

Can exercise capacity assessed by the shuttle walk test predict the development of post-operative complications in patients with lung cancer?

Yurdanur ERDOĞAN¹, Ersin GÜNAY², Pınar ERGÜN³, Dicle KAYMAZ³,
Gökten TEMİZ⁴, Nurettin KARAOĞLANOĞLU⁴

¹ SB Ankara Atatürk Göğüs Hastalıkları ve Göğüs Cerrahisi Eğitim ve Araştırma Hastanesi, 7. Göğüs Hastalıkları Kliniği, Ankara,

² Afyon Kocatepe Üniversitesi Tıp Fakültesi, Göğüs Hastalıkları Anabilim Dalı, Afyonkarahisar,

³ SB Atatürk Göğüs Hastalıkları ve Göğüs Cerrahisi Eğitim ve Araştırma Hastanesi, Evde Bakım ve Solunum Rehabilitasyon Ünitesi, Ankara,

⁴ SB Ankara Atatürk Göğüs Hastalıkları ve Göğüs Cerrahisi Eğitim ve Araştırma Hastanesi, Göğüs Cerrahisi Kliniği, Ankara.

ÖZET

Akciğer kanserli hastalarda mekik yürüme testi ile değerlendirilen egzersiz kapasitesi postoperatif komplikasyon gelişimini öngörebilir mi?

Giriş: Çalışmamızın amacı, akciğer kanseri rezeksiyon cerrahisinde postoperatif komplikasyon gelişiminde mekik yürüme testinin rolünü araştırmaktır.

Hastalar ve Metod: Erken evre akciğer kanseri tanısı ile akciğer rezeksiyon cerrahisi için aday olan hastalar bu çalışmaya dahil edildi. Çalışmaya katılan tüm hastalara egzersiz kapasitesinin değerlendirilmesi için mekik yürüme testi uygulandı.

Bulgular: Çalışmaya 24 hasta dahil edildi. Yaş ortalaması 46 ± 8.6 yıl idi. Pnömonektomi, lobektomi, bilobektomi ve wedge rezeksiyon sırasıyla 11 (%46), 10 (%42), 2 (%8) ve 1 (%4) hastaya uygulandı. Postoperatif komplikasyon sadece altı hastada gelişti. Postoperatif komplikasyon gelişme riski ile yaş, artan hızda mekik yürüme testi, endürans mekik yürüme testi ve akım VO_2 (mL/kg/dakika) ile değerlendirilen egzersiz kapasitesi arasında istatistiksel olarak anlamlı bir ilişki saptanmadı ($p > 0.05$).

Sonuç: Mekik yürüme testleri (artan hızda ve endürans) akciğer kanseri rezeksiyonlarında postoperatif komplikasyonları öngörmede sınırlı role sahiptir.

Anahtar Kelimeler: Egzersiz kapasitesi, akciğer kanseri, postoperatif komplikasyon, rezeksiyon, mekik yürüme testi.

Yazışma Adresi (Address for Correspondence):

Dr. Ersin GÜNAY, Afyon Kocatepe Üniversitesi Tıp Fakültesi, Göğüs Hastalıkları Anabilim Dalı,
AFYONKARAHİSAR - TÜRKİYE

e-mail: ersingunay@gmail.com

SUMMARY**Can exercise capacity assessed by the shuttle walk test predict the development of post-operative complications in patients with lung cancer?**

Yurdanur ERDOĞAN¹, Ersin GÜNAY², Pınar ERGÜN³, Dicle KAYMAZ³,
Gökten TEMİZ⁴, Nurettin KARAOĞLANOĞLU⁴

¹ Clinic of 7th Chest Diseases, Ataturk Chest Diseases and Chest Surgery Training and Research Hospital, Ankara, Turkey,

² Department of Chest Diseases, Faculty of Medicine, Afyon Kocatepe University, Afyonkarahisar, Turkey,

³ Home Care and Pulmonary Rehabilitation Unit, Ataturk Chest Diseases and Chest Surgery Training and Research Hospital, Ankara, Turkey,

⁴ Clinic of Chest Surgery, Ataturk Chest Diseases and Chest Surgery Training and Research Hospital, Ankara, Turkey.

