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ENHANCING SURGICAL OUTCOMES IN BRONCHIECTASIS: PREDICTING EARLY SURGICAL COMPLICATIONS WITH THE BRONCHIECTASIS SEVERITY INDEX

BRONŞİEKTAZİ TEDAVİSİNDE CERRAHİNİN YERİ: BRONŞİEKTAZİ ŞİDDET İNDEKSİ İLE ERKEN CERRAHİ KOMPLİKASYONLARIN ÖNGÖRÜLMESİ

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ABSTRACT

Objective: Bronchiectasis is defined as the irreversible dilation of the large and smaller airways. This study is a retrospective data analysis of patients with localized bronchiectasis who underwent anatomical resection at our institution. The aim of the study was to detect quality of life improvements after lung resection in localized bronchiectasis patients.

Material and Method: 68 patients were evaluated between the years 2001 and 2019. Patient demographics, pathological data, preoperative period, Bronchiectasis Severity Index (BSI) score, and long-term outcomes were reviewed. We selected patients who had undergone anatomical resection. Cases of unrelated deaths or of lost data during the follow-up period were excluded.

Result: The median age was 26, and the female and male ratio was nearly even. Pediatric patients are defined as individuals under the age of 17 and 26 patients were in the pediatric group. The preoperative BSI score was calculated on each patient. Seven patients had expected high readmission rates and high mortality rates, according to their high BSI score, but after the surgery period none of those patients needed to be re-hospitalized due to bronchiectasis. 14 patients had VATS procedures and 54 patients were operated on via thoracotomy. The average postoperative hospital stay was 13 days for all patient groups. Patients who had had VATS stayed in the hospital for eight days, but those who had had open surgery remained for 14 days (p=0.167). Based on the subgroup analysis, it was observed that

ÖZET

Amaç: Bronşiektazi, büyük ve küçük hava yollarının geri dönüşümsüz olarak genişlemesi olarak tanımlanır. Bu çalışmada, anatomik rezeksiyon uygulanmış lokalize bronşiektazi tanılı hastaların retrospektif veri analizi yapılmıştır. Çalışmanın amacı, lokalize bronşiektazi hastalarında akciğer rezeksiyonu sonrası yaşam kalitesindeki iyileşmeyi belirlemektir.

Gereç ve Yöntem: 2001 ile 2019 yılları arasında 68 cerrahi hastanın değerlendirmesi yapılmıştır. Hastaların demografik verileri, preoperatif dönem Bronşiektazi şiddet indeksi (BŞİ) skoru hesaplanmış, postoperatif erken dönem sonuçlar ve uzun dönem cerrahi sonuçlar incelenmiştir. Bronşiektazi nedeniyle anatomik rezeksiyon geçiren hastalar çalışmaya dahil edilmiştir. Bronşiektazi dışında sebeplerle ölen hastalar ve takip süresinde verilerine ulaşılamayan hastalar çalışma dışı bırakılmıştır.

Bulgular: Ortalama yaş 26 olup, kadın ve erkek oranı arasında anlamlı fark izlenmedi. Pediatrik yaş grubu 17 yaş altı hastalar olarak kabul edildi ve 26 hasta bu grupta değerlendirildi. Pediatrik grup 26 hastadan oluşmaktaydı. Her bir hasta için preoperatif BŞİ skoru hesaplandı. Yüksek oranda tekrar hastaneye yatış ve yüksek mortalite oranları beklenen yedi hastada, yüksek BŞİ skoruna rağmen ameliyat sonrası dönemde bu hastaların hiçbirinin bronşiektazi nedeniyle yeniden hastaneye yatışa ihtiyaç duymadığı görüldü. 14 hasta video yardımlı torakostopik cerrahi ile ve 54 hasta torakotomi ile opere edildi. Tüm hasta grubunda ortalama ameliyat sonrası hastanede kalış süresi 13 gün olup, VATS işlemi uygulanan hastalarda bu süre sekiz gün, açık cerrahi uygu-

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patients with a severity score of nine or higher experienced increased complication rates (p=0.35).

