

Role of six minute walk test in the evaluation of patients with chronic respiratory diseases

Prasad C N¹, Reddy C S K², Momin S K³

¹Professor, ²Postgraduate student, ³Assistant Professor, Department of Respiratory Medicine, Prathima Institute of Medical Sciences, Nagunur, Karimnagar, Telangana, India.

Address for correspondence: Dr C N Prasad, Professor, Department of Respiratory Medicine, Prathima Institute of Medical Sciences, Nagunur, Karimnagar, Telangana, India.

Email : seeprasad@gmail.com

ABSTRACT

Background: Six minute walk test (6 MWT) is an inexpensive, reliable and repeatable test for the functional assessment of subjects with chronic respiratory diseases.

Aims and Objectives: 1. To estimate the distance travelled on 6 MWT (6 MWD) by patients with chronic respiratory diseases. 2. To find any correlation between symptoms and 6 MWD in subjects with chronic respiratory diseases. 3. To find any correlation between spirometry based functional grading and 6 MWD in chronic respiratory disease subjects.

Materials & Methods: A total of forty two subjects were taken into the study who were having chronic respiratory diseases like COPD, Bronchiectasis, Tubercular fibrosis, Bronchial asthma, Diffuse parenchymal lung diseases etc. All the subjects underwent physical, radiological, spirometry and 6 MWT. Subjects were classified according to the grading on breathlessness, spirometry and performance on 6 MWT.

Results: Significant correlation was obtained when spirometry based functional grading was compared with impairment on 6 MWT. Significant correlation was also observed when grading of breathlessness was compared with performance on 6 MWT.

Conclusion: Study results correlated with other studies. This is a first study which evaluated 6 MWT in different diseases chronically affecting the respiratory system.

Keywords: Chronic obstructive airway diseases, Bronchiectasis, Diffuse parenchymal lung diseases, Six minute walk test

INTRODUCTION

The Six minute walk test (6 MWT) evaluates the integrated responses of respiratory system, cardiovascular system, blood and neuromusculoskeletal system.¹ The ability to walk for a distance is a quick and inexpensive measure of physical function and an important component of quality of

life, since it reflects the capacity to undertake day to day activities.² The six minute walk test is the most frequently used exercise capacity assessment for patients with chronic lung diseases.³ The distance walked in six minute is reduced by several types of diseases, including obstructive lung disease, cardiac failure, arthritis and neuromuscular diseases.⁴ 6 MWT is considered an important tool in pulmonary rehabilitation programme for COPD patients.⁵ By excluding patients with neuromuscular disease and arthritis, 6 MWT forms an inexpensive, reliable, repeatable test for the functional assessment of subjects with chronic lung diseases. Several studies have been reported in various journals where 6 MWT used and 6 minute walk distance (6 MWD) was estimated either among healthy subjects or among subjects with individual respiratory or cardiac diseases. Keeping the above in perspective, we have conducted 6 MWT to estimate the distance travelled (6 MWD) among subjects with various chronic respiratory diseases and evaluate the factors that may affect the distance travelled in these subjects.

MATERIALS AND METHODS

This study is a prospective and observational study conducted in the Pulmonology department of Prathima Institute of Medical Sciences, Karimnagar, Telangana in consecutive patients with chronic respiratory diseases. The period of study was between September 2014 and August 2016. The diagnosed cases of chronic respiratory diseases which included Bronchial asthma, COPD, Bronchiectasis, Interstitial lung disease and subjects who were in stable clinical condition at the time of the study and willing to participate were included. Subjects with active acute neurological, rheumatological, peripheral vascular or coronary arterial disease were excluded.

The six minute walk test was performed according to the ATS guidelines⁶ and it was supervised by a trained respiratory technician throughout the test.

The subjects were asked to walk at their own pace to as much distance as possible for six minutes. The course was a 30 meter long and straight hospital outpatient department

hallway marked at two meter intervals. The subjects were instructed to stop and if required sit if they developed any symptom like dyspnea, fatigue, chest pain, cramps etc. The subjects were allowed to resume the walk and the resting time was also included in the given six minutes. Any subject who did not want to continue the test was allowed to stop and their walked distance was noted. After the six minute walk test, the distance walked was duly noted to the last meter.

