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Application of six minute walk test in clinical practice

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ABSTRACT

The six-minute walk test is a recommended, practical, simple test for preliminary assessment of functional capacity, effort tolerance, adaptation to activities of daily living. The aim of the study was to analyze and summarize the current knowledge of guidelines, application and usefulness of a six-minute walk test in clinical practice. On the basis of the leading publications and the latest reports, articles the basic scope of knowledge on the assessment of the functional exercise capacity based on a six-minute walk test was synthesized. A set of examples of the application of the test in clinical practice in cardiology, pulmonology, rehabilitation and on the interventional branches of medicine such as surgery is mentioned in publication. Analysis of current state of knowledge shows that the six-minute walk test is used in cardiology to assess functional exercise capacity, effort tolerance, course and effects of treatment of patients with cardiovascular diseases, including coronary heart disease, arterial hypertension, after pacemaker implantation and other cardiac operations. A similar application was found in pulmonology in patients with COPD, lung restrictive diseases, before and after surgeries. The six-minute walk test has found a wide application in clinical practice in assessing efficiency, exercise tolerance, effects of rehabilitation in cardiology, pulmonology and other branches of medicine. The test has been used for preoperative and postoperative evaluation, measuring the

response to interventions, rehabilitation. Due to its universality and the ability to reflect the actual state of functional capacity, tolerance of effort it can be used in other areas of medicine according to its indications.

Keywords: Six minute walking test, functional capacity

1. INTRODUCTION

The 6 Minute Walk Test (6MWT), also called the marching test, or the corridor test, is used in clinical practice for exercise tolerance assessment, evaluation of eligibility for treatment and rehabilitation as well as determination of their outcomes and patient prognosis.

The 6 Minute Walk Test is well-tolerated, safe for the patient and easy to perform. It does not require any specialist medical equipment or advanced training of healthcare professionals. It allows to determine exercise tolerance, adaptation to daily life activities, effectiveness of treatment and patients prognosis in a simple way [1, 2]. It has become a popular tool for the assessment of functional capacity in clinical practice, particularly in pulmonology, cardiology and rehabilitation. Publications in the world's leading medical journals have proved its utility in the assessment of eligibility for surgical treatment, the patient preparation and the prediction of postoperative functional rehabilitation [3].

Apart from the 6MWT, the most popular complex exercise tests include the stair-climbing test, the incremental shuttle-walk test, the cardiac stress test (for patients with asthma or cardiac diseases) and the cardiopulmonary exercise testing [4, 5, 6]. Laboratory measurements of functional capacity are considered more objective than self-reports obtained in medical history.

In the 1960s, Balke developed a simple test for functional capacity evaluation, which measured the distance covered by a patient in a given time [7]. The 12-minute walk test was primarily designed for healthy individuals and then adapted for disability assessment in patients with chronic bronchitis [8]. Despite the modifications, the 12-minute walk test proved too physically challenging for the patients, while the 6-minute walk test was equally effective and informative [9]. The 6MWT is regarded as easier to perform, better tolerated and more reflective of the patients' daily activities in comparison with other tests [1].

One of the most easy and cheap method to assess physical capacity in people in ability to walk some distance in special conditions. This special distance achieved during walking, test has been used to assess response to different therapeutical interventions. In this way we can predict exertional desaturation in daily routine and need of long- term oxygen therapy, other hand we can predict morbidity and even possible mortality.

Walking is a natural part of daily routine. The 6MWT consists of measuring the distance that a patient can walk on a flat hard surface in a period of 6 minutes, as well as his perceived exertion resulting from the activity, measured according to the Borg scale. In order to perform the test, a 30-meters corridor is required. The 6MWT evaluates the integrated response of all human body systems, including the cardiovascular system, the pulmonary system and the locomotor system. Contrary to the maximal exercise tests, it does not provide specific information on the function, nor on the involvement of a specific organ or system in the response. The patients are allowed to choose their own pace, as well as the intensity of the exercise, or even take a rest during the test. Usually, the submaximal level of functional

capacity is achieved during the test. Since a comparable level can be accomplished in the course of basic daily activities, the 6MWT is considered to reflect the patients' functional capacity more adequately than other tests.

