10. Criteria of the healthy cardio-vascular system

The healthy cardio-vascular system parameters shall stay within the normal range which is rather wide. When any parameter is out of normal range, the prompt recovery is very important. First of all it refers to physical activity that is essential element. Therefore, it is very important not only to exercise the cardiac muscles, but also to know how to recondition them quickly and effectively.

The organism never fritters away the energy. If a person leads a quiet life and escapes the physical exercise, then it would be very trying to resume the active life. This happens due to the following: the energy demand has been sufficiently reduced because some of the functions were not used by a person.

The cardio-vascular system is healthy only when loads and relaxations are in balance.

It should be recognized that male and female organisms differ with regard to physical loads and recuperation. As a rule, their excitability and attention concentration thresholds differ.

10.1 Hemodynamic parameters

10.1.1 Phase volumes of blood

In cardiometry, 7 volumes of blood are used for diagnostics:

SV – stroke volume of blood, ml

MV – minute stroke volume (cardiac output), l/min

PV1 – volume of blood entering the heart in the early diastole phase. It characterizes the sucking-on function of the ventricle, ml or % of filling volume

PV2 – volume of blood entering the heart ventricle during the atrial systole phase, characterizes the atrium transport/contraction function, ml or % of filling volume

PV3 – volume of blood ejected by heart ventricle during the rapid ejection phase, ml

PV4 – volume of blood ejected by heart ventricle during slow ejection phase, ml

PV5 – volume of blood transferred by ascending aorta during the systole, acts as a peristaltic pump, ml.

First four volumes are most frequently used in medical practice. Thus, PV2 shows the cardiac muscles condition. Frequently it is enough to understand the current state of the myocardium.

The relative normal stroke volume (SV) in the age of 16 and further corresponds to 55 ml level.

The following equation is always applied:

$$SV = PV1 + PV2 = PV3 + PV4$$

The normal minute volume (MV) corresponds to 3.7 l/min.

The normal blood volume variation range equals to ± 30 %. These are the normal – pathology range borders. The medical instrument CARDIOCODE provide the indication of these ranges on the display as the dark- and light-green background (Fig. 128).

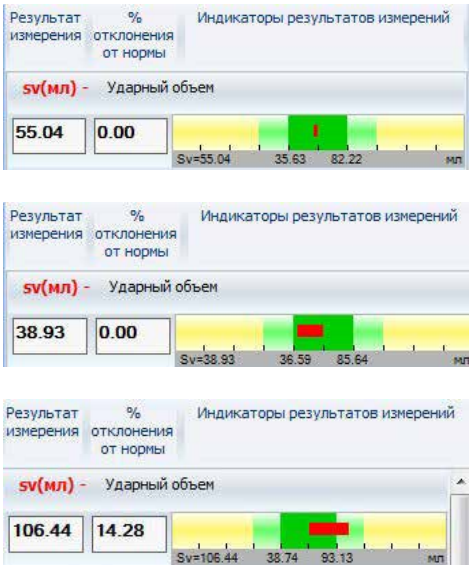

Fig.128. Combined presentation of the measured SV (stroke volume) values and its quality represented by red bar against the dark-green color (representing the normal range). The presentation of normal states (similar to other phase volumes) a) and b) correspond to 0% variations from norm, while c) corresponds to 14.28% above normal.

Note, that the parameters are changed during the orthostatic test. It shall be taken into account. If the parameters go beyond the normal range when changing to vertical position, the patient's CVS state is potentially dangerous. It can manifest itself in a greater degree during motion activity.

PV2 parameter (volume of blood in the atrial systole phase) is the most informative (Fig. 129).

PV5 parameter is blood volume (SV part) transferred by ascending aorta acting as a peristaltic

pump. It characterizes the volume of blood moving in vessels. Functionally this parameter is related with the level of energy available when the blood enters the aorta. If it is high, the aorta works under load and facilitates the sanguimotion in vessels.

For the heart energy potential evaluation, the parameter "diastolic volume PV1 percent of stroke volume SV". It is designated RV1. It is indirect characteristic of the cardiac fatigue. The "normal condition" notion is non-dimensional. Based on experience, the value corresponding to "golden proportion 1.62" can be used, i.e. RV1 = 62 %. It is variable and can have another value in orthostatic test.

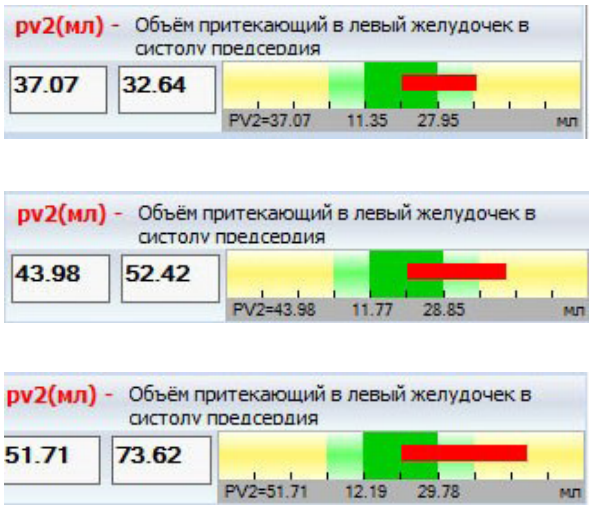

Fig. 129. PV2 parameter shows the volume of blood entering the left ventricle of heart during the auricular systole (data obtained in the course of a patient monitoring). The measuring data was taken every hour (quaque hora). It is evident, that the blood volume rises from 32.64% of normal value to 73.62%. This is indicative both of the load on the atriums and of the low flexibility of cardiac muscles.

