EVALUATION OF THE DEPENDENCY BETWEEN THE CLAUDICATION DISTANCE REPORTED BY THE PATIENT AND THE ANKLE-BRACHIAL INDEX AT REST, AND THE DISTANCE COVERED ON THE TREADMILL TEST IN PATIENTS WITH LOWER LIMB ISCHEMIA

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Views concerning the dependency between the claudication distance and ankle-brachial index values are ambiguous.

The aim of the study was to determine the correlation between the distance covered during the treadmill test and ankle-brachial index, and the distance covered during the treadmill test and claudication distance reported by the patient.

Material and method. The study group contained 75 patients of both genders, above the age of 40 years, treated at the Vascular Disease Outpatient Clinic, diagnosed with one or both-sided intermittent claudication, and with an ankle-brachial index below 0.9. In all patients we evaluated the ankle-brachial index at rest, considering both lower limbs, as well as the claudication distance on the treadmill test (3.2 km/h, 12° gradient). We determined the distance traveled until the manifestation of pain (distance free of pain), and the distance until complete stop (total walking distance). Analysis always considered one (the worse) lower limb of the patient.

Results. There was no correlation between the ankle-brachial index and distance covered during the treadmill test. However, there was a statistically significant dependency between the claudication distance reported by the patient, and that observed during the treadmill test. A moderate correlation was observed between the total walking distance and the claudication distance reported by the patient (r=0.441, p=0.001).

Conclusions. 1. The ankle-brachial index at rest should not be used as a measure of the intensification of lower limb ischemia symptoms in patients with intermittent claudication. 2. The claudication distance reported by the patient only moderately correlates with the total observed walking distance.

Key words: ankle-brachial index, total walking distance, intermittent claudication

Intermittent claudication is such a characteristic and repeatable symptom of chronic lower limb ischemia that it is often possible to establish an initial diagnosis based on this symptom alone. Accurate physical examination and the evaluation of the pulse, as well as ankle-brachial index measurements, provides confirmation of the diagnosis (1). Further quantification of symptoms reported by the patient can be performed during walking efficiency trials on a treadmill. The treadmill test enables us to objectively determine the patients’ activity limits, and the standardized protocol provides data allowing for the comparison of walking efficiency in different patients (2). The claudication distance reported by the patient is often an imprecise parameter. In order to better determine the patients’ activity limits, further information is required including the pace of the walk, step distance, and factors in-
fluencing a person to stop. Several systems have been created to evaluate a person’s walking capabilities (for example the Walking Impairment Questionnaire), although these questionnaires are only used in clinical programs. Apart from the treadmill test, questionnaires are also used to evaluate the progress of intermittent claudication therapy (3). Thus, data obtained from questionnaires reported by the patient remains the basic input appraising a given patient’s functional limitations.

In the cases of patients with intermittent claudication, the ankle-brachial index usually ranges between 0.5-0.8 (4, 5). Most clinical trials evaluating patients with intermittent claudication require patients to have the ankle-brachial index exceeding 0.5, although clinical practice reveals patients with a lower index and without critical lower limb ischemia symptoms. Lower ankle-brachial index values reported in the literature tightly correlate with critical lower limb ischemia (diagnosis is based on absolute pressure values). The lower ankle-brachial index is reduced in the case of the vascular disease localized at different levels, as well as in the case of proximal lesions. It has been suggested that the value of the ankle-brachial index corresponds to the stage of lower limb lesions (6).

In the present study, we evaluated data obtained during the initial patient examination, the claudication distance and the ankle-brachial index, and their correlation with the objective claudication distance observed during the treadmill test. The following were considered:

- whether the claudication distance reported by the patient (subjective) correlated with the distance traveled during the treadmill test,
- whether the ankle-brachial index at rest corresponds to the objective claudication distance.

**MATERIAL AND METHODS**

The study group was comprised of 75 patients (Vascular Disease Outpatient Clinic) of both sexes, >40 years of age, with symptoms of intermittent claudication in one or both legs, and with an ankle-brachial index below 0.9 at rest.

The following were evaluated in every patient:

- claudication distance – based on the patient’s history,
- the ankle-brachial index at rest,
- the claudication distance on the treadmill test- 3.2 km/h, 12° gradient
  - walking distance free of pain,
  - total walking distance.

The analysis considered data obtained from one of the limbs responsible for the termination of the treadmill test.

The study group comprised 13 female and 62 male patients (median age – 57 years, ranging between 45-70 years). Dominating symptoms were localized in 40 lower right and 35 left lower limbs.

