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Original Article / *Özgün Makale*

Surgical treatment of bronchiectasis: Our 23 years of experience

Bronşektazide cerrahi tedavi: 23 yıllık deneyimimiz

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ABSTRACT

Background: In this study, we aimed to evaluate the success of surgery and a complete resection for bronchiectasis treatment and to present our 23 years of surgical experience.

Methods: Between January 1991 and December 2013, a total of 1,357 patients (667 males, 690 females; mean age 30.5±14.3 years; range, 3 to 73 years) with the diagnosis of bronchiectasis who underwent pulmonary resection in our clinic were retrospectively analyzed. Demographic and clinical characteristics of the patients, etiologies, symptoms, localizations, surgical procedures, and long-term follow-up results were evaluated.

Results: There were 1,394 surgeries, as 37 (2.7%) patients had bilateral disease. The surgical procedures included lobectomy (n=702, 50.3%), pneumonectomy (n=183, 13.1%), segmental resections (n=114, 8.2%), bilobectomy (n=83, 6.0%), and lobectomy + segmentectomy (n=312, 22.4%). During the postoperative period, 1,269 (93.5%) patients were followed at a mean duration of 51.6 (range, 1 to 120) months. After surgery, 774 (61%) patients were asymptomatic, 456 (35.9%) showed an improvement, and 39 (3.1%) had no response or deterioration.

Conclusion: The surgical treatment plays an important role in the clinical and symptomatic improvement of patients with bronchiectasis. Surgery reduces the morbidity and mortality rates with careful preoperative preparation and appropriately selected cases.

Keywords: Bronchiectasis, resection, surgery.

ÖZ

Amaç: Bu çalışmada, bronşektazi tedavisinde cerrahinin ve tam rezeksiyonun başarısı değerlendirildi ve 23 yıllık cerrahi deneyimimiz sunuldu.

Çalışma planı: Ocak 1991 - Aralık 2013 tarihleri arasında kliniğimizde bronşektazi tanısı ile pulmoner rezeksiyon yapılan toplam 1.357 hasta (667 erkek, 690 kadın; ort. yaş 30.5±14.3 yıl); dağılım, 3-73 yıl) retrospektif olarak incelendi. Hastaların demografik ve klinik özellikleri, etiyolojileri, semptomları, lokalizasyonları, cerrahi işlemler ve uzun dönem takip sonuçları değerlendirildi.

Bulgular: Hastaların 37'sinde (52.7) iki taraflı hastalık olduğu için toplam 1.394 cerrahi yapıldı. Cerrahi işlemler arasında lobektomi (n=702, %50.3), pnömonektomi (n=183, %13.1), segmental rezeksiyonlar (n=114, %8.2), bilobektomi (n=83, %6.0) ve lobektomi + segmentektomi (n=312, %22.4) vardı. Ameliyat sonrası dönemde 1.269 (%93.5) hasta ortalama 51.6 (dağılım, 1-120) ay süre ile takip edildi. Ameliyat sonrasında hastaların 774'ü (%61) asemptomatik idi, 456'sında (%35.9) iyileşme görüldü ve 39'unda (%3.1) yanıt ya da kötüleşme yoktu.

Sonuç: Bronşektazili hastalarda cerrahi tedavi, klinik ve semptomatik iyileşmede önemli bir rol oynamaktadır. Cerrahi, titiz bir ameliyat öncesi hazırlık ve uygun şekilde seçilmiş olgularda morbidite ve mortalite oranlarını azaltır.

Anahtar sözcükler: Bronşektazi, rezeksiyon, cerrahi.

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Bronchiectasis is the abnormal and permanent dilatation of the bronchi and the destruction of the elastic and muscular layers of the bronchial wall.[1] It was first described in 1819 by Laënnec.[2] The most frequent cause of bronchiectasis is a chronic bacterial infection.[1,3-5] Effective vaccination programs for pertussis and measles, the development of preventive medicine, and the use of antibiotics have decreased the prevalence of bronchiectasis. However, in developing countries, including Turkey, it remains an important problem due to tuberculosis, pneumonia, pertussis, and measles infections.[1,6,7] Recent publications have reported that the bronchiectasis prevalence and the number of hospitalized bronchiectasis patients have increased.[8,9]

In the present study, we aimed to evaluate the success of surgery and a complete resection for bronchiectasis treatment and to present the long-term results based on our 23 years of surgical experience.

