

Report

Study of artificial aortic valve influence on hemodynamics by heart cycle phase analysis method

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Abstract

The results of study of an artificial aortic valve by the heart cycle phase analysis are given in the paper. The main aim of the study is identifying the artificial aortic valve influence on cardiovascular system functions, the way and ranges of these functions change. The results of phase blood volume measurement and the numerical values that characterize the metabolic processes in heart muscles are given herein.

Keywords

Aortic valve • Hemodynamics • Cardiac cycle • Cardiac volume • Metabolism • Heart muscles

Imprint

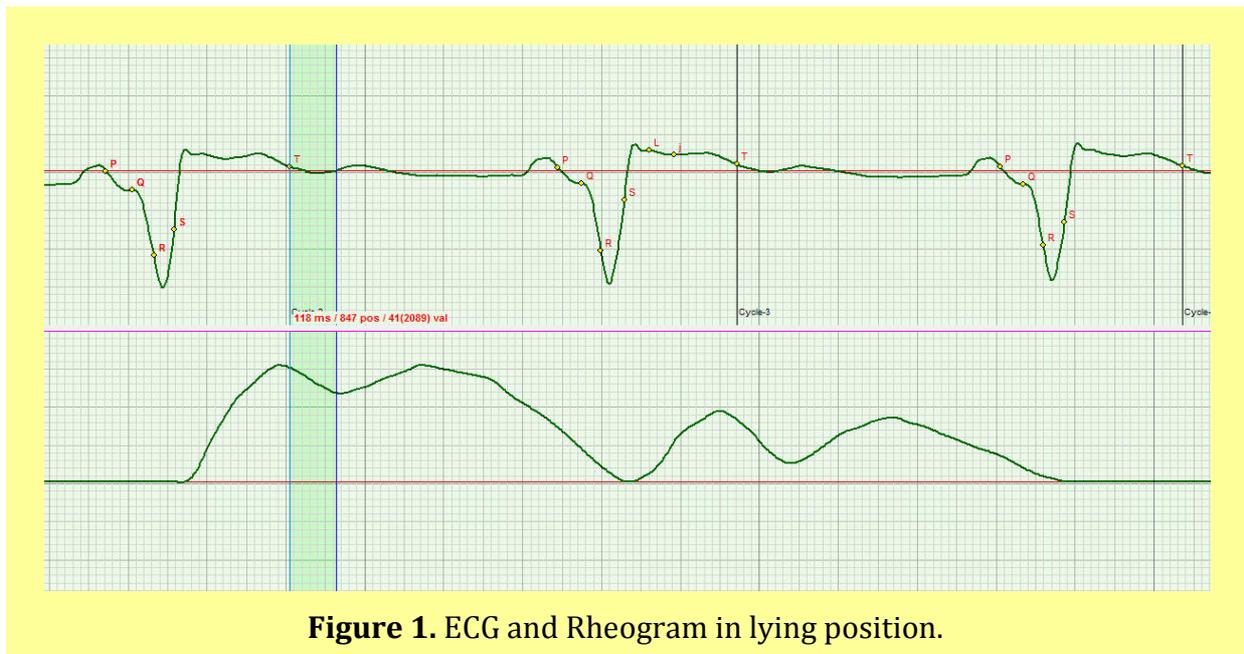
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Introduction

Implantation of artificial heart valves has been practicing for a long time. Nevertheless, methods for evaluation of the degree of artificial valves compliance with the natural valves still do not exist. Practically, the development of the valve manufacturing technologies is based on the theoretical calculation of reliability of the cusp mechanical motility, not considering the influence on hemodynamics. The hemodynamic volume parameters and the evaluation of cardiovascular system functions and metabolic processes in cardiac muscles obtained by heart cycle phase analysis method for a case when an artificial aortic valve is implanted are considered in the article [1-10].

Materials and methods

For obtaining more information on the artificial aortic valve influence on hemodynamic parameters, an orthostatic test was applied. An ECG and a Rheo of the ascending aorta were recorded (see Fig.1 and 2). The phase volumes of blood are presented in Table 1. The values characterizing an acid-alkaline balance in cardiac muscles (in relative units) are presented in Table 2 below.



