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Bronchial Artery Embolization Due to Hemoptysis; is it Really Effective?

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ABSTRACT

Objective: We aimed to evaluate retrospectively the data of patients undergoing bronchial artery embolizatıon (BAE) for massive or non-massive hemoptysis in our clinic and discussed with the literature.

Materials and Methods: We retrospectively evaluated patients with acute severe or chronic recurrent hemoptysis admitted to the pulmonology department and submitted to BAE for the purpose of embolization.

Results: A total of 52 patients were submitted to BAE, 41 (78.8%) were male, with a mean age 53.7±14.8 years. Hemoptysis was considered severe in 22 (42.3%) patients. Bronchiectasis (other than cystic fibrosis) (n=12; 23.1%) and tuberculosis (TB) sequelae (n=11; 21.2) were the major etiology for hemoptysis. None of our patients developed early or late complications related to the procedure. Hemoptysis recurred in five patients at 12-month follow-up of each patient. There was no significant difference between the amount of hemoptysis and the presence of lesion on computed tomography, active bleeding on bronchoscopy or recurrence.

Conclusion: Bronchiectasis (except those associated with cystic fibrosis), TB, and TB sequelae were the major etiologies for hemoptysis. Our results show that BAE is a safe and effective treatment supporting the current literature for acute massive and chronic recurrent hemoptysis.

Keywords: Bronchial artery embolization, hemoptysis, pulmonary

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INTRODUCTION

Hemoptysis, bleeding from the lung and/or bronchial system; it may be associated with pathologies such as infectious, inflammatory, malignant, hematologic, cardiovascular and toxin exposure, or iatrogenic or idiopathic. Massive hemoptysis accounts for 8–20% of hemoptysis (1). Massive hemoptysis is one of the important emergencies of chest diseases and thoracic surgery. Although there are various definitions, bleeding in 200 ml at a time or 600 ml in 24 h is defined as massive hemoptysis and mortality due to massive hemoptysis is 50% (2). Tuberculosis (TB), bronchiectasis, and bronchogenic carcinomas are among the most important causes of hemoptysis, especially in underdeveloped countries (3). Bronchial and non-bronchial systemic arteries are more frequent sources of hemoptysis than pulmonary arteries (4).

Our main goals in the treatment approach are to maintain airway patency, localize bleeding, stop bleeding, correct hemodynamics, and prevent recurrence of bleeding. Pharmacological treatments are generally used in non-massive hemoptysis, provided that the patient's clinic is considered. Surgical mortality and morbidity in massive hemoptysis were approximately 20% and 25–50%, respectively (5). Considering the high mortality and morbidity rates, it has become evident that alternative methods should be developed. Bronchoscopy is important because of the detection of bleeding locus and therapeutic approaches with hot-cold methods. It has been shown that 85% of bleeding has been effectively stopped by bronchial artery embolization (BAE) in patients who have not been successfully treated with bronchoscopic methods (6).

In this study, we aimed to evaluate retrospectively the data of patients undergoing BAE for massive or non-massive hemoptysis in our clinic and discussed with the literature.

MATERIALS and METHODS

Patients

Between July 2015 and November 2018, 52 patients (11 females and 41 males) who underwent BAE for hemoptysis were included in the study. Massive hemoptysis was accepted as bleeding with more than 200 ml at 1 time. Demographic characteristics, amount of hemoptysis and presence of previous episodes, etiology of hemoptysis, radiology, flexible bronchoscopy, and angiography findings were recorded. Patients were followed up for at least

1 year. Recurrent cases were recorded. After BAE, immediate success was defined as the absence of bleeding during the 1st month after BAE. Recurrence was defined as hemoptysis after BAE requiring medical intervention.

We obtained ethical approval (Health Sciences University Dr Suat Seren Chest Disease and Surgery Training and Research Hospital Ethics Committee, approval number January 8, 2018; 531/491094).

