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## Improving patients with chronic lower limb arterial ischaemia

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### Abstract

Atherosclerosis of the lower limb arteries is the cause of ischemia in their area. Improper supply of nutrients to the leg muscles by blood results in pain, in particular those that intensify during exercise, when the nutritional need increases in the contracting muscles. The task of the physiotherapist is to improve the patient's quality of life. At the beginning, proper diagnostics should be performed to assess the level of ischemia, its severity and the patient's physical abilities. To assess these properties, a 6-minute gait test, ABI index and intermittent claudication distance test can be used. In therapy, special attention should be

given to training on the treadmill, cycloergometer, walks and resistance exercises. The basic premise of improvement is to extend the patient's pain-free distance.

**Key words: physiotherapy, PAD, atherosclerosis, intermittent claudication**

## **Introduction**

Atherosclerosis is the main cause of arterial ischemia of the lower limbs, which is a growing problem associated with the development of civilization. The main risk factors affecting atherosclerosis are: nicotine, improper high-calorie diet, and low levels of physical activity. Atherosclerosis obliterans (PAD), besides being the cause of amputation of the lower limb many times, carries the risk of complications such as coronary artery disease or myocardial infarction or stroke [1]. The narrowing or closure of the arteries supplying blood to the lower limbs, caused by atherosclerosis, results in chronic ischaemia of the lower limbs and a number of clinical symptoms associated with it. Insufficient oxygen supply to the muscles is manifested by pain, initially occurring during physical exertion, and in the case of critical limb ischemia at rest. The area of pain felt depends on the location of the arterial stenosis and collateral circulation. One of the most characteristic symptoms of PAD is the so-called intermittent claudication, defined as the distance during which pain occurs. After a short rest, the patient is able to continue walking, but the situation repeats in turn [2]. To assess the severity of vascular disorders in the lower extremities, use a four-point scale developed by Fontaine, in which qualifying for group I is evidence of the absence of clinical symptoms or possible tingling sensation, numbness or hypersensitivity to cold. The last qualification level, i.e. IV, concerns patients with ulceration or foot necrosis [3]. Depending on the level of narrowing or occlusion of the vessel, the patient experiences different localized pain. There are four forms of atherosclerosis of the lower extremities:

- a) Obstruction of the distal segment of the abdominal aorta or iliac arteries Leriche syndrome - pain in the buttock or thigh area with impotence is characteristic.
- b) Obstruction of the femoral popliteal arteries - pain in the calf area.
- c) Obstruction of the lower leg arteries (defined as peripheral) - stress pains.
- d) Multilevel obstruction - pain symptoms are heterogeneous due to narrowing or occlusion of the vessel in several places.

A precise description of pain experienced by the patient makes it easier to localize the level of arterial stenosis [4].

## **Physiotherapeutic diagnosis**

When planning to improve a PAD patient, a physiotherapist should first assess the fitness and degree of limb ischemia using appropriate tests. One of the most common and simple tests is the so-called six-minute corridor test used to assess physical performance. The test involves the patient covering the longest distance possible during 6 minutes [5]. Considering the occurring intermittent claudication, two types of distances can be determined using the test, i.e. the maximum distance in which there is enough pain that prevents further walking (MWD - maximum walking distance) and the distance measured until the first pain occurs. (WD-walking distance). In addition to the fact that the test allows classification of patients according to the degree of arterial ischemia, it also helps in the subsequent planning of individual patient improvement [6]. Measuring the distance of stopping claudication is also possible using an electric treadmill.

To analyze the effectiveness of rehabilitation and assess the blood supply to the lower limbs, you can use the measurement of the so-called ankle-brachial index (ABI). This index determines the ratio of the higher SBP on one limb measured on the dorsal artery of the foot and the posterior tibial artery, to the higher SBP among both brachial arteries. The patient

should lie in a 15-20 minute rest before taking the measurement. The correct measurement result is in the range of 0.9-1.3. A value below 0.9 indicates ischemia, while a value that is too high, i.e. above 1.3, is characteristic for abnormal stiffness of the vessels, most commonly associated with diabetes (in this case, finger toe measurement is recommended). Blood pressure and pulse should be measured before and after physical training, due to the fact that patients with atherosclerosis are burdened with diseases such as coronary heart disease or diabetes [7].

