ORIGINAL RESEARCH

Bagcilar Med Bull 2025;10(2):153-159
DOI: 10.4274/BMB.galenos.2025.66375

Evaluation of Surgical Approaches in Patients Presenting with Hemoptysis

Hemoptizi ile Başvuru Sonrası Opere Edilen Hastaların Değerlendirilmesi

İlteriş Türk[1], Kadir Baturhan Çiflik[2], Mustafa Özdemir[3], Gizem Pehlivan Martlı[1], Mehmet Çetin[4], Necati Solak[4], Muhammet Ali Beyoğlu[5], Selim Şakir Erkmen Gülhan[1]

[1]University of Health Sciences Turkey, Ankara Atatürk Sanatory Training and Research Hospital, Department of Thoracic Surgery, Ankara, Turkey
[2]Kızıltepe State Hospital, Clinic of Thoracic Surgery, Mardin, Turkey
[3]University of Health Sciences Turkey, Ankara Bilkent City Hospital, Department of Radiology, Ankara, Turkey
[4]University of Health Sciences Turkey, Ankara Etlik City Hospital, Department of Thoracic Surgery, Ankara, Turkey
[5]University of Health Sciences Turkey, Dr. Abdurrahman Yurtaslan Oncology Training and Research Hospital, Department of Thoracic Surgery, Ankara, Turkey

Abstract

Objective: Hemoptysis is the expectoration of blood from the lower respiratory tract. Since the definitive treatment of hemoptysis often involves surgical intervention targeting the underlying disease, the initial assessment and preparation for surgical treatment are of critical importance.

Method: In our study, we retrospectively evaluated the data of patients who presented to the emergency department with hemoptysis and were operated on after being consulted by the department of thoracic surgery between 2012 and 2018. Patients were divided into groups: Those who underwent emergency surgery within the first 24 hours after hospitalization, those who underwent sub-elective surgery between the 1st and 3rd days, and those who underwent elective surgery on the 4th day and later.

Results: Of the 82 patients in our study, 60 (73.2%) were male and 22 (26.8%) were female. Hemoptysis was most frequently observed attributable to bronchiectasis (39%). During the preparation process for surgery, bronchial artery embolization (BAE) was performed on 16 patients (19.5%). The amount of hemoptysis in patients who underwent BAE was found to be statistically significantly higher (p=0.016). A total of 21 patients (25.6%) developed complications, none of whom had undergone pneumonectomy. Complications were found to be related to the amount of hemoptysis and length of hospital stay, but not to the

Öz

Amaç: Hemoptizi alt solunum yollarındaki kanamanın ekspektorasyonudur. Hemoptizinin kesin tedavisi altta yatan hastalığa yönelik cerrahi olduğu için ilk değerlendirme ve bu değerlendirmeye göre cerrahi tedaviye hazırlık süreci önem arz etmektedir.

Yöntem: Çalışmamızda 2012-2018 yılları arasında hemoptizi nedeniyle acil servise başvuran ve göğüs cerrahisine konsülte edildikten sonra opere edilen hastaların verileri retrospektif olarak değerlendirildi. Hastalar, başvuru sonrası ilk 24 saat içerisinde acil opere edilenler, 1-3. günler arasında subelektif opere edilenler ve 4. gün ve sonrasında elektif olarak opere edilenler olmak üzere gruplara ayrıldı.

Bulgular: Çalışmamızdaki 82 hastanın, 60'ı (%73,2) erkek, 22'si (%26,8) kadındı. En sık bronşiektazi (%39) nedeniyle hemoptizi izlendi. Operasyona hazırlık sürecinde 16 hastaya (%19,5) bronşiyal arter embolizasyonu (BAE) gerçekleştirildi. BAE uygulanan hastaların hemoptizi miktarı istatistiksel olarak anlamlı derecede yüksek hesaplandı (p=0,016). Toplamda 21 hastada (%25,6) komplikasyon gelişti, hiçbiri pnömonektomi uygulanan hasta değildi. Komplikasyonların hemoptizi miktarı ve yatış süresi ile ilişkiliyken BAE uygulaması ile ilişkisi olmadığı tespit edildi (sırasıyla p=0,017, p<0,001 ve p=1,000). Komplikasyon gelişen hastaların oranı elektif grupta (%28,6) diğer gruplara göre düşük bulundu ama istatistiksel olarak anlamlı fark saptanmadı (p=0,594). İki hastada (%2,4) cerrahi mortalite izlendi.

