REVIEW ARTICLE

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Weight training and appropriate nutrient supplementation as an alternative method to pharmacological treatment in rehabilitation of post-myocardial infarction patients

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Abstract

The article describes the impact of weight training, micro-elements and vitamins on rehabilitation in post-myocardial infarction patients. Cardiac rehabilitation is a multi-disciplinary and multi-faceted intervention aimed at restoring well-being and retarding disease progression in patients with heart disease. It has been shown that exercise-based cardiac rehabilitation is effective in reducing total and cardiovascular mortality. Intake of vitamins and other diet supplements was reported to exert beneficial effects. Pharmacological medication is associated with an increased risk of severe arrhythmia, and many adverse outcomes. Therefore, since conventional medicine only relieves the symptoms, cellular nutrition should be used in order to improve the quality of life in post-myocardial infarction patients. These elements prevent another infarction. The following nutrients are reported to have beneficial effects on general and cardiovascular health: amino acids, vitamins, coenzyme Q10, pycnogenol, inositol, omega-3 fatty acids, macromineral elements, and trace mineral elements. In conclusion, the review indicates that appropriate weight training and diet supplementation ensure full recovery and elimination of risk factors for cardiovascular diseases.

Key words

weight training, cardiac infarction, rehabilitation, diet supplements

CELLULAR MEDICINE AND CARDIAC REHABILITATION

Cardiovascular diseases are the main causes of morbidity and premature mortality among inhabitants of the Eastern and Central European countries, including Poland [1, 2, 3, 4, 5, 6, 7].

The highest rates of cardiovascular morbidity are observed in the case of cardiac infarction, coronary disease and hypertension [8, 9, 10]. Cardiac infarction results from advanced coronary atherosclerosis with limited blood flow. Persistent myocardial ischemia leads to cardiomyocyte necrosis where the muscles are replaced with fibrous tissue that does not have contraction ability [11].

Long-term myocardial ischemia with no optimal oxygen and nutrient supply results in necrosis. Cardiac infarction is most often the outcome of serious angina pectoris and requires immediate hospital care. The quicker the help, the smaller is the area of permanent myocardial damage. Statistically, every third cardiac infarction causes serious heart disease and death. After cardiac infarction, when the system of the generation and conduction of electrical impulses had been damaged, the patient must be prepared to suffer from symptoms such as: shortness of breath, oedema, impaired physical condition, arrhythmia, and impaired conduction of the heart.

Cardiac rehabilitation is a set of activities aimed at restoring to health patients with diseases of the circulatory system. In cardiovascular diseases, the ability to exercise is limited for a long time. This impairment is caused by pathologies in the heart and vascular system, as well as alterations in mechanisms regulating the circulatory system, homeostasis caused by a persistent lack of physical activity or immobilization [9, 11].

The aim of regenerative medicine is to restore normal coronary blood flow as soon as possible, accompanied by the therapy of damaged organs and tissues. In this case, the aim is to restore contractile tissue and local microcirculation, as well as to improve the quality of life after the cardiac infarction [11, 12]. Cardiac rehabilitation is a multi-disciplinary and multi-faceted intervention aimed at restoring well-being and retarding disease progression in patients with heart disease [13]. It has been shown that exercise-based cardiac rehabilitation is effective in reducing total and cardiovascular mortality [14, 15]. Intake of vitamins and other diet supplements are reported to exert beneficial effects [16, 17, 18], but are not commonly applied by doctors.

Pharmacological medication is associated with an increased risk of severe arrhythmia, and many adverse outcomes. Therefore, since conventional medicine only relieves the symptoms, cellular nutrition should be used in order to

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improve the quality of life in post-myocardial infarction patients. These elements prevent another infarction [12].

Modern cellular medicine allows for natural prevention and is a safe adjuvant therapy. Rath and Pauling [19] and Rath [20] claim that administration of cellular nutrients to patients improved their ejection fraction and physical condition by 20%. Arrhythmia, prostration and shortness of breath, all subsided with no side-effects.

It is now known that in many cases heart failure is caused by a chronic deficiency in vitamins and other nutrients in heart cells [21], as well by the lack of physical activity [22]. This condition leads to the impairment of the function of the heart as a pump, relatively low blood pressure, poor perfusion of organs, and insufficient fulfillment of current metabolic needs of the organism. The kidneys, which have the function of filtering excess body water from the blood to urine, fail. This process depends on optimal blood pressure, so in the case of heart failure, when the pressure is low, the water in tissues is retained.

