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# Role of Bronchial Artery Embolization in Hemoptysis

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***Abstract:*** *Life threatening hemoptysis is one of the most challenging conditions encountered in critical care and requires a thorough and timely investigation. Despite advances in medical and intensive care unit management, massive hemoptysis remains a serious threat. According to recently published data, 28% of chest clinicians had experienced a patient's death from massive hemoptysis [1]. Conservative management of massive hemoptysis carries a mortality rate of 50 % – 100 % (3). The cause of death is usually asphyxiation [2]. The reported mortality rates for surgery performed for massive hemoptysis range from 7.1 % to 18.2 % and surgical mortality in patients with pulmonary tuberculosis and its sequelae with life threatening hemoptysis varies from 26% to 36% [3,4]. However, the mortality rate increases significantly upto about 40%, when the surgery is undertaken as an emergency procedure [3]. Bronchial artery embolisation is a well-established procedure for control of massive hemoptysis. There are only few studies which have assessed possible prognostic factors that determine outcome in patients who have undergone bronchial artery embolisation. Studies describing long term outcome and the factors that influence outcome in patients who have undergone bronchial artery embolisation for massive hemoptysis due to tuberculosis or its sequel are conspicuously absent. Many studies have proved the effectiveness of bronchial artery embolisation. Our study was performed to evaluate the radiological features and technical factors influencing the long-term outcome of bronchial artery embolisation in the control of hemoptysis. Our study was also done to identify specific factors affecting chance of recurrence after embolisation from those which do not recur.*

***Keywords:*** *hemoptysis, bronchial artery, embolisation*

## I. Introduction

Hemoptysis, defined as bleeding that originates from the lowerrespiratory tract, is symptomatic of potentially serious or even life threatening thoracic disease and warrants urgent investigation [5]. Theimmediate risk posed by hemoptysis is airway compromise. Thus, assessment ofthe clinical significance of an episode of hemoptysis should take in toaccount not only the volume of expectorated blood but also the effects on thepatient's respiratory and cardiovascular reserves. Massive hemoptysis has been described as the expectoration of an amount of blood ranging from 100 mL to more than 1,000 mL over a period of 24 hrs, and the most widely used criterion is the production of 300–600 mL per day [6,7]. However, depending on the ability of the patient to maintain a patent airway, a life threatening condition may be caused by a rather small amount of hemorrhage. Thus, a more functional definition of "massive" is an amount sufficient to cause a life threatening condition should be used in deciding whether to undertake interventional management [6,8].

**Causes of hemoptysis** - Hemoptysis may result from various causes, and the frequency with which these causes occur differs greatly between the Western and the non-Western world. Pulmonary tuberculosis, and its various manifestations, is the most common cause of life - threatening hemoptysis in the developing countries, with an incidence of 52% to 73%. Active pulmonary tuberculosis contributes to 38% to 50% of the cases. Bronchogenic carcinoma and chronic inflammatory lung diseases due to bronchiectasis, cystic fibrosis, or aspergillosis are the more prevalent causes of hemoptysis in Western countries [2,6,7]. Other causes include lung abscess, pneumonia, chronic bronchitis, pulmonary interstitial fibrosis, pneumoconiosis, pulmonary artery aneurysm (Rasmussen aneurysm), congenital cardiac or pulmonary vascular anomalies, aorto- bronchial fistula, ruptured aortic aneurysm, and ruptured bronchial artery aneurysm [9].

**Pathophysiology of hemoptysis :** The lungs are supplied by a dual arterial vascular system composed of *(a)* the pulmonary arteries,which account for 99% of the arterial blood supply to the lungs and take part in gas exchangeand *(b)* the bronchial arteries, which are responsible for providing nourishment to the supporting structures of the airways and of the pulmonary arteries themselves (vasa vasorum) but do not normally take part in gas exchange [10,11]. The bronchialvasculature feeding the intrapulmonary airways is situated close to thepulmonary arteries at the level of the vasa vasorum, and histologically the two systems are connectedby anastomoses between the systemic and pulmonary capillaries [10].Thiscommunication betweenthebronchialand pulmonaryarteries contributes toanormal right-to-left shunt that accounts for 5% of

