ORIGINAL ARTICLE

A Retrospective Cross-Sectional Study of Bronchial Artery Embolization in Management of Hemoptysis from a Single Tertiary Care Setting in Rawalpindi, Pakistan

Karamat Ali[1], Amir Rashid[2*], Attia Khaliq[2], Ghulam Abbas[3], Shahzeb Ahmad Satti[2], Mumtaz Ali[2]

ABSTRACT

Objective: To evaluate the effectiveness of bronchial artery embolization in patients with hemoptysis by assessing immediate technical success, clinical control of bleeding, and procedure-related complications.

Study Design: Retrospective cross-sectional study.

Place and Duration of Study: This study was conducted at the Departments of Pulmonology and Interventional Radiology, Pakistan Emirates Military Hospital (PEMH), Rawalpindi, Pakistan, from January 2019 to December 2022.

Methods: Patients with hemoptysis who presented to our emergency or outdoor patients department were included according to the inclusion and exclusion criteria. All patients were stabilized before undergoing bronchial artery embolization. Informed consent was obtained from patients and family, where applicable. The clinical success and complications of procedures were evaluated.

Results: A total of 63 patients were included in the study. Of these, 43 (68.30%) were male and 20 (31.70%) were female, with a mean age of 47.42 ± 16.46 years. Bilateral bronchial artery embolization was performed in 25 (39.70%) patients, while right-sided embolization was carried out in 24 (38.10%) and left-sided embolization in 14 (22.20%) patients. Pulmonary tuberculosis was identified as the most common underlying cause of hemoptysis in 31 (49.20%) patients, followed by bronchiectasis in 22 (34.90%) patients. Clinical success was achieved in 60 (95.20%) patients, while the procedure failed to control bleeding in 3 (4.80%) patients.

Conclusion: Bronchial artery embolization is a safe and effective therapeutic option for managing hemoptysis, with a high rate of clinical success and minimal adverse events. It should be considered a valuable first-line intervention in appropriately selected patients.

Keywords: *Aneurysm, Bronchial Artery, Hemoptysis, Tuberculosis.*

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Introduction

Hemoptysis is defined as the expectoration of blood in sputum. Expectoration of a large amount of blood threatens life and increases morbidity and mortality associated with this condition.[1] Various definitions and cut-off criteria have been used by researchers to describe massive hemoptysis. Currently, there has been a shift to include clinical aspects like hemodynamic instability, impairment of gas exchange, and associated cardio-pulmonary conditions, rather than mere quantification of blood volume. Moreover, quantification of blood volume is quite challenging especially in settings of clinical instability. Whatever definition or criteria are used, hemoptysis can be immediately life-threatening if not recognized and treated on an urgent basis.[2] Arteries involved in massive hemoptysis are bronchial arteries and other non-bronchial collateral

[1]*Department of Pulmonology/Medicine*[2]
Pak Emirates Military Hospital (PEMH), Rawalpindi, Pakistan
[3]*Department of Radiology*
Armed Forces Institute of Radiology & Imaging (AFIRI) Rawalpindi, Pakistan

Correspondence:
Dr. Amir Rashid
Department of Medicine
Pak Emirates Military Hospital (PEMH), Rawalpindi, Pakistan
E-mail: drpafmj@gmail.com

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arteries, with pulmonary circulation being a cause of hemoptysis in less than five percent of cases.[3]

Common causes of hemoptysis include bronchiectasis, aspergilloma, malignancy, bleeding diathesis, and cardiac causes.[4] For management of massive hemoptysis, one needs to get focused history, clinical examination, investigations including imaging, management of airway breathing circulation, volume replacement, keep affected side down in the lateral decubitus position, systemic and inhaled Tranexamic acid, correction of bleeding diathesis, local bronchoscopic drugs administration, and definite procedure in the form of bronchial artery embolization and surgery.[5] In recent years, bronchial artery chemoembolization has emerged as the treatment of choice for the management of life-threatening hemoptysis and non-life-threatening recurrent hemoptysis. This is a minimally invasive procedure with negligible morbidity and mortality as compared with surgical options.[6]

Bronchial artery embolization (BAE)was first introduced in 1973 and is now the procedure of choice for life-threatening hemoptysis. It is a safe and effective method to control bleeding, especially after recent advances that have made it less invasive and more effective, with minimal complications.[7]

The purpose of the study is to share experience with bronchial artery embolization at our center and discuss culprit vessels, vessel anatomy, and anatomical variation.

