



6 Minute Walk Test (6-MWT) as a Tool for Predicting Post Operative Pulmonary Complications in Abdominal Surgeries

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Background: Post operative pulmonary complications (PPC) contribute to increased morbidity and mortality. Thus pre operative assessment is required. Six minute walk test (6-MWT) is a simple and reliable test which is recently being included in pre operative evaluation.

Objectives: The objective of this study is to determine the value of the six minute walk test as a reliable tool in detecting post operative pulmonary complications in patients undergoing abdominal surgery.

Materials and Methods: It is a prospective observational study conducted in a tertiary care centre for a period of 3 months. 66 patients in the age group of 40-60 years undergoing elective abdominal surgery under general anaesthesia were included in this study based on universal sampling method. Patients with recent coronary syndrome, uncontrolled hypertension, cardiac diseases, pregnancy and conditions which impair walking (eg. Arthritis) were excluded from the study. 6 minute walk test was performed before the surgery. The procedure was explained to the patients and consent was obtained. The test was conducted on a flat surface of 20m near our pre anaesthetic clinic and the patient was asked to walk for a period of 6 minutes in their own comfortable pace. The distance covered by the patients in the 6 minutes was noted. Vitals such a

SpO₂, heart rate, systolic and diastolic blood pressures were recorded before and after the test. The patients were followed up for the development of pulmonary complications in the post operative period.

Results: Out of the 66 patients included in the study, 35 patients did not develop PPC (Group 1) and 31 patients developed PPC (Group2) including one death due to respiratory failure. The six minute walk distance in the PPC group was significantly less ($p=0.0001$) when compared to that of the non PPC group. Patients in the PPC group also required prolonged hospital stay. Pneumonia was the most commonly developed post operative pulmonary complication.

Conclusion: Six minute walk test is a useful tool in predicting post operative pulmonary complication in patients undergoing abdominal surgery.

Keywords: Post operative pulmonary complication; six minute walk test; abdominal surgery; SpO₂; heart rate.

1. INTRODUCTION

Post operative pulmonary complications are common and major cause of morbidity and mortality[1]. They are defined as complications that present within 30 days after the surgical procedure and includes mechanical ventilation for more than 24 hours, hypoxemia, atelectasis, hemoptysis, empyema and death caused by heart or respiratory failure[2]. Pre operative evaluation is a basic process of evaluating the patients health and the identification of risk factors for the development of any complications in relation to the patient and to the anaesthesia and the planned surgical procedure. Pre operative assessment for those at risk, pulmonary evaluation methods like Spirometry (Pulmonary Function Test-PFT) and Cardio Pulmonary Exercise Testing (CPET) is being employed. The PFT reports are highly influenced by interpretation and patient performance hence it may not be reliable. Cardiopulmonary exercise testing helps in identifying patients who are at a higher risk of developing complications and mortality. However, its application is restricted due to the limited availability of the test. This has indeed stimulated the search for alternate methods which provide similar information that is also simpler and more cost effective[3]. Among the alternatives, the step test, the shuttle walk test and the six minute walk test have been studied[1,3].

Six minute walk test is an exercise test that requires the measurement of distance walked over a span of six minutes. This test gives us details about the functional capacity, therapeutic response of the patients and their prognosis across a wide range of chronic cardiac and pulmonary diseases. This test is easy to perform, not expensive, does not require special equipment or trained personnel. Thus it is

currently being employed in pre operative evaluation[4]. The aim of this study is to determine the performance of pre operative 6 minute walk test for predicting post operative pulmonary complications in patients undergoing abdominal surgery.

2. MATERIALS AND METHODS

2.1 Type of Study

It is a prospective observational study conducted in a tertiary care centre for a period of three months between January and March of 2021.

2.2 Sample Size

Sample size was calculated using the formula $4pq/d^2$ and was found to be 66. A total of 66 patients undergoing elective abdominal surgery under general anaesthesia were included in the study based on universal sampling.

2.3 Selection Criteria

Patients in the age group of 40-60 years undergoing elective abdominal surgery under general anaesthesia were included in the study. Since cardiopulmonary reserve tends to become low as age advances, patients between 40-60 years of age are included for the study. Patients with recent acute coronary syndrome, uncontrolled hypertension, cardiac diseases and conditions which impair walking like Arthritis were excluded from the study.

