

Bronchial artery embolization in the treatment of massive hemoptysis

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ABSTRACT

Objectives: To evaluate the efficacy of bronchial arteriography and bronchial artery embolization (BAE) in the management of massive hemoptysis in a developing Asian country.

Methods: A retrospective review was carried out from March 2000 to March 2005 to evaluate the demographics, clinical presentation, radiographic studies, bronchoscopy results, and complications of bronchial arteriography and BAE at a tertiary care hospital in Pakistan.

Results: Fourteen patients (9 males, 5 females) with a mean age of 49 years underwent bronchial arteriography and BAE for massive hemoptysis. Hemoptysis was caused by bronchiectasis (10 patients), active pulmonary tuberculosis (3 patients), and lung malignancy (one patient). A CT scan of the chest was carried out in 11 patients, which revealed bronchiectasis (8 patients), cavity with infiltrates (3 patients), and mass lesion (one patient). Bronchoscopy was performed in all patients. Bleeding lobe or segment was identified in 12 patients. Bronchial arteriography revealed hypervascularity (13 patients), bronchial artery hypertrophy (5 patients), hypervascularity with shunting (one patient), dense soft tissue staining (7 patients), extravasation of contrast (one patient) and pseudoaneurysm (one patient). Bronchial artery embolization was carried out in all patients. Rebleeding occurred within 24 hours in 2 patients who underwent surgery, and within one week in another 2 patients who were managed with repeat BAE. The complication of embolization occurred in one patient (transverse myelitis). Thirteen patients improved and were discharged home. One patient with terminal lung carcinoma died due to cardiogenic shock secondary to acute myocardial infarction.

Conclusion: Bronchial artery embolization is an effective method for management of massive hemoptysis in developing countries and has a low complication rate.

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Massive hemoptysis is defined in literature as expectoration of an amount of blood varying from 200-1,000 mL over 24-48 hours.¹⁻⁴ In 90% of cases, the source of hemoptysis is bronchial circulation. It has a poor prognosis with a mortality rate of >50% when untreated.⁵ Massive hemoptysis may result from various causes. Tuberculous bronchiectasis is the most common cause of massive hemoptysis in Southeast Asia. Bronchogenic carcinoma and chronic lung diseases, such as cystic fibrosis are the common causes in the Western world.⁵ Other causes include pneumonia, lung abscess, chronic bronchitis, pulmonary interstitial fibrosis, pneumoconiosis, pulmonary artery aneurysm, congenital, cardiac or pulmonary vascular anomalies, ruptured aortic aneurysm, and ruptured bronchial artery aneurysm. Surgery was once regarded as the treatment of choice in operable patients with massive hemoptysis, but surgical intervention in the acute state is associated with high mortality. The mortality rates for elective surgery performed for massive hemoptysis ranges from 7.1-18.2%. However, the mortality rate increases significantly, up to 40%, when surgery is undertaken as an emergency procedure.⁶ Hence, many patients who are not surgical candidates are best managed by bronchial artery embolization (BAE). Bronchial artery embolization was first reported by Remy et al in 1973, and has become an established non-surgical procedure in the management of massive and recurrent hemoptysis.⁷ It is proven to be a very effective therapeutic modality with low morbidity and mortality. In a large study of 209 patients, the success rate within 24

hours was 98%; however 16% of patients had recurrent bleeding within a one-year follow-up period.⁷ It is now a popular means of achieving immediate control of active, moderate to severe hemoptysis; mostly carried out on an emergency basis. Moderate hemoptysis is defined as ≥ 3 episodes of blood loss of 100 mL per day within a week.⁸ We describe our experience with 14 patients who underwent bronchial arteriography and BAE. We reviewed the demographic characteristics, clinical and imaging features, complications, and outcome of BAE. The aim of this study was to assess the immediate and short-term outcome of this procedure in management of massive hemoptysis in our setting.

Methods. The medical records of all patients who underwent bronchial arteriography at Aga Khan University Hospital, Karachi, Pakistan from March 2000 to March 2005 were reviewed for clinical features, chest roentgenography, CT scan, bronchoscopy, bronchial arteriography, and results and complications of BAE. This is a retrospective study of the patients presenting with life threatening hemoptysis who underwent bronchial artery embolization. The inclusion criterion was all adult patients admitted for massive hemoptysis who underwent bronchial arteriography and embolization at University Hospital. A search of the Interventional Radiology database identified 14 patients who underwent BAE for the control of hemoptysis. Endoscopic findings, including the bleeding site determined by bronchoscopy, and results and complications of BAE were retrieved from the records.

