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ORIGINAL ARTICLE / ÖZGÜN MAKALE

Analysis of bronchiectasis patients who underwent video-assisted thoracoscopic surgery in a tertiary thoracic surgery center: Ten years of experience

Üçüncü basamak göğüs cerrahisi merkezinde video yardımlı torakoskopik cerrahi uygulanan bronşektazi hastalarının analizi: On yıllık deneyim

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ABSTRACT

Background: This study aimed to analyze our video-assisted thoracic surgery (VATS) experience in the surgical treatment of bronchiectasis and the reasons limiting VATS application.

Methods: Two hundred one patients (106 males, 95 females; mean age: 39.7±14.1 years; range, 12 to 68 years) who underwent surgical treatment for bronchiectasis between January 2012 and October 2021 were included in the retrospective study. Three groups were created based on the surgical technique used: VATS, thoracotomy, and patients who were converted from VATS to thoracotomy.

Results: The most significant presenting symptoms were cough (43%) and excessive sputum expectoration (40%). Surgical intervention was applied to the left side of 60% of the patients, and the most common resection performed in all three groups was left lower lobectomy. The rate of conversion from VATS to thoracotomy was 28.8%, and it was found that dense pleural adhesions were the most common reason. Revision surgery was performed on a total of 11 (5.47%) patients. The frequency of revision surgery did not differ significantly among the three groups (p=0.943). The most common postoperative complication was prolonged air leakage. There was no statistically significant difference in postoperative complication rates among the groups (p=0.417). The rate of surgical treatment of bronchiectasis with VATS was observed to have increased from 11.1% to 77.7% in our clinic.

Conclusion: In experienced hands, VATS can be safely applied in the surgical treatment of bronchiectasis.

Keywords: Bronchiectasis, thoracotomy, video-assisted thoracic surgery.

ÖZ

Amaç: Bu çalışmada, bronşektazi cerrahi tedavisinde video yardımlı göğüs cerrahisi (VATS) deneyimimizin analiz edilmesi ve VATS uygulamasını sınırlayan nedenler incelendi.

Çalışma planı: Ocak 2012 - Ekim 2021 tarihleri arasında bronşektazi nedeniyle cerrahi tedavi uygulanan 201 hasta (106 erkek, 95 kadın; ort. yaş: 39.7±14.1 yıl; dağılım, 12-68 yıl) retrospektif çalışmaya dahil edildi. Kullanılan cerrahi tekniğe göre üç grup oluşturuldu: VATS, torakotomi ve VATS'tan torakotomiye döndürülen hastalar.

Bulgular: En önemli başvuru semptomları öksürük (%43) ve aşırı balgam çıkarma (%40) idi. Hastaların %60'ının sol tarafına cerrahi müdahale uygulandı ve her üç grupta da en sık uygulanan rezeksiyon sol alt lobektomi idi. Video yardımlı göğüs cerrahisinden torakotomiye dönüş oranı %28.8 olup, yoğun plevral yapışıklıkların en sık neden olduğu belirlendi. Toplam 11 (%5.47) hastaya revizyon ameliyatı uygulandı. Revizyon cerrahisi sıklığı üç grup arasında anlamlı farklılık göstermedi (p=0.943). Ameliyat sonrası en sık görülen komplikasyon uzamış hava kaçağıydı. Gruplar arasında ameliyat sonrası komplikasyon oranlarında istatistiksel olarak anlamlı fark saptanmadı (p=0.417). Kliniğimizde bronşektazinin VATS ile cerrahi tedavi oranının %11.1'den %77.7'ye çıktığı gözlemlendi.

Sonuç: Bronşektazinin cerrahi tedavisinde VATS, deneyimli ellerde güvenle uygulanabilmektedir.

Anahtar sözcükler: Bronşektazi, torakotomi, video yardımlı göğüs cerrahisi.