Address for Correspondence: İlteriş Türk, University of Health Sciences Turkey, Ankara Atatürk Sanatory Training and Research Hospital, Department of Thoracic Surgery, Ankara, Turkey
E-mail: turkilteris@gmail.com **ORCID:** orcid.org/0000-0001-6385-4722
Received: 12.08.2024 **Accepted:** 16.01.2025 **Epub:** 17.01.2025 **Publication Date:** 24.06.2025

Cite this article as: Türk İ, Çiflik KB, Özdemir M, Pehlivan Martlı G, Çetin M, Solak N, et al. Evaluation of surgical approaches in patients presenting with hemoptysis. Bagcilar Med Bull. 2025;10(2):153-159

Abstract

application of BAE (p=0.017, p<0.001, and p=1.000, respectively). The proportion of patients who developed complications was lower in the elective group (28.6%) compared to other groups, but this difference was not statistically significant (p=0.594). Surgical mortality was observed in two patients (2.4%).

Conclusion: Although medical treatment and BAE play a significant role, in controlling the clinical condition preoperatively, the definitive treatment for hemoptysis is surgery targeting the underlying disease. In suitable patients, emergency surgery and complete resections such as pneumonectomy can be performed with acceptable rates of complications and mortality.

Keywords: Bronchial artery embolization, hemoptysis, surgery

Öz

Sonuç: Preoperatif dönemde medikal tedavi ve BAE klinik durumun kontrolünde önemli rol oynasa da hemoptizinin tedavisi altta yatan hastalığa yönelik cerrahidir. Uygun hastalarda acil cerrahi ve pnömonektomi gibi komplet rezeksiyonlar, kabul edilebilir komplikasyon ve mortalite oranlarıyla uygulanabilir.

Anahtar kelimeler: Bronşial arter embolizasyonu, cerrahi, hemoptizi

Introduction

Hemoptysis is defined as the expectoration of blood from the lower respiratory tract. It ranges from the blood-stained sputum to life-threatening clinical conditions (1). In past years, hemoptysis was classified based on the volume of blood expectorated, and treatment options were tiered accordingly (2). Presently, the predominant perspective is that the volume may be overestimated or underestimated due to the patient ingesting blood (2,3). Therefore, the assessment of hemoptysis should incorporate a thorough consideration of the patient's clinical status. The average anatomical deads pace volume in the respiratory system is approximately 150 milliliters (mL). Consequently, even minimal volumes of hemorrhage can pose a significant threat to life.

The source of hemoptysis is the bronchial artery or its branches in 90% of cases. Controlling the bleeding focus is critically important during the initial phase of treatment (1-3). Advancements in interventional bronchoscopic and radiological procedures have significantly altered the criteria for surgical treatment indications. These interventional procedures are especially advantageous in mitigating the increased mortality particularly associated with emergency surgery. Specifically, bronchial artery embolization (BAE) has been reported to successfully halt bleeding in the initial stage in 73-98% of cases (4,5). However, non-surgical treatments have a high probability of hemoptysis recurrence. In cases of life-threatening hemoptysis resulting in blood gas exchange abnormalities, the mortality rate can escalate to 50-85%. Therefore, the definitive treatment for hemoptysis is stil considered to be surgical (1-5). In this study, we aimed to evaluate the outcomes of surgical operations performed on patients presenting to the emergency department with an attack of hemoptysis, based on the timing of surgery and in combination with interventional procedures.