cardiac output. In certain situations, the thin-walled capillarycommunications between the high pressure systemic bronchial arterial system and the lower pressure pulmonary arterialsystemcan vasodilateand enlarge. Conditions causing reduced pulmonary arterial perfusionsuch as chronic thromboembolic disease and vasculitic disorders, in whichthereis areductionin pulmonary arterialsupply distaltotheemboli, can lead toagradualincreasein the bronchial arterial contribution [10],thereby increasingtheimportance of bronchial to pulmonary artery anastomoses in regions of the lung that are deprived of their pulmonary arterial blood flow. Experimental studies have suggestedthatthe increased bronchialarterialblood flowisdueto neovascularization [10,12]. The anastomotic vessels, which are subjected toincreased systemicarterialpressure,areoften thin walled and prone to rupture into the alveoli orbronchial airways,giving risetohemoptysis. Chronicinflammationcan alsolead toan increase in systemic arterial bloodflow[10].Chronicinflammatorydisorderssuch asbronchiectasis,chronic bronchitis,and chronic necrotizing infections tuberculosis and mycotic lung disease are associatedwiththereleaseof angiogeneticgrowthfactorssuch asvascular endothelialgrowthfactorandangiopoietin 1, leading to neovascularization and vascular remodelingaswellasanincreaseinthecollateralsupply from nearby systemic vessels[8,10,].Such newlyformed collateral vessels areusually fragile and"leaky" and prone to rupture. Neoplasticdiseasecan also be responsible for such tumormediated neovascularization.

Bronchial artery angiography with embolization has become a mainstay in the treatment of hemoptysis. Major complications are rare and immediate clinical success defined as cessation of hemorrhage ranges in most series from 85% to 100%, although recurrence of hemorrhage ranges from 10% to 33%. Bronchial artery embolization offers a minimally invasive procedure for even the most compromised patient serving as first-line treatment for hemorrhage as well as providing a bridge to more definitive medical or surgical intervention focused upon the etiology of the hemorrhage.

## II. Materials And Methods

The present study was carried out –

1. To determine the factors influencing the outcome in patients undergoing bronchial artery embolization (BAE) for massive hemoptysis.
2. To determine the immediate (2 weeks), short term (1-3 months), intermediate (3-6months) and long term (1 year) outcome of these patients.
3. To compare our results with existing studies.

This study was conducted in the Department ofRadio-Diagnosis at NRI General Hospital,ChinakakaniGuntur dt,in45 patients who were referred clinically with hemoptysis to the Department of Radiology with hemoptysis from November 2013 to December 2014.

**Inclusion criteria:** All patients who have hemoptysis which is clinically significant or of quantity more than 250 ml for each bout or quantity of hemoptysis 500 to 1000 ml for 24 hours.

**Exclusion criteria:**Patients with hemoptysis due to arteriovenous malformations (Pulmonary circulation related hemoptysis) and hemoptysis due to pulmonary artery aneurysms.

**Examination technique:** All patients presenting with acute hemoptysis were admitted in TBCD ward as a protocol and underwent standard medical management, including correction of hypoxemia with high concentrations of oxygen through a face mask, IV vasopressin, correction of hemodynamic instability with fluids and blood products; antibiotics in caseof documented or suspected secondary bacterial infection and cough suppression. Chest radiograph and sputum AFB were done for all at admission to assess for active tuberculosis. CECT thorax/ High Resolution Computed Tomography (HRCT) were done routinely for all patients presenting with acute or chronic massive hemoptysis in order to identify the cause of hemoptysis and to a fair extent localize the site of bleeding. For patients with hemoptysis not responding to initial medical management, bronchial artery embolization is done prior to bronchoscopy and CT thorax as an immediate life saving measure to stop bleeding.