Methods

This retrospective study was conducted jointly by the Departments of Pulmonology and Interventional Radiology at Pakistan Emirates Military Hospital (PEMH), Rawalpindi, Pakistan, from January 2019 to December 2022. Approval for the study was obtained from the hospital's Ethical Review Board vide letter No: A/28/EC/585/18, dated: 18th November 2018. Informed written consent was obtained from all patients prior to the procedure.

Patients presenting with hemoptysis secondary to various pulmonary pathologies in the emergency department or outpatient clinics were included. All patients were initially stabilized in the emergency department or hospital ward before undergoing bronchial artery embolization. Hemodynamically unstable patients, those with hemoptysis secondary to hematological disorders, and patients with known primary or metastatic lung malignancy were excluded.

Baseline laboratory investigations, including complete blood count (CBC), coagulation profile (PT/INR), renal function tests (RFTs), and blood grouping and cross-match, were performed prior to the procedure. Relevant radiological imaging, including chest radiograph and contrast-enhanced computed tomography (CECT) of the chest, was reviewed to identify the probable site and etiology of bleeding.

All the procedures of BAE were performed under strict aseptic measures. Local anesthetic agent, Lignocaine 2% was used for local anesthesia. Arterial access was obtained with 5 French sheath in right femoral artery under fluoroscopic and ultrasound guidance. The C2/SIM I catheter was then introduced under direct visualization to access the bronchial arteries that needed to be embolised. Selective catheterization of involved arteries was carried out with a microcatheter after confirmation of the catheter position. Angiogram before and after the embolization was performed to check the success of the procedure. Polyvinyl alcohol (PVA) was used in the procedures for embolization.

Procedures were performed by a team of experienced interventional radiologists in collaboration with pulmonologists. Technical and clinical data were obtained from hospital records and procedural logs. Procedural success was defined as complete cessation of hemoptysis for at least 24 hours post-procedure or during the same hospital stay, whichever was longer, as a short-term outcome, and absence of recurrent bleeding at one-month follow-up as a long-term outcome.

The Statistical Package for Social Sciences, version 23 (SPSS Inc., Chicago, IL, USA) was used for the statistical analysis. To study the baseline characteristics of the subject patients, descriptive analysis was used. Continuous variables were used to describe the mean, range, and standard deviation. Categorical variables were described as numbers, and non-parametric variables were described by percentages and medians.

Results

A total of 63 patients were included in this study. Of

63 patients, 43 (68.30%) were male, and 20 (31.70%) were female, with a mean age of 47.42 ± 16.46 years. The most common BAE was performed bilaterally in 25 (39.70%) patients, followed by right-sided in 24 (38.10%) and left-sided in 14 (22.20%) of patients. The most common underlying cause leading to hemoptysis was pulmonary tuberculosis in 31 (49.20%), bronchiectasis in 22 (34.20%), cavitary lung disease in 9 (14.30%), and lung mycetoma in 1 (1.60%). The rate of clinical success was 60 (95.20%) and failure in 3(4.80%) of the patients. 60 out of 63 patients remained symptom-free at the end of 1-month post-procedure. Most of the procedures were performed in December 13 (20.60%) and May 10 (15.90%), as shown in Table 1.