Technique. Digital subtraction angiography was performed in all cases using the common femoral artery approach. Non-ionic contrast, iohexol (Omnipaque; Nycomed, Princeton, NJ, USA) was used in all cases. The catheters used were 4 or 5 French preshaped angiographic catheters; the most common initial shape chosen was the Simmons 1 or Headhunter 1. Initially, angiography of bronchial arteries was carried out to detect and embolize the source of bleeding followed by arteriography of subclavian, lateral thoracic, costocervical, internal mammary, intercostals, and inferior phrenic arteries when required. Embolization was performed using polyvinyl alcohol (PVA) particles of 355-500 microns. A coaxial micro catheter system was employed if stable cannulation of the offending vessel was not possible with the larger catheter, or if more distal cannulation was required. The end point of embolization was either complete stasis in the injecting artery or reflux along the distal end of the catheter.

Results. Fourteen patients, 9 males (64%) and 5 females (36%) with a mean age of 49 years (range, 22-84 years), were admitted to our hospital with massive

hemoptysis, which required bronchial arteriography and embolization. Ten patients were identified to have bronchiectasis, 3 had active pulmonary tuberculosis, and one had bronchogenic carcinoma. Nine patients had massive, and the rest had moderate hemoptysis. Chest radiography was carried out in all patients. Fibrocystic lung changes were seen in 9 patients (69%). Other findings were cavitory infiltrates in 3 (23%), and mass like opacity in one (8%). A CT chest was carried out in 11 patients, 8 (73%) had bronchiectasis. Other findings were infiltrates and cavity in 3 scans (27%), and mass in one scan (9%) (**Figure 1**). Bronchoscopy was performed in all patients before arteriography and embolization. Bleeding site was identified in 12 of 14 patients (7 from left, 4 from right, and one bilateral). The most common site of bleed was left upper lobe (7 patients, 58%). Bronchial angiography was performed in all patients. The findings of arteriography included hypervascularity in 13 patients (93%), dense soft tissue staining in 7 patients (50%), bronchial artery hypertrophy in 5 patients (36%), hypervascularity with shunting in one patient (7%), pseudoaneurysm in one patient (7%), and extravasation of contrast in one patient (7%) (**Figures 2 & 3**). A total of 20 arteries (9 right bronchial, 6 left bronchial, 4 internal mammary, 4 intercostal, one costocervical, one inferior phrenic) were found and considered to be the origin of hemoptysis in 14 patients. In 11 patients, embolization was limited to the bronchial arteries (**Figure 4**). In others, systemic collateral arteries of non-bronchial origin were responsible for hemoptysis. Among all, 2 patients (14%) rebled within 24 hours who underwent surgical intervention to maintain hemostasis. Among discharged patients, the duration of follow-up ranged from 0-12 months. Two patients (14%) rebled within a week; one patient presented with hemoptysis (100 mL) 4 days after embolotherapy and another presented with hemoptysis (200 mL) within 3 days of the procedure. Both patients had repeat BAE procedure emergently, and hemostasis was maintained. One patient developed transverse myelitis as a complication of embolization, and recovered completely within a few weeks of the procedure. Another patient died from terminal lung malignancy.

Discussion. Bronchial artery embolization has proven to be a very effective modality in immediate control of massive hemoptysis in several studies. In terms of initial management of life-threatening hemoptysis, surgery is indicated on an emergency basis if the bleeding point is localized and pulmonary function tests permit resection.⁹ The main advantage of surgery is that it permits a definitive treatment of hemoptysis because it removes the bleeding source. Emergency surgery is

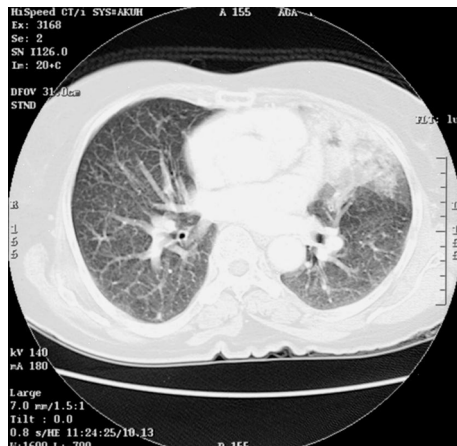


Figure 1 - Computerized tomography scan showing area of consolidation/hemorrhage in lingular segment which was confirmed on bronchoscopy.

