

6-MINUTE WALK TEST ON THE TREADMILL IN THE PROCESS OF EFFORT TOLERANCE ASSESSMENT IN PATIENTS WITH COPD

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SUMMARY

Treadmill test, cycloergometer test and walk tests are used to assess effort tolerance in patients with COPD. The 6-minute walk test (6MWT) is an easy and objective tool frequently used in clinical practice. The 6-minute walk test is used to assess effort tolerance in the process of qualification for an adequate model of pulmonological rehabilitation and as a way of assessing the effects of physiotherapy. The objective of this work was to verify the usefulness of the 6-minute walk test on the treadmill for effort tolerance assessment in patients with COPD.

The research included 33 in-patients with COPD (18 males and 15 females) treated in MSWiA Hospital in Glucholazy. Before therapy, all patients were given a 6-minute walk test conducted in the hospital corridor and a 6-minute walk test on the treadmill. Distance, average walk speed and energy expenditure were recorded for each patient. Obtained data was subjected to statistical analysis with the use of the Wilcoxon Test with the level of statistical significance at $p < 0.05$ for all tests.

The comparison of the results achieved by the patients in the 6-minute walk test carried out in the hospital corridor and the results of the 6-minute walk test conducted on the treadmill showed significant differences between these two test methods within the same group of patients. The differences in the values of parameters indicating both distance and MET in the two tests were of statistical significance ($p < 0.05$).

Significantly higher parameter values indicating distance covered and MET were observed in the patients tested in the hospital corridor. The 6-minute walk test on the treadmill should not be used as an alternative to other tests for effort tolerance assessment for the same patients.

Keywords: 6-min walk test, COPD, physiotherapy.

INTRODUCTION

Increasing effort tolerance in patients with COPD is related to applying physical workload of appropriate intensity adjusted individually for each patient [1, 2, 3, 4].

Treadmill test, cycloergometre test and walk tests are used to assess effort tolerance in patients with COPD. The 6-minute walk test (6MWT) is an easy and objective tool frequently used in clinical practice. It allows assessment of most systems and organs involved in physical effort [5].

So far, there have been no complex studies related to the possibility of using the 6-minute walk test on the

treadmill as an alternative to other test methods for effort tolerance assessment in patients with COPD.

Objective. The 6-minute walk test is used to assess effort tolerance in the process of qualification for an adequate model of pulmonological rehabilitation and as a way of assessing the effects of physiotherapy.

The aim of this work was to verify the usefulness of the 6-minute walk test on the treadmill for effort tolerance assessment in patients with COPD.

METHODS

The research included 33 in-patients with COPD (18 male and 15 female) treated in MSWiA Hospital in Glucholazy. Random selection was used to chose patients for the test. All patients were given a 6-minute walk test conducted in the hospital corridor and a 6-minute walk test on the treadmill. Median age of the patients was 60.8 ± 7.7 years. Both before and after the test, all patients' blood pressure, pulse and saturation were checked and dyspnea and tiredness levels were measured on the 20-point Borg scale.

The results obtained in the corridor 6-minute walk test and the treadmill 6-minute walk test were subjected

to statistical analysis. Distance, average walk speed and energy expenditure were measured.

The corridor 6-minute walk test involved covering the longest possible distance within the time limit of 6 minutes. The test was conducted in the hospital corridor, 30 meters in length and 3 meters in width. The starting line and the turning point were marked with posts. For quick and accurate measurement, the distance was divided into 3-meter segments.

A stopwatch, lap measuring device, chair, posts, manometer and Borg's dyspnea and tiredness questionnaire were used to conduct the test. Within the

two hours prior to the test, the patients were not allowed to do intensive exercise.

Comparative tests in the same group of patients were conducted twice using the ERT 100 treadmill one day after the first test. The first test on the treadmill was a control test to instruct patients on how to walk on the treadmill. The results of the second 6-minute walk test on the treadmill were analyzed. The total distance covered was not visible to patients while the 6-minute walk test on the treadmill lasted. The initial speed was 3 km/h. Before the test, patients were asked to fill in the 20-point Borg scale dyspnea and tiredness protocol. They were instructed how to increase and reduce treadmill speed and how to stop and re-start the treadmill. Blood pressure, pulse and saturation were monitored throughout the test.

Based on the walk distance and time, walk speed and energy expenditure levels were calculated [6].

Average walk speed of the patients was calculated using the following formula:

$$\text{Average walk speed} = (\text{number of meters} \times 10) / 1000$$

In case of patients who covered the distance below 250 meters, energy expenditure was calculated using the formula:

$$\text{MET} = [(V \times 1.667) + 3.5] / 3.5$$

In case of patients who covered the distance above 250 meters, energy expenditure was calculated using the formula:

$$\text{MET} = -0.0971 \times V^3 + 1.5021 \times V^2 - 5.3762 \times V$$

In the formulas V represents average walk speed [7, 8].