These studies were performed using ALLENGERS DSA SYSTEM (Angio scan). All patients were given intravenous sedation and local anesthesia. Patient was laid supine on the angiography table and the planned site of access was cleaned and draped. In most cases, the right common femoral artery was accessed with a retrograde puncture using the Seldinger technique. After securing the vascular access, a pigtail catheter was introduced with its tip at the arch of aorta and arch aortogram was performed on all patients with 20-25 ml of a non-ionic contrast agent, usually Ultravist injected using a pressure injector. Abnormal bronchial, intercostal and subclavian artery branches visualized on the aortogram were selectively catheterized using cobra catheter and selective angiograms were performed to note the abnormality. Spinal artery origin from the bronchial or intercostals arteries was carefully looked for prior to embarking on embolization. Visualization of spinal artery was not considered a contraindication for BAE; however the vessel from which spinal artery

originated was not embolized. This was followed by particle embolization of the abnormal vessels using microcatheter in all cases. Our approach in ill patients with hemoptysis consisted of transcatheter embolization of the bronchial arteries most likely responsible for causing the bleeding and search for bronchial or non-bronchial arteries if abnormal vessels were not found on aortogram. Pulmonary angiography was performed only in selected patients were no abnormality was found on bronchial angiography. Images were recorded as angiographic runs on a compact disc and documented on PACS. Procedure details and complications were also documented on the procedure notes attached to the angiogram images and inpatient records. As a routine all patients who underwent BAE were kept as inpatients for three days post procedure, they were followed up for immediate response and procedure related complications.

## III. Results And Observations

The present study sample includes 45 patients who were referred to department of Radio-Diagnosis with hemoptysis. The outcome of BAE was investigated from in-patient and out-patient medical records in the clinical work station and outpatient charts or, if needed, after direct contact with the patient through phone call, when the outpatient follow-up had ceased.

Primary outcome: Control of bleeding.

Secondary outcome: Survival post procedure, morbidity.

Several aspects of outcome were analyzed as:

- Immediate control of bleeding·
- Recurrence of hemoptysis within the first 2 weeks of BAE, within first month after BAE, between 30 and 90 days after BAE, between 3 months to 6 months after BAE, between 6 months to one year.
- Morbidity of the procedure.
- Mortality of the procedure.

Median age of the study population was 43 years with age range of 18-68 years. There was predominance of 41-50yrs age group. Majority were male patients, constituting 86% of the total study population.

We had 8 patients presenting with acute massive hemoptysis and 26 patients with chronic hemoptysis, 3 of them had single episode and 32 of them had multiple episodes of hemoptysis with quantity of bleeding ranging from 100-1500 cc (median of 350 cc) (Table 1).

13 patients had active tuberculosis at presentation and 27 patients had post tuberculosis sequelae. Among patients with active tuberculosis four were on category 1, five on category 2 DOTS regimen, four had multi drug resistant tuberculosis (MDRTB) and one patient had atypical mycobacterial infection. 29 patients were smokers, 10 were ex-smokers. 6 patients were non-smokers.

Review of chest radiograph and HRCT/ CT thorax showedthat Chest X-ray were normal in 4and abnormal in 41 patients. 36 patientshad bilateral lung involvement and 9had unilateral lung involvement. 28 patientshad diffuse lung involvement and 17had focal area of lung involvement. Lung cavitations were seen in 14 patients.Bronchiectasis was seen in 38 patients. 8 patients had fungal balls within one of their cavities. Pleural thickening was present in 41patients. Total of 37patients showed consolidation on HRCT. Fibrosis mimicked consolidation in 5 patients on imaging. Tree-in-bud opacities were seen in 40 patients. Thickening and irregularity of the cavity wall, cavity with fluid level were the other features seen in patients with active TB. Volume loss, fibrosis with traction bronchiectasis, calcification and pleural thickening were seen in all patients with old TB (Table 2).

49 embolisations were performed for 45 patients. Arch aortogram was performed in all patients to assess the number of abnormal vessels and the type of abnormality. Angiogram showed various abnormalities.Vessel hypertrophy and tortuosity is seen in 45 out of 45 patients (100 %). Hypervascularity, abnormal blush and parenchymal staining is also seen in 45 out of 45 patients (100 %). Systemic artery to pulmonary artery shunting was seen in 2 patients. Aneurysm was seen in 1 patient. Active contrast extravasation is seen in 1 patient. (Table 3). Right intercosto bronchial trunk (ICBT) was abnormal in 32 patients, left bronchial artery in 26, right bronchial artery in 6 and intercostals in 22, common bronchial artery in 5, non bronchial systemic artery collaterals (NBSAC) from the subclavian artery or intercostals arteries were seen in 10 patients. (Table 4). None of the patients had bronchial or intercostal origin of spinal artery.