The patients symptoms were noted and treatment given accordingly. Saturation of Oxygen, heart rate, blood pressure was noted immediately after the test. The predicted values were calculated based on the Indian standards given by Ramanathan and team.⁷ The values for males is: $561.022 - [2.507 \times \text{age}(\text{years}) + 1.505 \times \text{weight}(\text{kg}) - 0.055 \times \text{height}(\text{cm})]$ The values for females is: $-30.425 - [0.809 \times \text{age}(\text{years})] - [2.074 \times \text{weight}(\text{kg})] + [4.235 \times \text{height}(\text{cm})]$. The percentage of the predicted value was calculated and the subjects were divided into normal (> 80 %), mild impairment (60 – 79 %), moderate impairment (40 – 59 %) and severe impairment (< 40 %). Similarly spirometry was performed either a day earlier or after the 6MWT. The spirometry was performed according to the standard protocol⁸ and the subjects were graded according to the standards. Prior to the test the patient's symptoms were evaluated. All the available past records were thoroughly examined. General physical and systemic examination was done and subjects who were not fitting into the inclusion criteria were excluded from the study. The following parameters were noted before and after the test: Pulse rate, systolic and diastolic blood pressure, saturation of Oxygen and respiratory rate. Post exercise symptoms of dyspnea, chest pain, fatigue, cramps etc were enquired upon and noted. Prior permission was taken from the institutional ethics committee.

Statistical analysis: Statistical analysis was performed using SPSS version 20. Wherever required test, ANOVA was calculated for quantitative variables and for qualitative variables Chi square test and Fischer's exact test was used. Pearson's correlation was estimated for normally distributed variables and Spearman's sign rank test was used for non normally distributed variables.

RESULTS

Our study consisted of forty two subjects among which 23 (54.8%) were males and 19 (45.2%) were females. The mean age in our study group was 51.69 ± 14.63 years (range 17 years to 85 years). (Table. No. 1) About 35 % of the subjects were illiterate (n= 15), 23.8% (n=10) completed up to primary education and 28.6% (n=12) completed up to secondary education. There were four subjects who completed intermediate and one subject was a graduate. There were about 48.8 % laborers (n = 20). The predominant symptoms observed were cough and breathlessness. Cough was found in

92.9% (n= 39) and among them 27 subjects (64.3%) complained of chronic cough. Most of the subjects had cough associated with expectoration (n= 34, 81%). Breathlessness was found in 92.9%. Among them 7.7% had grade I breathlessness according to NYHA classification of breathlessness.⁹ 42.9% had grade II breathlessness, 26.2% had grade III breathlessness and 16.7% had grade IV breathlessness. Thus 85.7% had higher grade of breathlessness at the time of presentation. About 29 subjects (69%) complained of wheeze along with breathlessness. Other symptoms include fever (11.9%) and small joints pain (11.9%). The number of smokers in our study was fourteen (33.3%). Thirteen (31%) were alcoholics. The chest X-ray did not reveal any abnormality in eleven (26.2%). Twelve subjects (29%) had emphysematous changes. Six (14%) had interstitial patterns and five (11.5%) showed bronchiectasis. (Table No. 1) All the suspected interstitial patterns were confirmed by the HRCT scan of the chest.

Spirometry was performed in all the subjects with pre and post bronchodilation. Normal values on spirometry were observed in 11.9 % (5). Majority of the subjects showed obstructive pattern (59.5%) and 19% showed restrictive pattern. Four subjects (9.5%) showed a mixed pattern. (Table No. 2) Among a total of 29 subjects with obstructive pattern eight (19%) showed a mild severity, eleven (26.2%) showed moderate severity and ten (23.8%) showed severe obstructive severity. Twenty one subjects showed a post bronchodilator response. Small airway disease pattern on spirometry was seen in 78.6% (n=33). Restrictive pattern was seen in twelve subjects (28.6%). Mild severity was seen in 4.8%, moderate in 11.9% and severe in 11.9%. Distance travelled after six minute walk test was noted for all the subjects and severity of impairment was assessed based on standard comparison values. Thus we have divided the subjects into normal, mild, moderate and severe impairment groups. About 23.8% showed normal values, 45 % showed mild impairment, 28.6% showed moderate impairment and one subject (2.3%) showed severe impairment.