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Bronchiectasis is the abnormal and permanent dilatation of bronchi caused by the destruction of muscle tissue and elastic components of the bronchial wall.[1] The aim of surgical treatment is to remove infected lung parenchyma by anatomic lung resection. With the widespread use of ERAS (enhanced recovery after surgery) protocols in the last two to three decades, minimally invasive surgeries have become the most important component affecting outcomes in these processes. In addition, ERAS protocols, which have been used in different disciplines for the last 10 years, are rapidly taking their place in thoracic surgery (ERATS [enhanced recovery after thoracic surgery]).[2] Dense pleural adhesions, incomplete fissures, multiple and sometimes even calcified giant lymph nodes, and hypertrophic bronchial arteries often encountered in bronchiectasis limit the use of minimally invasive surgeries, such as video-assisted thoracic surgery (VATS). Nonetheless, VATS has become a safe and successful treatment option in bronchiectasis surgery in recent years, particularly in the last decade.[3]

Hence, this study aimed to analyze our VATS experiences in the surgical treatment of bronchiectasis and the reasons limiting VATS application.

PATIENTS AND METHODS

In this retrospective study, the data of 201 bronchiectasis patients (106 males, 95 females; mean age: 39.7±14.1 years; range, 12 to 68 years) who underwent surgical treatment by the same surgical team at the Ankara Atatürk Sanatoryum Training and Research Hospital, Department of Thoracic Surgery between January 2012 and October 2021 were analyzed. Age, sex, patients' complaints at the time of hospital admission, surgery type, the transition from VATS to thoracotomy, resection type (lobectomy or segmentectomy), perioperative complications, need for reoperation, chest tube removal time, surgery time, and length of hospital stay were recorded. The surgical technique was divided into three groups: VATS group (Group V), thoracotomy group (Group T), and transition from VATS to thoracotomy group (Group VT). In addition, the reasons for conversion to thoracotomy were also evaluated.

Indications for surgical treatment in patients with localized bronchiectasis were accepted as nonimproving symptoms despite appropriate medical treatment, recurrent infection, and severe or recurrent hemoptysis. All patients were evaluated by posteroanterior chest X-rays, computed tomography (CT), pulmonary function tests, and fiberoptic bronchoscopy (FOB). Deep intrabronchial lavage samples were obtained through FOB, and for the patients with a positive culture result, appropriate antibiotherapy was started. Patients with stable cardiopulmonary function, no calcified lymph nodes near vascular structures with significant pleural adhesions on CT, and a history of purulent sputum production for less than five years were considered VATS candidates by the preoperative council within the framework of general clinical algorithms. All other patients underwent thoracotomy.

While a single 28 French (Fr) drain was used in cases with VATS lobectomy, two 28 Fr drains (apex and basal) were used in cases with thoracotomy and lobectomy. After the drains were removed, the patients were discharged after a chest X-ray was taken as part of a routine evaluation.

Statistical analysis

Data were analyzed using the SPSS version 24.0 software (IBM Corp., Armonk, NY, USA). Descriptive statistics were given as unit number (n), percentage (%), and mean ± standard deviation (SD) values for age and drainage time. The Pearson chi-square test was used to compare the distribution of categorical variables among groups of patients who underwent thoracotomy, VATS + thoracotomy, and VATS due to bronchiectasis. A p-value <0.05 was considered statistically significant.

RESULTS

The most significant symptom was cough (43%, n=87) followed by excessive sputum expectoration

Figure 1. Chest radiograph of a bronchiectasis case.

(40%, n=81), hemoptysis (31%, n=62), and recurrent infection (16.4%, n=33). One hundred twenty-one (60%) patients had left-sided disease. Chest X-ray image of a bronchiectasis case is shown in Figure 1, and thorax CT cases of bronchiectasis cases are shown in Figures 2 and 3.

It was determined that 41.7% (n=84) of the patients underwent VATS, 41.3% (n=83) underwent thoracotomy, and 17% (n=34) underwent thoracotomy, while conversion to thoracotomy after VATS was observed in 17% (n=34) patients. The ratio of the conversion to thoracotomy was 28.8%. Reasons for conversion to thoracotomy were pleural adhesions (n=14, 41.18%), incomplete fissure (n=9, 26.47%), abnormal vascular structures (n=1, 2.94%), and bleeding (n=10, 29.41%). Distribution of the groups by years is given in Table 1. Distribution of the surgical technique by percentages is shown in Figure 4.