A total of 101 arteries were embolized in 49 procedures (Table 5) with number of vessels embolized, varying within a range of 2 to 4 arteries. However, in most patients 1 to 3 arteries were embolized with an average of three arteries. Two arteries were most commonly embolized.

Gelfoam alone is the most common particle used for embolization. Poly vinyl alcohol (PVA) either alone or along with gelfoam was the next particle used for embolization (Table 6).

Procedure related complications were not uncommon, though most of them were minor. Chest pain was the most common complication noted in our patients, seen in 42 patients, followed by fever in 4 patients. There were no procedure related mortality or paraplegia in our series. (Table 7).

**Results of outcome analysis -** All patients were available for analysis of immediate outcome of the procedure. However one patient's follow up was lost after the procedure. Thus, of the total of45 patients who had BAE for hemoptysis, 44 patients (38 male,6 female)wereincludedforfurtheranalysis.Number of daysof followup rangedfrom 1day to365days. Out of 44 patients, 19 patients had recurrence of hemoptysis after various intervals of time after BAE, ranging from 1 to 365 days.Immediatearrestofhemoptysiswasobtainedin 43 patients. One patient had hemoptysis in evening after the procedure, one on 4$^{th}$day after procedure. One of them settled with conservative management. Another one had repeat BAE with successful control of hemoptysis and was included for further analysis.

Out of 44 patients, one patient had recurrence between15-30 daysafterBAE.He recurredon day21,only a single vessel (bronchial artery) was initially embolized. Repeat BAE was performed and previously embolized right bronchial artery was recanalized and embolizedand subclavian artery branches were embolized further. Patient remained free of hemoptysis for 62 days after second BAE. Patient decided against a third BAE and continued on conservative management.Thusat30 days, BAE wassuccessfulin 42 patients.

By 90 days, BAE was successful in 39 patients with two patientshaving recurrence of hemoptysis and onepatientlosing follow up.By 180 days, BAE was successful in 31 patients with 8 patients having recurrenceofhemoptysis.At the end of one year, outof31 patients,5 hadrecurrenceof hemoptysis.Oneof them had repeatBAEandhadsuccessfulcontrol of hemoptysisandiswellonfollow up281 daysafter 2$^{nd}$ BAE.Thusattheendof oneyearafterBAE26 patients, i.e.59% hadsuccessfulcontrolofhemoptysis.

## IV. Tables And Figures

**Table 1 – Quantity of hemoptysis in study population**

| Quantity of hemoptysis (ml/24hrs) | No.of patients | Percentage (%) |
|---|---|---|
| 100-250 | 4 | 8.8 |
| 250-500 | 7 | 15.5 |
| 500-1000 | 26 | 57.7 |
| 1000-1500 | 8 | 17.1 |
| Total | 45 | 100 |

**Table 2 – Summary of Imaging findings in study population**

| Imaging feature | No.of patients | Percentage (%) |
|---|---|---|
| Bilateral lung involvement | 36 | 80 |
| Unilateral lung involvement | 9 | 20 |
| Diffuse lung involvement | 28 | 62.2 |
| Focal lung involvement | 17 | 37.8 |
| Normal chest X-ray | 4 | 8.8 |
| Abnormal chest X-ray | 41 | 91.1 |
| Cavities | 14 | 31.1 |
| Fungal ball | 8 | 17.7 |
| Bronchiectasis | 38 | 84.5 |
| Pleural thickening > 10mm | 41 | 91.1 |
| Consolidation | 37 | 82.2 |
| Tree in bud opacities | 40 | 88.8 |
| Ground glass opacities | 38 | 84.4 |
| Hemorrhage | 2 | 4.4 |