The level of “vascular obliteration” (dominating stenosis or occlusion) included the aorto-iliac segment in 25 cases, the femoro-popliteal segment in 43 cases, and peripheral lesions were diagnosed in 7 patients. The "claudication distance" was defined as the distance, in meters, covered by the patient at a normal pace until the intensification of symptoms required the patient to stop. Due to the ambiguity and difficulties in the interpretation of the distance covered, we gave up the determination of the walking distance free of pain; instead we used precise evaluation of the total walking distance.

The ankle-brachial index was measured by one of two experienced angiological nurses after a 15 minute rest period. Index measurements were acquired with the patient in the supine position using a mercury sphingomanometer, and a continuous wave Doppler flowmeter (UDP-5R, Sonopan). The higher pressure value was estimated from the tibial posterior and dorsal foot arteries, as well as the higher value from both brachial arteries.

The treadmill test (Cardiovit CS-200, Schiller) was performed at a speed of 3.2 km/h and gradient of 12°. After initial training, the patient rested for a period of 30 minutes and then began the treadmill test while under surveillance. The Walking Distance Free of Pain and Total Walking Distance were determined in meters (m).

Results were subjected to statistical analysis, and the dependencies between investigated variables were evaluated using non-parametric correlation tests.

**RESULTS**

The distance of claudication reported by the patient ranged between 20 and 1000 m, with
the median amounting to 100 m, while the mean was 158.99 m (SD 153.08). The walking distance reported by the patients was typically rounded to the nearest 50 meters. Only select patients were able to precisely determine the claudication distance. Fifteen patients reported a distance of 50 meters, while one patient pointed to 20, 30, and 40 meters, respectively. Most patients (21 pts.) reported a distance of 100 m, while two each reported 60 and 75 m. In the following 50 meter interval, one patient reported a distance of 110 m, one reported 130 m, and 12 each reported 150 m. Seven patients estimated the claudication distance at 200 m, one at 250 m, and four at 300 m. More than 300 meters were reported by seven patients; two declared 400 m, four declared 500 m, and one declared 1000 m. Figure 1 illustrates the number of patients represented at given 50 m intervals.

The mean value of the ankle-brachial index in the investigated group amounted to 0.55 (SD – 0.17) and the median amounted to 0.57 (ranging between 0.1-0.9). Nearly all patients exhibited ankle-brachial values ranging between 0.3 and 0.8 (fig. 2).

The walking distance covered during the treadmill test was rounded to a full meter. The mean distance free of pain amounted to 74.24 m (SD – 36.95 m), while the median was 68 m (ranging between 21-196 m). The mean total walking distance amounted to 140.96 m (SD – 100.92), while the median was 120 m (ranging between 27-740 m). Figure 3 represents the total walking distance in 50 m intervals.

We determined the correlations between the reported claudication distance and ankle-brachial index, and the total walking distance obtained during the treadmill test. There was a statistically significant dependency between the reported walking distances and values obtained during the treadmill test. The correlation of the average between the claudication distance and distance free of pain was (r=0.441) (fig. 4).

We also compared the claudication distance and distance covered during the treadmill test, at particular distance intervals. A correlation between the claudication distance and total walking distance was observed in 21 cases. Twenty patients underestimated their distance as measured by the treadmill test result, while 34 patients did not reach the declared distance.

There was no significant dependency between the ankle-brachial index value and the claudication distance obtained during the treadmill test. Results are dispersed along the ankle-brachial index axis, which suggests that patients

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**Fig. 1. Claudication distance reported by patients in 50 meter intervals**

Claudication distance: mean 158.99; SD 153.08; median 100; range: 20-1000

**Fig. 2. Ankle-brachial index at rest**

Ankle-brachial index mean 0.55; SD 0.17; median 0.57; range: 0.1-0.9

**Fig. 3. Total walking distance mean 140.96; SD 100.92 median 120; range 27-740**
Claudication distance, ABI at rest, and treadmill test in lower limb ischemia patients

It seems that one of the methods facilitating the functioning of patients with intermittent claudication is to slow down the walking pace. An even and calm march enables the patient to cover longer distances. Many patients suggest a loss of faster walking capabilities, which is connected with the shortening of the claudication distance. The standard treadmill test is often more difficult than everyday activities. The walking pace of 3.2 km/h and increased gradient of the treadmill forces patients towards a more intense activity level compared to everyday exercise. The standard test is considered as rather dreadful, especially in case of elderly patients with limited general efficiency and balance disturbances, who often express their anxieties and fear during the treadmill test (7). For some patients, the presence of someone supervising the test is stimulating and can influence (increase) the distance covered despite negative symptoms, which would normally result in the termination of the test.