Conclusion: Even for patients with a high BSI score, surgery is a reliable option if clinical parameters are compatible. BSI shows the predictive value of postoperative complications. Patients should be evaluated in multidisiplinary centers. In making surgical decisions, experienced pulmonologists and thoracic surgeons are needed so that the best time for surgery is decided upon.

Keywords: Bronchiectasis, thoracic surgery, VATS, Bronchiectasis severity index score

lanan hastalarda ise ortalama 14 gün olarak bulundu (p:0,167). Alt grup analizine göre, BŞİ skoru dokuz veya daha yüksek olan hastalarda postoperative erken komplikasyon oranlarının arttığı gözlemlendi (p:0,35).

Sonuç: Yüksek BŞİ skoruna sahip hastalarda bile, klinik parametreler uygunsa cerrahi güvenilir bir seçenektir. Bronşiektazi şiddet indeksi, ameliyat sonrası komplikasyonların tahmin edilmesinde öngörü değerine sahiptir. Hastalar multidisipliner merkezlerde değerlendirilmelidir. Cerrahi karar verme sürecinde deneyimli göğüs hastalıkları hekimleri ve göğüs cerrahlarına ihtiyaç vardır.

Anahtar Kelimeler: Bronşektazi, göğüs cerrahisi, VATS, Bronşiektazi şiddet indeks skoru

INTRODUCTION

Bronchiectasis is a chronic lung disease characterized by recurrent airway infections and inflammation, resulting in irreversible structural damage to the small airways and often affecting the surrounding lung parenchyma. In 1819, Theophile Hyacinte Laennec provided the first clinicopathological description of bronchiectasis based on the case of a 72-year-old woman who died after experiencing chronic recurrent productive cough and hemoptysis (1). Autopsy findings revealed the presence of saccular bronchiectasis in the pulmonary parenchyma (2).

Advancements in non-invasive diagnostic methods have facilitated the identification of bronchiectasis in patients with asymptomatic clinical progression. Computed tomography (CT) features of bronchiectasis include bronchial dilatation, with a bronchioarterial ratio greater than 1 (presumably comparing the internal airway lumen to the adjacent pulmonary artery). Other indirect CT signs of bronchiectasis involve bronchial wall thickening, mucus impaction, and a mosaic perfusion pattern in the lung parenchyma (2). However, surgical intervention is typically recommended for patients who exhibit clinical symptoms (3).

Regarding recurrent pulmonary infections in the progress of bronchiectasis, developing countries remain at high risk. Despite this fact, children in developed countries with cystic fibrosis remain at high risk (4-8). The most commonly known pathologies are idiopathic, post-recurrent infection, immunodeficiency, chronic obstructive pulmonary disease, connective tissue disease, allergic bronchopulmonary aspergillosis, primary ciliary dyskinesia, asthma, non-TBC mycobacteria (9). The number of new patients currently under any stage of treatment is not definite. The patient count has risen over the last few years according to global statistics. Bronchiectasis can exist in any individual group. However, it generally occurs in childhood during the pre-antibiotic period (10). Recent evidence shows that bronchiectasis disproportionately affects women and older individuals and may be contributing to an increasing healthcare burden. Age-standardized incidence has declined from 13.9 per 100,000 persons in 2007 to 10.6 per 100,000 persons in 2017 (an average decline of 2.7% per year). This decline was steeper among men (15.6 per 100,000 in 2007 to 9.9 per 100,000 in 2017, an average decline of 4.4% per year) than women (12.4 per 100,000 in 2007 to 11.2 per 100,000 in 2017, an average decline of 1.0% per year), and the age-standardized incidence rate of bronchiectasis in women was slightly higher than that of men in 2017 (11).

The presence of sputum production alone or isolation of a pathogen without clinical signs of active infection is not always an indication for antibiotic treatment. The absence of clinical signs and symptoms, production of sputum, and isolation of pathogen microorganisms is not always an indication of antibiotic treatment. In cases of high fever, shortness of breath, or clinical deterioration, empiric antibiotic treatment should be started and continued for at least 14 days, after sending the sputum culture of optimal antibiotics. Antibiotics are used when the clinical picture deteriorates as demonstrated by an increased cough or sputum production, high fever, shortness of breath, and hemoptysis. Treatment should be started empirically (immediately after the sputum sample is sent for microbiological analysis) based on the previous isolation and continue for 14 days. Due to recommendations and rising antibiotic resistance, we do not advise starting 'routine' antibiotherapy (12).