Cellular nutrients enhance the healing of damaged arterial walls and help to reduce atherosclerotic deposits, as well as permanently improve the myocardium [11, 20].

NUTRITIONAL SUPPLEMENTS

Amino acids

Amino acids are the structural units that make up proteins. Most amino acids in the human body come from proteins present in the daily diet. Many of them, called endogenous amino acids, may be synthesized by the organism when needed. Amino acids that may not be synthesized by the organism are called exogenous [23, 24].

Lysine is an exogenous amino acid, which means that it must be provided for with food, and:
- is an essential element for building collagen and other stabilizing molecules;
- is a substrate for endogenous carnitine synthesis;
- together with proline has anti-infarction properties;
- is essential for the restoration and growth of tissues, the production of enzymes, hormones, antibodies, and serves as a basis for regulating the protein function; it also increases collagen production, strengthens the walls of arteries, and reduces the deposits found inside them;
- improves the utilization of fatty-acids essential for producing energy;
- lowers high serum triglyceride levels;
- increases brain concentration;
- regulates the function of the ovaries [25].

Proline is involved in the protection and healing of the arterial walls, and:
- builds bones, cartilage, skin, and blood vessels, and reduces the deposits found inside them;
- unlike lysine, it can be synthesized in the organism, which means it is an endogenous amino acid, although the amounts of proline produced are often insufficient;
- is a structural unit that makes up collagen molecules;
- together with lysine has anti-infarction properties;
- produces an energy reserve in the liver and muscles providing glucose when the organism is suffering from fatigue and needs more energy.

Arginine is a substrate for nitric oxide release which is the strongest known factor that relaxes blood vessels and normalizes high blood pressure. It also:
- decreases the viscosity of thrombocytes and facilitates blood flow;
- assists in the release of growth hormones and maintenance of a healthy immune system;
- aids in liver detoxification;
- causes retardation of tumours and cancer [19, 25, 26].

Cysteine is a substrate for glutathione synthesis which is one of the most important antioxidants. Together with other amino acids, it is responsible for the protection of the tissues against free radicals by neutralizing them. It protects and strengthens membranes, which means that it guarantees good health and a long life. This amino acid, which contains sulphur, stops all degenerative changes and processes. Cysteine is one of three amino acids that protects the tissues against free radicals and all kinds of pollutants, e.g. aldehydes, alcohol, smog, and cigarette smoke, by neutralizing them, together with the vitamin B group. Cysteine:
- helps to prevent metal toxicity;
- protects the organism against the deleterious effect of X-rays and other types of radiation.

However, it should be borne in mind that in combination with enzymes, vitamins and minerals (e.g. in aloes), it is very beneficial, but when administered as a single supplement it may be toxic.

Carnitine ensures effective usage of cellular bioenergy in mitochondria of the myocardium, and:
- supports the supply of bioenergy to mitochondria;
- may potentially increase the chance of survival of patients suffering from heart failure;
- improves the function of the heart as a pump, and normalizes its action in patients with arrhythmia;
- improves energy efficiency which, in turn, improves the condition of millions of heart cells;
- controls hypoglycaemia;
- enhances the effectiveness of antioxidants [24, 25, 27].

Taurine is a natural amino acid whose deficiency in heart cells is often a cause of heart failure, and:
- has positive, antiarrhytmic, inotropic and chronotropic effects;
- reduces blood pressure.

Taurine supplementation is recommended after myocardial infarction [24, 28, 29].

Vitamins

Vitamin A: decreases the risk of cardiovascular diseases. It:
- delays the process of ageing;
- protects the organism against free radicals;
- has an effect on hormone synthesis, especially in the thyroid gland;
- regulates immune function, vision, reproduction and cellular communication;
- supports cell growth and differentiation playing a critical role in the normal formation and maintenance of the heart, lungs, kidneys, and other organs [30, 31].

Vitamins B_1, B_2, B_3, B_5, B_6, B_9, B_{12} and biotin are carriers of bioenergy in cellular metabolism, especially for heart cells, as they improve the action of the heart, the pumping of the heart, and increase physical endurance.

Vitamin B_6 is involved in more than 100 enzyme reactions, mostly concerned with protein metabolism. Together with folic acid and vitamin $B_{12,}$ it reduces cardiovascular disease risk by lowering homocysteine levels [16, 30].