Introduction: The objective of this study was to assess the role of shuttle walk test in predicting post-operative complications in lung cancer resection surgery.

Patients and Methods: A consecutive series of patients who were candidate for lung resection surgery with the diagnosis of early stage lung cancer were included to this study. All patients in this study evaluated for exercise capacity testing with shuttle walk test.

Results: Twenty for patients were included in this study. Mean age was 61.5 ± 8.6 years. Pneumonectomy, lobectomy, bilobectomy and wedge resection were performed in 11 (46%), 10 (42%), 2 (8%), and 1 (4%) patients, respectively. Complications occurred only in six patients. There was no statistically significant relationship between risk for development of post-operative complication and age, incremental shuttle walk test, endurance shuttle walk test and exercise capacity evaluated with peak VO_2 (mL/kg/minute) ($p > 0.05$).

Conclusion: Shuttle walk tests (incremental and endurance) had a limited role in predicting post-operative complications in lung cancer resections.

Key Words: Exercise capacity, lung cancer, post-operative complication, resection, shuttle walk test.

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INTRODUCTION

Though surgery remains the treatment of choice for resectable lung carcinoma, postoperative complications of lung resection appear to be a major problem especially in patients with co-existing disease (1). Incidence of postoperative complications after lung resection was reported as 24-48% while the mortality rates of lobectomy and pneumonectomy were 4% and 14%, respectively (1,2). The most common complications and the main determinant of mortality and morbidity after lung resection are cardiopulmonary complications (2,3). Preoperative exercise capacity is an independent predictor of peri-operative risks in lung resection surgery so in order to assist the prediction of surgical outcome, a number of exercise tests have been used (1-3).

In this study we investigated the relationship between exercise capacity assessed by shuttle walk test (SWT) and development of post-operative complica-

tion in patients who were candidate for lung cancer surgery.

PATIENTS and METHODS

This study was performed in Home Care and Pulmonary Rehabilitation Unit with Chest Surgery Clinic in Ataturk Chest Diseases and Chest Surgery Training and Research Hospital between December 2007 and October 2008. Twenty-four consecutive patients who were candidate for lung resection surgery with the diagnosis of early stage lung cancer were included to this study. Pulmonary function test was performed for all patients. For evaluation of exercise capacity of these patients, field tests [Incremental Shuttle Walking Test (ISWT) and Endurance Shuttle Walking Test (ESWT)] were used. Peak VO_2 was calculated with a formulation of $[4.19 + (\text{walking distance} \times 0.025)]$ ($\text{mL} \cdot \text{min}^{-1} \cdot \text{kg}^{-1}$) (4-6).

Exclusion criteria included recent myocardial infarction (within six weeks), unstable angina pectoris and disor-

ders that might influence exercise performance such as back pain.

This study was approved by local ethics committee. Informed consents were obtained from each patient.

Shuttle Walking Test

The incremental shuttle walking test was performed similar to the method established by Singh et al. (5). The patients walked between two cones 10 m apart at an incrementally increasing pace. Each increment was signaled by a fully calibrated audiocassette. The end point was achieved when the patient could no longer maintain the required speed or became too breathless to proceed further or desaturation occurred.

The endurance shuttle walking test was performed similar to the method established by Revill et al. (6). Walking speed was adjusted from the level calculated from the walking distance on ISWT. Patients walked between two cones 10 m apart at this stable pace. Duration of this test was noted as endurance time (min).

Complications

Complications were defined as post-operative when they occurred within 30 days after resection.

These post-operative complications were defined as:

1. Prolonged mechanical ventilation (> 48 hour),
2. Hypoxemia,
3. Atelectasis on radiography,
4. Haemoptysis,
5. Empyema,
6. Death caused by respiratory insufficiency or heart failure.