**Table 3 – Abnormalities in DSA**

| Abnormality | No.of patients | Percentage (%) |
|---|---|---|
| Vessel hypertrophy and tortuosity | 45 | 100 |
| Hypervascularity and blush | 45 | 100 |
| Systemic artery – PA shunting | 2 | 4.4 |
| Aneurysm | 1 | 2.2 |
| Active extravasation of contrast | 1 | 2.2 |

**Table 4 – No.of abnormal vessels embolized**

| Abnormal vessels | No.of vessels | Percentage (%) |
|---|---|---|
| Right bronchial artery | 6 | 6 |
| Right ICBT | 32 | 31.6 |
| Left bronchial artery | 26 | 25.7 |
| Common bronchial artery | 5 | 4.9 |
| Intercostals | 22 | 21.7 |

| | | |
|---|---|---|
| NBSAC | 10 | 9.9 |

**Table 5 – No.of arteries embolized in individual patients**

| No.of patients | No.of arteries embollized |
|---|---|
| 36 | 2 |
| 7 | 3 |
| 2 | 4 |

**Table 6 – Embolizing material used**

| Embolizing material | No.of patients | Percentage (%) |
|---|---|---|
| Gelfoam | 35 | 77.8 |
| Gelfoam& PVA | 4 | 8.9 |
| PVA | 6 | 13.3 |

**Table 7 – Complications**

| Complications | No.of patients | Percentage (%) | Consequence |
|---|---|---|---|
| Chest pain | 42 | 80 | 3 had chronic pain |
| Dysphagia | 2 | 4 | Transient |
| Dissection | 0 | 0 | - |
| Fever | 4 | 7 | Self limiting |
| Contrast reaction | 1 | 1.9 | Self-limiting |
| TIA | 1 | 1.9 | Resolved completely |
| Swelling at femoral puncture | 2 | 43 | Resolved within 2 days |
| Femoral artery psuedoaneurysm | 0 | 0 | - |
| Paraplegia | 0 | 0 | - |
| Mortality | 0 | 0 | - |

**Table 8 – Recurrence according to imaging finding**

| Radiological feature | Recurrence | |
|---|---|---|
| | Yes | No |
| Unilateral disease | 2 | 7 |
| Bilateral disease | 16 | 19 |
| Diffuse disease | 12 | 15 |
| Focal disease | 6 | 11 |
| Cavity | 14 | 4 |
| Cavity with fungal ball | 7 | 1 |
| Bronchiectasis | 16 | 2 |
| Pleural thickening | 17 | 1 |

**Table 9- Recurrence according to BAE procedure**

| BAE procedure | Recurrence | |
|---|---|---|
| | Yes | No |
| Embolization of non-systemic bronchial arteries | 5 | 13 |
| Systemic to pulmonary artery shunting | 9 | 9 |
| Gelfoam | 12 | 2 |
| PVA+Gelfoam | 0 | 1 |
| PVA | 1 | 2 |
| No.of vessels embolized | 3+/-1 | 2+/-1 |
| Complications | 11 | 8 |