Folic acid (vitamin B_9, folate) plays a pivotal role in oxygen transport as it co-regulates the production and maturation of erythrocytes. It is essential for DNA synthesis and repair. Supplementation with folic acid reduces by 15% the risk of ischemic heart disease and stroke [16, 18, 23, 32, 33, 34].

Vitamin B_{12} is required for proper red blood cell formation, neurological function, and DNA synthesis. It functions as a co-factor for methionine synthase [30, 35].

Vitamin C provides energy for the metabolism of every cell; it stimulates transport molecules of vitamin B group and builds blood vessels, and:
- together with vitamin E has anti-infarction properties;
- together with folic acid and vitamin B_{12} causes maturation of erythrocytes;
- acts as an antioxidant;
- produces collagen, a protein required to help wounds heal;
- improves the absorption of iron from plant-based foods;
- helps the immune system work properly to protect the body from infectious disease [29, 35, 36, 37, 38, 39, 40].

Vitamin D is essential in the regular metabolism of calcium and phosphorus in the organism, especially the calcium in blood vessel walls. This vitamin also helps to remove the calcium from atherosclerotic deposits, and:
- modulates cell growth, neuromuscular and immune functions;
- reduces inflammation processes;
- strengthens bones by promotion of calcium absorption in the gut;
- modulates the function of genes encoding proteins that regulate cell proliferation, differentiation and apoptosis [29, 41].

Vitamin E is an antioxidant which, together with vitamin C, ensures the protection of plasma membrane, dilates blood vessels, and inhibits blood clotting by dissolving the clots. It actively acts with selenium. Vitamin E:
- inhibits the process of cell ageing;
- together with vitamin A protects the lungs against air pollutants;
- prevents ischemic heart disease;
- protects polyunsaturated fatty acids against free radicals, and with vitamin A prevents atherosclerosis;
- lowers blood pressure and acts as a mild diuretic;
- boosts the immune system against germs [30, 42].

Other compounds

Coenzyme Q10, also known as ubiquinone, plays a vital role with the enzyme in the respiratory chain inside the energy centres of cells – the mitochondria.

It is essentially important in supplying bioenergy to muscle cells, including the tissue of the heart, where the turnover of coenzyme Q10 is largely high because of the great effort. Moreover, coenzyme Q10:
- acts as an antioxidant;
- stimulates the immune system;
- protects the heart from damage caused by certain chemotherapy drugs [30, 43, 44, 45, 46].

Peter Langsioen, Karl Folkers et al. from the University of Texas in Austin [47] have shown that patients who took coenzyme Q10 lived three times longer than patients treated with standard medications.

Pycnogenol belongs to the group of bioflavonoids which play the important role of biocatalysts in different metabolisms. It:
- stimulates the stabilizing action of vitamin C on connective tissue, including the tissue of blood vessel walls;
- is an important antioxidant;
- exerts beneficial actions on blood lipid profile;
- enhances production of vasodilatatory endothelial nitric oxide and prostacyclin;
- lowers serum concentration of vasoconstrictory mediators endothelin-1 and thromboxane.

Clinical studies have demonstrated that supplementation with pycnogenol reduces platelet activity, lowers high blood pressure, relaxes artery constrictions, and improves blood circulation [20]. Watson [48] regards pycnogenol as having the potential to simultaneously counteract all important cardiovascular high risk factors.

Inositol is a biocatalyst in the metabolism of carbohydrates, proteins, and fats, and acts as a mediator in the exchange of biological information given to cells, e.g. contained in hormones. Inositol is vital in the circulatory system as it plays a pivotal role in regulating the action of the heart when hormones like adrenalin and insulin are secreted.

Inositol and choline play an important role in metabolic transport and optimal supply of nutrients to cells. Inositol is required in the formation of lecithin, which protects cells from oxidation and is an important factor in the building of cell membranes. It is lipotropic and prevents too much fat being stored in the liver [30].

Omega-3 fatty acids reduce all-cause mortality and various cardiovascular outcomes, such as sudden death, cardiac death and myocardial infarction. They exert beneficial effects on cardiac electrophysiology and arrhythmia, also on cardiovascular risk factors, such as blood pressure, and intermediate markers of disease such as heart rate variability [30].

Macromineral elements. Macrominerals are important catalysts essential in many reactions during metabolic changes. The most significant include: calcium, magnesium, potassium and silicon. Magnesium, calcium and potassium are vital for optimal conduction of electric impulses during the cardiac cycle. Magnesium, calcium and silicon are indispensable in bone mineralization, even without vitamin D. They also build collagen.