Obtained data was subjected to statistical analysis with the use of nonparametric Wilcoxon test, with the level of statistical significance $p < 0.05$ for all tests.

RESULTS

All patients completed both tests in the full time limit. Average distance covered in the corridor 6-minute walk test was 512 ± 85 m, whereas average distance achieved in the treadmill 6-minute walk test was 425 ± 83 m. The distance covered in the 6-minute walk test conducted in the hospital corridor was 18.6% longer than the distance achieved in the 6-minute walk test conducted on the treadmill.

Energy expenditure expressed in MET in the corridor test amounted to 7.3 ± 1.9 MET and in the treadmill test it came to 5.7 ± 1.4 MET. Energy expenditure expressed in MET was 21.5% higher in the 6-minute walk test on the treadmill (Figure). The difference was of statistical significance at the level of $p < 0.05$ [Table 1, 2].

Table 1. Comparison of the 6-minute walk test in the corridor and on the treadmill

Parameter	Corridor	Treadmill	Difference	T
Distance	512 ± 85 m	425 ± 83 m	18.6%	$p < 0.05$

Table 2. Comparison of average energy expenditure expressed in MET

Parameter	Corridor	Treadmill	Difference	T
MET	7.3 ± 1.9	5.7 ± 1.4	21.5%	$p < 0.05$

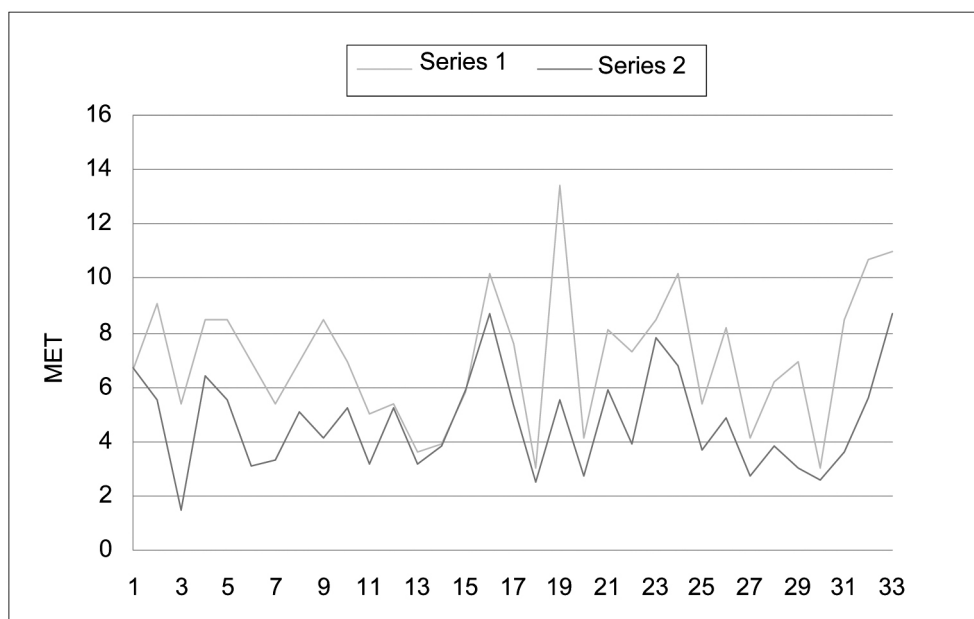


Figure. Comparison of effort tolerance level in the 6-minute walk test in the corridor (Series 1) and on the treadmill (Series 2)

DISCUSSION

The walk test was first used in clinical practice in patients with respiratory system diseases in the 70s of the twentieth century. It was not until the mid-80s that the test was used for assessment of effort tolerance in patients with chronic heart failure. Currently it is most frequently used with patients suffering from COPD [8, 9].

The 6-minute walk test, commonly known as the corridor test, is a modification of the 12-minute walking test suggested by McGavin. It is used in clinical practice and clinical tests for effort tolerance assessment, rehabilitation qualification, verification of physiotherapy effects and assessment of functional state of patients with respiratory system diseases [10, 11]. The 6-minute walk test can, to a great extent, replace standard exercise tests assessing respiratory and circulatory systems' diseases for many reasons. Its major advantages include the low cost of conducting the test, its simplicity, repeatability and minimal equipment requirements [12]. Although American Thoracic Society recommends conducting the tests in the corridor, some institutions use only the treadmill test. It results from lower space adaptation requirements for conducting the test and the need for constant monitoring of the patient during effort [13].

The objective of the research was to examine the possibility of alternative use of the 6-minute walk test in the corridor and the 6-minute walk test on the treadmill for the purpose of effort tolerance assessment in patients with COPD and for qualification for appropriate rehabilitation model. Research showed that there are significant differences between the results of the two tests conducted in the same group of patients. Therefore, it seems that these two tests should not be used interchangeably. It would require drawing up a new formula for calculating energy expenditure expressed in MET to be used for the 6-minute walk test on the treadmill.