PATIENTS AND METHODS

This retrospective study was conducted at Atatürk Chest Diseases and Thoracic Surgery Training and Research Hospital between January 1991 and December 2013. A total of 1,357 patients (667 males, 690 females; mean age 30.5±14.3 years; range, 3 to 73 years) with the diagnosis of bronchiectasis who underwent resections in our clinic were included in this study. Exclusion criteria were as follows: having only medical treatment and not being operated in bronchiectasis patients. A written informed consent was obtained from each patient and/or parent of pediatric cases. The study protocol was approved by the Institutional Review Board for Human Subjects Research and Ethics Committee of Ankara Keçiören Educational Research Hospital. The study was conducted in accordance with the principles of the Declaration of Helsinki.

The detailed histories of all the patients, physical examinations, complete blood counts, and serum biochemistry were evaluated, and pulmonary function tests (PFTs) were routinely performed. Each patient was evaluated for their surgical suitability using a posteroanterior chest X-ray and a previous bronchography, and then, with high-resolution computed tomography (HRCT). Previously, bronchographies were used for this purpose. Quantitative pulmonary ventilation perfusion scintigraphy was performed, if necessary. The decision and timing of the operation were based on an evaluation of the patient's age, symptoms, and HRCT findings. The patient was admitted for surgery, if only sufficient respiratory capacity would be left behind after the resection of unilateral or bilateral bronchiectasis based on the radiological findings and PFT results. The most common indications for surgery were limited disease, no response to adequate medical therapy, history of recurrent infection, and hemoptysis.

Before the operation, the secretions were cleaned out and the presence of foreign bodies or endobronchial lesions was determined using a rigid and/or flexible bronchoscope. The tracheobronchial lavage fluid underwent a culture and antibiogram and, according to the results, a prophylactic antibiotic treatment was administered. Preoperative bronchodilator therapy and postural drainage were performed for infection control in these patients. All of the patients were intubated with double-lumen endotracheal tubes, and the contralateral lung was protected from the blood and infected secretions using selective ventilation. A posterolateral thoracotomy or video-assisted thoracic surgery (VATS) was performed, and the type of resection was chosen based on the affected area and the cardiopulmonary reserve. For limited disease in one lobe, we performed a lobectomy, bilobectomy, or lobectomy with segmentectomy, and for extensive disease, a pneumonectomy was performed. In the pneumonectomy and upper lobectomy patients, we always supported the bronchial stump with the surrounding tissue, such as the mediastinal pleura, thymus, and pericardial adipose tissue to avoid a bronchopleural fistula.

A resection of the entire bronchiectatic area diagnosed by HRCT or during the operation was accepted as a complete resection. All of the specimens were evaluated via histological examinations, and the diagnosis of bronchiectasis was confirmed.

The patient follow-up was done with an outpatient control and/or by telephone call. The criteria for late surgical outcomes included the followings: the patient was assessed as having a full recovery or being asymptomatic, if they were completely disease-free after surgery; a decrease in the preoperative symptoms and the need for antibiotics was assessed as good; and no reduction in the preoperative complaints was assessed as being unable to respond or deterioration.