The most commonly accepted surgical indication for surgery is resistance to medical treatment. Surgical resection must be considered after running out of all conservative treatment options, but in some cases like periodic or massive hemoptysis, proceeding to surgical resection can be a more suitable option. For patients in high-risk groups, intensive hospital care and bronchial artery embolization should be considered (13). Surgical treatment may be considered for certain patients with bilateral localized bronchiectasis. All types of pulmonary resections can be conducted on patients with the right types of clinical progress. The most commonly seen area is the left lower lobe (14). The modern era of thoracic surgery dictates video-assisted thoracic surgery (VATS) on most

patients with suitable surgical conditions. In this study, there are patients who underwent a VATS procedure (15).

This article evaluates the clinical severity of surgery-candidate patients with bronchiectasis using the Bronchiectasis Severity Index (BSI). It also examines early complication rates and long-term outcomes in surgically treated patients.

MATERIALS and METHODS

In this article, we selected 68 patients who were operated on at the Department of Thoracic Surgery, Istanbul University, School of Medicine, from 2001 to 2019 to determine clinical changes in a follow-up period of at least two years. The study was approved by the Local Human Ethics Committee (Date: 14.04.2023, No: 8). All patients underwent preoperatively a series of clinical and radiological tests. Complete medical background, presence of cystic fibrosis, family history, incidence of pulmonary infections and antibiotic usage per year collected from all patients. Dynamic respiratory function tests were performed for all patients, and in selected patients, quantitative perfusion tests were done to predict the results of surgery. We performed high resolution computerized tomography on each patient. Bronchoscopy was performed on each patient by pulmonology specialists. The multifactorial bronchiectasis severity index was calculated preoperatively to determine the average severity of planned surgery patients: the Bronchiectasis Severity Index (BSI).

The BSI corresponds to a scale that evaluates the severity and prognosis of NCFB by analyzing nine parameters/variables: age, body mass index (BMI), FEV1% predicted, hospitalization and exacerbations before the study, degree of dyspnea, chronic colonization by P. aeruginosa and other microorganisms and radiological extension of the disease. The BSI score is shown in Table 1. Clinical parameters were calculated according to the BSI scoring system, and one to four-year mortality and hospitalization rates are shown on Table 2.

Before surgery, all patients had strict pulmonary exercise periods. Antibiotherapy were used according to the "British Thoracic Society Bronchiectasis (non-CF) Guideline Group, British Thoracic Society guideline for non-CF bronchiectasis" (11).

Table 1: Bronchiectasis Severity Index (BSI)

Bronchiectasis Severity Index Parameter	Score	Description
Age (years)	0	<50
	2	50-69
	4	70-79
	6	≥80
Body Mass Index (kg/m^2)	2	Less than 18.5
	0	18.5-25
	0	26-29
	0	≥30
FEV1 (%)	0	>80
	1	50-80
	2	30-49
	3	<30
History of previous hospital admission	0	None
	5	Present
Exacerbations before study (times)	0	0
	0	1-2
	2	≥3
mMRC dyspnea score	0	1-3
	2	4
	3	5
Pseudomonas colonization	0	Absent
	3	Present
Colonization with other microorganisms	0	Absent
	1	Present
Radiological severity (bronchiectasis present on lobes)	0	<3 lobes
	1	≥3 lobes

FEV1: Forced expiratory volume in 1 second, mMRC: Modified Medical Research Council

Table 2: Severity of bronchectasis (BSI score) and one year outcomes

Mild (0-4)	
0-4 Mild Bronchiectasis	0-2.8
Moderate (5-8)	0.8-4.8
Severe (≥9)	7.6-10.5

BSI: Bronchiectasis severity index

The surgical technique differs from patient to patient. However, if available we prefer the VATS technique. In the VATS patient group, we prefer uniportal and bi-portal surgery if viable. Segmentectomy, lobectomy, and pneumonectomy were performed in all cases because of the selection nature of anatomically limited disease. Early mortality, morbidity, and late mortality were noted. Patients with lost data in the follow-up period, those who had an unrelated cause of death, and patients with a secondary unrelated, medically deteriorating disease were excluded as well as patients with cystic fibrosis due to the nature of disseminated lung involvement. We also excluded patients with detected pulmonary foreign bodies. During the preoperative period, both rapid invasive and non-invasive sputum collection methods revealed no evidence of pathogenic bacterial growth. Cardiovascular anesthesiology specialists evaluated all patients preoperatively for clinical status and general anesthesia risks. Left-side selective intubation was applied to all patients for selective lung ventilation and to prevent aspiration on the non-diseased side.