Technique of BAE

Before the procedure, thorax computed tomography (CT) examination and bronchoscopy were performed to all patients to figure out the pathologic lesion and artery. Common femoral artery was chosen for access under ultrasound quidance. The decision of embolization and selection of embolic agents were made by the operators during the procedure. After inserting a 5Fr sheath to the common femoral artery, thoracic aortogram was taken with a 5Fr pigtail catheter to distinguish any abnormal sites and assess the origin of bronchial and non-bronchial systemic arteries. In all patients, internal thoracic, subclavian, and intercostal arteriograms in addition to bronchial arteriograms were performed to observe any abnormal contrast filling. Simmons 1 and Cobra 2 catheters were used to find the origin of pathologic arteries. Hand injection was used in selective bronchial or non-bronchial angıograms. After observing an abnormal angiographic finding, a microcatheter (Renegade microcatheter, Boston Scientif, Natick, Massachusetts) was advanced super selectively to the pathologic artery. Embolization was done after obtaining a super selective angiogram and after evaluating the angiographic findings. 500 µm or greater sized microparticles were used if there was a bronchopulmonary shunt. In other cases, embolization started with 350 µm sized microparticles to achieve complete embolization of the distal vascular territory. Microspheres (Embozene, Boston Scientific, Cork, Ireland) sized between 350 µm and 700 µm diameter were used as embolic agents. Embolization was ended when there were a significant contrast material stasis and no antegrade flow. Cois were not used to avoid any access difficulties in the case of possible recurrence.

Statistical Analysis

Data were analyzed using IBM SPSS version 21.0 for Windows. The suitability of continuous variables to normal distribution was investigated. By looking at the sample diameter, compliance with normal distribution, and skewness and kurtosis values, it was decided that all these variables did not meet the conditions of normal distribution and non-parametric methods were preferred. Mann–Whitney U-test was used for independent group comparisons. Pearson Chi-square test was used to investigate the relationships between categorical variables. Values are shown in median (min-max). P<0.05 was considered statistically significant.

RESULTS

The mean age of the patients was 53.7±14.8 years. About 71.2% of the active smokers and 9.6% of the patients had never smoked. In 15.4% of the cases, hemoptysis attack had occurred at least once. Bronchiectasis (23.1%), TB sequelae (21.2%), and lung cancer (19.2%) were found to be the most common causes of etiology.

Table 1. Demographic characteristics of patients according to the amount of hemoptysis

Characteristics	Amount of hemoptysis				p
	<200 (n=29)		≥200 (n=22)		
	n	%	n	%	
Age, median (min–max)	49 (20–76)		60 (32–82)		0.008
Female	7	63.6	4	36.4	0.737
Male	22	55	18	45	
Smoker	17	47.2	19	52.8	NA
Nonsmoker	9	100	0	0	
Ex-smoker	3	60	2	40	
Previous history of hemoptysis					0.549
Present	5	62.5	3	37.5	
Absent	24	57.1	18	42.9	

NA: Not available

About 42.3% of the patients had bleeding more than 200 ml at a time. Patients with hemoptysis over 200 were statistically older (Table 1). No statistically significant difference was found between the amount of hemoptysis and laboratory parameters such as hemoglobin, platelets, prothrombin time, ınternational ratio, and creatine (respectively, p=0.588, 0.159, 0.753, 0.696, and 0.065) (Table 2). None of our patients developed early or late complications related to the procedure. Hemoptysis recurred in five patients at 12-month follow-up of each patient. Three of the recurrence cases were TB sequelae and two of them were bronchiectasis. The most common localization was found in the right main bronchial artery (26.9%), right intercostal bronchial artery (21.2%), and left main bronchial artery (11.5%). However, 13.5% (seven cases) had no signs of bleeding in any bronchial artery. There was no significant difference between the amount of hemoptysis and the presence of lesion on CT, active bleeding on bronchoscopy, or recurrence (Table 3).

DISCUSSION

In our study, we found that BAE is a safe and highly effective procedure for hemoptysis control. These results were consistent with previously reported literature (7–10). Although the definition of emergency success of BAE varies in different studies, reported success rates vary between 80% and 90% (7). In our study, success achieved in 90.4% of our patients. The last two retrospective studies have reported 96% success rate in the control of hemoptysis after BAE (11, 12).

Massive hemoptysis is mostly seen in chronic inflammatory lung diseases. The most common cause of massive hemoptysis has been reported as pulmonary TB (13, 14). In a review from 2017, the most common causes of etiology were TB, TB sequelae, bronchiectasis, and aspergilloma (15). Bronchiectasis, TB sequelae, and lung cancer were the most common causes in our cases. In the series of 88 cases of Dabó et al. (16), bronchiectasis and TB sequelae were the most common causes similar to our study.