Statistical analysis

Statistical analysis was performed using the IBM SPSS version 21.0 software (IBM Corp., Armonk, NY, USA). Continuous variables were expressed in mean ± standard deviation (SD) or median (interquartile range [IQR]), while categorical variables were

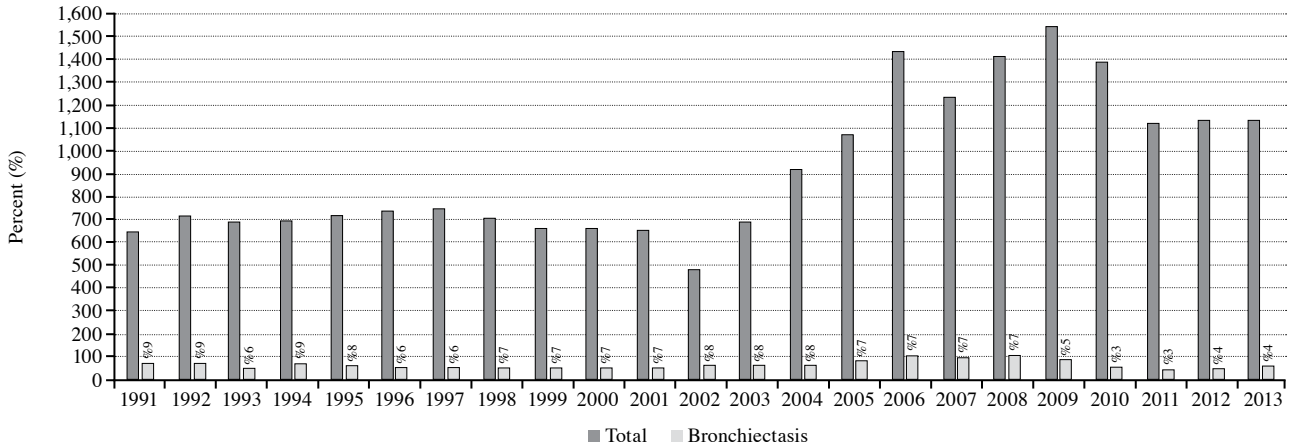

Figure 1. Comparison between the bronchiectasis surgeries and the total number of surgeries.

expressed in number and frequency. The independent samples t-test was used to compare two independent groups. The chi-square test was used to compare categorical distributions and the Pearson test was used to compare categorical data with the Monte Carlo simulation technique. A p value of <0.05 was considered statistically significant with 95% confidence interval (CI).

RESULTS

Throughout the study period, a total of 21,320 operations were performed, and bronchiectasis operations accounted for 6.4% of them. According to annual rate, the number and rate of operations decreased after 2010 (Figure 1), probably due to improved preventive health services in our country since 2000.

The most common age range was 21 to 30 years (23.9%). The most common etiology was a recurrent pulmonary infection (69.7%) (Table 1). A total of 1,132 (83.4%) patients presented with coughing, 917 (67.6%) with sputum, and 409 (30.1%) with hemoptysis (Table 2). Sweat testing was performed in 327 patients, and the results were negative and their histories were not compatible with cystic fibrosis (CF).

According to the location of bronchiectasis, left lung was involved in 66.2%, right lung in 31%, and bilateral lungs in 2.7% of the patients. The most commonly affected areas were the lower lobes (63.1%), particularly the left lower lobe (48.2%).

Pre- or perioperatively, foreign bodies were found in 23 (1.7%) patients with rigid and/or flexible bronchoscopy. The most common foreign body was the mouse barley plant (Hordeummurinum). Eight of the patients were unaware of the foreign body aspiration. However, 15 of the patients had histories dating back to a mean 10.2 (range, 1 to 25) years.

Table 1. Etiological factors

	n	%
Recurrent pulmonary infections	946	69.7
Tuberculosis	162	11.9
Viral infections in childhood	101	7.4
Foreign body	23	1.7
Infectious hydatid cyst	10	0.7
Kartagener syndrome	4	0.3
Traumatic bronchus stenosis	3	0.2
Unknown	108	8.0
Total	1,357	100

Table 2. Symptoms

	n	%
Cough	1,132	83.4
Sputum	917	67.6
Hemoptysis	409	30.1
Dyspnea	192	14.1
Chest pain	168	12.4
Fever	163	12.0
Night sweats	82	6.0
Halitosis	52	3.8
Palpitation	29	2.1
Growth retardation	25	1.8

