

9. Extrasystole types and causes. Theoretical foundations of arrhythmia

9.1 Effect of hemodynamic resistance rise on arteriovenous fistulas performance and extrasystole onset. V.Yermoshkin – V.Lukyanchenko law

V. Yermoshkin and V.Lukyanchenko law says: subject to rise in local hemodynamic resistance of vessels the part of arterial blood may enter the low tension circulation (venous) system through the arteriovenous fistulas without entering the capillary network.

The arterial blood mixing with the venous blood can be represented on traces obtained through synchronous recording of ECG and RhEO (Fig. 121, 122, 123).

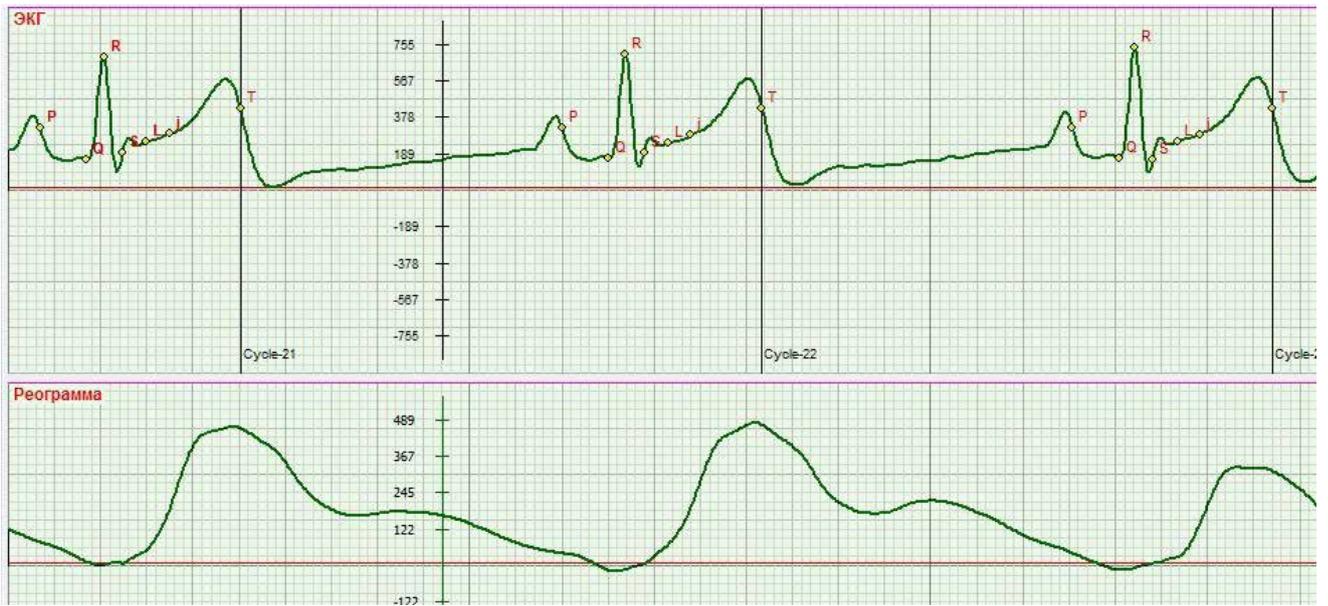


Fig. 122. Minor indications of venous return malfunction in lying position

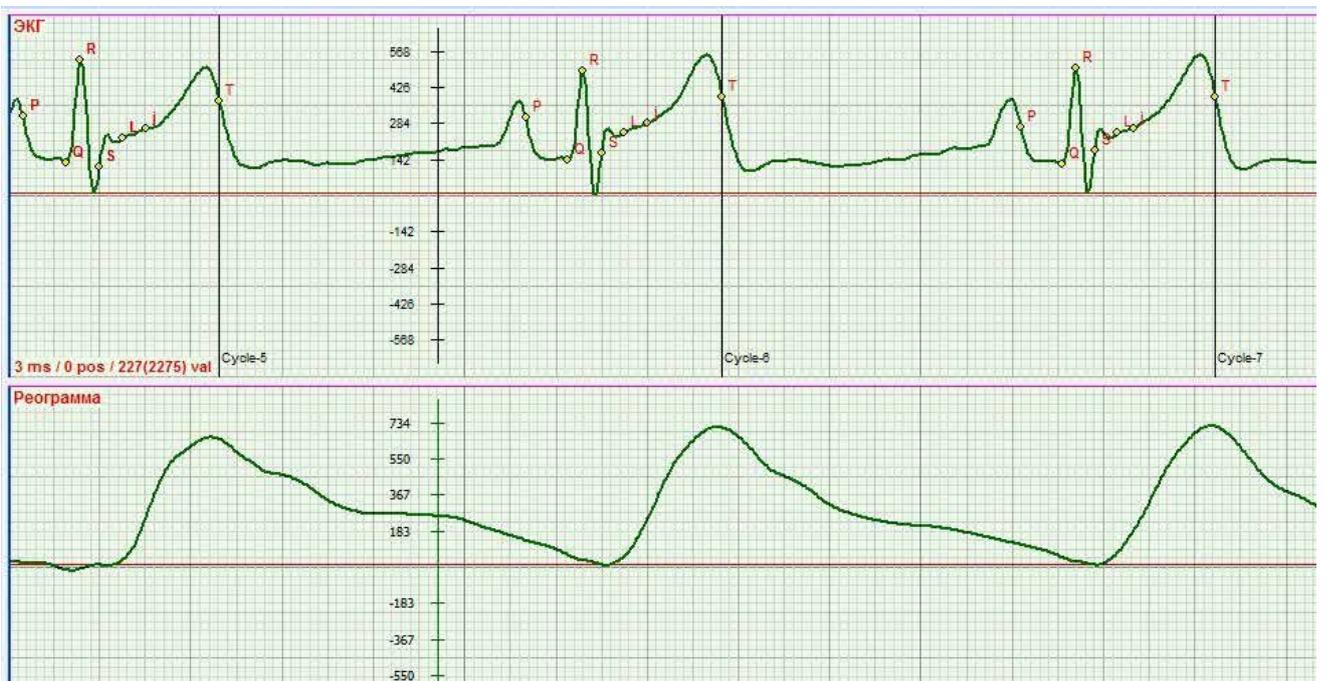


Fig. 123. No indications of venous return malfunction in standing position



Fig. 124. Standing position after 30 times of knee bending. RhEO amplitude contraction that indicates the sudden drop of pressure in aorta (moment 1). Corresponds to moment of the arteriovenous shunt opening

The actuating of the arteriovenous fistulas may be more evident when comparing three records, with two of them made during the orthostatic tests and the third one after 30 knee bendings. The above diagram shows that venous bloodflow changes insignificantly in laying position (Fig. 122). These changes can be taken for normal. On the RhEO, the early diastole phase has a minor rising. In standing position, the normalization of the venous blood flow is observed (Fig. 123). In fig. 124, the significant changes in RhEO amplitude are evident after the physical activity (30 knee bending). In particular, the first three cycles of RhEO show the rise of systolic pressure, that is formed by residual volume of blood in each cardiac cycle and by blood accumulation cycle after cycle. It proves the presence of the local interference with blood flow in one of the peripheral body areas. The full-scale blood circulation is not possible. Once the systolic pressure reaches the required level (point 3 in Fig. 124), it opens the arteriovenous shunt and release the accumulated arterial blood into venous bed. The systolic pressure drops dramatically (point 1 in Fig. 124). Later, the systolic pressure rises with each cycle, but the venous blood flow is hampered (point 2 in Fig. 124). In figure, the early diastole phase has a rise, instead of drop, ref. point 2. These

cycles will repeat at intervals till the increased local hemodynamic resistance is eliminated.