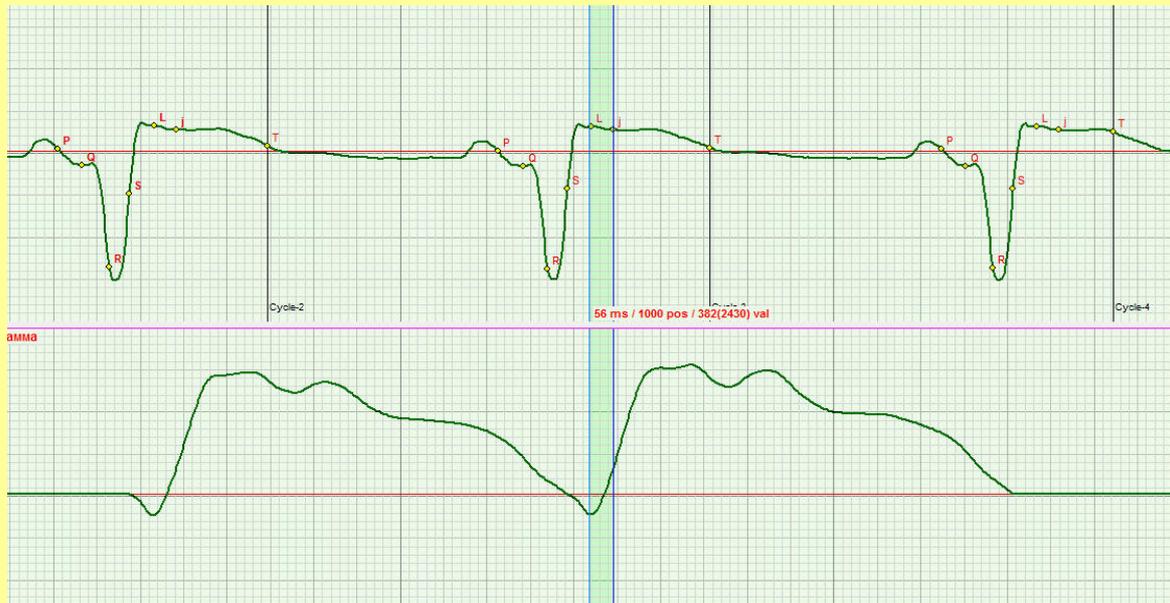


Figure 2. ECG and Rheogram in sitting position.

Table1. Phase volumes of blood

Blood volumes	In lying position	In sitting position
SV (ml)	78.34	59.86
MV (l)	4.32	3.70
PV1 (ml)	58.23	42.16
PV2 (ml)	20.10	17.70
PV3 (ml)	46.49	35.51
PV4 (ml)	31.85	24.35
PV5 (ml)	11.18	9.23

Table 2. The values that characterize an acid-alkaline balance in cardiac muscles (in relative units)

	In lying position	In sitting position	Norm
Aerobic process	0,21	0,02	0,5 - 0,82
Anaerobic process	0,25	34,0	3,0 - 7,0
Phosphocreatine	1,06	0,1	2,0 - 4,0

The above figures exhibit that there is no R wave on the ECG curves. That indicates the interventricular septum (IVS) does not contract at all. The figures show that the S – L phase amplitude is above the isoelectric line. It is an indication of the fact that the myocardium is under a constant tension. This happens because of the mechanism that compensates the lack of contraction in the IVS by the tension in the myocardium [11-13].

The hemodynamic parameters are practically within the norm in vertical position of the patient's body. They are increased in lying position. This is due to increasing in the blood flow resistance in lungs that is indicated by the Rheogram elevation in the early diastole phase.

The values of metabolic processes are also interesting. The aerobic process decreases by 10 times during the orthostatic test. And the anaerobic one increases by hundred times, respectively. That means that there is an instability in the processes, and first of all, that the muscles are under a huge load [14]. The artificial valve opens exactly in due time, i.e., at the beginning of the rapid ejection phase.

Conclusions

The patient says he feels better after the surgery but weak heart symptoms have not completely disappeared.

According to the data given above it is necessary to improve the considered artificial valve design to minimize the load on heart muscles.

Statement on ethical issues

Research involving people and/or animals is in full compliance with current national and international ethical standards.

Conflict of interest

None declared.

Author contributions

The author read the ICMJE criteria for authorship.

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