Statistical analysis

Statistical analysis was conducted using IBM SPSS version 26.0 for Windows (IBM Corp., Armonk NY, USA). Descriptive data were presented as median ± standard deviation (SD), median (min.–max.), number, and frequency. The distribution of variables and their adherence to a normal distribution were assessed using the Kolmogorov-Smirnov test. Group comparisons were performed using Student's t-test. Pearson correlation analysis was employed to evaluate the relationship between variables. Receiver operating characteristic (ROC) analysis was employed to determine the optimal cut-off values. A significance level of $p<0.05$ was used to determine statistical significance. Sensitivity and specificity analyses were performed for the platelet-to-lymphocyte ratio (PLR) using three different cut-off values, aiming to identify the values that maximize specificity and sensitivity. The primary focus of the survival analysis was overall survival (OS), defined as the time interval from the date of initial surgery to the date of death. IBM SPSS version 21 was used for the statistical analyses. Group relationships based on categorical variables were assessed using the $\chi 2$ test. The Kaplan-Meier method was employed to compute the OS of the groups. Cox regression analysis was used to analyze the impact of factors on OS and calculate the hazard ratio with a 95% confidence interval.

RESULTS

The age range was 5-63 with a median age of 26 (±15.62) years. A total of 68 patients were evaluated and classified by declaration; 37 were male and 31 were female. Body mass index values were 21 (±5.05) with a minimum of 13 and a maximum of 32.3. The patients were divided into two groups, adults (n=42) and children (n=26). The lower FEV1 ratio observed in the pediatric group compared to the adult group might suggest a potential greater impact of bronchiectasis on the pediatric group. However, it is important to note that this difference did not indicate a statistical significance. Among all the patients, 8 (11.8%) patients had shortness of breath, but according to the mMRC scoring system, none of the patients reached more than 3 points on the dyspnea score. 21 patients (30.9%) demonstrated sputum presence but, according to the surgical selection criteria, none of the patients had more than 50 ml of sputum daily. Eleven patients (16.2%) had no history of antibiotic usage due to lower airway infections, and 15 patients (22%) had a non-anti-tuberculosis type of antibiotherapeutics. 37 patients had a history of antibiotic usage due to lower airway infections and 37 patients (54%) had a hospitalization history due to lower lobe infections. Even though all patients were negative for acid-resistant staining on sputum, 5 (7.4%) had a history of anti-TB antibiotics. No pathogenic microorganisms, including Pseudomonas, were detected in the multiple sputum cultures conducted before the operation. 19 patients (27.9%) had a history of minor hemoptysis, and no patient had a history of massive hemoptysis.

According to BSI, 29 patients (42.6%) got 0 to 4 points, which showed mild bronchiectasis, 32 patients (47.1%) got BSI score 5 to 9 points, showing moderate bronchiectasis and seven patients (10.3%) had 10 plus points which was described as severe bronchiectasis. Four patients (5.9%) underwent embolization due to recurrent hemoptysis. Fourteen patients (20.6%) had a VATS procedure and 54 (79.4%) were operated on via thoracotomy. Resection types and ratios are shown in (Table 3). Three patients underwent thoracomyoplasty due to lung expansion insufficiency and one patient needed plication due to complications related to diaphragmatic paralysis. All these surgical interventions were performed in the early postoperative period.