Table 3. Bilateral bronchiectasis

Localization	Number	Number of segments
Right lower lobe + left lower lobe	8	9
Right middle lobe + left lower lobe	7	6
Right middle lobe + left lower lobe and lingula	7	8
Right middle lobe + lingula	5	4
Right lower lobe + left lower lobe and lingula	3	11
Right lower and middle lobes + left lower lobe	2	11
Right upper lobe + left lower lobe and lingula	2	9
Right lower lobe + left upper apicoposterior segment	1	6
Right upper anterior segment + left lower lobe	1	5
Left pneumonectomy + right upper posterior segment	1	9

As 37 of the patients (2.7%) had bilateral bronchiectasis, 1,357 patients underwent 1,394 surgeries. The pulmonary localizations affected in the patients with bilateral bronchiectasis are shown in Table 3. Nine operations were done with VATS. In our series, there were 409 patients with hemoptysis, and 87 of them (21.3%) underwent emergency surgery due to massive hemoptysis. The localizations affected and surgical procedures are shown in Table 4. All of the specimens were evaluated via histological examinations, and the bronchiectasis diagnoses were confirmed.

Mortality was not seen during the peri- or postoperative period at 90 days, and postoperative complications were observed in 132 (9.7%) patients. The complications and their frequencies are shown in Table 5. The wound infections in our patients were controlled with antibiotics and frequent dressing. In addition, bronchoscopies were performed in those patients with secretion stasis and atelectasis. The patients with prolonged air leaks (>7 days) were treated with chest tube thoracostomies and did not require revisions. Five of the patients who developed pleural effusion were treated with tube

Table 4. Surgical procedure/affected areas

	Right		Left		Total	
	n	%	n	%	n	%
Pneumonectomy	33	2.4	150	10.8	183	13.1
Lobectomy	299	21.4	403	28.9	702	50.3
Lower	111	7.9	355	25.5	466	33.4
Upper	47	3.4	48	3.4	95	6.8
Middle	141	10.1	-	-	141	10.1
Bilobectomy inferior	78	5.6	-		83	6.0
Bilobectomy superior	5	0.4				
Lobectomy + segmentectomy	3	0.2	309	22.2	312	22.4
Lower lobectomy + lingulectomy	-		309	22.2		
Middle lobectomy + lower lobe superior	1	0.1	-			
Middle lobectomy + upper lobe anterior	2	0.1	-			
Segmentectomy	40	2.9	74	5.3	114	8.2
Lingulectomy	-		60	4.3		
Upper lobe	22	1.6	6	0.4		
Lower lobe	18	1.3	8	0.6		
Total	458	32.9	936	67.1	1394	100

Table 5. Postoperative complications

	n	%
Wound infections	51	3.75
Atelectasis	37	2.72
Prolonged air leak	14	1.03
Empyema	12	0.88
Postoperative hemorrhage	7	0.51
Pleural effusion	7	0.51
Bronchopleural fistula	5	0.36
Pneumonia	5	0.36
Chylothorax	2	0.14
Contralateral pneumothorax	1	0.07

thoracostomies, and two of them were treated with thoracenteses. The patients with empyema were treated with antibiotics, tube thoracostomies, and intrapleural irrigation with saline. Two of the patients had bronchial fistulas and the main culprit was the necrosis of the bronchial stump due to excessive bronchopleural and lymph node dissection during revision surgery. In these cases, the bronchial stump was revised, resutured more proximally, and supported by the surrounding tissues. The other three patients with microfistulas were followed with antibiotics, tube thoracostomies, and drains without underwater seals. The drainage tubes were taken out after the fistulas were closed. Four of the patients who developed postoperative hemorrhage underwent revisions, and the bleeding was controlled. The other three were followed with tube thoracostomies, and the bleeding stopped spontaneously. These patients with postoperative chylothoraxes were treated with no oral intake and a conservative approach. The patient with pneumothorax was treated with a tube thoracostomy.