This article gives practical information about six minute walk test (6MWT). It reviews indications, contraindications, details about method, protocols points of its performance, safety measures, preparation of patients, clinical interpretation of results. Summary of information about application of 6MWT is according to recent and actual knowledge.

2. INDICATIONS FOR THE SIX- MINUTE WALK TEST

The test is used for exercise tolerance assessment in patients with cardiac insufficiency, chronic obstructive pulmonary disease, restrictive lung diseases, primary and secondary pulmonary hypertension or peripheral vascular diseases. The indications also include functional capacity evaluation in elderly patients or patients with chronic diseases eligible for rehabilitation. Besides, the 6MWT allows to assess treatment outcomes and determine prognosis in patients with cardiac insufficiency, respiratory failure and primary or secondary pulmonary hypertension. It is also recommended in postoperative thoracic or cardiac surgery patients (coronary artery bypass surgery, surgical treatment of congenital heart defects and acquired heart disease, heart transplantation) in order to assess the effect of cardio-pulmonary rehabilitation.

In conclusion, the indications for the 6MWT are:

- 1) the evaluation of exercise tolerance
- 2) the assessment of treatment outcomes
- 3) the determination of patient prognosis [2]

The 6MWT does not measure peak oxygen uptake, diagnose the cause of dyspnea or determine the causes and mechanisms of exercise limitation [4]. It provides information on the functioning of human body systems as an integrated whole. A significant correlation ($r = 0,73$) has been established between the 6 MWT results and peak oxygen uptake in patients with advanced lung diseases and pulmonary failure [10].

The indications for the 6MWT based on the guidelines of the American Thoracic Society are presented in Table 1.

Table 1. Indications for the six-minute walk test [1].

<u>Comparison of pre- and postoperative functional capacity</u>
Lung transplantation
Lung surgery (including lung resection, lung volume reduction)
Pulmonary rehabilitation
Chronic obstructive pulmonary disease
Pulmonary hypertension
Cardiac insufficiency

Assessment of functional capacity and exercise tolerance

Chronic obstructive pulmonary disease
Cystic fibrosis
Cardiac insufficiency
Peripheral vascular diseases
Fibromyalgia
Elderly patients

Prediction of morbidity and mortality

Cardiac insufficiency
Chronic obstructive pulmonary disease
Pulmonary hypertension

3. CONTRAINDICATIONS FOR THE SIX- MINUTE WALK TEST

Absolute contraindications for the six-minute walk test include the following [11, 12]:

- unstable angina (during the previous month according to the guidelines)
- heart failure exacerbation
- myocardial infarction during the previous month
- primary angioplasty for STEMI within 7-10 days
- elective coronary angioplasty within 24 h
- myocarditis or endocarditis
- symptomatic arrhythmia and/or conduction disorder
- acute deep vein thrombosis, pulmonary embolism, pulmonary infarction

Relative contraindications include:

- resting heart rate of more than 120
- systolic blood pressure of more than 180 mm Hg or diastolic blood pressure of more than 100 mm Hg; according to the Polish Respiratory Society guidelines: systolic blood pressure of more than 140 mm Hg, diastolic blood pressure of more than 90 mm Hg
- uncontrolled arterial hypertension

Patients with any of the aforementioned diseases or symptoms must not perform the test. At high-risk patients, it is recommended that the results of electrocardiogram done 6 months prior to the test be reviewed. Stable angina pectoris does not constitute an absolute contra-indication for the six-minute walk test. However, it is important that the patients' standard medication should be administered prior to the test and rescue nitrate medication be readily available during the test.

According to practical knowledge during the test patient can suffer from muscle pain, cramps, dyspnea, fatigue, uncontrolled balance problems. These symptoms are usually associated with basic diseases. It is very important for physician to properly examine patient before qualification and to analyse previous state of health with evaluation of complaints.

Patients from previously mentioned groups are at increased risk of arrhythmia and cardiovascular collapse during exercise testing. According to the guidelines, the patients should walk independently at their own pace during the test. If the symptoms occur, they are allowed to stop the test and rest. On the other hand, the 6MWT has become widely used in elderly patients and patients with heart failure or cardiomyopathy [16]. Based on medical studies, no significant adverse effects or complications during or after the 6MWT have been observed [13]. Nonetheless, several contraindications have been introduced with respect to the safety of the patients.