Statistical Approach

Statistical analyses were performed using the SPSS 17.0 Base System and advanced statistics programs (SPSS, Chicago, IL, USA). Descriptive statistics were performed for all the recorded variables. The Pearson's correlation was used to find a correlation between post-operative complications and other study parameters. Threshold for statistical significance was set at 0.05.

RESULTS

One (4%) female and 23 (96%) male patients were included in this study with age range from 43 to 75. Mean age was 61.5 ± 8.6 years. All of the patients were smoker. Mean value for cigarette usage was 50.5 ± 25.9 pack-year. There were only 10 patients (42%) with concomitant COPD. Pneumonectomy, lobectomy, bilo-

bectomy and wedge resection were performed in 11 (46%), 10 (42%), 2 (8%), and 1 (4%) patients, respectively. Complications occurred only in 6 (25%) patients. There was no prolonged mechanical ventilation as post-operative complication. Demographic characteristics, pulmonary function test results, types of lung resection, complications, hospital stay data of 24 patients participated in this study are given in Table 1.

Shuttle walking test results (ISWT, ESWT, level) and calculated peak VO_2 are given in Table 2.

There was no statistically significant relationship between post-operative complication risk and age, amount of cigarette usage (pack-year), ISWT (meter), ESWT (minute), exercise capacity evaluated with peak VO_2 (mL/kg/minute), FEV_1 (L), FEV_1 (%) and presen-

Table 1. Demographic characteristics, pulmonary function test results, resection types, complications and length of hospital stay of the patients.

Characteristics	Results
Age (years)	61.5 ± 8.6
Sex	
Male	23 (96%)
Female	1 (4%)
Smoking (pack-year)	50.5 ± 25.9
Pulmonary function test	
FEV_1 (%)	63.5 ± 20.0
FEV_1 (L)	1.9 ± 0.6
FVC (%)	69.3 ± 19.0
FVC (L)	2.6 ± 0.8
FEV_1/FVC	72.0 ± 10.3
COPD as a concomitant disease (N)	10 (42%)
Resection types (N)	
Lobectomy	10 (42%)
Pneumonectomy	11 (46%)
Bilobectomy	2 (8%)
Wedge resection	1 (4%)
Complications (N)	6 (25%)
Atelectasis	2 (8%)
Hemoptysis	1 (4%)
Hypoxemia (oxygen desaturation)	1 (4%)
Empyema	1 (4%)
Death	1 (4%)
Prolonged mechanical ventilation	0
Length of hospital stay (day)	15.7 ± 7.7

COPD: Chronic obstructive pulmonary disease.

Table 2. Preoperative field test and calculated VO₂ peak results.

Variables	Results
Shuttle walk test	
ISWT (meter)	307.9 ± 92.9
Level	8.7 ± 2.3
ESWT (minute)	12.0 ± 7.2
VO ₂ peak (mL/kg/minute)	11.9 ± 2.3

ISWT: Incremental shuttle walk test, ESWT: Endurance shuttle walk test.

ce of COPD as a concomitant disease ($p > 0.05$). There was a statistically significant relationship between FEV₁ (L) and ISWT (meter) ($p = 0.007$, $r = 0.534$) and VO₂ peak ($p = 0.007$, $r = 0.534$). There was no statistical relationship between type of resection and post-operative complications (Table 3).

ISWT (m), ESWT, VO₂ peak and FEV₁ (L) and FEV₁ (%) values was not decisive in the development of complications depending on the type of resection (lobectomy or pneumonectomy).

When the border of FEV₁ (L) is taken 1.5 L and 2 L for lobectomy and pneumonectomy, respectively, and peak VO₂ is taken 10 mL/kg/minute for all types of resection, these cut-off values and the type of resection did not have the effect for predicting complications.