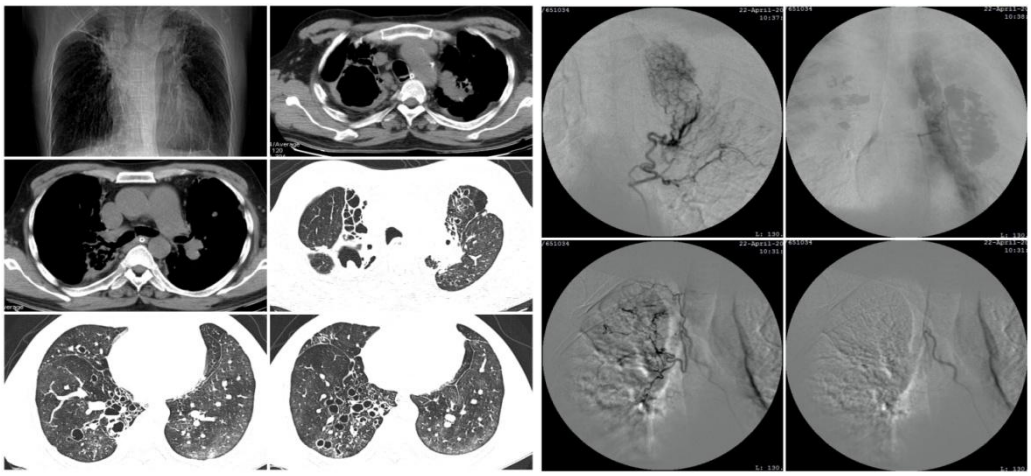

Figure 1: HRCT chest showing fibrosis with traction bronchiectasis in b/l upper lobes. Cystic bronchiectasis noted in right middle and lower lobe and left upper lobe. Some of them are showing air fluid level – s/o secondary infection. Super selective angiography of and left BA, right ICBT showing vessel hypertrophy, abnormal blush and parenchymal staining. Post embolization shows significant decrease in blush with complete embolization.

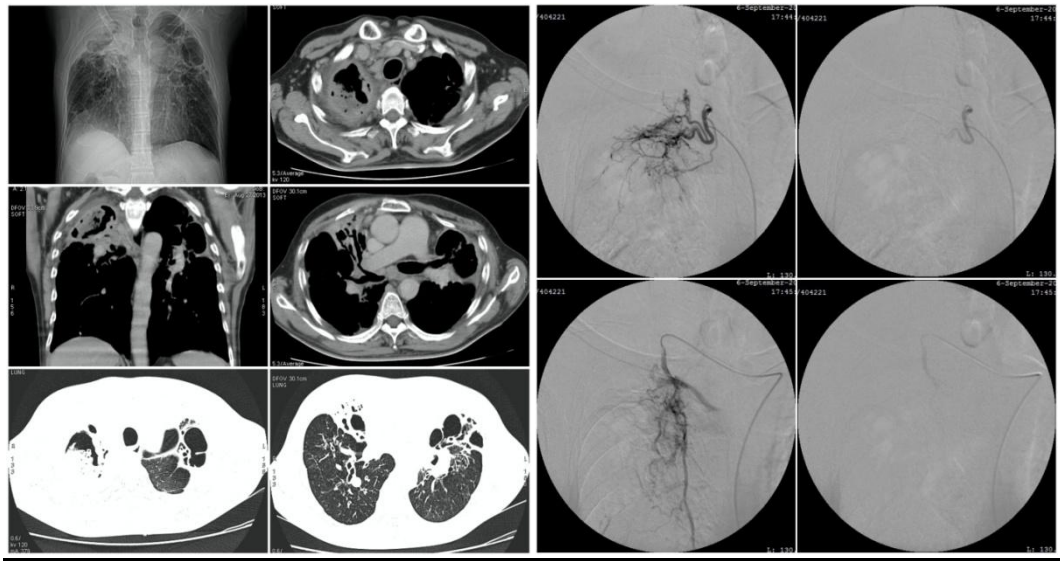

Figure 2: CECT chest showing fibrosis, volume loss and tractional bronchiectasis in b/l upper lobes. Cavitory lesion on rightt side shows mobile soft tissue. Consolidation in rightt upper lobe – f/s/o kochs with fungal ball. Super selective angiography of right BA and right IMA showing vessel hypertrophy, abnormal blush and parenchymal staining. Post embolization shows significant decrease in blush with complete embolization.