The study group consisted of subjects with chronic respiratory diseases with varying severity. There were 14.3% with bronchial asthma, 26.2 % with COPD, 19% with interstitial or diffuse parenchymal lung diseases, 11.9% with bronchiectasis, 14.3% with parenchymal fibrosis secondary to old tuberculosis. 4.8% showed features consistent with byssinosis and obstructive sleep apnea in 4.8%. Two subjects (4.8%) had Cor Pulmonale, but were stable. Two subjects were on long term oxygen therapy. About 64.3% of subjects complained of breathlessness after the six minute walk test. Fatigue was complained by 7.2% and leg pain by one subject. About 26.2% had no complaints. The mean baseline pulse rate of the subjects was 90.62 ± 11.82 . Post test pulse rate was 97.31 ± 15.28 . The mean baseline systolic blood pressure was

120.95 ± 13.4mm of Hg and mean post test systolic blood pressure was 122.86 ± 12.35 mm of Hg. The baseline respiratory rate was 17.76 ± 1.394 and post test respiratory rate was 21.50 ± 2.472. (Table No. 3) The mean distance travelled was 317.33 ± 77.59 meters (range 170 m to 462 m). The subjects mean predicted distance was 476.36 m.(Table No.1) The mean BMI observed was 21.85 ± 4.70 (range 14.0 to 33.7) . The distance travelled on 6 MWT correlated well with the grading of breathlessness. Out of three subjects with grade I breathlessness, two had normal 6MWD and the other one had mild impairment. Among subjects with grade II breathlessness 27.7% had normal 6 MWD, 55.5% had mild impairment and 16.6% had moderate impairment. Among subjects with grade III breathlessness 15.4% had normal values, 46% showed mild impairment and 38.4% showed moderate impairment .There were about eight subjects who had grade IV breathlessness. Among them 12.5 % had mild 6MWD impairment, 62.5% had moderate impairment and 25% had severe impairment. Thus the NYHA grading of breathlessness correlated with the performance on 6MWD (P= 0.043, significant). When spirometry was compared with 6 MWD, we had a significant correlation (p=0.033). Among subjects with normal spirometry 80 % had normal 6 MWD values and one (20%) had milder impairment. Obstructive disease with normal values of FEV1 were seen in four subjects who had normal 6 MWD values also. Thirteen subjects with mild FEV1 decrease also had milder impairment on 6 MWD. Eight subjects with obstructive lung disease with moderate decrease in FEV1 values also had moderate impairment of 6MWD. Among eight subjects with pure restrictive lung disease 25% had normal 6MWD, 37.5% had mild impairment, 25% had moderate impairment and 12.5 % had severe 6MWD impairment. Four subjects had mixed pattern on the spirometry, of which 50% showed mild 6 MWD impairment and 50% had moderate impairment.

TABLE 1. DEMOGRAPHIC AND CLINICAL FINDINGS OF THE PRESENT STUDY

SUBJECTS	42
MALES	23(54.8%)
FEMALES	19(45.25)
AGE YRS MEAN	51.69±14.63
BMI KG/M2	21.85±4.70
SMOKERS	14
RADIOLOGICAL FEATURES	11(26.2%)
1)NORMAL	12(29%)
2)EMPHYSEMATOUS CHANGES	6(14%)
3)INTERSTITIAL PATTERN	5(11.5%)
4)BRONCHIECTASIS	

NUMBER OF SUBJECTS IN EACH DISEASE	
COPD	26.2%
BRONCHIAL ASTHMA	14.3%
DPLD	19%
BRONCHIECTASIS	11.9%
PARENCHYMAL FIBROSIS	14.3%
BYSSINOSIS	4.8%
OSA	4.8%
COR PULMONALE	4.8%
6 MWD MEAN	317.33±77.59

TABLE 2.SPIROMETRIC FINDINGS IN THE PRESENT STUDY

SPIROMETRY	TOTAL	MILD	MODERATE	SEVERE
OAD	59.5%	19%	26.2%	23.8%
RESTRICTIVE LUNG DISEASE	28.6%	4.8%	11.9%	11.9%

*Spirometric values correlated significantly with 6MWD (p=0.03)