Materials and Methods

The study enrolled patients who underwent surgery following their admission to the emergency department with hemoptysis between 2012 and 2018. The study protocol was approved by the Local Ethics Committee of University of Health Sciences Turkey, Ankara Atatürk Sanatory Training and Research Hospital under decision number 2012-KAEK-15/2743. The study was conducted in accordance with the principles of the World Medical Association Declaration of Helsinki. Patients' age, gender, amount of hemoptysis, diagnosis and treatment methods, treatment processes, and outcomes were retrospectively evaluated. Those under 18 years of age, patients with incomplete data, individuals who did not consent to participate in the study, patients with hemoptysis due to trauma, and those whose treatment involved methods other than surgical intervention were excluded from the study.

Preoperative Patient Management

The time intervals until surgery were grouped as follows: Patients in Group 1 underwent surgery with in the first 24 hours after admission to the hospital, patients in Group 2 were operated on between days 1 to 3 after initial assessment, and patients in Group 3 underwent elective surgery ≥4 days after hemoptysis was controlled. The surgical timing was determined based on the patient's cardiopulmonary readiness and the localization of the bleeding focus. Patients were closely monitored in the intensive care unit until surgery. Only 13 patients had the bleeding focus identified in the emergency department and were immediately operated on after stabilizing cardiopulmonary

(Group 1). All patients underwent computed tomography. In Groups 2 and 3, BAE was performed if the bleeding could not be controlled with medical treatment or if there was no decrease in hemoptysis volume. Patients were managed to maintain a hemoglobin level ≥7 g/dL, with blood transfusion and fresh frozen plasma administration as needed. Medical oxygen and intravenous nutritional support were provided to all patients in the intensive care unit. Medical treatment included broad-spectrum antibiotics, antitussive agents, vitamin K, and tranexamic acid. Patients with difficulty maintaining airway patency were managed with intubation. Biochemical parameters, complete blood counts, and coagulation tests were regularly monitored in all patients. Prior to surgery, all patients underwent flexible bronchoscopy to maintain airway patency, and in an attempt to visualize the bleeding site. Cryotherapy for bronchial lesions was performed using rigid bronchoscopy in only two patients. Following double-lumen intubation, 12 patients underwent video-assisted thoracic surgery in the standard lateral decubitus position, while others underwent open surgery.

Statistical Analysis

All analyses of the study were conducted using the SPSS version 24.0 software package. Descriptive statistics were presented as the number of units (n), percentage (%), and mean ± standard deviation for age. Independent two-sample t-tests or Mann-Whitney U tests were used for continuous numerical variables between two groups. One-Way ANOVA or Kruskal-Wallis tests were employed for continuous numerical variables among multiple groups. The distribution of categorical variables among groups was evaluated using Pearson's chi-square test. A p-value less than 0.05 was considered statistically significant for all comparisons.

Results

Demographic and Clinicopathological Findings

In our study, out of 82 patients, 60 (73.2%) were male and 22 (26.8%) were female. The mean age was 49.32±16.40 years. The median amount of hemoptysis was 200 cc (min: 20 - max: 800). The etiology included bronchiectasis in 32 patients (39%), hydatid cyst in 12 patients (14.6%), malignancy in 11 patients (13.4%), and sequelae of previous tuberculosis in 10 patients (12.2%). The median time from hospital admission to operation was 2 days (min: 0 - max: 30). Right lower lobectomy was performed in eighteen patients (22%), left lower lobectomy in fourteen patients (17.1%), and cystotomy and capitonnage in ten patients (12.2%). The median duration from operation to discharge was 7 days (min: 1 - max: 21). Overall, complications occurred in 21 patients (25.6%), with prolonged air leak identified as the most prevalent complication, observed in eight patients (9.8%). Surgical mortality was observed in two patients (2.4%). All demographic and clinicopathological findings are summarized in Table 1. Bronchoscopic image of a patient with hemoptysis is shown in Figure 1, while theetiology of patients is presented in Figure 2.

Comparison of Operation Periods

There were 13 patients (15.9%) in Group 1, 38 patients (46.3%) in Group 2, and 31 patients (37.8%) in Group 3. Although Group 3 had a lower median hemoptysis amount compared to the other groups, no statistically significant difference was found (p=0.312). The rate of patients developing complications was lower in Group 3 (19.4%) compared to other groups, but this difference was not statistically significant (p=0.594). There were no statistically significant differences among groups in terms of age, gender, intubation, and median hospital stay after surgery (Table 2).