Table 2. The relationship between the amount of hemoptysis and laboratory parameters

	Amount of hemoptysis		
	<200 Median (Min–Max)	≥200 Median (Min–Max)	p
Hemoglobin	12.5 (6.3–15.7)	12.7 (9.5–16.0)	0.588
Platelets	255000 (47000–541000)	235000 (80.000–436000)	0.159
aPTT	26.7 (23.8–34.9)	28.1 (16–33.7)	0.753
INR	1.0 (0.57–1.23)	0.99 (0.82–1.26)	0.696
Aspartate aminotransferase	19.5 (11.0–46.0)	24 (10.0–52.0)	0.043
Alanine aminotransferase	14 (6.0–38.0)	17 (9.0–84.0)	0.200
Creatine	0.78 (0.48–7.96)	0.92 (0.45–1.12)	0.065

Min: Minimum; Max: Maximum; aPTT: Prothrombin time; INR: International ratio

Unlike sequelae after active TB, malignancies accounted for a small spectrum of the general population with an incidence of 1% to 12.9% (6, 17). In our study, in contrast to the literature, lung cancer was 19.2% in the etiology of hemoptysis. This may be due to the follow-up of patients with active TB in our hospital made in a separate clinic.

Diagnostic studies are performed to determine the cause and location of bleeding in a patient with hemoptysis. Finding of bleeding localization is important for planning and success of treatment. Chest graphy, CT, and bronchoscopy are the most commonly used methods for the localization of hemoptysis (18). Diagnostic efficacy is higher with the combination of CT and bronchoscopy (19). The most important advantage of bronchoscopy is that it can also be a therapeutic modality (19). However, in patients with massive hemoptysis, excessive filling of the airways with blood may affect the efficacy of bronchoscopy and endobronchial treatment negatively (14). Hsiao et al. (20) reported that bronchoscopy was not necessary before BAE because it delayed treatment and increased hypoxemia and economic burden. Likewise, Poyanli et al. (13) reported that bronchoscopy does not have to be performed before the procedure in active bleedings since they do not affect the BAE procedure. In our study, bronchoscopy was performed in 86.5% of the cases. The majority of these bronchoscopies were in the non-massive hemoptysis group.

There are no recommendations for performing bronchoscopy and CT angiography (CTA) before procedure, and it is a personalized decision based on institutional availability. There is also a lack of data on the benefit of these surveys before the BAE in terms of reducing the BAE procedure time and improving BAE results. The American Radiology Society recommends chest graphy in the initial evaluation of all patients with hemoptysis because not only lateralizes the bleeding but it also identifies the cause in the majority of cases (4). CTA is the most appropriate research to be done in hemoptysis patients (4). CT is similar to bronchoscopy in localizing bleeding, but is better in detecting the cause, and plots the vascular roadmap for therapeutic interventions. Patients with massive hemoptysis can be given surgery without embolization or CT. In our study, all patients except one had chest graphy.

Recurrence of hemoptysis after successful BAE is a common problem. Causes include recanalization of embolized vessels, collateral circulation feeding the bleeding lesion, and progression of the underlying disease. In our study, bleeding recurrence rate was 9.6% in long-term follow-up. Inconsistent bleeding rates have been reported in different studies. One study reported re-bleeding in 28% of patients after successful BAE (21). Fruchter et al. (7) reported bleeding recurrence in 57.7% of patients after BAE. Relapse rates were reported to be associated with the etiology of hemoptysis. Lung cancer, TB, aspergillosis, and bronchiectasis are associated with a high risk of bleeding recurrence. The results and long-term efficacy of BAE may also vary depending on the

Table 3. The relationship between the amount of hemoptysis and the findings of radiology, etiology, and bronchoscopy

Parameters	Amount of hemoptysis				p
	<200		≥200		
	n	%	n	%	
Etiology					NA
Bronchiectasis	6	25	6	28.6	
COPD	1	4.2	2	9.5	
TB sequelae	6	25	5	23.8	
Lung cancer	5	20.8	4	19	
Pneumonia	1	4.2	4	19	
Hypertension	1	4.2	0	0	
Arteriovenous malformation	1	4.2	0	0	
Active TB	3	12.5	0	0	
Chest X-ray					0.617
Lesion is present	19	54.3	16	45.7	
No lesions	10	66.7	5	33.3	
Lesion in tomography					0.625
Present	25	55.6	20	44.4	
Absent	3	75	1	25	
Bleeding in bronchoscopy					0.241
Present	7	38.9	11	61.1	
Absent	16	61.5	10	38.5	

NA: Not available; TB: Tuberculosis; COPD: Chronic obstructive pulmonary disease

underlying disease. Recurrence rate was significantly higher in patients with aspergilloma and cavities (22, 23). In the study of Van den Heuvel et al. (24), patients with aspergilloma accounted for 18% of the population, and recurrent bleeding was 5 times higher than patients without aspergilloma. Similarly, in the study of Shin et al. (22), aspergilloma patients accounted for 17.2% of the patient population, which was significantly associated with higher recurrence rates (p=0.015). Han et al. (25) investigated the experience of BAE in the management of hemoptysis in patients with primary lung cancer. Technical success, defined as the ability to selectively embolize the abnormal vessel, was achieved in 83 patients (98.8%), and clinical success was achieved in 69 (82.1%) patients. In another study, BAE failed in 12 cases. In the 167 successful cases, surgery was required in 16 and bronchial occlusion was performed in 4; three patients died due to recurrent massive hemoptysis (26). In our study, there was no significant difference between the amount of hemoptysis and the presence of lesion on tomography, whether there was active bleeding on bronchoscopy, recurrence, and etiology.