Mixed pattern on spirometry found in 9.5%

TABLE 3.PRE AND POST STUDY PARAMETERS

	Pre	Post
PULSE RATE	90.62±11.82	97.31±15.28
SYSTOLIC BLOOD PRESSURE	120.95±13.4	122.86 ± 12.35
RESPIRATORY RATE	17.76±1.394	21.50 ± 2.472
SPO2		
1)BRONCHIAL ASTHMA	97.3	96.8
2)INTERSTITIAL LUNG DISEASE	94	91.6
3)TUBERCULAR FIBROSIS	92.8	86.6
4)*COPD	96.2	93.9
5)BRONCHIECTASIS	93	90.4
6)BYSSINOSIS	90.5	88.5
7)COR PULMONALE	87.5	82.5
8)‡OSA	98	96.5
OVER ALL	93.66	90.85

*COPD-Chronic Obstructive Pulmonary Disease

‡OSA-Obstructive Sleep Apnea

DISCUSSION

The mean Six minute walk distance (6 MWD) among all the subjects in our study was 317.33±(range of 170 to 462 m) which is very less compared to the Caucasian healthy adults value of 659±62 m¹⁰ and 483.36 m among Western Indian healthy adults¹¹ and 536.12±46.96 m among healthy North Indians.¹² Significant results were obtained in our study when spirometry values were compared with the impairment observed in 6 MWD with that of the predicted values.(p = 0.033, significant). The grading of breathlessness correlated with the performance on 6 MWT. (p = 0.043, significant).

The mean 6 MWD among COPD subjects in our study was 327.4 m, which was comparable with 394.5 ±101.1 m , among western population.¹³ Among Indian studies the mean 6 MWD observed was 317.62±88.85 m¹⁴ in one study and 334.0±69 m in another study.¹ P K Vyas in his study from Jaipur observed a mean 6 MWD in COPD subjects as 290.81 m.¹⁵ Another Indian study showed the mean 6 MWD among obstructive airway disease subjects as 279.2 m.¹⁶

The 6 MWD among subjects of bronchial asthma ,in our study was 372.2 m, which was less compared to 473.0±106.0 m in P K Vyas study.¹⁵ Among bronchiectatic subjects in the same study the 6 MWD was 418±114.69 m and in our study it was 294.4 m. A L Lee observed a 6 MWD of 547.4 ±115.8 m among western population.¹⁷

Among the subjects with diffuse parenchymal lung diseases our study showed a mean 6 MWD of 324.0 m ,which was higher than a Mumbai based study which showed a mean 6 MWD of 235.88 m¹¹ , but comparable with the Canadian study of O Nishiyama where the result was 394±102 m.³

When we evaluated the 6 MWT among the subjects with cor pulmonale , the mean distance observed was 294 m, and among the subjects with OSA the distance observed was 375 m. This is the first Indian study which included Cor Pulmonale and OSA subjects for evaluation of 6 MWT.

Similarly among subjects with Byssinosis the 6 MWD observed in our study was 295 m and among subjects with Tuberculosis sequela of fibrosis , the 6 MWD observed was 310.3 m.

CONCLUSION

Very few studies tried to evaluate six minute walk test among different chronic respiratory diseases. Our study also included subjects with Tubercular parenchymal fibrosis, Byssinosis subjects, Obstructive sleep apnea subjects and Cor Pulmonale subjects.

The results were comparable with similar Indian and western population based studies. Significant results were obtained when spirometry values were compared with the

impairment observed in 6 MWD with that of the predicted values.(p = 0.033, significant). The grading of breathlessness correlated with the performance on 6 MWT. (p = 0.043, significant).

Thus we can conclude that six minute walk distance is an useful, inexpensive and reliable test among different chronic respiratory diseases.

A larger study with a larger volume of subjects intake may confirm the results obtained in our study.