The over-symptomatic patients with extensive bronchiectasis were unable to undergo complete resections; however, when the medical treatment was inadequate, palliative surgery was performed to relieve the symptoms. These were considered incomplete resections; therefore, complete resections were performed in 1,182 (93.1%) patients. During the postoperative period, 1,269 (93.5%) patients were followed, with 88 lost to follow-up. The mean follow-up time of these patients was 4.3 (range, 2 to 10) years. In addition, 774 (61%) patients were asymptomatic, 456 (35.9%) exhibited improvement, and 39 (3.1%) exhibited worsening or no response to surgery during the postoperative period. The postoperative follow-up results are shown in Table 6. Those patients who underwent complete resections showed favorable results, compared to those who underwent incomplete resections, indicating a statistically significant difference ($p<0.001$).

DISCUSSION

This study is the largest series in the English literature after the previous publication of 790 patients by Zhang et al.[3] In our study, we present our long-term experience in the treatment of bronchiectasis treatment. Our study results showed that the surgical treatment of bronchiectasis played a pivotal role in the clinical and symptomatic improvement of these patients.

Bronchiectasis is still a significant problem in developing countries including Turkey.[1,6,7] However, in Germany, between 2005 and 2011, the number of hospitalized bronchiectasis patients increased an average of 2.9% each year. In a multicenter study from England and Europe involving 1,310 patients, the acute exacerbation rate was found to be 1.8 to 3%, while the hospitalization rate was 26.6 to 31.4%.[9] This finding indicates that bronchiectasis still remains an important concern worldwide.[8]

Both congenital and acquired factors play a role in the etiology of bronchiectasis. Congenital causes of bronchiectasis are seen in 4 to 11% of the cases, with CF being the most common cause.[1] The sweat tests for 327 of the patients in our series were negative, and their histories were not compatible with CF. However, there may have been undiagnosed CF patients.

Table 6. Complete and incomplete resection results

	Complete resection		Incomplete resection		Total	
	n	%	n	%	n	%
Complete remission/asymptomatic	748	58.9	26	2.0	774	60.9
Improvement	422	33.3	34	2.7	456	35.9
No response/worsening	12	0.9	27	2.1	39	3
Total	1182	93.1	87	6.9	1269	100

Recurrent pulmonary infections are the most important factor in acquired cases (36 to 78%).[6,7] In addition, tuberculosis (9.4 to 12%) and bronchial obstructions (0.4 to 4.3%) also play roles in the etiology.[6,7,10-14] In our series, as in the literature, the most common etiological factors were recurrent pulmonary infections (69.7%) and tuberculosis (11.9%). Moreover, the majority of the patients had histories of childhood pneumonia.

In our study, the most important reasons for performing surgery were the symptoms, which most commonly included a chronic cough, sputum, hemoptysis, and halitosis. Chest pain, dyspnea, and fever were also among the symptoms, and the chronic disease process can progress to respiratory failure and cor pulmonale.[3,5,11,12,14,15] Our patients usually presented with chronic coughing, sputum, hemoptysis, and dyspnea. Massive hemoptysis with bronchiectasis is a rare, but life-threatening complication and, in our series, 87 (21.3%) of 409 patients with hemoptysis underwent emergency surgery due to massive hemoptysis.

The extensivity of the disease and the lung areas to be resected should be well-determined to protect the healthy lung tissue. Previously, bronchographies were used for this purpose; however, HRCT has become the gold standard for the diagnosis and treatment planning for bronchiectasis over the last two decades.[1,4,16,17] We used HRCT in the preoperative diagnoses of our patients.

