The effect of endurance training conducted under hypoxic conditions on exercise tolerance and hemodynamic parameters of the left ventricle in patients after myocardial infarction

Cardiovascular diseases, in particular ischemic heart disease, still constitute the greatest health threat in Poland, accounting for approximately 35% of all deaths.

Dynamic progress in the field of diagnostics, pharmacotherapy and interventional cardiology has influenced the search for new, more effective forms of rehabilitation training, enabling the patient to return to daily functioning as quickly as possible. The recommendations of the Polish Society of Cardiology contain precise strategies for dosing physical activity and the risk of cardiac events supported by scientific research. However, there is a lack of information on contemporary forms of training, especially in relation to environmental conditions and changes. More and more people decide to spend their free time in mountainous areas for passive or active recreation. Numerous sanatoriums and rehabilitation centers, often accepting cardiac patients, are also located in mountainous areas. The availability of oxygen decreases with altitude, which, combined with changes in atmospheric factors (temperature, air humidity, atmospheric pressure, etc.) creates a stressful environment for the cardiovascular system. Moreover, performing physical activity at altitude is a unique challenge for the entire circulatory system due to the body's additional demand for oxygen, the availability of which is already relatively low compared to conditions at sea level. Therefore, in patients who are endangered or have been diagnosed with cardiovascular disease, the risk of side effects may be increased during their stay at altitude.

Literature analysis indicates that there is a small number of documented studies assessing the impact of the high mountain environment on patients with coronary heart disease. Normobaric hypoxia chambers enable the elimination of the influence of unpredictable variables and a number of detrimental factors occurring in the natural mountain environment, such as temperature, wind or air humidity, while ensuring a controlled and safe hypoxic environment. They may be helpful in answering the question whether returning to physical activity and recreation in the mountains (such as hiking, skiing) will be safe for a patient after a myocardial infarction and determining safe conditions for such activity.

The aim of this study was to assess the effect of endurance training conducted under normobaric hypoxia in patients after myocardial infarction at the exercise tolerance and hemodynamic parameters of the left ventricle.

The study involved 36 men (57,75± 7,66 years old) after myocardial infarction treated with coronary angioplasty. They were randomly assigned to one of two groups: the experimental group (HIPO, n=17), performing interval endurance training on a cycle ergometer in conditions of normobaric hypoxia, corresponding to an altitude of 3000 m above sea level. – approx. 14.5% oxygen in the air; or control (NORM, n=19) who performed the same training under normoxia conditions (21% oxygen). The program included 22 training units, lasting about 80 min.

Before and after the training program, the level of exercise tolerance was evalueted based on a submaximal spiroergometric exercise test, the parameters of the left ventricle were assessed using ultrasound combined with tissue Doppler, and an analysis of selected biochemical (fibrinogen, interleukin 10, interleukin 1β, tumor necrosis factor) and peripheral (white and red blood cells, hemoglobin, hematocrit, platelets) blood parameters was performed.

The analysis showed that rehabilitation training conducted in hypoxia conditions has a greater exent on exercise tolerance and a similar effect on changes in hemodynamic heart parameters compared to training conducted in normoxia.in normoxic conditions. In turn, the oxygen conditions in which the rehabilitation is carried out, do not have a significant impact on the results of the analyzed blood parameters.. Therefore, training in hypoxic conditions is safe and can be a beneficial alternative to classic rehabilitation programs in cardiology.

Keywords: cardiac rehabilitation, normobaric hypoxia, endurance training, exercise tolerance, left ventricle.