DISCUSSION

The relationship between postoperative complications and patient-related risk factors (cigarette smoking and advanced age) is not clearly demonstrated (1-3). Similar to previous reports, in our study, no relationship between development of postoperative complication and patient-related risk factors (age and smoking) was observed. It has been reported in previous studies that presence of COPD as a concomitant pulmonary disease

have an important protective role in the development of post-operative pulmonary complications in lung resection surgery (7-9). In this study, we also did not observe any relationship between post-operative complications and presence of COPD as a concomitant disease in lung cancer patients.

To date, in the studies a correlation between the resection width and postoperative mortality and morbidity is reported. While segmental or “wedge” resections are carrying a low risk for developing post-operative complications, pneumonectomy has been reported to have the highest risk (3,8-10). In our study, no relationship was determined between types of resection and the development of post-operative complications.

Due to FEV₁ % or measured absolute value (L) in pre-operative pulmonary function tests is meaningful and easy method for the prediction of postoperative complications; it is implemented as a first step test (1,3). Also, calculation of predicted post-operative FEV₁ via ventilation and perfusion scintigraphy or segment formula has important role in predicting complications. In our study, pre-operative FEV₁ in predicting postoperative complications of global assessment of all types of resections was not effective. Additionally, it was not effective for comparison of the cut-off levels of preoperative FEV₁ as 2 L for pneumonectomy and 1.5 L for lobectomy.

In order to assess functional capacity, maximal exercise testing [cardiopulmonary exercise testing and the ISWT and submaximal exercise tests (6MWT, stair-climbing tests)] can be used (11-14).

In some studies, although concordant relationship between cardiopulmonary exercise test results (measurement of maximal oxygen uptake) and predicted post-operative pulmonary complications have been reported, the controversial reports in the publications are also available (2,3,7,15). However, in our study, peak VO₂ calculated via the walking distance of the ISWT was used for the evaluation of maximal exercise capacity and no effect in predicting for post-operative complications for resection surgery could be found.

There is evidence that tests such as the modified shuttle walk test, Cooper walk run test, and the multi-stage shuttle run test correlate better with oxygen consumption than the shuttle walk test (16-18). However, these procedures require vigorous exercise and, as such, would be inappropriate to perform in our patient population who are elderly. Another walk test often used is the six minute walk test. However, interpretation of the distance walked in six minutes is currently not well standardized (19). The SWT has been shown to be repro-

Table 3. Complication frequency according to the types of resection.

	Complication present	No complication
Lobectomy	3* (12.5%)	7 (29%)
Pneumonectomy	3** (12.5%)	8 (33%)
Bilobectomy	0	2 (8%)
Wedge resection	0	1 (4%)

* Complications after lobectomy: Haemoptysis (N= 1), atelectasis (N= 1), desaturation (N= 1).
 ** Complications after pneumonectomy: Atelectasis (N= 1), empyema (N= 1), death (N= 1).

ducible and a good predictor of the impact of breathlessness on functional capacity in patients with cancer (20). We therefore chose to perform the SWT as a reliable field test on our patients.

ISWT in preoperative evaluation of lung cancer was suggested to be used (7,12). Although the literature suggests the increased risk for postoperative complications in patients of which walking distance was shorter than 250 m, there are conflicting studies indicating the SWT as inadequate to predict complications (12).

Our study also did not demonstrate any benefit of ISWT in predicting the development of perioperative complications. Moreover, taking the cut-off for the walking distance as 250 m was not effective in predicting the development of complications.

Although there are some restrictions such as limited number of patients, nonhomogeneous distribution of types of resection, and participation of only one female patient, this is the first study evaluating the availability of ISWT in prediction of post-operative complications in patients candidate for resection surgery for lung cancer in our country population.

As a result, ISWT and ESWT had a limited role in predicting post-operative complications for patients candidate for resection surgery for lung cancer. Further investigations with wider series are warranted to determine availability of ISWT for predicting post-operative cardiopulmonary complications, especially in centers that cardiopulmonary exercise testing is not applicable.

CONFLICT of INTEREST

None declared.

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