BAE

Sixteen patients (19.5%) underwent BAE. Although the mean age was higher in patients who did not undergo BAE (50.47±16.41 years), this difference was not statistically significant (p=0.198). The amount of hemoptysis was significantly higher in patients who underwent BAE (p=0.016). No significant association was found between BAE and the duration from admission to surgery, length of hospital stay, and complications (Table 3).

Postoperative Complications

The average age of patients manifesting complications (53.33±14.06 years) was higher, although no statistically significant difference was found (p=0.195). In patients with complications, the median hemoptysis volume (250 cc) was significantly higher (p=0.017). Additionally, hospital stay duration and intubation rate were found to be significantly higher in this patient group (p<0.001 and p=0.035, respectively) (Table 4).

Discussion

Hemoptysis is a rare condition, with prevalence reported to range from 0.2% to 14% (2). In a study conducted in France, it was found to constitute 0.2% of all hospital admissions (4). Its etiology varies depending on geographical and

Table 1. General information of patients

Parameter	n (%)
Gender	
Female	22 (26.8)
Male	60 (73.2)
Age (years)	49.32±16.40
Hemoptysis amount (cc)	200 (20-800)
Bronchial artery embolization	
Yes	16 (19.5)
No	66 (80.5)
Time of operation	
Group 1 (Emergency)	13 (15.9)
Group 2 (Subelective)	38 (46.3)
Group 3 (Elective)	31 (37.8)
Intubation	
Yes	6 (7.3)
No	76 (92.7)
Surgical preference	
Open surgery	70 (85.4)
VATS	12 (14.6)
Surgical side	
Right	55 (67.1)
Left	27 (32.9)
Operation	
Right lower lobectomy	18 (22)
Left lower lobectomy	14 (17.1)
Cystotomy and capitonnage	10 (12.2)
Right upper lobectomy	9 (11)
Middle lobectomy	7 (8.5)
Left upper lobectomy	7 (8.5)
Pneumonectomy	6 (7.3)
Segmentectomy	5 (6.1)
Wedge resection	2 (2.4)
Cryotherapy	2 (2.4)
Cavitectomy	1 (1.2)
Aortobronchial fistula repair	1 (1.2)
Time until surgery (days)	2 (0-30)
Hospital stay after surgery (days)	7 (1-21)
Complications	
Prolonged air leak	8 (9.8)
Pneumonia	4 (4.9)
Bleeding	2 (2.4)
Ischemic/toxic hepatitis	1 (1.2)
Pulmonary thromboembolism	1 (1.2)
Acute renal failure	1 (1.2)
Atrial fibrillation	1 (1.2)
Wound site infection	1 (1.2)
Empyema	1 (1.2)
Depression	1 (1.2)
Surgical mortality	
Present	2 (2.4)
Absent	80 (97.6)

VATS: Video-assisted thoracic surgery

seasonal conditions (2). Tuberculosis is generally prevalent in developing and under-developed countries, while malignancy is more common in developed countries. Although rankings may vary, bronchiectasis, tuberculosis sequelae, and malignancies are commonly reported causes (1-6). The proportion of hemoptysis with unknown etiology is also known to be around 10-20% (1-6). In our study, we found that bronchiectasis, hydatid cyst, malignancies, and tuberculosis sequelae were the most common causes of hemoptysis. Pulmonary hydatid cyst causing hemoptysis has been reported in case reports and case series (7-9). It is noteworthy that hydatid cyst ranks second among the leading causes, likely due to our country's endemic regions for hydatid disease (10-11).

Determining the etiology of hemoptysis is as important as determining its treatment plan. In our study, BAE was performed in 16 patients (19.5%) to stabilize the patients before surgical treatment. These patients had a higher level of hemoptysis than those who did not undergo BAE. Previous studies on surgical treatments for hemoptysis have raised concerns about high morbidity and mortality rates, highlighting the importance of interventional radiology. BAE is now commonly preferred as a first-line treatment option to control bleeding (1,4-6). Although effective in controlling bleeding in 75-94% of cases, the treatment has reported recurrence rates of bleeding between 9-29% (3,12-14). Therefore, BAE is considered a temporary treatment until stable conditions for surgical treatment are achieved, rather than a definitive treatment (1,3,6). We also believe that BAE is one of the most important tools in preparing patients for surgical treatment when hemoptysis does not decrease or even increases despite medical treatment.