Number of patients, mean age, type of resection, length of stay, and complications by groups are

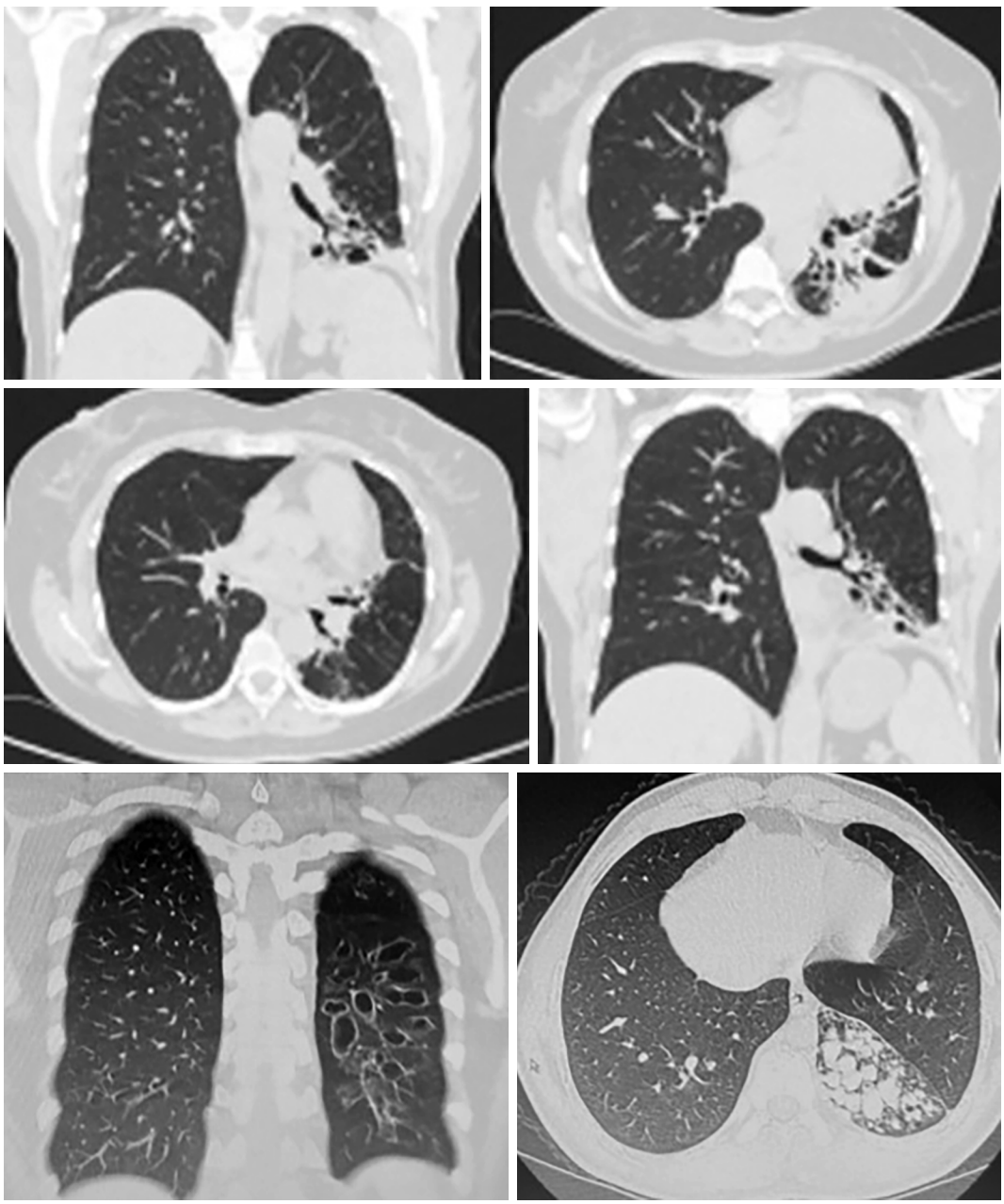

Figure 2. Thorax computed tomography images of bronchiectasis cases.