The mean postoperative hospital stay was 13 (±11) days for all patient groups. VATS patients spent 8 days in the hospital, and open surgery patients were there for 14.89 days (p:0.167). Patients with higher BSI score had a longer hospital stay. The median hospital stay for higher and lower scored patients was 22.7/12.4 (p:0.002). No patients experienced mortality within 30 days after surgery. Out of the 24 patients, 22 developed intrathoracic complications, while two patients developed postoperative atrial

Table 3: Distribution of the study group according to the resection type

Resection type	n	%
	Left sided resections	
Left upper lobectomy	4	5.9
Left lower lobectomy	25	36.8
Lingulectomy	8	11.8
Left common basal segmentectomy	4	5.9
Left pneumonectomy	4	5.9
Left trisegmentectomy	1	1.5
	Right sided resections	
Right upper lobectomy	3	4.4
Right lower lobectomy	11	16.2
Right middle lobectomy	7	10.3
Right pneumonectomy	1	1.5
Total	68	

Table 4: Major intrathoracic and extrathoracic complications

Complications	n	%
Acute miyocardial infarction	2	2.9
Empyema	4	5.9
Prolonged air leak	4	5.9
Pleural effusion	1	1.5
Pneumonia	9	13.2
Wound infection	4	5.9
Total	24	

fibrillation, which was effectively managed with medical intervention within the first 48 hours. No significant differences were found between the gender groups on complications (p=0.47). Major intrathoracic and extrathoracic complications are listed on table (Table 4). The most common postoperative complications were pneumonia (5.9%), local wound infection (5.9%), and prolonged air leak (5.9%). No patient reported late-period readmission and surgery-requiring complications. The median follow-up period was 147 months (Least follow up period mentioned). According to subgroup analysis, if the severity score is nine or higher, patients are faced with higher complication rates (p=0.035). No disease-related mortality occurred during the follow-up period. Seven (10.3%) patients had severe bronchiectasis during the preoperative clinical approach according to BSI, but after surgery, none of those patients were reported as having mortality or re-hospitalization due to bronchiectasis.

DISCUSSION

In our study, there were no differences in the overall follow–up period, VATS/open surgery ratios, and median hospital stay days. Male gender tended to be slightly younger although this age difference did not reach statistical significance. According to the WHO, average BMI values are 27.8 kg/m² for both gender but in our study, they were 21 (±5.05) kg/m². This may be due to recurrent infectious periods of the patient's lifespan. The BSI score is an accepted scoring system for clinical severity. The scoring system anticipated that patients with more than 9 points (indicating severe bronchiectasis) would have hospitalization rates of up to 52.6% within one year. However, in our study, no readmissions were observed within the one-year period. Nonetheless, in our study, we found that a higher BSI score was associated with increased early postoperative complications and a longer hospital stay. Differences between adult and pediatric patients on FEV1 ratios were not statistically significant but the overall adult population had higher rates of FEV1 ratios.

Despite pediatric-term lung infections becoming less and less common, bronchiectasis incidence is expected to rise due to improvements in chest imaging and diagnostic testing, plus improvements in thoracic surgical methods leading to more minimally- invasive surgery. Likewise we prefer the VATS technique for all viable patients. However in some cases, considering the general anesthesia period, extensive adhesions, and VATS complications, open surgery is still a reliable and considerable model.

In our study, median hospital stays for VATS and thoracotomy procedures were statistically not significant, but

overall they were longer than other studies in the literature Alban et al. reported that the main hospital stays for both groups were four to five days. This may be attributed to the fact that bronchiectasis patients experienced more prolonged early postoperative complications (17).

Accordingly to previous studies, we recommend that bronchiectasis patients being considered for surgery should undergo examination and be assessed by experienced thoracic surgeons and chest disease specialists (18,19). In the British Thoracic Surgery Guideline for Bronchiectasis, surgical treatment is described as lacking high-quality randomized control studies, and the advantages of surgery over conservative management remain unclear. Additionally, there is a reporting bias evident in the available case series.

CONCLUSION

In this research, our objective was to assess postoperative complications in bronchiectasis surgery using the BSI scoring system, which delineates clinical severity. Surgical intervention and patient evaluation are anticipated to yield optimal surgical outcomes.

Ethics Committee Approval: This study was approved by Istanbul Faculty of Medicine Clinical Research Ethics Committee (Date: 14.04.2023, No: 8).

Informed Consent: Written informed consent was obtained.

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