In the periods leading up to surgical treatment, we observed lower median hemoptysis amounts, intubation rates, and complication rates in Group 3. Studies have reported that emergency surgery increases complication rates in hemoptysis (1). Our data were consistent with literature findings, suggesting that prolonging the time from hospital admission to surgery reduces complications. Additionally, studies have reported that procedures such as emergency pneumonectomy increase complication and mortality rates. In our study, no complications or mortality were observed in patients undergoing pneumonectomy. Patient condition and severity of the lesion may play a more significant role (1). Studies with larger subgroups of patients are needed to explore factors such as intraoperative conditions, comorbidities, and surgical techniques that may affect complication and mortality rates.

Figure 1. Sequential fiberoptic bronchoscopy images of a hematoma originating from the left lower lobe and extending to the trachea in a patient presenting to the emergency department with hemoptysis

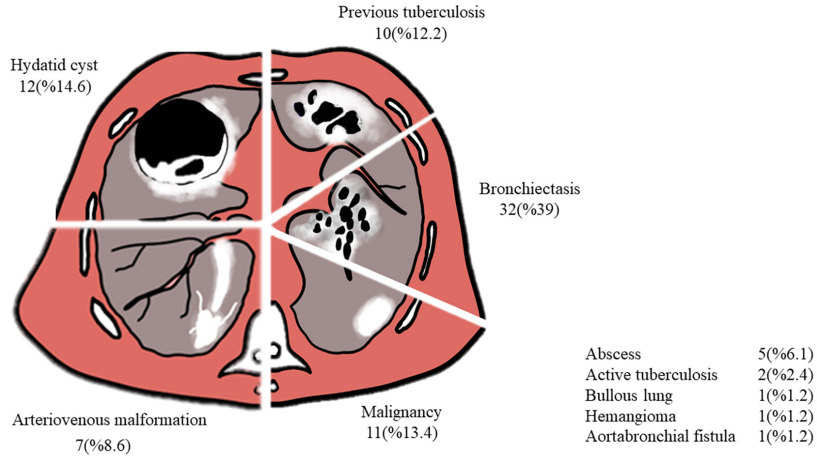

Figure 2. Etiology of hemoptysis

Table 2. Comparison of time intervals until surgery among groups

	Time elapsed until surgery			p
	Group 1	**Group 2**	**Group 3**	
Gender				
Female	4 (30.8)	11 (28.9)	7 (22.6)	0.789
Male	9 (69.2)	27 (71.1)	24 (77.4)	
Age **(year)**				
$\bar{x}$ ± SD	45.54±14.39	47.32±17.35	53.35±15.61	0.210
Hemoptysis amount **(cc)**				0.312
M (min-max)	200 (100-700)	200 (50-800)	150 (20-400)	
Intubation				0.362
Present	2 (15.4)	3 (7.9)	1 (3.2)	
Absent	11 (84.6)	35 (92.1)	30 (96.8)	
Postoperative length of stay, **(day)**				0.397
M (min-max)	6 (2-17)	7 (1-21)	7 (2-21)	
Complications				0.594
Present	4 (30.8)	11 (28.9)	6 (19.4)	
Absent	9 (69.2)	27 (71.1)	25 (80.6)	

Patient numbers and percentages (in parentheses) are indicated in rows. $\bar{x}$: Mean, SD: Standard deviation, M: median, cc: Cubic centimeter, p: Statistical value

Table 3. Information regarding bronchial artery embolization.