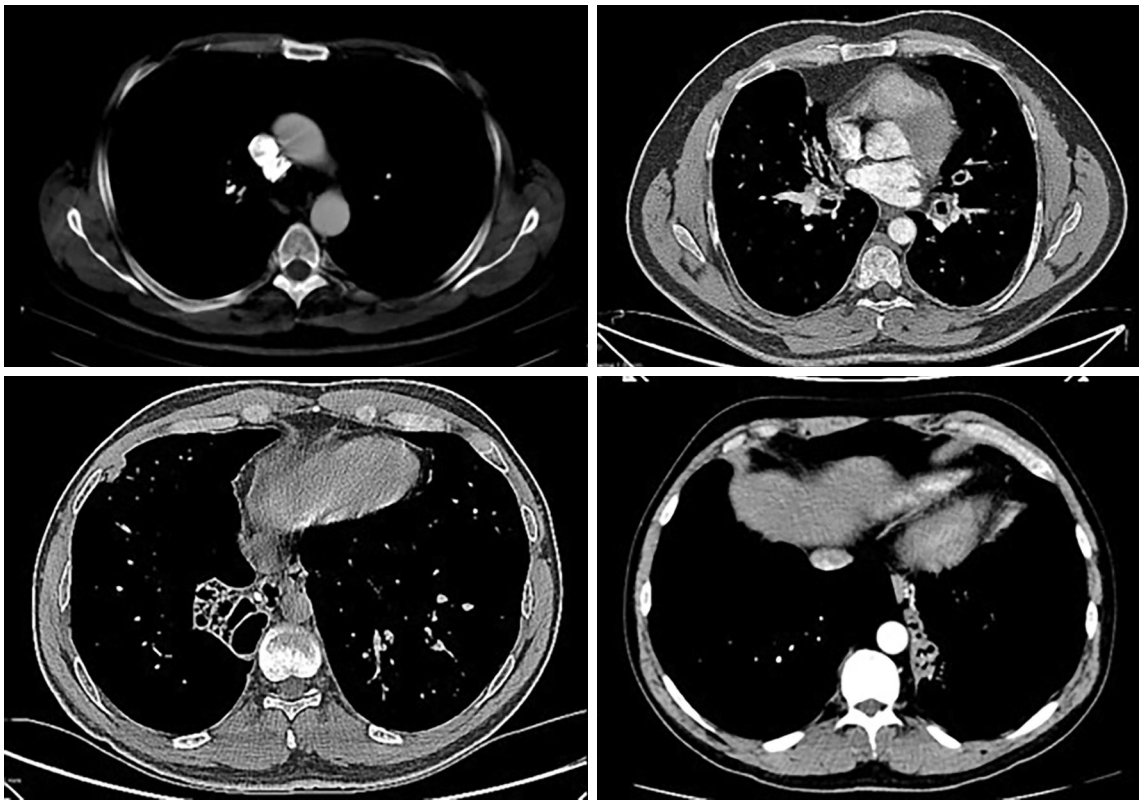

Figure 3. Thorax computed tomography images of bronchiectasis cases

listed in Table 2. Postoperative complication rates were 19% (n=16) in Group V, 27.2% (n=23) in Group T, and 23.5% (n=8) in Group VT. Although less complications developed in Group V, there was no statistically significant difference (p=0.417). The overall complication rate was 21% for left lower lobectomy cases, with seven (20%) patients in Group V, four (17.4%) patients in Group T, and five

Table 1. Distribution of surgical technique by years

	Thoracotomy		VATS + thoracotomy		VATS		Total
Year	n	%	n	%	n	%	n
2012	20	74.1	4	14.8	3	11.1	27
2013	10	52.6	5	26.3	4	21.1	19
2014	18	60.0	3	10.0	9	30.0	30
2015	11	50.0	1	4.5	10	45.5	22
2016	4	17.4	5	21.7	14	60.9	23
2017	7	30.4	2	8.7	14	60.9	23
2018	7	26.9	8	30.8	11	42.3	26
2019	5	31.3	4	25.0	7	43.8	16
2020	0	0	1	16.7	5	83.3	6
2021	1	11.1	1	11.1	7	77.8	9

VATS: Video-assisted thoracic surgery.