2.4 Data Collection Procedures

A total of 66 patients in the age group of 40-60 years undergoing elective abdominal surgery under general anaesthesia were taken as the

study group. All patients underwent the routine pre operative evaluation. Based on the inclusion criteria patients were selected and the procedure was explained to them.

The test was conducted in a straight hallway near the pre anaesthetic clinic of our anaesthesia department. Patients were asked to walk on a flat surface of 20m marked between two points. A stop watch, measuring tape, portable pulse oximeter and sphygmomanometer were used. Emergency cart and defibrillator were also kept available for emergency assistance. The test was done under the supervision of an anaesthetist trained in cardiopulmonary resuscitation. After obtaining informed written consent, patients were asked to walk on a flat surface back and forth in their own comfortable pace for a period of 6 minutes and the distance covered was noted. They were also informed that they could stop the test in case they experienced any discomfort. The patient's blood pressure (BP), heart rate and oxygen saturation (SpO₂) were noted before and after the test. The patients underwent surgery as planned by general anaesthesia and were followed up for the development of post operative pulmonary complications (PPC) until discharge.

The patients were divided into two groups based on the development of post operative pulmonary complications:

- Group 1: No PPC
- Group 2: with PPC

Along with this, the pulmonary complications, duration of hospital stay, ICU stay was also noted.

2.5 Data Analysis

The data collected were tabulated and analysed using the SPSS software. Statistical tests applied on the samples were mean, standard deviation and the independent sample t test. Significance is assessed at 5% level of significance and 95% confidence interval. The categorical variables were represented using percentage.

3. RESULTS

The study included 66 patients who underwent elective abdominal surgeries under general anaesthesia. Out of 66 patients, 40 patients (60.6%) were male and 26 patients (39.4%) were female. (Fig 1).

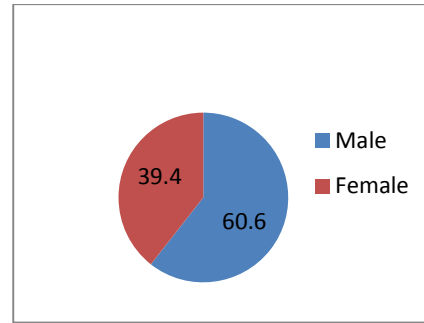


Fig. 1. Showing sex distribution of patients who underwent Elective abdominal surgeries

The 66 patients were divided into four groups based on their age as, 40-45; 46-50; 51-55; 56-60. Among these groups, majority of the males (27) and females (16) belonged to the age group of 51-55 years. There was no significant association between gender and PPC.

According to the development of post operative pulmonary complications, the patients were divided into two groups: Group 1: (patients without PPC) and Group 2: (patients with PPC). Thirty one patients (47%) developed post operative pulmonary complications and 35 patients (53%) did not develop post operative pulmonary complications. The mean age in the non PPC group was 50.23 and that of the PPC group was 52.81. There was significant variation in age between the two groups ($p=0.016$).

Pre test SpO₂ was significantly lower ($p=0.0001$) and the pre test heart rate was significantly higher ($p=0.0001$) in the PPC group. The mean 6 minute walk distance in the PPC group was significantly less (mean=322.9 m) compared to the group without PPC (mean=412.9).

The post test parameters showed significant variation in the heart rate ($p=0.0001$), systolic BP ($p=0.0001$) and diastolic BP ($p=0.001$) between the two groups. The post test SpO₂ ($p=0.0001$) was also significantly low in the PPC group compared to the non PPC group.

Pneumonia was the most commonly observed complication in the post operative period (55%). Out of the 31 patients who developed post operative pulmonary complications, 17 patients developed Pneumonia, 5 patients developed Bronchospasm, 4 patients developed Atelectasis, 2 patients developed ARDS, 2 patients developed Bronchitis, 1 patient developed Respiratory failure and succumbed to death.