	Bronchial artery embolization		p
	Present	Abset	
Gender			
Female	4 (25)	18 (27.3)	0.854
Male	12 (75)	48 (72.7)	
Age, (year)			0.198
χ ± SD	44.56±15.94	50.47±16.41	
Hemoptysis amount (cc)			0,016
M (min-max)	250 (100-800)	150 (20-700)	
Intubation			0.855
Present	1 (16.7)	5 (7.6)	
Absent	5 (83.3)	61 (92.4)	
Time until surgery (day)			0.357
M (min-max)	2.5 (1-10)	2 (0-30)	
Postoperative length of stay (day)			0.911
M (min-max)	7 (1-19)	7 (2-21)	
Complications			0.950
Present	17 (25.8)	4 (25)	
Absent	49 (74.2)	12 (75)	

Patient numbers and percentages (in parentheses) are indicated in rows. χ : Mean, SD: Standard deviation, M: Median, cc: Cubic centimeter, p: Statistical value, statistically significant p-value is bolded

Table 4. Evaluation of parameters with postoperative complications

Parameters	Postoperative complications		
	Absent n (%)	Present n (%)	p
Age (year)	47.93±17.01	53.33±14.06	0.195
Gender			
Male	45 (73.8%)	15 (71.4%)	0.835
Female	16 (26.2%)	6 (28.6%)	
DSA			
Absent	49 (80.3%)	17 (81%)	1.000
Present	12 (19.7%)	4 (19%)	
Hemoptysis amount (cc)	175 (min: 20, max: 700)	250 (min: 50, max: 800)	0.017
Postoperative length of stay (day)	6 (min: 1, max: 12)	11 (min: 4, max: 21)	<0.001
Intubation			
Present	59 (96.7%)	17 (81%)	0.035
Absent	2 (3.3%)	4 (19%)	

In our study, 25.6% of patients developed complications during the postoperative period. We found that patients who developed complications had higher age, volume of hemoptysis, intubation rates, post-surgery hospital stay, and mortality rates. Similarly, complications are commonly observed in hemoptysis surgeries. The most common complications in the postoperative period include recurrent hemoptysis, prolonged air leakage, bronchopleural fistula, empyema, and prolonged mechanical ventilator need (1,2). Our findings were similar to those reported in the literature. Our postoperative mortality rate (2.4%) was lower compared to rates reported in the literature, which range from 3.2% to 27%. The most important factors affecting mortality are reported to be emergency surgery, intubation, pneumonectomy, and postoperative intensive care unit stay (3,4,6,12).

Study Limitations

This study has limitations as a retrospective, single-center study without random distribution among groups. We believe that studies with a larger number of patients could yield statistically more significant results.

Conclusion

In conclusion, the definitive treatment for hemoptysis is surgery for the underlying disease. Patient-based approaches should be developed to ensure surgical treatment at the most appropriate time; importance should be given to preoperative patient management. In patients who can be managed electively, medical treatment and BAE can be used as strong tools in the preoperative period. Emergency surgery and complete resection options, including pneumonectomy, should not be avoided in suitable patients.

Ethics

Ethics Committee Approval: The study protocol was approved by the Local Ethics Committee of University of Health Sciences Turkey, Ankara Atatürk Sanatory Training and Research Hospital under decision number 2012-KAEK-15/2743. The study was conducted in accordance with the principles of the World Medical Association Declaration of Helsinki.

Informed Consent: Since our study is a retrospective research article and no additional examination or procedure was performed on the patient group, there is no need for a patient consent form.

Footnotes

Authorship Contributions

Concept: M.A.B., S.Ş.E.G., Design: M.A.B., S.Ş.E.G., Data Collection or Processing: G.P.M., M.Ç., M.Ö., Analysis or Interpretation: İ.T., K.B.Ç., N.S., Drafting Manuscript: İ.T., K.B.Ç., G.P.M., M.Ç., N.S., Critical Revision of Manuscript: M.Ö., M.A.B., S.Ş.E.G., Final Approval and Accountability: İ.T., M.Ç., M.A.B., S.Ş.E.G., Technical or Material Support: M.Ö., N.S., G.P.M., K.B.Ç., Writing: İ.T., M.Ç., M.A.B., S.Ş.E.G.

Conflict of Interest: No conflict of interest was declared by the authors.

Financial Disclosure: The authors declared that this study received no financial support.

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