Table 1: Demographic data of patients who underwent bronchial artery embolization (N=63)

Demographic parameters	**N (%)**
Age (years)	
Mean + SD	47.42 ±16.46 years
Range (min-max)	27 years - 62 years
Gender	
Male	43 (68.30%)
Female	20 (31.70%)
Procedure performed	
BAE	63 (100%)
Procedure success	
Yes	60 (95.20%)
No	03 (4.80%)
Bronchial artery embolization	
Bilateral	25 (39.70%)
Left side	14 (22.20%)
Right sided	24 (38.10%)
Underlying diagnosis	
Pulmonary tuberculosis	31 (49.20%)
Bronchiectasis	22 (34.90%)
Cavitary lesion	09 (14.30%)
Mycetoma	01 (1.6%)

Discussion

The respiratory system has a dual blood supply: bronchial and pulmonary circulation. The largest number of cases of hemoptysis are from the bronchial circulation, around 90% of cases.[7,8] BAE was first reported in 1973 as a novel treatment modality for hemoptysis.[9]

BAE is a game-changer as far as the management of hemoptysis is concerned. The procedure is life-saving and less invasive than surgical intervention. It is an effective modality of choice for all types of cases of hemoptysis.[10]

In our study, the most common underlying condition leading to hemoptysis was secondary to pulmonary tuberculosis, followed by bronchiectasis. This is similar to a study conducted by Garg P et al. in India and Chan VL et al. in Hong Kong.[11,12] The study conducted in China from 2000 to 2005, in which 62 patients were included by Shigemura N et al., showed tuberculosis as a leading underlying cause of hemoptysis.[13] According to Fruchter O et al., lung cancer, along with the bronchiectasis, was the major underlying pathology. In the literature review, cases of sarcoidosis, cystic fibrosis, and aspergilloma were also reported.[14]

The procedure success rate was very high in our study, about 95.20%. As per the literature, the success rate for BAE ranges from 70 to 99% of cases.[15] Ittrich H et al. in their study highlighted the importance of the clinical experience of the operator

performing the procedure as an important factor for successful procedure, better outcome, and lower complication rates.[16]

No major complication was noticed in our patients. The literature review showed transient chest pain in 1.4% of cases, back pain in 34.5% of cases, and dysphagia was reported in 0.7 to 30% of cases. The most severe complication of transient or permanent involvement of the spinal cord leading to paraparesis or paraplegia was seen in 0.6 to 4.4% of cases secondarily to embolization of spinal arteries during the procedure.[17]

Our study is unique because we examined the number of procedures performed during a specific time of year. Previously, in the literature, no study had been carried out to study the effect of time of the year and its relationship with hemoptysis. As per our study, most of the cases were seen in both extremes of the seasons, May in summer and December in the winter season. It is likely due to cold and dry winter conditions increasing respiratory tract infections and airway inflammation, leading to increased bronchial blood flow and vessel fragility, while seasonal allergies in spring and early summer may cause persistent coughing and airway irritation, precipitating bleeding. Recognition of these patterns has clinical significance in identifying high risk periods and enabling timely intervention. Studies with larger sample sizes and different parts of the world should be carried out to study this seasonal effect on hemoptysis.

The procedure is very effective in massive as well as moderate cases of hemoptysis and it is equally effective in patients with recurrent mild hemoptysis.[18]

The chemical agent used for embolization at our center was Polyvinyl alcohol particles ranging from (PVA) 250-900 microns, most commonly 350-500 in most of our cases. The other options for embolization are gelatin sponges, trisacryl gelatin microspheres, N-butyl cyanoacrylate glue and different metal coils can be used for occlusion of bleeding vessels.[19] No mortality was reported during or immediately after procedure in our study. Data from the literature review reported 9-38% mortality rate secondary to massive hemoptysis.[20]

This study has certain limitations. Its retrospective and single-center design with a relatively small sample size limits the generalizability of the results. Additionally, procedures were performed by interventional radiologists with varying levels of experience, which may have influenced technical and clinical outcomes. Larger, multicenter prospective studies are recommended to better assess outcomes and procedure-related complications.

Conclusion

Bronchial artery embolization is safe and effective procedure in management of hemoptysis with fewer complications and side effects. The procedure is under performed due to high cost and lack of availability in most of the tertiary care centers especially in developing countries.

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Author Contributions

KA: Conception and design of the work
AR: Manuscript writing for methodology design and investigation
AK: Revising, editing, and supervising for intellectual content
GA: Data acquisition, curation, and statistical analysis
SAS: Validation of data, interpretation, and write-up of results
MA: Writing the original draft, proofreading, and approval for final submission