Calcium plays many different roles in the cardiovascular system. Most of all, it is responsible for maintaining the

correct action of the heart by regulating the conduction of nerve impulses. It is also important in the process of building bones. Moreover, calcium is required for vascular contraction and vasodilation, muscle function, intracellular signaling and hormonal secretion. Some studies indicate that it lowers blood pressure and reduces the risk of hypertension [41, 49].

Magnesium is a natural calcium antagonist; it helps by lowering high blood pressure and normalizes irregular heartbeat. Magnesium in the body serves several important functions:
- contraction and relaxation of muscles;
- function of certain enzymes in the body;
- production and transport of energy;
- production of protein;
- supporting a healthy immune system.

There is an increased interest in the role of magnesium in preventing and managing disorders such as hypertension, cardiovascular disease and diabetes. Some studies suggest that higher blood levels of magnesium lower the risk of coronary heart disease and stroke [30, 50, 51, 52, 53].

Potassium is crucial in the regulation of nerve impulses, including regulation of the generation and conduction of electrical impulses. It:
- prevents the occurrence of stroke in the human brain;
- maintains an appropriate blood sugar level;
- maintains regular muscle contraction;
- ensures muscular strength;
- maintains the normality of blood pressure;
- keeps the heart and kidneys in good health [49].

Silicon elasticizes blood vessels and makes them more resistant, stimulating better blood flow. Silicon also decreases the permeability of the capillary vessels, which prevents bruising and predisposition to haemorrhage – especially silicon found in plants. It prevents atherosclerosis and helps in strengthening the bones [49].

Trace mineral elements. These are important biocatalysts essential in thousands of biochemical reactions of metabolism. Zinc, manganese, copper, selenium, chromium and molybdenum play a significant role in metabolism. Their name suggests that they are needed in small, trace amounts; however, even the slightest lack of any of the trace elements causes symptoms of deficiency and abnormal metabolism.

Zinc has an effect on enzyme systems. It:
- has antioxidant properties;
- accelerates wound healing;
- is required in DNA and RNA synthesis, and in protein synthesis;
- stimulates regular development and regeneration of cells;
- participates in metabolism of vitamin A;
- manages the contractility of muscles;
- regulates the acid-alkaline balance;
- is required for catalytic activity of approximately 100 enzymes;
- enhances immune function, is required for the development and activation of T-lymphocytes [50].

When the organism is provided with insufficient zinc, it absorbs more heavy metals.

Manganese delays the process of ageing. It:
- stimulates normal growth and development;
- is a component of many enzymes vital for energy production, especially for the regular action of biotin, vitamins B_1 and C;
- is important in the reproduction process, and in the normal function of the central nervous system;
- has antioxidant properties;
- controls the level of sugar in the blood;
- prevents epilepsy and osteoporosis [32, 49].

Copper facilitates the incorporation of iron into hemoglobin. It:
- cooperates with vitamin C;
- stimulates regular function of the vascular and nerve systems;
- takes part in the synthesis of enzymes that participate in the process of intracellular respiration;
- is vital for a normal function of the connective and nerve tissues;
- is a strong antioxidant;
- reduces symptoms of arthritis;
- plays a significant role in the synthesis of haemoglobin, myelin, melanin and collagen [49].

Copper deficiency may cause the dissolution of clots in blood vessels to take 2.5 more time than normally.

Selenium is an antioxidant that delays the process of tissue ageing. It:
- together with vitamin E acts synergically;
- decreases the capacity of platelets to form clots, which prevents clotting in heart and brain vessels;
- prevents vascular diseases, stroke and myocardial infarction;
- regulates inflammatory response in asthma.

Selenium is incorporated into proteins to make selenoproteins which are important antioxidant enzymes. There is strong evidence that selenium has a protective effect against some forms of cancer (prostrate, colon and lung cancers) [30, 54].

Chromium is crucial in organism development as it stimulates beta-cells in the pancreas. It:
- cooperates with insulin in glucose metabolism;
- participates in carbohydrate metabolism;
- prevents diabetes;
- stimulates the action of insulin in burning glucose;
- prevents decrease of blood pressure and diminishes the risk of myocardial infarction.

Chromium deficiency may act in favour of diabetes and atherosclerosis, as this trace element regulates the level of lipids in blood.

Molybdenum plays a role in the metabolism of carbohydrates, and fats and is an important component of the enzyme responsible for iron absorption. It also prevents anaemia. Molybdenum reduces the levels of nitrosamines which are associated with cancer, and functions as a sulfite detoxifier. It is needed for normal cell function and nitrogen metabolism [8, 20, 33, 55, 56].

