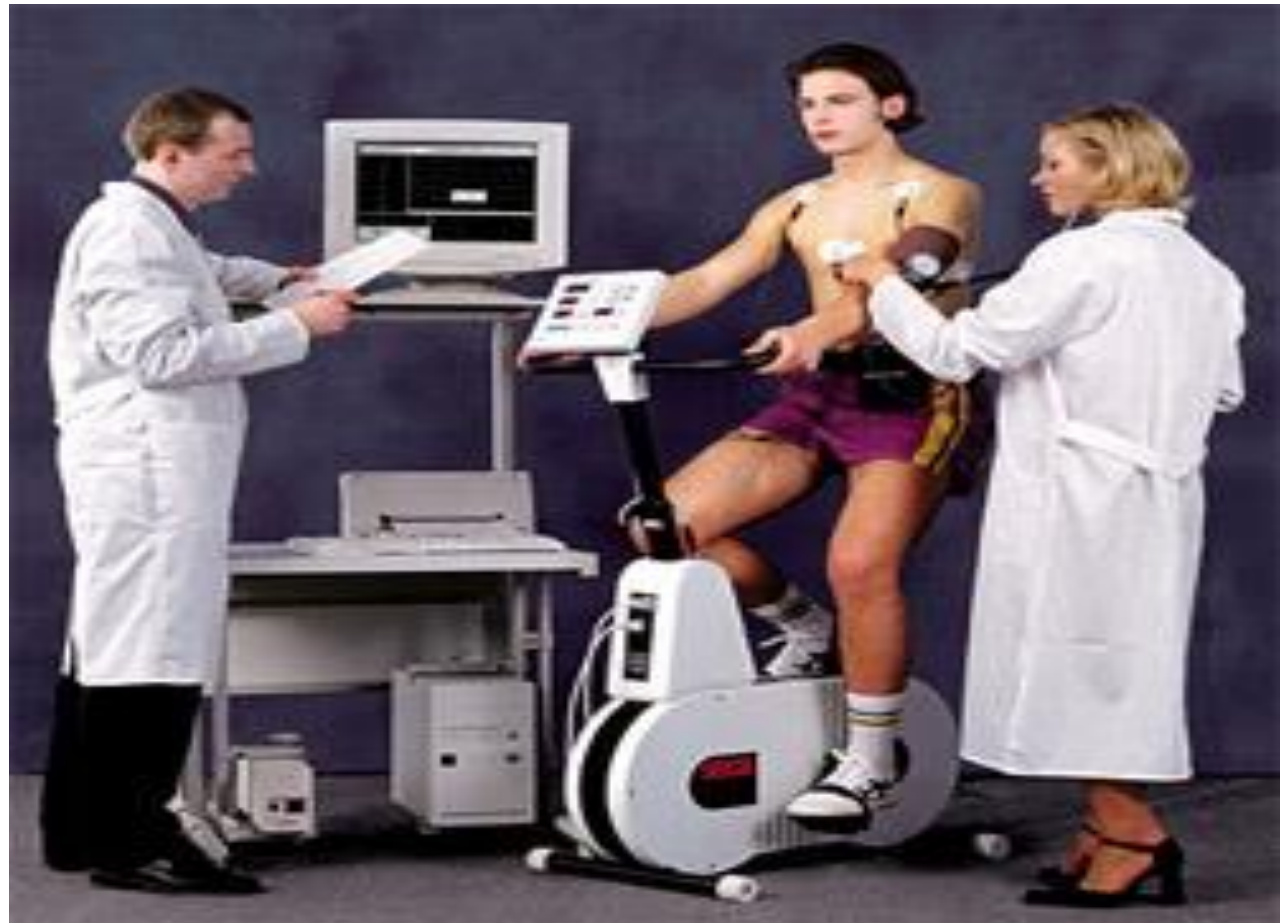
- Cause of unexplained syncope patients
- Patients with unexplained palpitations
- Patients with dyspnea, chest pain or fatigue of unknown cause
- MI patients with LV dysfunction
- Patients with CHF
- Evaluation of antiarrhythmic therapy
- Evaluation of the function of the implanted cardio stimulator
- Monitoring of myocardial ischemia

# Effort ECG test

- The most widely used exploration for diagnostic and / or risk stratification of patients with stable angina, unstable angina stabilized therapeutically, in patients with post myocardial infarction or revascularization .



# CEM



# Treadmill test



# Treadmill test



# Treadmill test

The patient is brought to the exercise laboratory where the heart rate and blood pressure are recorded at rest. Sticky electrodes are attached to the chest, shoulders and hips and connected to the EKG portion of the Stress test machine. A 12-lead EKG is recorded on paper. Each lead of the EKG represents a different portion of the heart, with adjacent leads representing a single wall. Three of the EKG leads are also constantly displayed on the treadmill monitor. Each lead representing a different wall. The physician has the option of selecting different combinations of three.

The treadmill is then started at a relatively slow "warm-up" speed. The treadmill speed and its slope or inclination are increased every three minutes according to a preprogrammed protocol (Bruce is the commonest protocol in the USA, but several other protocols are perfectly acceptable). The protocol dictates the precise speed and slope. Each three minute interval is known as a Stage (Stage 1, Stage 2, Stage 3, etc. Thus a patient completing Stage 3 has exercised for  $3 \times 3 = 9$  minutes). The patient's blood pressure is usually recorded during the second minute of each Stage. However, it may be recorded more frequently if the readings are too high or too low.

# Effort EKG test

## **Absolute contraindications for exercise ECG test are:**

- acute myocardial infarction (within 2 days of the onset)
- high-risk unstable angina,
- symptomatic or uncontrolled cardiac arrhythmias with haemodynamic instability that develops,
- tight aortic stenosis, symptomatic
- decompensated heart failure,
- Acute pulmonary embolus or pulmonary infarction,
- Acute myocarditis or pericarditis,
- Acute dissection of the aorta.

## **There are also relative contraindications:**

- common coronary trunk stenosis,
- mild valvular stenosis,
- electrolyte imbalances,
- uncontrolled severe hypertension (systolic over 200 mmHg and diastolic over 110 mm Hg),
- tachi - or bradyarrhythmias,
- obstructive hypertrophic cardiomyopathy or other diseases that cause obstruction to left ventricular emptying,
- physical or mental conditions that prevent effort
- atrio - ventricular severe blocks.

## **Stopping Effort ECG is made in case of:**

- decrease in systolic blood pressure over 10 mm Hg from baseline despite increased effort threshold when associated with other signs of ischemia,
  - in case of angina moderate / severe
  - when type symptoms dizziness, ataxia or presyncope
  - manifesting signs of hypoperfusion (cyanosis or pallor).