Table 1. Male and female ratio

Age group	Male (60.6%)	Female (39.4%)	
40-45	2	6	12.12%
46-50	4	3	10.6%
51-55	27	16	65.15%
56-60	7	1	12.12%

Table 2. T-Test-Independent T-test-Comparing the mean difference between the complication7 non-complication grps

	GRPS	N	Mean	Std. Deviation	P-value
Pre test SpO2	No complication	35	98.6	1	.000(S)
	Complication	31	96.6	1	
Post test SpO2	No complication	35	97.8	0.8	.000(S)
	Complication	31	94.7	0.9	
Pre test heart rate	No complication	35	84.9	3	.000(S)
	Complication	31	90.2	4	
Post test heart rate	No complication	35	92.1	3	.000(S)
	Complication	31	108.4	6	
Pre test SBP	No complication	35	124.9	8	.000(S)
	Complication	31	135.8	6	
Post test SBP	No complication	35	130	9	.000(S)
	Complication	31	144	6	
Pre test DBP	No complication	35	75.1	7	.052(NS)
	Complication	31	78.7	8	
Post test DBP	No complication	35	80.3	7	.001(S)
	Complication	31	86.5	7	
6m walk distance (m)	No complication	35	412.9	35	.000(S)
	Complication	31	322.9	28	

The duration of hospital stay was also more in the patients who developed complications. About 7 patients (23%) in the PPC group required ICU stay. Out of the seven patients who required ICU stay 1 patient succumbed to death due to respiratory failure.

4. DISCUSSION

The six minute walk test is an inexpensive and simple test to perform. Hence it can be used for pre anaesthetic evaluation for patients undergoing various abdominal surgeries which can serve as a predictor for post operative pulmonary complications.

The PPC rate of our study population was 46.96% which is almost as same as that of the study conducted by Sethu Lekshmi et al (46.66%) [5] Similarly, Ozdilekcan et al had a PPC rate of 40% in their study group[6]. The mean age between the two groups (PPC and non PPC) were significant in our study (p= 0.016). In our study there was no significant correlation between gender and PPC which correlated with the study conducted by Sethu Lekshmi et al.[5].

The pre test parameters like heart rate and systolic blood pressure was significantly high in the PPC group and that of SpO2 was significantly low which correlates with the study conducted by Sethu Lekshmi et al.[5] In our study, the pre test diastolic blood pressure was not significant (p=0.052) between the two groups, but the pre test diastolic blood pressure was significant between the two groups in the study conducted by Sethu Lekshmi et al.[5].

The mean 6 minute walk distance (p=0.0001) in the PPC group was less compared to that of the non PPC group which correlates with the study conducted by Keeratichananont et al.[7] The study conducted by Santos BFA et al also showed that the group without PPC travelled a greater distance than the group with PPC [4].

The post test parameters like heart rate and systolic blood pressure showed significant variation between the non PPC and the PPC group which correlated with the study conducted by Sethu Lekshmi et al [5]. The post test SpO2 also showed a significant variation between the PPC and the non PPC group (p=0.0001). Post

test SpO₂ was significantly lower in the PPC group.

The most common pulmonary complication in our study was Pneumonia (54.8%) followed by Bronchospasm (16.1%), Atelectasis (12.9%), Acute Respiratory Distress Syndrome (6.4%), Bronchitis (6.4%), Respiratory Failure (3.2%). This correlates with the study conducted by Sethu Lekshmi et al who also reported Pneumonia as the most commonly observed complication [5]. Flavia et al also observed Pneumonia as the most frequent complication [8]. Ozdilekcan et al observed Atelectasis and Bronchospasm as the most frequently observed PPCs [6]. In a review done by Miskovic and Lumb showed that respiratory failure was the most frequently observed complication [9].

The limitation in our study is that the study was conducted in a short period of time with a small sample size and co morbidities like obesity, obstructive sleep apnea was not taken into account. Conducting the study for a longer duration of time and with a larger sample size would yield better results. Other parameters like smoking, alcohol consumption and correlation with the FEV₁ values were not done in our study which would probably show its relation with the 6 minute walk test. Further improvements can be done in our study by taking into account other parameters like race, ethnicity, biochemical values, and comparison with other exercise tests.

5. CONCLUSION

Six minute walk test is an easy, safe, inexpensive and reliable test which can be used as a tool for predicting post operative pulmonary complications in patients undergoing abdominal surgeries. As it is a valuable predictor of PPC, better post operative care can be given to the patients at risk which may be helpful in preventing the development of pulmonary complications.

CONSENT AND ETHICAL APPROVAL

As per international standard or university standard guideline Patient's consent and ethical approval has been collected and preserved by the authors.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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