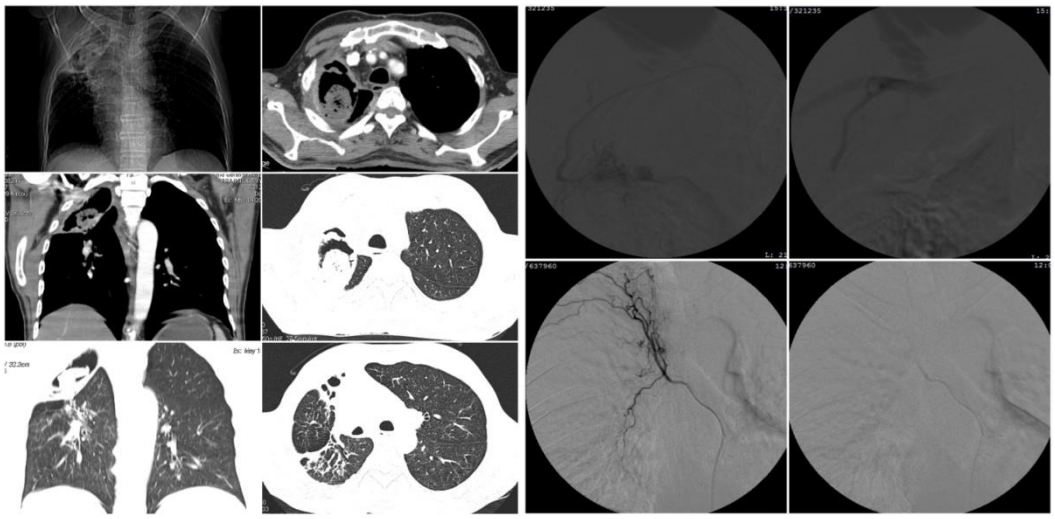

Figure 3: CECT chest showing cavitory lesion in right upper lobe with mobile soft tissue density lesion – s/o fungal ball. Pleural thickening and volume loss of right upper lobe with adjacent bronchiectasis. Super selective angiography of right IMA showing abnormal blush with small aneurysm. Right BA showing vessel hypertrophy and abnormal blush, parenchymal staining. Post embolization shows significant decrease in blush with complete embolization.

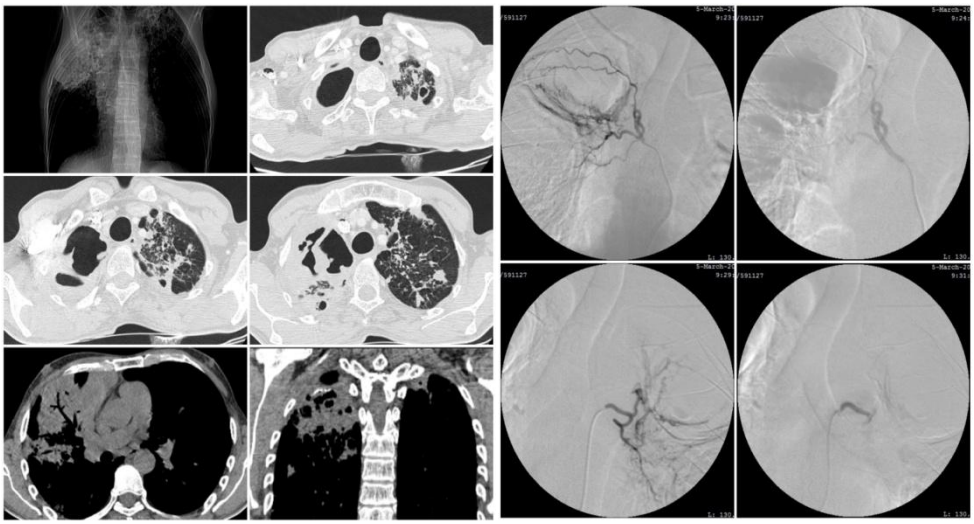

Figure 4: HRCT showing smooth thick walled cavitory lesion in right upper lobe with adjacent soft tissue density with air bronchograms. Small cavitory lesions in apical segment of left upper lobe. Fibrosis and bronchiectasis in bilateral upper lobes. Super selective angiography of right ICBT and left BA showing vessel hypertrophy, abnormal blush and parenchymal staining. Post embolization shows significant decrease in blush with complete embolization.