### **Marching trainings**

An effective form of improving patients with chronic arterial ischemia is treadmill walking training, which should be carried out under the close supervision of a physiotherapist. It should be remembered, however, that this type of therapy is only conservative treatment, aimed at improving the quality of life, increasing the distance of intermittent claudication and therefore reducing the frequency of pain. Regular physical activity also reduces the risk of cardiovascular complications [8]. It is recommended to use trainings lasting 30 to 60 minutes, frequency three times a week, for a minimum period of 3 months. The most optimal is treadmill training started at a speed of about 3 km / h, with the possibility of increasing to about 5 km / h, gradually increasing the angle of the treadmill so that the patient moves upwards. During activity, care should be taken to prevent the occurrence of maximum pain during gait. The effectiveness of walking training is manifested by: increasing blood flow in small capillaries, reducing blood viscosity, and changing the degree of pain perception [9]. The benefits of walking activity improve walking ergonomics. The problem of pain in patients with PAD is primarily due to the increase in the metabolic demand of muscles during exercise, which cannot be sufficiently supplemented due to narrowed or closed vessels. Systematic cardio training improves local arterial flow, resulting in longer claudication distance. A physiotherapist should educate the patient about undertaking walking activities so that the patient can continue their activities in their daily lives [10]. It is recommended to walk 3-5 km / day, with breaks at the time of the appearance of the first pain symptoms. The speed of walking at home and on walks among people over 60 should be about 60 steps per minute, while for younger people at twice the speed. Marching trainings are best repeated up to 2-3 times a day. The patient should also be instructed on the selection of appropriate footwear, ensuring ergonomic gait and foot care [11].

In patients with intolerance to walking training, indirect activity may be recommended through upper limb exercises. To diversify the forms of activity, training on a bicycle ergometer is also suggested. This type of activity is also a better option for patients who have other diseases, primarily the musculoskeletal and nervous system, and because of this, walking training is too burdensome for them. Exercise on a bicycle activates primarily the proximal muscles of the lower extremities, so make sure that the patient during pedaling rests the feet on the pedals with the forefoot area (this affects the increase in the activity of the ankle muscles, i.e. gastrocnemius, soleus, extensor muscles) [12].

### **Resistance training**

In improving PAD patients, we should also introduce strength exercises aimed at increasing the strength of those weakened as a result of muscle ischemia. In particular, muscles such as quadriceps thighs, dorsal and plantar flexors of the foot should be strengthened [13]. Resistance exercises should be performed in three sets of 8 repetitions. You should also individually determine the training load, which should be 30-50% of the maximum muscle strength (determined on the basis of a test in which repeated repetition causes fatigue). Strength training significantly improves muscle strength and endurance, improving the quality of life and the ability to perform many activities during everyday lifestyle [14].

## **Buerger exercises**

To improve blood supply to the lower extremities, so-called Buerger exercises. During this type of effort, three phases follow:

- 1) Ischemia phase: the patient is recommended to lie in the back position, with the lower limbs raised and supported at an angle of 45°. In this position, alternate dorsal and plantar flexion movements are performed in the ankle joints. Exercises should be repeated for up to 1.5 minutes or until 75% of the number of repetitions at which intermittent claudication occurs.
- 2) Congestion phase: the patient exercises in a sitting position with the lower limbs lowered downwards. At this stage, we also perform dorsal and plantar flexion movements in the ankles or recommend the patient to remain seated for 2-3 minutes.
- 3) Rest phase: at this stage, the patient is in the supine position with the lower legs straightened. It is recommended to fully relax your muscles and take deep breaths. This phase also lasts about 2-3 minutes.

A cycle of three consecutive phases should be repeated 3-4 times, three times a day [15].

## **Summary**

The steady increase in atherosclerosis among the world's population is largely due to the development of civilization. Low levels of physical activity, stress, a high-calorie diet and obesity are the main risk factors for morbidity. Atherosclerosis affects not only the coronary vessels or the brain, the arteries of the lower limbs are also affected many times, causing ischemia in their area. A characteristic symptom of flow disorders as a result of occlusion or narrowing of the artery of the lower limb is the so-called intermittent claudication. Pain limits patients in their daily activities, making them reluctant to undertake physical effort or even walking. In critical limb ischemia, pain occurs when patients are at rest, preventing them from functioning daily. Physiotherapy is an extremely important element in the therapy of these patients. The goal of rehabilitation is primarily to extend the distance of intermittent claudication, increase muscle strength, eliminate contractures and improve overall physical performance. Treadmill training, walking, Nordic Walking, as well as resistance and blood supply training are recommended. Buerger exercises. Regular training, supervised by a physiotherapist, can bring benefits in the form of improved quality of life.

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