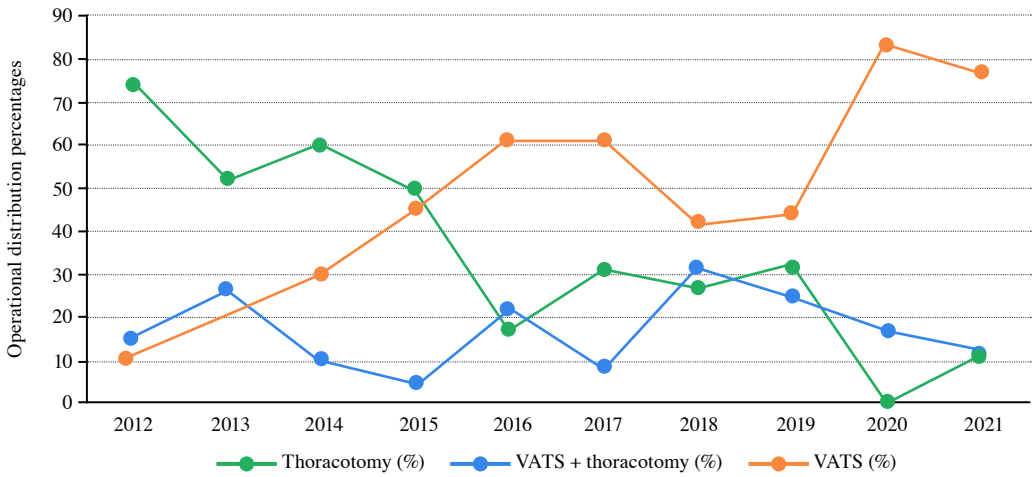

Figure 4. Distribution of surgical technique by years.
VATS: Video-assisted thoracic surgery.

(27%) patients in Group VT according to the type of surgery. Complications according to resection type are shown in Table 3.

Eleven (5.47%) patients underwent revision surgery due to postoperative complications. Subgroup analysis revealed the need for reoperation was 6% in Group V, 4.8% in Group T, and 5.9% in Group VT. While the most common reason for reoperation was postoperative bleeding/hematoma formation (81.9%, n=9), one patient had a prolonged air leak, and the other had a bronchopleural fistula. When reoperation rates were evaluated on a group basis, five (45.5%) patients were in Group V, four (36.4%) were in Group T, and two (18.2%) were in Group VT. There was no statistically significant difference between the groups in terms of reoperation rates (p=0.943). Eleven patients required intraoperative blood replacement due to excessive bleeding and a total of 13 units of erythrocyte suspension was replaced (mean: 1.18±0.4). The duration of hospital stays and mean age are shown in Table 2.

DISCUSSION

Bronchiectasis is the abnormal and permanent dilatation of bronchi caused by the destruction of muscle tissue and elastic components of the bronchial wall. The most frequent sites effected are the left lower lobe, right lower lobe, and right middle lobe. Bronchiectasis must be treated since it can lead significant complications, such as hemoptysis, recurrent pneumonia, empyema, sepsis, metastatic brain abscess, cor pulmonale, amyloidosis, and delay in development.[1] In our study, 89% (n=179) of the patients had lower lobe or middle lobe disease. Left-sided disease was more frequent than the right side in line with the literature (n=121 and n=80, respectively). Symptoms on admission were due to the complications of the disease (mostly hemoptysis and recurrent pneumonia).