The complication rate for BAE has gradually decreased over the years as a result of technical (super-selective technique) improvements and more appropriate embolic materials. The main complications are transverse myelitis, bronchial infarction, esophago bronchial fistula, ischemic colitis, transient cortical blindness, and stroke (27). The most feared of these complications is anterior spinal cord ischemia due to accidental embolization of the spinal artery. The incidence of spinal artery ischemia after BAE is reported to be between 1.4% and 6.5% (28). There were no procedure-related complications in 47 patients (64%) in a series of 73 cases by Okumuş et al. (29) Complications detected in the first 30 days; chest pain disappeared in 2–7 days in ten cases, and fever in six cases, pneumonia developed within 48 h after the procedure, dissection of the bronchial artery in one case, paresthesia in the left arm and leg in one case and arterial back escape in one case. In our study, no early and late complications were observed after BAE.

The study has some limitations. First, the number of patients is low. The second was a retrospective study, so it was difficult to detect recurrent cases. Recurrence status from some patients could not be reached. Some patients were lost to follow-up. Due to the low number of patients, more cases of TB, bronchiectasis, and cancer were observed in the etiology while diseases such as pulmonary arterio malformation were not encountered.

Obtaining data on etiology and relapse through prospective studies with higher number of patients will help us clinicians to manage patients. In addition, prospective planning of studies comparing surgery with BAE will be beneficial in terms of both economic and scientific data.

CONCLUSION

Bronchiectasis (except those associated with cystic fibrosis), TB and TB sequelae were the major etiologies for hemoptysis. Our results show that BAE is a safe and effective treatment supporting the current literature for acute massive and chronic recurrent hemoptysis.

Ethics Committee Approval: The Health Sciences University Dr. Suat Seren Chest Disease and Surgery Training and Research Hospital Ethics Committee granted approval for this study (date: 08.01.2018; number: 531/491094).

Informed Consent: Written informed consent was obtained from patients who participated in this study.

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REFERENCES

1. Erturan S. Massive hemoptysis. Respiratory 2003; 5: 307–11.
2. Chun JY, Morgan R, Belli AM. Radiological management of hemoptysis: A comprehensive review of diagnostic imaging and bronchial arterial embolization. Cardiovasc Intervent Radiol 2010; 33(2): 240–50.
3. Santiago S, Tobias J, Williams AJ. A reappraisal of the causes of hemoptysis. Arch Intern Med 1991; 151(12): 2449–51. [CrossRef]
4. Ketai LH, Mohammed TL, Kirsch J, Kanne JP, Chung JH, Donnelly EF, et al. ACR appropriateness criteria® hemoptysis. J Thorac Imaging 2014; 29(3): W19–22. [CrossRef]
5. Cahill BC, Ingbar DH. Massive hemoptysis. Assessment and management. Clin Chest Med 1994; 15(1): 147–67.
6. Swanson KL, Johnson CM, Prakash UB, McKusick MA, Andrews JC, Stanson AW. Bronchial artery embolization: Experience with 54 patients. Chest 2002; 121(3): 789–95. [CrossRef]
7. Fruchter O, Schneer S, Rusanov V, Belenky A, Kramer MR. Bronchial artery embolization for massive hemoptysis: Long-term follow-up. Asian Cardiovasc Thorac Ann 2015; 23(1): 55–60. [CrossRef]
8. Chen J, Chen LA, Liang ZX, Li CS, Tian Q, Yang Z, et al. Immediate and long-term results of bronchial artery embolization for hemoptysis due to benign versus malignant pulmonary diseases. Am J Med Sci 2014; 348(3): 204–9. [CrossRef]
9. Daliri A, Probst NH, Jobst B, Lepper PM, Kickuth R, Szucs-Farkas Z, et al. Bronchial artery embolization in patients with hemoptysis including follow-up. Acta Radiol 2011; 52(2): 143–7. [CrossRef]
10. Dave BR, Sharma A, Kalva SP, Wicky S. Nine-year single-center experience with transcatheter arterial embolization for hemoptysis: Medium-term outcomes. Vasc Endovascular Surg 2011; 45(3): 258–68.
11. Cornalba GP, Vella A, Barbosa F, Greco G, Michelozzi C, Sacrini A, et al. Bronchial and nonbronchial systemic artery embolization in managing haemoptysis: 31 years of experience. Radiol Med 2013; 118(7): 1171–83. [CrossRef]
12. Shao H, Wu J, Wu Q, Sun X, Li L, Xing Z, et al. Bronchial artery embolization for hemoptysis: A retrospective observational study of 344 patients. Chin Med J (Engl) 2015; 128(1): 58–62. [CrossRef]
13. Poyanli A, Acunas B, Rozanes I, Guven K, Yilmaz S, Salmaslioglu A, et al. Endovascular therapy in the management of moderate and massive haemoptysis. Br J Radiol 2007; 80(953): 331–6. [CrossRef]
14. Jean-Baptiste E. Clinical assessment and management of massive hemoptysis. Crit Care Med 2000; 28(5): 1642–7. [CrossRef]

