SIX MINUTE WALK TEST: A LITERARY REVIEW

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ABSTRACT:

Exercise testing forms an important part in assessment of any patient requiring physical training. The methods of such exercise testing have undergone enormous changes Apart from being a basis for training; such testing procedures have helped to delineate patients having high risk from beneficiaries for major surgical procedures. The conventional methods of physical capacity evaluation needed many sophistications and facilities to make them reliable and safe. In developing country like India, the cost of treatment burdens the patient, as most is spent on initial assessment. Moreover periodic evaluation is precluded due to lack of the required setting all times. Thus, the usage of field tests gained importance, as they are noninvasive, easy to administer, patient friendly and cost effective. Initially twelve-minute walk test (TMWT) was developed to assess the exercise capacity of patients with respiratory dysfunction, as they were unable to complete the conventional sub maximal exercise testing. The TMWT also posed limitation to patients with moderate to severe cardio respiratory dysfunction. Hence Six-minute Walk Test (SMWT) was developed and validated in different patient groups. The importance of SMWT was recognized and usage widened from being a basic exercise testing of patient to the level of prediction of patient outcomes, reflection of quality of life, prediction of mortality and morbidity. This review intends to describe and analyse the clinical utility of the most widely used field test. It also outlines the limitations and future applications to be explored.

Key words : *Six minute walk test, exercise testing, Cardiopulmonary rehabilitation*

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INTRODUCTION:

Exercise testing is an important component of initial patient assessment in cardiac rehabilitation. Assessment of functional exercise capacity has gained importance in the patient care in various diseased states. Timed walking tests are widely used to evaluate functional exercise performance, as they are likely to measure the ability to undertake the activities of day-to-day life. Functional capacity is an important clinical outcome measure in rehabilitation of any patient and thus necessitating an exercise testing procedure.[1]

Assessment of functional capacity was traditionally done by asking patients about the work capacity like how many times they climb stairs, or how much they walk etc. However these recollection methods and questionnaire methods most often report over estimation or under estimation of the true functional capacity.

Exercise Testing:

An objective exercise testing procedure was developed by using a treadmill or bicycle ergo meter to determine maximal exercise capacity. Maximal exercise testing has been extensively validated for diagnosis, prognosis and exercise prescription. Maximal exercise testing requires specialized facilities, equipment and personnel and is associated with considerable cost. However, most of the human activities are always associated with sub maximal exercise capacity level. Hence sub maximal exercise testings were considered to be safe and feasible for more debilitated patients or patients with low exercise capacity or high risk population for graded, maximal exercise testing.

Field tests:

In 1960's Balke developed a simple walk test with defined period of time [2,3] which was later modified to twelve minute walk test.[4] When this 12 minute walk test was performed in patients with respiratory and cardiac problems, it was too exhausting[5] and therefore a six minute walk test was developed which is easy to administer, better tolerated and more reflective of daily activities of living.[6] The six minute walk test was developed by Guyatt *et al*. for exercise testing before exercise prescription.[3]

Lipkin has first introduced the 6MWT as a functional exercise test in 1986. Its results were highly correlated with those of the 12-minute walk test from which it was derived and with those of cycle ergometer or treadmill based exercise tests. The 6MWT was also found to be a valuable instrument to assess progression of functional exercise capacity in different clinical intervention studies.

In a cardiac rehabilitation set up while prescribing exercises, six minute walk test as originally described by Guyatt et el[3] can be used for both initial assessment and document functional outcomes after completion of cardiac rehabilitation program.[7] There are equations in six-minute walk test using which, the distance walked can be converted into a measure of functional capacity [vo2max].[8,9] The distance walked can be used as the marker of disease, severity, and prognosis and as the outcome measure in clinical trail testing in medical and surgical procedural therapy.

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Validity and Reliability of SMWT:

Usually age, gender, height, body mass determine the walk performance in adult population.[10,11,12] According to American association of cardiovascular and pulmonary rehabilitation (AACVPR) risk stratification most of the adults having history of sedentary life style and low physical function, determined by SF 36 questionnaire[7], showed corresponding low performance in SMWT. There are several studies that have assessed the correlation between the functional capacity derived out of 6MWT and symptom limited graded exercise testing and found to be highly correlated.[13]

There is maximum correlation in the rehabilitation equivalent value when compared to rate of perceived exertion suggesting that the 6MWT is more a sub maximal exercise test [4,14] and hence can be considered as the exercise testing procedure in cardiac rehabilitation set up.[15]The reliability of the test in healthy elderly persons and patients were high (Intra Class Correlation = 0.93) and it has been established as a valid and reliable test to assess the exercise capacity of various patient groups.[7]

The baseline 6MWT distance in (UAB) University of Alabama at Birmingham cardiac rehabilitation (9) program of ischemic heart disease patients in total number of n = 30 was mean equivalent to 1351 feet $\pm$ 361.(411meter) with minimum value of 120ft (36meters) and maximum value of 2322ft (707meters). A British cardiac rehabilitation program reported an improvement in 6-min walk distance from 1032 $\pm$ 249 to 1238 $\pm$ 258 ft over 6 weeks of training (two exercise sessions per week) but did not indicate the proportion of patients improvement.[7]

Technical Aspects of the 6mwt:

A complete description of the test is given by ATS.[12]

Location

The 6MWT should be performed indoors, along a long, flat, straight, enclosed corridor with a hard surface that is seldom traveled. If the weather is comfortable, the test may be performed outdoors. The walking course must be 30 m in length. A 100-ft hallway is, therefore, required. The length of the corridor should be marked every 3 m. The turnaround points should be marked with a cone (such as an orange traffic cone). A starting line, which marks the beginning and end of each 60-m lap, should be marked on the floor using brightly colored tape.