CASE DESCRIPTION ILLUSTRATING BENEFITS OF AN ALTERNATIVE METHOD OF REHABILITATION IN A POST-MYOCARDIAL INFARCTION PATIENT

A 69-year-old man, who had never been treated for cardiovascular diseases, was admitted to the Cardiology Department because of chest pain, and epigastrium with ST-segment depression in ECG.

On the basis of the patient's medical history, clinical observation and additional tests, the patient was diagnosed with fresh necrosis of the myocardium.

The patient was offered a coronary catheterization but did not give consent to perform the test. During the hospital stay, the patient was in a good, stable condition, with no events of angina pectoris.

The patient was treated pharmacologically for 5 days, after which coronary circulation became stable and the general condition of the patient improved. At the same time, the patient was administered with 100 ml of Aloe Barbadensis Miller, Colostrum and LRoxan (vitamins A, E, C, coenzyme Q10 and zinc) every day.

Since the patient still refused to undergo coronary catheterization, he was discharged from hospital on day 6 with the following recommendations:

- spare yourself;
- follow the antiarteriosclerotic diet;
- avoid physical strain;
- take the following medications:
  1. Plavix – 1 ×1 tab. in the morning;
  2. Polocard – 75 mg, 1 × 1 tab. in the morning;
  3. Nolpaza – 20 mg, 1 ×1 tab. in the morning;
  4. Concor – 10 mg 1 × 0.5 tab. in the morning;
  5. Tritace 10 mg, 1 × 0.5 tab. in the morning;
  6. Torvacard – 40 mg, 1 × 1 tab. in the evening;
  7. Nitromint – spray, 1 × under the tongue, in the evening in the case of pain.

After discharge from hospital, the patient ceased to take the pharmacological medication, but took every day:

- 2 × 50 ml Aloe vera gel Barbadensis Miller (before meals) which, among many others, contains such amino acids as lysine, proline, arginine, a complex of B vitamins and trace elements
- 2 × 1 tab. LRoxan (during meals) which contains vitamins E, A, C, coenzyme Q10 and zinc
- 2 × 4 tab. Probalance (after meals) which contains calcium, magnesium, potassium, sodium, copper, silicon, and molybdenum;
- 1,000 mg vitamin C.

Immediately after discharge from hospital, the patient began to exercise and tried to sleep 7 hours per day, and 30 minutes after lunch, if needed.

On day 9 he began exercises in the gym which involved all muscles to avoid any disproportion.

Exercises performed with lower than maximum load differ in the physiological mechanism from exercises with maximum and submaximal load. However, with the progression of tiredness, the tension created by motor units decreases. More and more motor units are involved and in the last phases their number rises to maximum. At the same time, the frequency of motor movements increases and they synchronize. The load that one could easily lift at the beginning changes into submaximal, and becomes a high-intensity physiological stimulus.

A big loss of energy (small load with maximum number of repetitions) may have a positive effect when exercising for health reasons. Nonetheless, exercises should be performed until one is completely tired in order to establish the increase in strength. The pulse should be monitored constantly. Such training helps to avoid injuries. Physical training is beneficial by producing a better physical condition and general and coronary circulation when undertaken regularly with an appropriate load. Furthermore, it should be undertaken throughout life so the patient should feel the need to exercise, and any lack of it should be experienced as discomfort.

After 3 years of training, accompanied by the taking of supplements, and despite doing various types of jobs for 12 hours a day, the symptoms of cardiac infarction did not appear even once, nor was any discomfort of that kind experienced.

Regular exercise and appropriate supplements guarantee that these problems will not recur, despite intensive work. In order for a patient to attain his goal, he/she should have an individual rehabilitation plan adjusted to his/her capabilities, as well as his/her physical and mental condition. The patient should take the responsibility for limiting risk factors, should be self-reliant in everyday life in order to be able eliminate any risk factors for cardiovascular diseases, and prevent disorders.

CONCLUSIONS

The main conclusion from the above-reviewed facts and figures is that the well-fitted diet supplementation and weight training should be applied in the rehabilitation of post-myocardial infarction patients to a much greater extent than it is applied at the present time.

We neither neglect the need for pharmacological treatment in the individual cases of post-myocardial infarction patients, nor incite them to disobey a doctor's recommendations, but believe that the application of the proposed alternative rehabilitation is healthier, and protects patients against the side-effects of many pharmacological drugs.

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