4. METHODOLOGY

Patient preparation:

- Comfortable clothing and appropriate shoes should be worn
- Routine medication should be continued and administered on the day of the test
- a light meal before the test is acceptable
- the patient should refrain from strenuous exercise within 2 hours before the test

Required equipment:

- stopwatch (mechanical lap counter)
- pulse oximeter
- path marking
- chair
- source of oxygen if needed
- medication: nitrates, aspirin, bronchodilators (inhalers or nebulisers, depending on patient's condition)
- sphygmomanometer
- telephone
- automated external defibrillator
- prepared worksheets

Before the 6MWT, blood pressure, heart rate and oxygen saturation should be measured; besides, the following anthropometric measurements should be taken: weight, height, BMI, waist circumference. The patient's perceived level of exertion and dyspnea ought to be assessed with the help of the Borg scale. After the preliminary tests, provided that no contra-indications have been found, the patient should be considered eligible for the 6MWT.

The 6MWT should be performed in clinically stable patients, after a 10-minute rest. During the test, the patient should walk along a flat, seldom travelled corridor (e.g. in a

hospital) of 30 metres minimum length, as mentioned in the guidelines. The walking course ought to be marked every 3 metres in order to facilitate the measurements. The starting line and turning points should also be marked. It is recommended that repeated testing take place in the same corridor or in a corridor of equal length [14]. The patient is instructed to walk independently at his own pace in the period of 6 minutes. After the test, the distance covered by the patient and his perceived level of exertion according to the Borg scale are evaluated. The patients are permitted to take a short rest during the test.

Table 2. Subjective, modified Borg scale for dyspnea and exertion

0	Dyspnea does not occur
0,5	Very, very slight dyspnea
1	Very slight dyspnea
2	Slight dyspnea
3	Moderate dyspnea
4	Somewhat severe dyspnea
5	Severe dyspnea
6	Dyspnea intensity between 5 and 7
7	Very severe dyspnea
8	Dyspnea intensity between 7 and 9
9	Almost maximal dyspnea
10	Maximal dyspnea

Table 3. 6MWT- report [1]

<p><u>This elements should be present on the 6MWT worksheet and report:</u></p> <p>Patient name and ID Date Gender: F/M Race Height Weight Blood pressure Medications taken before the test (dose and time) Supplemental oxygen during the test Start and End of Test time</p>

Heart Rate Dyspnea Borg scale Fatigue, SpO ₂ Pause or stopped before 6 minutes and the reasons Other symptoms at the end of exercise Number of lamps Total distance walked in 6 minutes Predicted distance Percent of predicted distance Interpretation

The 6MWT is safe – it does not require ECG monitoring. However, the use of pulse oximeter is recommended.

The test should be interrupted in the event of the following symptoms [1]:

- chest pain on walking
- dyspnea
- motor discoordination, balance disorder
- syncope, weakness
- diaphoresis, pallor
- saturation decrease below 85%
- intermittent claudication

In addition, blood pressure, heart rate and blood saturation should be taken immediately after the test and after a ten-minute rest. The patient's assessment of perceived exertion and dyspnea according to the Borg scale should also be repeated after the test.

5. INTERPRETATION OF RESULTS

The six minute walk test is used to assess the level of functional capacity and the level of adaptation to activities of daily living. During the test, distance covered by the patient and his perceived level of fatigue or dyspnea are evaluated. According to the results of relevant studies, the distance walked by a healthy subject on flat, hard surface in the course of 6 minutes ranges from from 400 to 700 metres [2]. Reference values for the average distance in a group of healthy men and in a group of healthy women ranged from 735 metres (\pm 98 metres) to 580 metres and from 657 metres (\pm 56 metres) to 500 metres, accordingly [15, 16].

The six minute walk distance is affected by [17] :

- age
- gender
- height
- body weight and waist circumference
- daily physical activity

- smoking
- cardiovascular diseases (coronary artery disease, past myocardial infarction, heart failure, peripheral atherosclerosis)
- respiratory diseases (chronic obstructive pulmonary disease, asthma, etc.)
- musculoskeletal diseases –muscle and joint diseases, osteoarthritis
- neurological diseases

Furthermore, pathologies such as renal failure, diabetes, anaemia, neoplastic diseases, infections and depression have been found to shorten the six-minute walk test distance [16].