Required Equipment

1. Countdown timer (or stopwatch)
2. Mechanical lap counter
3. Two small cones to mark the turnaround points
4. A chair that can be easily moved along the walking course
5. Worksheets on a clipboard
6. A source of oxygen
7. Sphygmomanometer
8. Telephone
9. Automated electronic defibrillator

Patient Preparation

1. Comfortable clothing should be worn.
2. Appropriate shoes for walking should be worn.
3. Patients should use their usual walking aids during the test (cane, walker, etc.).
4. The patient's usual medical regimen should be continued.
5. A light meal is acceptable before early morning or early afternoon tests.
6. Patients should not have exercised vigorously within 2 hours of beginning the test.

Measurements

1. Repeat testing should be performed about the same time of day to minimize intraday variability.
2. A "warm-up" period before the test should not be performed.
3. The patient should sit at rest in a chair, located near the starting position, for at least 10 minutes before the test starts. During this time, check for contraindications, measure

   Pulse and blood pressure, and make sure that clothing and shoes are appropriate.
4. Pulse oximetry is optional. If it is performed, measure and record baseline heart rate and oxygen saturation (SpO 2) and follow manufacturer's instructions to maximize the signal and to minimize motion artifact. Make sure the readings are stable before recording. Note pulse regularity and whether the oximeter signal quality is acceptable.
5. Have the patient stand and rate their baseline dyspnea and overall fatigue using the Borg scale
6. Set the lap counter to zero and the timer to 6 minutes. Assemble all necessary equipment (lap counter, timer, clipboard, Borg Scale, worksheet) and move to the starting point.
7. Instruct the patient as follows:

   "The object of this test is to walk as far as possible for 6 minutes. You will walk back and forth in this hallway. Six minutes is a long time to walk, so you will be exerting yourself.

   You will probably get out of breath or become exhausted. You are permitted to slow down, to stop, and to rest as necessary. You may lean against the wall while resting, but resume walking as soon as you are able. You will be walking back and forth around the cones. You should pivot briskly around the cones and continue back the other way without hesitation. Now I'm going to show you. Please watch the way I turn

without hesitation." Demonstrate by walking one lap yourself. Walk and pivot around a cone briskly. "Are you ready to do that? I am going to use this counter to keep track of the number of laps you complete. I will click it each time you turn around at this starting line.

Remember that the object is to walk as far as possible for 6 minutes, but don't run or jog. Start now or whenever you are ready."

8. Position the patient at the starting line. You should also stand near the starting line during the test. Do not walk with the patient. As soon as the patient starts to walk, start the timer.
9. Do not talk to anyone during the walk. Use an even tone of voice when using the standard phrases of encouragement. Watch the patient. Do not get distracted and lose count of the laps. Each time the participant returns to the starting line, click the lap counter once (or mark the lap on the worksheet). Let the participant see you do it. Exaggerate the click using body language, like using a stopwatch at a race.

   After the first minute, tell the patient the following (in even tones): "You are doing well. You have 5 minutes to go." When the timer shows 4 minutes remaining, tell the patient the following: "Keep up the good work. You have 4 minutes to go." When the timer shows 3 minutes remaining, tell the patient the following: "You are doing well. You are halfway done." When the timer shows 2 minutes remaining, tell the patient the following: "Keep up the good work. You have only 2 minutes left." When the timer shows only 1 minute remaining, tell the patient: "You are doing well. You have only 1 minute to go." Do not use other words of encouragement (or body language to speed up). If the patient stops walking during the test and needs a rest, say this: "You can lean against the wall if you would like; then continue walking whenever you feel able." Do not stop the timer. If the patient stops before the 6 minutes are up and refuses to continue (or you decide that they should not continue), wheel the chair over for the patient to sit on, discontinue the walk, and note on the worksheet the distance, the time stopped, and the reason for stopping prematurely. When the timer is 15 seconds from completion, say this: "In a moment I'm going to tell you to stop. When I do, just stop right where you are and I will come to you." When the timer rings (or buzzes), say this: "Stop!" Walk over to the patient. Consider taking the chair if they look exhausted. Mark the spot where they stopped by placing a beanbag or a piece of tape on the floor.
10. Post-test: Record the post walk Borg dyspnea and fatigue levels and ask this: "What, if anything, kept you from walking farther?"
11. If using a pulse oximeter, measure SpO 2 and pulse rate from the oximeter and then remove the sensor.
12. Record the number of laps from the counter (or tick marks on the worksheet).
13. Record the additional distance covered (the number of meters in the final partial lap) using the markers on the wall as distance guides. Calculate the total distance walked, rounding to the nearest meter, and record it on the worksheet.
14. Congratulate the patient on good effort and offer a drink of water.