The left lung is most often affected in bronchiectasis, and this is connected to the anatomical structure of the left main bronchus. The left main bronchus is longer and more angularly separated from the trachea, mediastinal vascular structures, and lymphatic structures. It is difficult to drain due to the pressure of the left main bronchus, and the left lower lobe is more susceptible to bronchiectasis development.[5,10,12-14,18] According to the frequency order, the left lower lobe, right middle lobe/lingula, total left lung, total right lung, right upper lobe, and left upper lobe have been reported in the anatomical distribution of bronchiectasis.[17] Left lung involvement occurs at a rate of 55.1 to 78%, and the involvement of the lower lobes is 68.1%.[5,10-14,18] Moreover, 34.8 to 53.6% of the bronchiectasis in the lower lobes are seen in the left lower lobe, and 15.9% are seen in the right lower lobe.[5,12] The rate of bilateral localized involvement is 3.6 to 13%.[5,11-13] In our series, the lower lobe involvement was 63.1%, the left lower lobe involvement was 48.2%, the right lower lobe involvement was 14.9%, and the bilateral involvement was 2.7% among the surgically resected patients.

Bronchoscopy plays an important role in cleaning the tracheobronchial system, determining the preoperative isolation of microorganisms, detecting the hemoptysis focus, and determining whether the obstruction is connected to the bronchiectasis. In localized bronchiectasis patients, particularly in children and intellectually disabled persons, foreign body detection and removal must be done. If there is an obstruction, this also allows for the differential diagnosis of a benign or malignant etiology.[10,12] By applying flexible or rigid bronchoscopy, one can clean the tracheobronchial system, and we found foreign bodies in 23 (1.7%) and traumatic bronchial stenosis in three (0.2%) of our patients. As a general rule, there should be a short time frame from foreign body aspiration, until surgery is done in patients with moderate bronchiectasis. If bronchiectasis persists after three months, HRCT should be repeated. The patients with radiological regression are diagnosed as having pseudobronchiectasis.[19] After administering the anesthesia to our surgical patients and before intubation, we cleaned the tracheobronchial system and prevented the secretions from going to the opposite side using bronchoscopy. In the patients with excessive secretions, the cleanliness of both sides was achieved postoperatively via bronchoscopy. In our clinical experience, after the anesthesia is administered, before starting, and at the end of the operation, it is necessary perform bronchoscopic cleaning to reduce the chance of postoperative complications.

A posterolateral thoracotomy or VATS are applicable surgical treatments. With the introduction of VATS, it has become the method of choice in the appropriate cases. The feasibility of resection depends on the local anatomical situation, particularly adhesions.[20] Previous studies comparing thoracotomies and VATS have reported similar results for the activity levels with treatment. The VATS was reported to be cosmetic, the postoperative pain and blood loss were significantly lower in the VATS treatment group, and the operation time was shorter than in a thoracotomy.[21] In addition, a shorter hospital stay and less complication in the VATS patients were reported in another study.[22] In our study, we performed resections with VATS in nine patients over the last two years. At our center, the VATS rate has been increasing and, currently, we believe that a VATS resection is a viable option in bronchiectasis that is applied often.

To achieve successful surgical results, the patient should be operated in terms of the most appropriate infection, bronchodilation, and dry period. Even in the intraoperative detection of bronchiectasis without HRCT, the lesion should be resected. Although a

resection can be performed for bronchiectasis detected in childhood, it should be limited to patients with well-localized disease.[23] This is because the that space remaining after a resection can be filled in by the growth of the lung.[5] However, in children scheduled for pneumonectomy, if there is no urgent indication, a resection should be performed after the age of 18 years old to prevent the development of deformities in the thorax and spine.[24] According to our clinical experience, in childhood bronchiectasis cases, if there are no frequent infections preventing the child's development, a clinical operation should be performed as late as possible. Before the age of 18 years, a pneumonectomy must be avoided, since the reduction in the hemithorax size after a resection can lead to a thoracic deformity in adolescence.

In one study comparing the medical therapy and surgical resection results, the length of the hospital stay was shorter in the patients who underwent complete resections.[25] Of these, 94.4% of them were asymptomatic, and 5.6% were instructed to restart medical treatment; however, there was a reported decrease in their antibiotic needs. The authors showed that the need to restart medical treatment was 40% in the medical therapy group. In the complete resection group, the remaining asymptomatic rate was reported to be statistically significant. In our series 92.2% (1,170/1,269) of the patients in the complete resection group achieved complete remission or improvement. A previous study examining the quality of life of patients after a surgical resection reported that although there was a functional decrease in the lung volume, there was no reduction, but an increase of 52% in the exercise capacity.[26] There was also an increase in the quality of life after the resection in the general, physical, and mental health of the patient.

