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## Original Research Article

## Six minute walk test for predicting postoperative pulmonary complications in high risk patients undergoing major abdominal elective surgery

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## ABSTRACT

**Background:** The morbidity and mortality of patients are increased when postoperative pulmonary complications occurs. To prevent postoperative pulmonary complications, thorough preoperative cardiopulmonary functional assessment is required.

**Objectives:** To study was the preoperative 6-minute walk test (6MWT) and to determine the association of 6 minute walk distance with postoperative pulmonary complications (PPC) in patients undergoing elective abdominal surgery under general anaesthesia.

**Materials and Methods:** The study was done in 60 adult high risk patients who were undergoing planned elective abdominal surgery under general anaesthesia. Patients having acute coronary disease, NYHA IV, unable to walk etc. were excluded.

Preoperatively 6MWT was conducted according to the American Thoracic Society guidelines and patients were observed for PPC until they discharged from the hospital or died. Statistical analysis was done using SPSS software

**Results:** A total of 60 patients were recruited into the study. 6MWT was done completely in all cases without any complications. Out of the 60 patients, 32 patients had no PPC (group 1) and 28 patients had PPC (group 2). The 6MWD of group with PPCs was significantly less ( $344 \pm 61.927$  m) compared to the group without PPCs ( $442.28 \pm 83.194$  m, P value = 0.001). The cut off 6MWD obtained was 390 m, which correlated with longer duration of hospital stay and ICU stay (P = 0.001).

A multiple regression analysis showed elderly, smoker and shorter 6-minute walk distance (6MWD) were the independent factors associated with PPC.

**Conclusion:** 6MWT is a reliable predictor of postoperative pulmonary complications with a cutoff 6MWD of 390m in the high risk elderly patients posted for upper abdominal surgery patients.

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## 1. Introduction

Six minute walk test (6MWT) is easy to perform, inexpensive and no need special equipment or trained personnel, so recently being included in preoperative evaluation. This gives an assessment of tolerance of daily activities. It was introduced in 1982 for pulmonary evaluation in lung surgery. For major surgery under general

anaesthesia, pulmonary evaluation is necessary because changes to the respiratory system started immediately under general anaesthesia. Method for Pulmonary evaluation are spirometry evaluation, pulmonary function tests (PFT), cardiopulmonary exercise testing. The standard method is cardiopulmonary exercise testing (CPET). The PFT reports are depends on interpretation and patient performance, so sometime it is not reliable. While CPET is a complex procedure requiring specialised equipments and expertise.

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Alternative methods of pulmonary evaluation for functional capacity assessment like 6MWT, incremental shuttle walk test and stair climbing test.<sup>1,2</sup>

## 2. Aims and Objectives

Our aim was to see association between 6 min walking distance (6MWD) and postoperative pulmonary complications (PPC) among high risk patients appearing for major abdominal surgery.

## 3. Objectives

1. To assess 6MWD with occurrence of postoperative pulmonary complications.
2. To find association of 6MWD with length of hospital stay
3. To find the association of PPC with risk factors like smoking
4. To find different in haemodynamic parameters like blood pressure (BP), heart rate (HR) and oxygen saturation (SpO<sub>2</sub>).

The mean 6MWD can vary between different ethnic groups requiring need of a study in our patient population.

### 3.1. Inclusion criteria

Study population included all patients undergoing elective abdominal surgery with duration more than 2 hour under general anaesthesia

1. Age more than 60 years,
2. Chronic smoker
3. History of cardiovascular diseases or pulmonary diseases (like interstitial lung diseases and parenchymal diseases)
4. Chest X-ray with abnormal lung parenchymal findings.

### 3.2. Exclusion criteria

1. Patients with acute coronary disease, NYHA IV.
2. Patients with unable to walk (orthopaedic problems in lower limb, CV stroke, cerebral palsy).
3. Patients with severe pain.
4. Patients with uncontrolled hypertension and resting tachycardia (HR  $\geq$  120 beats per min).

## 4. Materials and Methods

The study conducted in adult patients undergoing elective abdominal surgery of probable duration  $\geq$  2 hour under general anaesthesia. Patients who fulfill criteria of inclusion and exclusion, 60 patients were enrolled and underwent the 6MWT preoperatively after taking informed and written consent.

The test was done on a flat surface, 25 metres long, near our pre anaesthesia clinic opd during pre operative assessment, where emergency assistance was available who was trained for cardio respiratory resuscitation. A watch, measuring tape, portable pulse oximeter with probe, and sphygmomanometer were used as per the ATS guidelines.