One of the main stages in the treatment of bronchiectasis is medical treatment. The use of antibiotics is the cornerstone in management; it decreases systemic inflammation by reducing the bacterial load. Mucolytic agents, respiratory physiotherapy, and postural drainage are used for the clearance of the secretions. Anti-inflammatory agents decrease both airway and systemic inflammation. Bronchodilators are used effectively to treat bronchospasm.[4] In our clinic, similar to the literature, main approach in the management of bronchiectasis includes preoperative antibiotherapy, respiratory physiotherapy, and the use of mucolytic agents. If present, smoking should be stopped. In addition, FOB should be performed to rule out etiologic obstructive conditions, such as endobronchial malignancy and foreign body aspiration, in the preoperative period. Fiberoptic bronchoscopy also provides a good lavage sample for microbiologic studies.

Surgical resection in the permanent treatment of bronchiectasis was first described by Samuel Robinson in 1912.[5] At first, surgery-related complications like bronchopleural fistula and empyema were frequent. However, by the 1950s, discovery of antibiotics and improvements in surgical

Table 2. Surgical technique by number of patients, mean age, type of resection, length of stay, and complications

	Thoracotomy			VATS + thoracotomy			VATS		
	n	%	Mean±SD	n	%	Mean±SD	n	%	Mean±SD
Number of patients	83	41.3		34	17		84	41.7	
Age (year)			41.2±14.5			43.4±14.1			36.7±13.2
Type of resection	83	100		34	100		84	100	
Left lower lobectomy	23	27.7		18	52.9		35	41.6	
Right lower lobectomy	5	6		2	5.8		20	23.8	
Middle lobectomy	7	8.5		5	14.7		19	22.6	
Left upper lobectomy	4	4.8		1	3		0	0	
Right upper lobectomy	6	7.2		0	0		3	3.6	
Bilobectomy inferior	6	7.2		0	0		0	0	
Right pneumonectomy	1	1.2		0	0		0	0	
Left pneumonectomy	3	3.6		0	0		1	1.2	
Left lower lobectomy + lingulectomy	21	25.3		7	20.6		2	2.4	
Segmentectomy	7	8.5		1	3		4	4.8	
Lingulectomy	2	2.5		0	0		1	1.2	
Right lower lobe superior segmentectomy	1	1.2		1	3		2	2.4	
Right lower lobe basal segmentectomy	1	1.2		0	0		0	0	
Left lower lobe basal segmentectomy	1	1.2		0	0		1	1.2	
Lingulectomy + left lower lobe basal segmentectomy	1	1.2		0	0		0	0	
Right lower lob superior + upper lobe posterior segmentectomy	1	1.2		0	0		0	0	
Length of stay (days)			6.0±3.4			6.0±3.3			5.2±3.7
Complication	23	27.7		8*	23.5		16*	19	
Prolonged air leak	9	10.8		4	11.7		7	8.3	
Bronchopleural fistula	2	2.4		0	0		1	1.2	
Atelectasis	5	6		4	11.7		4	4.7	
Hematoma	4	4.7		2	5.5		5	5.8	
Empyema	1	1.2		0	0		0	0	
Wound site infection	2	2.4		0	0		0	0	

SD: Standard deviation; VATS: Video-assisted thoracic surgery; * In both groups, there are cases in which more than one complication occurs in the same patients.