A. F. Lanssen et al. [14] tested a sample of 69 patients to check how close the 6-minute walk test in the corridor and the treadmill test agree. The tests were conducted in the University Center in the Netherlands. Average distance covered in the corridor test (547 ± 103) was slightly longer than the distance recorded on the treadmill (538 ± 124). Since the difference between average distances covered in the two tests was not significant, it

cannot be concluded that walking on the treadmill is more difficult and requires more advanced skill. Due to wide individual differences, and consequently, big discrepancy between the results of the two test methods, the tests are not interchangeable.

In their research, D. Stevens et al. [15] compared the 6-minute walk test conducted in the corridor with the test on the treadmill. Average distance covered in the corridor test amounted to (1228 ± 255 m), whereas average distance covered in the treadmill test was (1060 ± 389 m) with $p < 0.05$. The results of the tests conducted on the treadmill were significantly different from the results of the corridor tests. The difference amounted to 168 ± 280 m. The distance covered in the corridor tests was longer than the distance in the treadmill tests. D. Stevens claimed that the difference might possibly result from unfamiliarity with the technique of walking on the treadmill.

D. A. Redelmeier et al. [16] showed that the smallest difference between the covered distance recorded in tests, resulting in noticeable clinical difference between the two tests is 54 m. S. T. O'Keeffe et al. [17] reduced this distance difference to 43 m. C. Opasich et al. [18] claimed that minimal differences in the distance which can be considered representative of real difference between the two tests amount to approximately 10%.

D. Swents et al. [15] compared the distance results achieved by patients with acute COPD with the use of the 6-minute walk test in the corridor and the 6-minute walk test on the treadmill. The study showed that the distance covered in the corridor was significantly longer than the distance on the treadmill.

M. D. Chang et al. [19] showed in their research that the higher discrepancy of the distance covered in the 6-minute walk test on the treadmill might result from the lack of skill of walking on the treadmill which probably reduces the speed of walking during the test. Result analysis showed that the difference between the distance covered in the 6-minute walk test in the corridor and the 6-minute walk test on the treadmill is too big for the two tests to be used interchangeably. It might be assumed that patients cover longer distance in the corridor test due to the fact that it is closer in nature to their real functional abilities.

CONCLUSIONS

1. Research showed significant differences in the assessment of effort tolerance in patients with COPD with the use of the two test methods.

2. Significantly higher values of parameters indicating covered distance and MET were observed in patients given the corridor test.

3. The 6-minute walk test on the treadmill should not be used as an alternative to other tests for effort tolerance assessment for the same patient.

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ŠEŠIŲ MINUČIŲ ĖJIMO BĖGTAKIŲ TESTAS, VERTINANTIS SERGANČIŲJŲ LĖTINĖ OBSTRUKCIINĖ PLAUČIŲ LIGA PASTANGŲ TOLERANCIJĄ

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SANTRAUKA

Bėgtakio, veloergometro ir ėjimo testai naudojami sergančiųjų LOPL (lėtine obstrukcinė plaučių liga) pastangų tolerancijai įvertinti. Šešių minučių ėjimo testas (6MET) yra patogus ir objektyvus, todėl dažnai naudojamas klinikinėje praktikoje. Juo vertinama pastangų tolerancija, kai siekiama paskirti tinkamą pulmonologinę reabilitaciją ir įvertinti kineziterapijos poveikį. Tyrimo tikslas – patikrinti šešių minučių ėjimo bėgtakio testo naudingumą vertinant LOPL ligonių pastangų toleranciją.

Buvo tiriami 33 stacionarus ligoniai, sergantys LOPL (18 vyrų ir 15 moterų) ir gydomi Glucholazų MSWiA ligoninėje. Prieš gydymą ligoniai atliko 6 MET ėjimo ligoninės koridoriumi ir bėgtakio testus. Buvo užrašomas kiekvieno ligonio nueitas atstumas, vidutinis ėjimo greitis ir energijos sąnaudos. Gauti duomenys analizuojami statistiškai taikant Vilkoksono testą ir pasirenkant statistinio reikšmingumo lygmenį $p < 0,05$ visiems testams.

Šešių minučių ėjimo koridoriumi ir ėjimo bėgtakio testai parodė, kad ėjimo bėgtakio testo rezultatai statistiškai reikšmingai skyrėsi nuo ėjimo koridoriumi rezultatų toje pačioje ligonių grupėje. Abiejų testų metu nueito kelio ir MET įverčiai taip pat skyrėsi statistiškai reikšmingai ($p < 0,05$).

Tirtų ligonių grupėje nueito kelio ir MET įverčiai skyrėsi statistiškai reikšmingai ir buvo didesni atliekant ėjimo koridoriumi testą. Šešių minučių ėjimo testas bėgtakio neturėtų būti taikomas kaip alternatyvus metodas vertinant tų pačių ligonių pastangų toleranciją.

Raktažodžiai: 6 min ėjimo testas, lėtinė obstrukcinė plaučių liga, kineziterapija.