The test was stopped if patient experienced any chest pain, intolerable dyspnoea, leg cramps and medical assistance was given. Before and after the test, the patient's blood pressure (BP), heart rate (HR), oxygen saturation (SpO<sub>2</sub>) and Borg dyspnoea scores were noted. All patients were given conventional general anaesthesia.

### 4.1. Borg dyspnoea scores<sup>1</sup>

#### Borg rating of perceived exertion

##### # Level of Exertion

- 6 : No exertion at all
- 7-7.5: Extremely light
- 8-9 : Very light
- 10-11: Light
- 12-13: Somewhat hard
- 14-15: Hard (heavy)
- 16-17: Very hard
- 18-19: Extremely hard
- 20: Maximal exertion

The PPC were observed and recorded were Bronchospasm, Prolonged mechanical ventilation  $>$ 48 hrs, Atelectasis, Bronchitis, URTI, Acute respiratory failure, COPD.

Postoperative Evaluation: All patients were accompanied daily in the postoperative period by the same medical team who evaluated them before until they were given hospital discharge or they died.

The patients were divided into two groups based on occurrence of PPC:

- Group 1- No PPC (patients who had not developed PPC)
- Group 2 -With PPC (patients who had developed PPC)

Between these groups, we compared difference in 6MWD, pre and post test haemodynamic Parameters, dyspnoea scores and other risk factors. Risk factors associated with PPC was also studied.

Statistical analysis was done using SPSS software. Categorical variables were assessed using Chi square/Fisher's exact test and continuous variables using student's t test/Mann Whitney U test. Association was tested using logistic regression.

## 5. Observation and Results

The PPC Group had a statistically significant elder age group, more in ASA class  $>$ 2, smoking, underlying diseases compared to No PPC Group.

Pre test SpO<sub>2</sub> was significantly lower and diastolic blood pressure was significantly higher in PPC group. The mean 6

**Table 1:** Demographic data of patients

Characteristic	With PPC Group 2	No PPC Group 1	P value
Age	69.5 ± 7.2	59.5±8.4	<0.001
Gender (F:M)	41:58	47:52	0.117
BMI	24.8±4.1	25.8±4.7	0.40
ASA class	23:76.5	54.1:45.9	0.026
Smoking (%)	82.4	55.7	0.046
Underlying disease (%)	100	64	0.002

**Table 2:** Relation of ASA grade with PPC

	No PPC n= 32	With PPC n= 28	P Value
ASA-I	5	1	>0.05
ASA-II	19	10	
ASA-III	8	17	< 0.05

Patients who developed PPC had more than ASA-II status.

**Table 3:** Hemodynamic changes

Parameters	Group	Number	Mean	SD	P value
Pre test	1	32	98	1.1	0.001
SpO <sub>2</sub> (%)	2	28	96	1.8	
6MWD (m)	1	32	442	85.6	0.001
	2	28	344	62.4	
Pre test	1	32	128	17	0.04
SBP(mmHg)	2	28	135	15	
Pre test	1	32	72	8.4	0.008
DBP(mmHg)	2	28	77	9.4	
Post test	1	32	130	16	0.006
SBP(mmHg)	2	28	140	15	
Post test	1	32	75	17.7	0.361
DBP(mmHg)	2	28	78.9	8.7	
Post test HR (beat per min)	1	32	90	16.33	0.001
	2	28	103	16.22	
Post test	1	32	97	1.21	0.001
SpO <sub>2</sub> (%)	2	28	94	3.55	
BORG	1	32	6	1.84	0.001
Dyspnea score	2	28	8	2.055	

min walk distance of group with PPC was significantly less compared to the group No PPC. The post test hemodynamic parameters showed significant changes in systolic BP and HR between two groups. The post 6 min walk test, SpO<sub>2</sub> was significantly lower and borg dyspnea score after test was more with PPC group.

**Table 4:** Duration of hospital stay and ICU stay

Factor	6MWD	Number of days	P value
Hospital stay	Upto 390	49	< 0.05
	>390	26	
ICU stay	Upto 390	51	<0.05
	>390	24	

The duration of hospital stay, ICU Stay was significant more in patients with PPC group.

**Table 5:** Relation of 6MWD with PPC

Groups	<390 m n=28(%)	>390 m n=32(%)	Total n=60
With PPC	20(71.4%)	8 (25%)	28
No PPC	8(28.5%)	24 (75%)	32
Total	28	32	60

A 6 min walk distance of below 390 m was significantly associated with PPC (71.4%). While 75% of the patient of No PPC group had 6MWD > 390 m.

## 6. Results

The present study included total 60 adult high risk patients who had underwent upper abdominal surgeries under general anaesthesia.