15. Panda A, Bhalla AS, Goyal A. Bronchial artery embolization in hemoptysis: A systematic review. Diagn Interv Radiol 2017; 23(4): 307–17.
16. Dabó H, Gomes R, Marinho A, Madureira M, Paquete J, Morgado P. Bronchial artery embolisation in management of hemoptysis--A retrospective analysis in a tertiary university hospital. Rev Port Pneumol (2006) 2016; 22(1): 34–8. [CrossRef]
17. Bhalla A, Kandasamy D, Veedu P, Mohan A, Gamanagatti S. A retrospective analysis of 334 cases of hemoptysis treated by bronchial artery embolization. Oman Med J 2015; 30(2): 119–28. [CrossRef]
18. Yoon W, Kim JK, Kim YH, Chung TW, Kang HK. Bronchial and nonbronchial systemic artery embolization for life-threatening hemoptysis: A comprehensive review. Radiographics 2002; 22(6): 1395–409.
19. Abal AT, Nair PC, Cherian J. Haemoptysis: Aetiology, evaluation and outcome--a prospective study in a third-world country. Respir Med 2001; 95(7): 548–52. [CrossRef]
20. Hsiao EI, Kirsch CM, Kagawa FT, Wehner JH, Jensen WA, Baxter RB. Utility of fiberoptic bronchoscopy before bronchial artery embolization for massive hemoptysis. AJR Am J Roentgenol 2001; 177(4): 861–7.
21. Chun JY, Belli AM. Immediate and long-term outcomes of bronchial and non-bronchial systemic artery embolisation for the management of haemoptysis. Eur Radiol 2010; 20(3): 558–65. [CrossRef]
22. Shin BS, Jeon GS, Lee SA, Park MH. Bronchial artery embolisation for the management of haemoptysis in patients with pulmonary tuberculosis. Int J Tuberc Lung Dis 2011; 15(8): 1093–8. [CrossRef]
23. Yoo DH, Yoon CJ, Kang SG, Burke CT, Lee JH, Lee CT. Bronchial and nonbronchial systemic artery embolization in patients with major hemoptysis: Safety and efficacy of N-butyl cyanoacrylate. AJR Am J Roentgenol 2011; 196(2): W199–204. [CrossRef]
24. van den Heuvel MM, Els Z, Koegelenberg CF, Naidu KM, Bolliger CT, Diacon AH. Risk factors for recurrence of haemoptysis following bronchial artery embolisation for life-threatening haemoptysis. Int J Tuberc Lung Dis 2007; 11(8): 909–14.
25. Han K, Yoon KW, Kim JH, Kim GM. Bronchial artery embolization for hemoptysis in primary lung cancer: A retrospective review of 84 patients. J Vasc Interv Radiol 2019; 30(3): 428–34. [CrossRef]
26. Miyano Y, Kanzaki M, Onuki T. Bronchial artery embolization: First-line option for managing massive hemoptysis. Asian Cardiovasc Thorac Ann 2017; 25(9): 618–22. [CrossRef]
27. Lorenz J, Sheth D, Patel J. Bronchial artery embolization. Semin Intervent Radiol 2012; 29(3): 155–60. [CrossRef]
28. Brown AC, Ray CE. Anterior spinal cord infarction following bronchial artery embolization. Semin Intervent Radiol 2012; 29(3): 241–4.
29. Okumuş G, Güven K, Kıyan E. Early and late results of bronchial artery embolization. Turk Thorac Cardiovasc Surg J 2010; 18(1): 23–6.