An eventual alternative to the treadmill test is a 6-minute walk on a flat terrain – usually the hospital hallway (7).

Another limitation in the comparison of data is the definition of the "claudication distance". In practice, the determination of the dependency between the distance covered and the walking pace is difficult. This problem is partly solved by specific quality of life tests and questionnaires determining the walking capabilities of a given patient. The obtained results present a higher correlation with the objective results (8, 9).

However, in spite of the objections presented concerning the definition of the claudication distance and difficulties connected with the treadmill test, the comparison of results demonstrated statistically significant, though relatively minor correlations.

Thus, precise medical history data confirms not only the clinical diagnosis, but also approximates the degree of dysfunction. There was no relationship between the subjective and objective walking capabilities, and the ankle-brachial index. Patients with a low ankle-brachial index can cover longer distances on the treadmill test compared to those with the ankle-brachial index around 0.8. Thus, the ankle-brachial index serves to confirm the diagnosis of chronic lower limb ischemia, as well as the differential diagnosis. Additionally, risk of cardiovascular complications can be determined by this index. For instance, there was a dependency between the value of the ankle-brachial index and occurrence of vascular complications including death (the lower the index the higher the risk of complications and death) (10). However, the comparison of the ankle-brachial index with general quality of life tests shows no relation. Furthermore, specific quality of life tests and questionnaires evaluating the walking capabilities of patients show no connection, or very poor dependency with the ankle-brachial index (9). Therefore, the ankle-brachial index cannot be considered as a
measure of the intensification of clinical symptoms.

CONCLUSIONS

1. The claudication distance reported by the patient moderately correlates with the objective evaluation of the total walking distance.

2. The ankle-brachial index at rest should be used as a measure of the intensification of lower limb ischemia symptoms in patients with intermittent claudication.

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COMMENTARY

The current study is very interesting and enlightening, and should be an obligatory lecture for every physician wanting to gain knowledge in vascular diseases.

Information concerning the ankle-brachial index can be obtained from any vascular disease textbook.

An ankle-brachial index of 0.33 is possible in case of upper extremity pressure amounting to 90 mm Hg and lower extremity pressure amounting to 30 mm Hg, as well as pressures amounting to 180/60 mm Hg, respectively. The former might experience pain at rest, while the latter can cover a distance of 150-200 meters. The authors highlighted that the sum of the pressure and ankle-brachial index values enables us to gain deep insight into the stage of the disease.

Gardner and co-authors observed 43 male subjects for a period of 18 months, with a mean patient age of 69 years. During the 18 month period, decreases were reported in the claudication distance (22%), lower leg muscular blood flow (18%), and subjective activity evaluation (27%). Only the ankle-brachial index remained unchanged (1). These observations are in accordance with the conclusion presented in the study that the ankle-brachial index should not be used as a measure of the intensification of the symptom, considering patients with intermittent claudication.

The Authors justly underline that patient data were ambiguous with regard to the asymptomatic claudication distance. Based on our observations, we noted a significant divergence between the maximum distance mentioned by
the patient, and that measured in the hospital at a pace of 100 steps per minute, when accompanied by an escort. In the hospital, patients covered a significantly longer distance, as compared to the distance declared. Additionally, the patients mentioned that they covered the hospital distance at a much faster pace, in comparison to out-patient conditions.

The Authors mentioned that the ankle-brachial index serves to confirm the diagnosis of chronic lower limb ischemia and indicates of the risk of cardiovascular complications, accurately defining the value of the index. Consequently, there is no connection between the subjective and objective walking possibilities, and the ankle-brachial index. The results obtained by the Authors are evidence of the correlation of the dynamic examinations, considering the claudication distance mentioned by the patient and that observed in the hospital. Thus, there exists a need to measure the ankle-brachial index after exertion, which is rarely performed during everyday practice. Therefore, patients with the ankle-brachial index amounting to 0.3 can cover a longer distance, in comparison to those with the index amounting to 0.8. Patients with an index amounting to 0.3 often present with a well-developed collateral circulation, in the presence of advanced arterial lesions. The weakness of the study is the absence of information concerning patients with diabetes mellitus, which can influence ankle-brachial index values.

REFERENCES


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