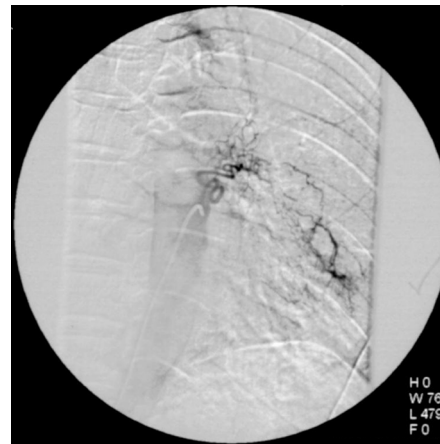


Figure 3 - Extravasation noted around the abnormal vessel

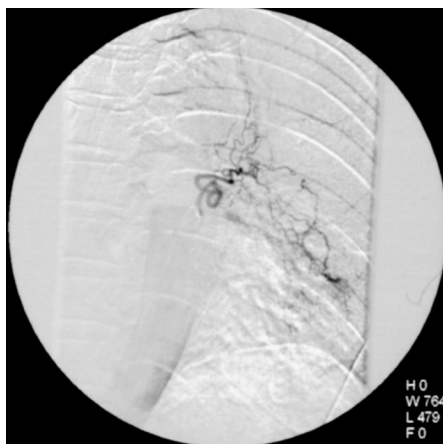


Figure 2 - Preembolization angiogram through left bronchial artery showing abnormal dilated artery in lingular segment.

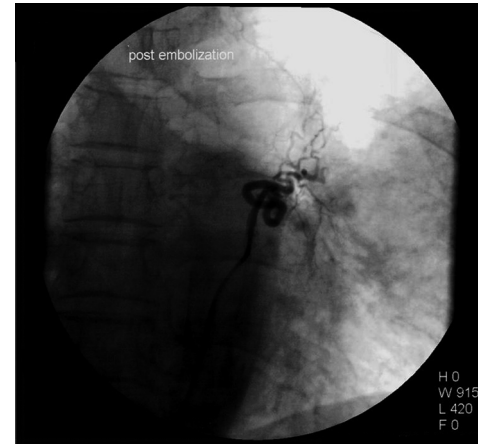


Figure 4 - Post embolization angiogram: Complete obliteration of abnormal vessels after embolization with polyvinyl alcohol (PVA) particles.

however, associated with a high mortality rate.¹⁰ With the advent of digital subtraction angiography, non-ionic contrast media, and microcatheter coaxial system, BAE has become easier, faster, and safer.¹¹ Recurrence rate after BAE is probably influenced by the etiology of hemoptysis. The initial success rates for BAE have been reported to be 73-98%, with a mean follow-up period ranging from one day to one month.¹¹ The primary success rate in our study was 72%, which is comparable to reported literature. The long-term success rate of BAE in hemoptysis is lower, reported to be 10-52%, with a mean follow-up period ranging from 1-46 months.¹² Out of 14 patients embolized, bleeding recurred in 4, 2 of which were successfully re-embolized. The secondary success rate was 84%. Tuberculosis was the most common cause of hemoptysis in our study population.

Non-bronchial systemic artery embolization was carried out in 3 patients in our series, hence, an attempt should be made to identify the abnormal vessel for embolization. We advocate the use of a microcatheter system to achieve stable cannulation of the abnormal vessel for embolization. Also, the risk of vessel occlusion by vascular spasm/catheter wedging due to a larger catheter can be avoided by the use of a microcatheter. Complications of BAE were rare in our series. Spinal cord injury related to invisible anastomotic connections between the bronchial circulation and anterior spinal artery, sub-intimal dissection of the aorta, and transient thoracic pain have been observed in several studies. The potential risks of the procedure imply that BAE should be reserved for patients with life-threatening bleeding and should be avoided in other situations. One (7%)

of our patients developed transient paraparesis after BAE. This complication has also been reported by other studies.¹³

In conclusion, our study favors that BAE is an effective technique in the treatment of life threatening hemoptysis with a low complication rate.

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Case Reports

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