Clinical Application:

Initially, SMWT was used as field test to monitor the outcomes of therapy specifically in pulmonary conditions; Later was used to assess the exercise tolerance in patients with low work capacity and high risk group for graded, maximal exercise testing. Thus, gradually SMWT was used in cardiac rehab programs with validation with standard testing protocols and self-reported measures.[15, 16, 17] The 6MWT data guides the exercise prescription in cardiac Rehabilitation by making use of American College of Sports Medicine (ACSM) working equation.[13]

Example of Using 6-Min Walk Data for Exercise Prescription

Distance walked by the patient: 420 metres in 6 min.Calculate walking speed: Calculate speed in m/min: 420 m/6 min = 70m/min Calculate metabolic value for walking without grade:1 MET = 3.5ml/kg/min; 0.1 is the constant for converting m/min to ml/kg/min Estimated oxygen consumption(V)2) = 3.5ml/kg/min + O2 consumed in 6MWT(in ml/kg/min)Thus, VO2 = 3.5ml/kg/min + 70m/min × 0.1 = 3.5 + 7ml/kg/min = 10.5 ml/kg/min.MET level achieved: 10.5 ml/kg/min/3.5 = 3 METs. Metabolic value can be used for exercise prescription on apparatus other than treadmill MET, metabolic equivalent.

Using the cahalin formula [VO2 MAX = 0.006 X 6MWD (FEET) + 3.38 also can be used Walter villobos *et al.*, have concluded in their study that 6MWT is more reliable in cardiac rehabilitation and have better correlation in term of Vo_2 Max.[16, 17] In their study they also concluded patients with a 6MWD of less than 360 have low level exercise capacity and those with 6MWD great than 546 have moderate to high level of exercise capacity. They also use an equation to find the predicated value for 6MWT equation 218 + (5.14 X HT IN CM – 5.32 X AGE) – (1.80 X WT + 51.31). It is observed that in healthy individuals will have a predicted 6MWD of 631 ± 93meter.

Widening Horizons:

Six-minute walk test is a universally accepted field test. It is safe, simple and well tolerated by most patients, even by frail elderly. It is reliable and feasible for many patient populations including the renal patients. The six-minute walk test (SMWT) is a simple, safe, and inexpensive test that uses an exercise mode relevant to everyday activities. The SMWT is a good measure of functional exercise ability because it is self-paced and sub maximal

in nature. The SMWT is also well-accepted by patients, easily administered, and easily reproduced.[15-20] Recent studies indicate that Six minute walk distance predicts the mortality in different groups of patients. The SMW distance was found to be correlated with mortality prediction inpatients with colon cancer and lung transplant.[21, 22] It is quite interesting to note that a recent study have found the prediction ability of the SMWT in patients waiting for liver transplant, which was equivalent to predictability as that of MELD (Model for End stage Liver Disease) score which is used for prioritizing patient waiting for liver transplantation.[23] Thus, the applications of SMWT extends beyond Cardiopulmonary testing and monitoring therapy response.

Limitations:

The SMWT could an useful method for fragile, debilitated individual but may not be a suitable tool for normal subjects and sports training as it does not show a correlation with maximal exercise testing in this population. Moreover, it has value of correlation rather than exact measure of sub-maximal exercise capacity of an individual.[12, 18] However, psychological factors such as depression and cognitive impairment all have a negative effect on the timed walking distance.[24] The SMWT interpretation should include consideration of vascular, pulmonary, and musculoskeletal exercise limitations, as the mechanisms to limitation in the physical capacity might not have same physiological process and may have confounding variables also.[25] The reliability in prediction of changes in VO_2 max among the patients awaiting cardiac transplantation still remains unestablished.[26]

Future directions:

The SMWT is well established for safe clinical test for variety of patients. As its role expands to prediction of outcomes of patients requiring surgical interventions and high risk individuals, the test needs to carefully used with due precautions taking into consideration of the limitations. The normative data, effects of medications, nutritional status, and level of racial differences in patient groups needs further testing before generalization. The predictive valve still needs clarification due to less number of published data in various conditions other than cardiac and pulmonary diseases and need to consider the confounding variables as SMWT could not point out the source of deficit in all patients.

Conclusion:

Six minute walk test is a simple, valid and reliable field test with high level of patient compatibility and clinically sensitive with predictive of outcomes in different groups of cardiac and pulmonary patients. The normative and comparative data in Indian population for various groups is yet to be established, which could provide more insight on the minimal standards of exercise tolerance and predictive values in those patients. Thus, SMWT could serve as a clinically useful tool facilitating efficient method of estimating an individual's physical capacity with a functional test. The SMWT should be considered as useful complementary information about the functional status of patients with cardiovascular or pulmonary disease, while the utility needs further testing in other groups of patients.

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