Table 3. Complications by resection type

	Prolonged air leak		Bronchopleural fistula		Atelectasis		Hematoma		Empyema		Wound site infection	
	Thoracotomy	VATS	Thoracotomy	VATS	Thoracotomy	VATS	Thoracotomy	VATS	Thoracotomy	VATS	Thoracotomy	VATS
	n	n	n	n	n	n	n	n	n	n	n	n
Type of resection												
Left lower lobectomy	6	4	-	1	4	-	2	3	-	-	1	-
Right lower lobectomy	-	2	-	-	-	1	1	1	-	-	-	-
Middle lobectomy	2	-	-	-	-	-		-	-	-	-	-
Left upper lobectomy	-	-	-	-	-	-	1	-	-	-	-	-
Right upper lobectomy	1	-	-	-	-	2	1	-	-	-	-	-
Bilobectomy inferior	1	-	-	-	-	-	-	-	-	-	1	-
Right pneumonectomy	-	-	-	-	-	-	-	-	-	-	-	-
Left pneumonectomy	-	-	-	1	-	-	-	-	1	-	-	-
Left lower lobectomy + lingulectomy	4	-	-	1	3	1	1	-	-	-	-	-
Segmentectomy	-	-	-	-	-	-	-	-	-	-	-	-
Lingulectomy	-	-	-	-	-	-	-	-	-	-	-	-
Right lower lobe superior segmentectomy	-	-	-	-	1	-	-	-	-	-	-	-
Right lower lobe basal segmentectomy	-	-	-	-	1	-	-	-	-	-	-	-
Left lower lobe basal segmentectomy	-	-	-	-	-	-	-	-	-	-	-	-
Lingulectomy + left lower lobe basal segmentectomy	-	-	-	-	-	-	1	-	-	-	-	-
Right lower lob superior + upper lobe posterior segmentectomy	-	-	-	-	-	-	-	-	-	-	-	-

VATS: Video-assisted thoracic surgery.

techniques reduced the morbidity and mortality of the operations. Over the years, high number of case series evaluating the results of surgery in bronchiectasis from all over the world have taken their place in the literature.[6] The first meta-analysis in 2015 evaluated 2,786 studies, and 2,748 of them were excluded. The remaining 38 studies were included, and the effectiveness and safety of the surgery and postoperative complications were evaluated. In this meta-analysis, while 11 of the reports were from developed countries, 27 were from developing countries, and there were 16 reports from Türkiye. This study showed that surgical treatment is an acceptable choice of treatment in the management of bronchiectasis, with low morbidity and mortality rates.[7]

As it was first described, the type of surgical treatment for bronchiectasis is anatomic resection of the infected lung parenchyma by segmentectomy, lobectomy, or pneumonectomy.[1] Apart from surgery for infectious diseases, the use of VATS has become widespread with the technological developments in the last 20 years, particularly in lung malignancies.[8] The addition of ERATS as an indispensable component to minimally invasive surgical practices has also contributed to these developments.[2] The first VATS lobectomy in Türkiye was performed in 2001, and its use has since been increasing, particularly in the field of lung cancer surgery.[9] Although VATS is an increasing field of application in bronchiectasis, one of the infectious diseases of the lung, the presence of enlarged and adherent lymph nodes, bleeding during dissection, presence of fragile tissue, existing adhesions, enlarged bronchial arteries, and vascular structures are significant obstacles to this application. However, our literature review revealed that there are few studies on this subject. In the meta-analysis of Kamal and Elkhayat,[6] the rate of VATS use in the treatment of bronchiectasis was reported to be between 40 and 62.5% in different studies. As Ceylan et al.[10] stated, while VATS indication tended to be limited at first, an increase is observed in selected cases with increasing experience. Similarly, in our clinic, the use of VATS in the treatment of bronchiectasis has increased with experience. While the rate of cases starting with VATS in the treatment of bronchiectasis in our clinic was limited in 2012, it was observed in this study that this rate has increased significantly in recent years. It is thought that technological developments in surgery and increasing surgical experience are effective in increasing these rates. Although there was no comprehensive ERATS protocol until recent years, our department tries to comply with the requirements of this protocol to a large extent.[2] Therefore, we believe that detailed perioperative preparation within the scope of ERATS, as well as detailed evaluation of appropriate case selection by the surgical committee, are among the main factors of this development.