Mean age of study group was 64.5 years.

According to the occurrence of PPC, patients were divided into two groups. Group 1 – No PPC, group 2- with PPC.

Out of 60 patients, 46.6%, (28 patients) patients were developed PPC. 13 patients had pneumonia, 8 patients had atelectasis, 7 patients had bronchospasm.

82.4% of patients of with PPC group were smoker.

Total 27 patients were having ASA class more than II in with PPC group.

Patients with history of smoking were developed PPC compared to non smoker.

Pre test Spo2 was lower and DBP was higher in PPC group.

The mean 6MWD of with PPC group was significantly less compared to the group No PPC.

The duration of hospital stay and ICU stay were significantly more in with PPC group (< 0.05).

Post 6MWT SpO<sub>2</sub> was significantly lower and borg dyspnea score after test was more with PPC group (p=0.001).

6MWD of below 390 m was significantly associated with PPC, 71.4% of patients with PPC group having a 6MWD below 390m Shorter 6MWD correlated with longer Hospital stay.

The PPC rate of our study population was 46.66%, which is slightly more than the general incidence of PPCs (2-40%). The most common postoperative pulmonary complication was pneumonia followed by atelectasis and bronchospasm.

## 7. Discussion

The purpose of preoperative assessment is to evaluate the patients thoroughly and to stratify the risk associated with comorbid disease of patients.

Traditionally exercise tolerance of the patient is evaluated by their routine household work.

Metabolic equivalent of task (MET) is a simple concept which measures the exercise tolerance of patient. This MET represent the energy expenditure value from 1 to 10. One MET is the amount of oxygen used during quite rest and its value is equal to 3.5 ml O<sub>2</sub> /kg/min. The ability of patient to climb two flights of stairs without breathlessness is equivalent to 4 METs. The cardiopulmonary exercise is more reliable tool than MET to evaluate exercise tolerance and functional status of patient and to predict the morbidity and mortality.

The 6 min walk test is an inexpensive test and simple to perform. There is no need of any equipment. So this 6 min walk test is used when CPET is not available e.g. in rural area. In 6 min walk test, pt is asked to walk continuously for 6 min until they feel uneasiness, breathlessness, chest pain. As patient walk for long distance, more functional status of patient.

Keeping all these in mind present study was conducted to evaluate 6 MWT to determine functional capacity of patient and to predict the cardiopulmonary complication in post operative period.

Total 60 adult patient were enrolled for the study who had fulfilled the inclusion criteria. All patients were undergone major abdominal surgery under general anaesthesia.

Viviana et al.<sup>3</sup> stated that cutoff value of 6 min walk distance 489m had a sensitivity of 83.3% and a specificity of 60% for prediction of post operative cardiopulmonary complication.

In a multivariate regression analysis, Independent risk factors are age, sex and distance of the preoperative 6MWT which are associated with outcome of postoperative cardiopulmonary complication.

Many references shows that there is a significant correlation between cutoff value and postoperative cardiopulmonary complication. Most reference showed 6MWD of less than 300 m is associated with increase morbidity in form of postoperative cardiopulmonary complications.<sup>1</sup> In our study, we got a cutoff value of 390 m.

Keeratchananout et al.<sup>4</sup> stated that cut off value of 6 min walk distance of  $\leq 325$  m had a sensitivity of 77%, specificity of 100% for prediction of post operative cardiopulmonary complication.

A multiple regression analysis showed that 6MWD  $\leq 390$  m, FEV1  $< 60\%$  predicted, elderly, ASA class  $> 2$  and smoking history were independent predictors for PPC.<sup>4</sup>

The most common postoperative pulmonary complication pneumonia, atelectasis, bronchospasm and respiratory failure.<sup>4</sup>

Study done by Sathyaprasad et al.<sup>1</sup> stated that A 6MWD of below 400m is associated with postoperative pulmonary

complication in form of increased duration of hospital stay and ICU stay. Our findings are also consistent with this, with a cutoff 390m. So 6MWD is a good indicator of preoperative assessment for postoperative cardiopulmonary complication.

## 8. Conclusion

Six-minute walk test is easy, reliable, no cost, for prediction of post-operative pulmonary complications with a cutoff 6MWD of 390m in elective abdominal surgery patients. The study has limitations. The sample size was too small for estimation of the performance of 6MWT as a predictor of postoperative pulmonary complications and so bias is not excluded. The scope for research in the utility and significance of 6MWT is enormous and should be explored.

## 9. Source of Funding

None.

## 10. Conflict of Interest

The author declares no conflict of interest.

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