REFERENCES

1. Khandelwal MK, Maheshwari VD, Garg S, Kumar K, Gupta R, Khandelwal S. Six minute walk distance: Correlation with spirometric & clinical parameters in chronic obstructive pulmonary disease. *Int J of Healthcare & Biomed Research*. 2013 April ; 1 (3): 217-226.
2. Enright PL, Sherill DL. Reference equations for the six-minute walk distance in healthy adults. *Am J of Respir Crit Care Med* 1998; 158 (5 pt 1) : 1384-7.
3. Nishiyama O, Yamazaki R, Sano H, Iwanaga T, Higashimoto Y, Kume H and Tohda Y. Pulmonary Hemodynamics and Six-Minute Walk Test Outcomes in Patients with Interstitial Lung Disease. *Can Respir J*. 2016;2016:3837182. doi: 10.1155/2016/3837182.
4. Guyatt GH, Sullivan MJ, Thompson PJ, Fallen EL, Pugsley SO, Taylor DW, Berman LB. The 6-minute walk: a new measure of exercise capacity in patients with chronic heart failure. *Can Med Asso J* 1985 April ; 132(8): 919-23.
5. Spruit MA, Wouters EF. New modalities of pulmonary rehabilitation in patients with chronic obstructive pulmonary disease. *Sports Med*. 2007;37(6):501-18.
6. ATS statement: guidelines for the six-minute walk test. *Am J Respir Crit Care Med*. 2002 Jul ;166(1):111-7.
7. Ramanathan PR, Chandraekharan B. Reference equations for 6-min walk test in healthy Indian subjects (25-80 years). *Lung India* 2014 ; 31(1): 35-38.
8. Brusasco V, Crapo R, Viegi G, Miller M R, Hankinson J. ATS/ERS task force: standardisation of lung function testing -standardisation of spirometry. *Eur Respir J* 2005; 26: 319–33.
9. The Criteria Committee of the New York Heart Association. (1994). *Nomenclature and Criteria for Diagnosis of Diseases of the Heart and Great Vessels*. (9th ed.). Boston: Little, Brown & Co . 253–256.
10. Camarria B , Peter R E, Nola M C, Philip J T, Jenkins S. Six minute walk distance in healthy subjects aged 55–75 years. *Respiratory Medicine* 2006;100: 658–665.

11. Fernandes L , Mesquita A M , Vadala R , Dias A. Reference Equation for Six Minute Walk Test in Healthy Western India Population .Journal of Clinical and Diagnostic Research 2016 ;10(5): CC01-CC04.
12. Vaish H, Ahmed F, Singla R, Shukla DK. Reference equation for the 6-minute walk test in healthy North Indian adult males. Int Jof Tuberc Lung Dis. 2013 ;17(5):698-703.
13. Ivana G L, Juliano F Arcuri, Sentanin A C, Da Costa J N F, Bruna V P and Pires Di Lorenzo V. Should the 6-Minute Walk Test Be Compared When Conducted by 2 Different Assessors in Subjects With COPD?. Respiratory Care 2016;61 (10): 1323-1330.
14. Agrawal S A, Joshi R, Jain A .Correlation of severity of chronic obstructive pulmonary disease with health-related quality of life and six-minute walk test in a rural hospital of central India. Lung India 2015 ; 32 (3): 233-240.
15. Vyas P K, Rang S V, Shah J R, Mathur R S, Ghatavat G and Chaudhary P. Six Minute Walk Test as a Criteria for Evaluation of Functional Status and Disability by One Time Single Measurement of Distance Walked in Six Minutes for Breathless Patients. International Journal of Pulmonary & Respiratory Sciences 2017;1(3): 001-009.
16. Agrawal M B , Awad N T. Correlation between Six Minute Walk Test and Spirometry in Chronic Pulmonary Disease. Journal of Clinical and Diagnostic Research 2015 .9(8): OC01-OC04.
17. Lee AL , Button B M, Ellis S , Stirling R , Wilson J W d, Holland A E, Denehy L. Clinical determinants of the 6-Minute Walk Test in bronchiectasis . Respiratory Medicine 2009;103: 780-785.

How to cite this article : Prasad C N , Reddy C S K, Momin S K. Role of six minute walk test in the evaluation of patients with chronic respiratory diseases. Perspectives in Medical Research 2018;6(2):29-33.

Sources of Support: Nil, Conflict of interest: None declared