With the presence of bilateral bronchiectasis in selected patients, if the pulmonary reserve is sufficient, there is no contraindication to surgery.[5,6,12,15,27,28] In a study examining bilateral resection cases, the symptoms were alleviated in 66%, while there was no response in 14% of the cases.[29] The authors concluded that a bilateral resection can be done at any age. Resections of 11, 12, and 13 segments were performed in 30 patients with bilateral disease in another study, and they were followed for 30 years.[30] The long-term results of these patients were reported to be excellent. The authors suggested that, in patients with sufficient PFT results, a resection should be performed, if at least two lobes or six segments remained after surgery. In our series, we performed 2.7% bilateral resections and 5 to 11 segment resections; there were no complications and, in the follow-up period, there were excellent results. A staged thoracotomy should be performed in bilateral bronchiectasis, the more severe bronchiectasis side must be operated on primarily, and there should be at least one to two months between the two operations.

The postoperative complication rate was 8.8 to 24%, and 0 to 8% mortality was seen in the bronchiectasis cases.[3,5,6,10-15,21] In our series, the rates were 9.7% and 0%, respectively. The complications included wound infections, secretion stasis, atelectasis, prolonged air leakage, pleural effusion, empyema, bronchopleural fistulas, and postoperative bleeding.[11,12,14] Two of the patients had bronchial fistulas and, during revision surgery, there was bronchial stump necrosis due to excessive bronchopleural and lymph node dissection. The bronchial stump was revised again more proximally, and it was supported by the surrounding tissues. The other three patients with microfistulas were followed with pleural drainage and medical treatment, and the drainage tubes were taken out after the fistulas were closed. Based on our experience, unnecessary bronchial and lymph node dissection and a long bronchial stump increase the possibility of a bronchial fistula. Therefore, one should avoid excessive bronchial and lymph node dissection during the resection, the peribronchial tissue must be protected, and the bronchial stump should not be long.

The main goals of surgical treatment are to cure the disease with complete resection, improve the quality of life of the patients who do not benefit from the medical treatment, and prevent empyema due to bronchiectasis, massive or recurrent hemoptysis, and complications such as lung abscesses. In our series, complete resections were performed in 1,182 (93.1%) patients. In previous studies, this ratio ranged between 64.7% and 90.7%.[3,5,11-14,31,32] In the patients who underwent complete resections, we found that 58.9% were asymptomatic, 33.3% showed an improvement, and 0.9% showed a deterioration, consistent with the literature. If a complete resection cannot be done due to excessive bronchiectasis and medical treatment is inadequate in life-threatening hemoptysis or infection-related complications which affect the patient's daily routine, a palliative resection (incomplete resection) can be done by removing the areas most affected to relive the symptoms.[33,34] Similarly, we performed palliative resections in 97 of our patients (7.14%) for these reasons in our study.

Nonetheless, the present study has several limitations. First, it has a retrospective design, despite its long-term analysis. Second, the data on the

symptoms, PFT results, and detailed comorbidity and complication histories are limited and we were unable to obtain all of the background information from the patients' files to employ a time to event analysis. Finally, our study is lacking in the quality of life scores, and it used subjective outcome measures.

In conclusion, the surgical treatment of bronchiectasis, which is the most optimal curative method, plays an important role in the clinical and symptomatic improvement of patients. Overall, the prognosis of the patients undergoing complete resections is more favorable than that of those undergoing incomplete resections. In general, anatomical resections should be done, and incomplete resections should be avoided. If the respiratory capacity remains adequate after a complete resection, it is also safe to perform surgery for bilateral bronchiectasis with staged operations. In the treatment of bronchiectasis, surgery has low morbidity and mortality rates with careful preoperative preparation and appropriately selected cases.

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