Chronic and recurrent infections lead to widespread pleural adhesions, enlarged bronchial arteries, and large calcified lymph nodes. This may cause complications during the dissection of vascular structures and increase the rate of conversion from VATS to thoracotomy. While Mitchell et al.[11] reported this conversion rate as 5% in surgery for infectious diseases, another study reports this rate as high as 15.3% due to pleural adhesions.[12] Again Zhang et al.[13] reported this rate to be 13%. In our study, apart from years, the rate of conversion to thoracotomy was 28.8%. For surgically treated bronchiectasis, while the rate of our cases completed with VATS in 2012 was 11.1%, this rate increased to 77.7% in 2021. This is an indication that, in parallel with the literature, the increase in experience brings a decrease in complications and the rate of conversion to thoracotomy.[10] We believe that the high rate of pleural adhesions due to recurrent infections and chronic processes in developing countries such as our country may be effective in the rate of conversion to thoracotomy, regardless of years. In our study, when the reasons for conversion to thoracotomy were evaluated, pleural adhesions and incomplete fissures were observed to a large extent (67.65%; Table 2). The absence of life-threatening bleeding in patients who were returned to thoracotomy due to bleeding is also a finding in favor of VATS. In our study, we also evaluated the difference between VATS and thoracotomy in terms of complications. Our complication rate in VATS was lower than in the thoracotomy group, although there was no significant difference. Furthermore, it has been reported in the literature that the complication rate of VATS is reasonable compared to thoracotomy in experienced hands.[14] Atelectasis, a postoperative complication, develops due to secretion retention, and in our study, secretion cleaning through FOB was sufficient in the treatment without any need for additional interventional procedure. When we evaluated our patients who underwent segmentectomy with VATS, no postoperative complications were observed, except for one patient who underwent lower lobectomy and lingulectomy, which indicates that segmentectomy can be performed safely with

VATS. Similarly, Hao et al.[15] were unable to demonstrate any significant difference in terms of complications between VATS and thoracotomy in their evaluation of 99 patients undergoing surgery for bronchiectasis. Moreover, bronchopleural fistula was observed in 1.4% of all cases but 1.2% of VATS resections. According to the European Society of Thoracic Surgery database, the overall rate of bronchopleural fistula in segmentectomy, lobectomy, and pneumonectomy is 1.9%.[16] Considering that chronic infectious conditions such as bronchiectasis are more risky than malignancy surgery in terms of bronchopleural fistula, our results in both the bronchiectasis and VATS groups appear to be at a reasonable level when compared to the literature. However, since there are few publications in the literature comparing these two techniques, there is a need for more studies to be conducted in this area.

This study has some limitations. First, the study was conducted at a single center. Second, the small number of patients and the retrospective design do not allow an ideal evaluation over the years. Third, operation times were not compared, and the change in durations over the years could not be shown. Finally, in the patient selection for VATS, it was stated that pathological conditions, such as large calcified lymph nodes and dilatation of bronchial arteries caused by bronchiectasis, were factors that excluded VATS application. Therefore, the study is limited in terms of giving a general result. However, while the patient-based evaluation of the surgical committee was taken as the criterion in this selection, limiting the potential for catastrophic complications was also considered a factor.

In conclusion, VATS is becoming a better choice in the surgical treatment of infectious diseases of the lung, with similar complication rates and even lesser length of hospital stay compared to thoracotomy. In this regard, the importance of increasing clinical experience on VATS should not be forgotten. We recommend VATS in selected cases of bronchiectasis, which increases the patient's postoperative comfort without increasing complication rates and perioperative risks. Additionally, effective preoperative preparation and clinical evaluation of these patients will contribute to the increase in patients who can undergo VATS. More comprehensive prospective studies are required to determine the situations that hinder the application of VATS in bronchiectasis and the possible solutions.

Ethics Committee Approval: The study protocol was approved by the Ankara Atatürk Sanatorium Training and Research Hospital Clinical Research Ethics Committee (date: 10.05.2023, no: 2012-KAEK- 15/2712/2023). The study was conducted in accordance with the principles of the Declaration of Helsinki.

Patient Consent for Publication: Informed consent was waived because of the retrospective nature of the study and the analysis used anonymous clinical data.

Data Sharing Statement: The data that support the findings of this study are available from the corresponding author upon reasonable request.

Author Contributions: Organized the article: K.A., G.F.; Collected the data: E.Y.; Co-wrote: M.Ç., K.A., Ş.M.D.; Edited the article: F.İ.; Revised the final version of the article: K.A., M.Ç., A.A., G.F.

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