The six-minute walk distance is considered to determine the final patient prognosis. It has been shown that a six-minute walk distance of below 300 metres is a negative prognostic factor. In patients with heart failure, the 6MWT result is considered an independent factor for sudden death [18].

A correlation has been found between the 6MWT results and peak oxygen uptake, which makes it a reliable method for functional capacity and disease progression assessment. An increase of more than 60 metres in the six-minute walk distance in subsequent tests is considered a significant improvement in terms of rehabilitation outcomes [19].

PREDICTED NORMAL VALUES FOR 6MWT [20]:

- predicted equation for males

$$6\text{MWT (m)} = 867 - (5,71 \times \text{age (years)}) + (1,03 \times \text{height (cm)})$$

- predicted equation for females

$$6\text{MWT (m)} = 525 - (2,86 \times \text{age (years)}) + (2,71 \times \text{height (cm)}) - (6,22 \times \text{BMI})$$

Factors decreasing 6 MWT include:

- older age
- shorter height
- female sex
- higher body weight
- cardiac disease
- pulmonary disease

Factors increasing 6 MWT:

- taller height
- male sex
- increased motivation
- past performance of the test
- muscle mass
- supplemental oxygen

Data according to: Bittner V., Singh S., *The six minute walk test*, The Cardiology Advisor, (2016)

6. APPLICATION IN CLINICAL PRACTICE

The 6MWT is used in the evaluation of rehabilitation eligibility and in the assessment of its functional outcomes. It is recommended when standard cardiac stress tests cannot be performed or are contraindicated [21]. The test allows to determine the appropriate level of exercise intensity in high-risk patients, particularly in postoperative cardiac surgery patients. After the sixth minute of the 6MWT, the oxygen uptake and maximum heart rate reach the anaerobic threshold [22], which is recommended in cardiac rehabilitation. Furthermore, the 6MWT has been proved useful in the diagnosis of cardiac sarcoidosis and the monitoring of its progression. The standard 6MWT has been proposed as an evaluation modality for cardiac rehabilitation [23].

The 6MWT has also found its application in exercise tolerance assessment in patients after coronary artery bypass surgery. The following factors: obesity, female gender, arterial hypertension and decreased forced vital capacity (FVC) have been found to reduce the six-minute walk distance in patients.

The 6MWT is useful in the evaluation of exercise tolerance in patients with cystic fibrosis considered for lung transplantation. It may provide important data for the diagnostic and therapeutic process, which could contribute to the assessment of the patient's general condition.

The 6MWT is widely used in the assessment of eligibility for rehabilitation and physiotherapy in patients with chronic obstructive pulmonary disease.

In patients who undergo preoperative functional capacity assessment prior to thoracic surgery, the 6MWT might constitute the basis for identification of patients at greater risk of postoperative pulmonary complications. The potential prognostic factors are: decreased values of the six-minute walk distance and reported symptoms [24].

The 6MWT showing validity, reliability and the capacity to detect changes in patients rehabilitation especially in pulmonology. In easy way it can identify the presence of exercise induced hypoxemia, patients disability. Other hand it can show by its interpretation benefits from exercise and give base for prescription of a walking programme [25].

7. CONCLUSIONS

The six minute walk test is a simple test used for the assessment of functional capacity, exercise tolerance and adaptation to activities of daily living. It is highly recommended by a variety of medical communities, including cardiologists, pulmonologists, rehabilitation physicians, physiotherapists. New branches of its application constitute interventional branches of medicine as surgery- especially possibility of it use during the classification to operations. It can be performed both during hospitalisation and in outpatient care. It should be used as a diagnostic test in the evaluation of effects of medical interventions and rehabilitation, as well as in the determination of patient prognosis. In comparison with other exercise tests, the 6MWT is better tolerated by patients. During the test, the submaximal level

of functional capacity is achieved, which corresponds approximately to the effort required to perform basic daily activities. This test is relevant for elderly patients with limited tolerance of exercise. It leads to the conclusion that the 6MWT reflects the patients' functional capacity and their adaptation to activities of daily living better than other exercise tests.

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