Model of Physical Activity During Rehabilitation after Myocardial Infarction

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Abstract – **Effective rehabilitation requires a graduated exercise, existing mathematical models based on average data. The task is to identify the specific model organism.**

Keywords – **mathematical model, the cardiovascular system, heart rate, blood pressure.**

I. INTRODUCTION

The correct dosage of exercise and continuous monitoring of patients some of the main factors influencing the rehabilitation process [1]. Therefore, development of information technology framework that would combine model acceptable physiological loads adapted to the peculiarities of the patient and the technology of the automated monitoring of patients recommended load is the actual problem, the solution of which is devoted to this work.

II. FEATURES OF INFORMATION TECHNOLOGY

Modern information technologies allow us to build a system that includes process tracking and forecasting the allowable loads on the human body during rehabilitation. However, most publications on this subject, aimed at modeling the details of the process of heart attack, and publications on application models that are adapted to the features of a particular patient is of a commercial nature.

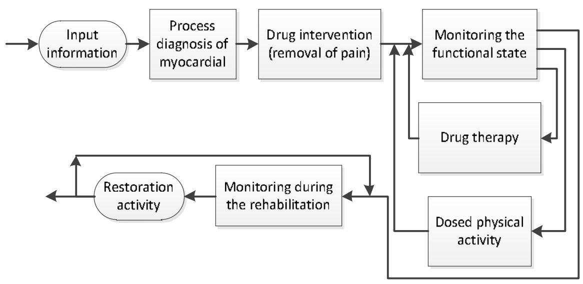

Fig. 1 Block diagram of a functioning model

Prior to rehabilitation conducted clinical evaluation. The main initial measurements to form a basic picture of the patient are: the volume of alveolar ventilation, blood pressure (systolic, diastolic), heart rate, oxygen saturation of the organism.

Based on analysis of current models that include a combination of these parameters [2-4] built a system of differential equations that models the parameters of the cardiovascular system (CVS) under the influence of physical activity. In this model, the need for additional O_2 approximated by the following differential equation [2]:

$$dq_{O_2}/dt = [q_{O_2 0} - q_{O_2} + 0{,}0127W]/T_W \quad (1)$$

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where $dq_{O_2 0}$ – necessity O_2 at rest; $q_{CO_2} = R_r q_{O_2}$; R_r – respiratory rate; T_W=1,0…1,5 c – time constant.

Mathematical description of the model consists of equations of gas dynamics of the respiratory system, muscle metabolism equations and equations of hydraulics cardiovascular system, which together represented a system of differential equations:

$$\frac{d\vec{x}}{dt} = j(\vec{x}, \vec{u}, \vec{f}); \quad \vec{y} = g(\vec{x}) \quad (2)$$

where $\vec{x}$ – state vector of the object, which includes the parameters of pressure and oxygen concentration, pressure distribution and flow in the cardiovascular system; $\vec{u}$ includes heart rate and blood flow through muscle tissue that act as control parameters; $\vec{y}$ includes the power of work and amount of atmospheric pressure, characterizing the external environment.

The following system of differential equations defines object management:

$$\frac{d\vec{z}}{dt} = \psi(\vec{z}, \Delta\vec{y}, \vec{x}); \quad \vec{u} = \vec{h}(\vec{z}) \quad (3)$$

where $\vec{z}$ includes the reaction of the sympathetic and parasympathetic nervous systems and increase blood flow through muscle tissue.

Because the systems are designed to study the general processes that occur in the CVS, is a topical problem of the construction method of identification by observation of a specific organism.

III. CONCLUSION

Developed further approach to the development of mathematical models automated monitoring system of rehabilitation patients with myocardial infarction whose identification requires a small amount of information which, unlike existing allows to predict a safe level of physical activity and the dynamics of restoration of normal functioning after their completion.

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