10.2 Prerequisites of coronary arterias filling with blood

According to data of item 4.2.8, the slope ratio on the RhEO in segment T_k – U should not be less than 1. It is a normal value. When it is less than 1, the bloodflow is not filled to full, that suggests the presence of the coronary occlusion or lack of blood in the aorta.

10.3 Metabolic parameters

It is required to analyse the oxygen, lactate and creatinephosphate quantitative parameters (in conventional units):

1. Oxygen quantity, initial normal level:
- for not trained people: from 0.5 to 0.55.
- for average trained people: from 0.6 to 0.65.
- for highly trained and hardy people: 0.7 to 0.85.

2. Lactate quantity:

Range of anaerobic-glycolytic processes metabolic cost assessment, normal: 3 to 7

3. Creatinephosphate quantity:

Range of creatinephosphatic processes metabolic costs assessment, normal: 2 to 4.

The accumulation of lactate indicates that the heart is functioning properly. But the quantity must not exceed significantly the normal value. When the quantity is significantly lower than normal, it can be expected that the heart service life is close to expiry.

The creatinephosphate parameter shows the feasibility of ATP resynthesis in the next cardiac cycle.

If all three metabolic parameters are below the normal values, this shows that the cardiovascular system energy is exhausted fully. As a rule this state is considered critical.

10.4 Amplitude characteristics of phase

Each phase of the ECG is characterized with its own amplitude changing within a normal range, Fig. 130. It is required to pay attention to the amplitude variations since they may be caused by compensation mechanism. Therefore the amplitude variations are considered and included in logical analysis aimed at detection of disease underlying cause.

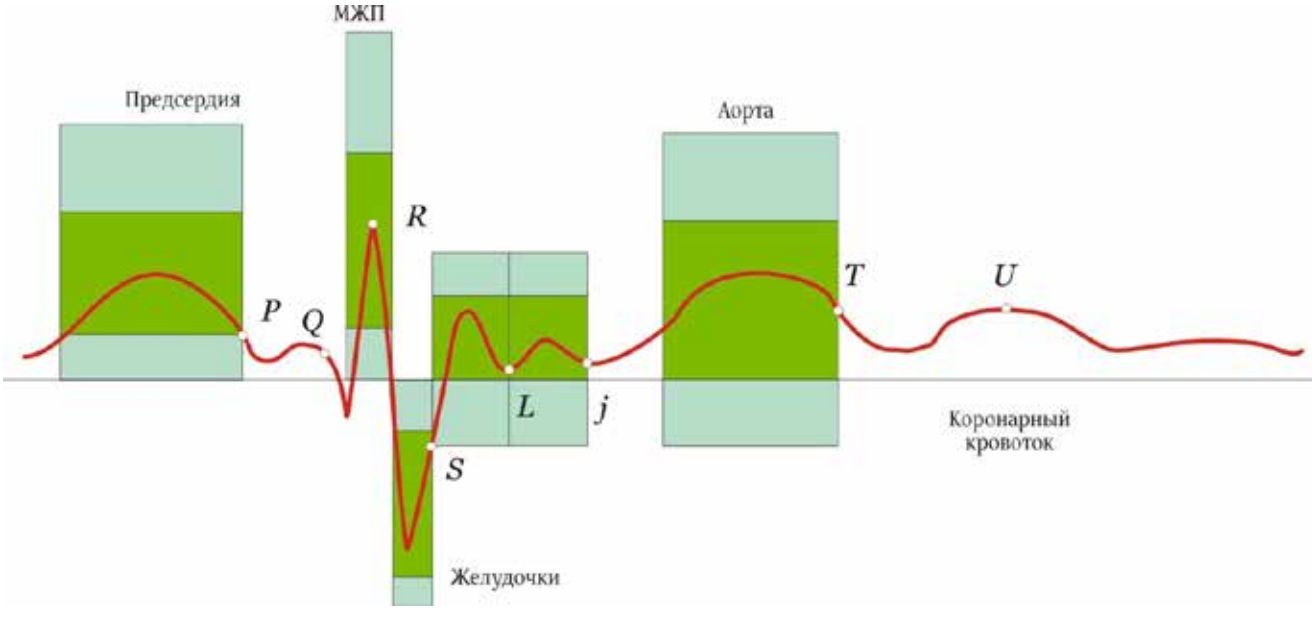

Fig. 130. Normal range of the ECG amplitude variations in cardiac cycle phases. The dark areas show the relative norm