The arteriovenous fistulas open during the early diastole. If the systolic pressure is high enough to open the arteriovenous fistulas, it moves along the venous bed and (since the atrioventricular valve is open) reaches the AV node (since the atrioventricular valve is open) forces on it and thereby the out-of-sequence response pulse is started. All the conditions required for this process are available exactly in diastole. The extrasystole takes place in the form of QRS complex.

The described arteriovenous fistulas working process is a theoretical basis for study of the most commonly encountered type of arrhythmia.

The process has a set of symptoms. It is a process of the vascular system anatomico-physiological rearrangement accompanied with specific patient's complaints, such as "pulsation in belly followed by the heartbeating. It begins with periodic pulses in the pancreatic area, or in the left side of belly, or just "inside the belly". After that, the heart beating, tachycardia, arrhythmia take place. In times, after some time of heartbeating the heart comes to norm, but sometimes a heartache arises.

The periodic opening of the arterial-to-venous shunts is a compensating defense-mechanism (nocifensor).

9.2 Auricular extrasystole

The auricular early contraction occurs when the compliance of cardiac muscles, myocard or interventricular septum degrades. Generally it occurs and is related with the coronary occlusion in case of multi-focal cardiosclerosis. Fig. 125 shows the extrasystoles of this type. Based on the cardiac cycle phases analysis the process can be described as follows: due to occlusion the muscles fail to relax in early diastole phase, so the blood shall be injected to ventricles by the atriums. The quantity of P waves depends on how much the muscle relaxation function is depressed. To cure the extrasystole of this type it is required to normalize the coronary blood flow and to restore the cardiac muscles elasticity.

The cardio-vascular system is meant for blood transportation which is feasible when pressure differential is provided. Fig. 126 shows the mechanism of the systolic pressure maintaining with the help of the auricular extrasystole. It can be seen, that in the initial cycles the systolic pressure is low due to problems in coronary blood flow. Onwards, the blood is pumped into ventricles thanks to four P waves. On RhEO one can see that the systolic pressure comes to normal condition, but only for short while. In the next cycle, only two P waves maintain the pressure, afterwards it decreases.



a)



b)

Fig. 125. Auricular early contraction



Fig. 126. Auricular extrasystole aimed to close the atrio-ventricular valve and to maintain the required level of systolic pressure

9.3 Potential of fibroblasts and sudden cardiac death

Fibroblasts are the basic cells of the conjunctive tissue. Their purpose is to produce the conjunctive tissue intercellular matrix that ensures the transportation of chemical elements and mechanical support of the cells. The fibroblasts contact with cardiomyocytes. The fibroblasts effectively transform the mechanical signals into electric potential, at that the excited potential, at that, the excited potential can modulate the cardiomyocytes depolarization potential. The paradoxicality of this process consists in the following: the potential of fibroblasts exceeds sufficiently the potential of the cardiomyocytes. Considering the fact that it takes place at the end of early diastole phase, the conditions for the IVS hypercontraction are created (fig.

127 a, b). During the IVS hypercontraction, its impaction may occur.

Actually, it is convulsion (myospasm). In result, the asystolia occurs that is followed by the sudden cardiac death. The transient vertigo or loss of consciousness are the subjective signs of this process.

The urgent actions are: high-voltage discharge in the heart area to relieve the impaction, or the acupuncture.



a)



b)

Fig. 127. The interventricular septum contraction amplitude is increasing that can result in IVS impaction and cardiac arrest. This is accompanied with the transient vertigo and loss of consciousness. In critical situations, the ST segment is straightened (Fig. b).

9.4 Respiratory extrasystole

This type of the extrasystole occurs in case of considerable disbalance of blood circulation in systemic and pulmonary systems. This extrasystole corrects the hemodynamics of the pulmonary cir-

culcation and systemic circulation systems. It is suppressed by the normalizing of respiration, that can be achieved by regular physical exercise. This type of the extrasystole is not qualified like pathology.