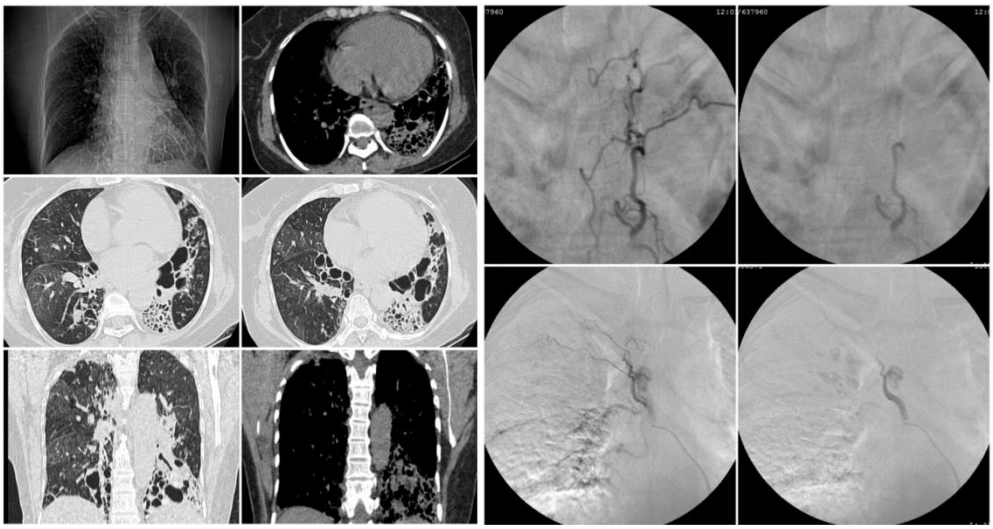

Figure 5: HRCT showing pleural thickening in right upper lobe. Tubular and cystic bronchiectasis noted in both lung fields. Known case of pulmonary tuberculosis. Super selective angiography of left BA and right BA showing vessel hypertrophy, abnormal blush and parenchymal staining. Post embolization shows significant decrease in blush with complete embolization.

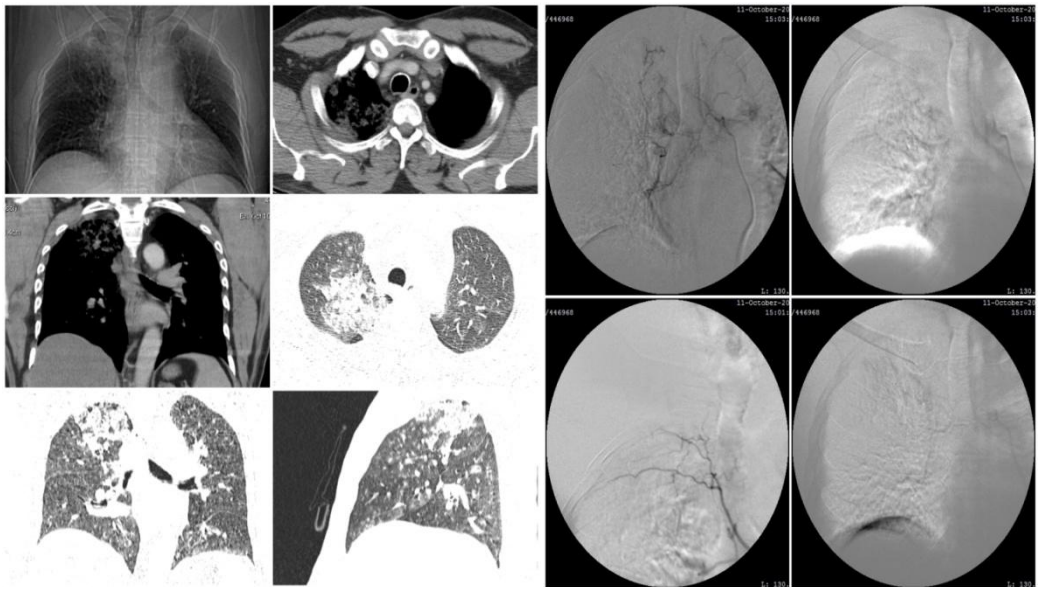

Figure 6: CECT chest showing haziness seen in right upper lobe, predominantly in the apical segment - findings suggestive of hemorrhage in right upper lobe. Super selective angiography of right icbt and right ba showing vessel hypertrophy, abnormal blush and parenchymal staining. Post embolization shows significant decrease in blush with complete embolization.

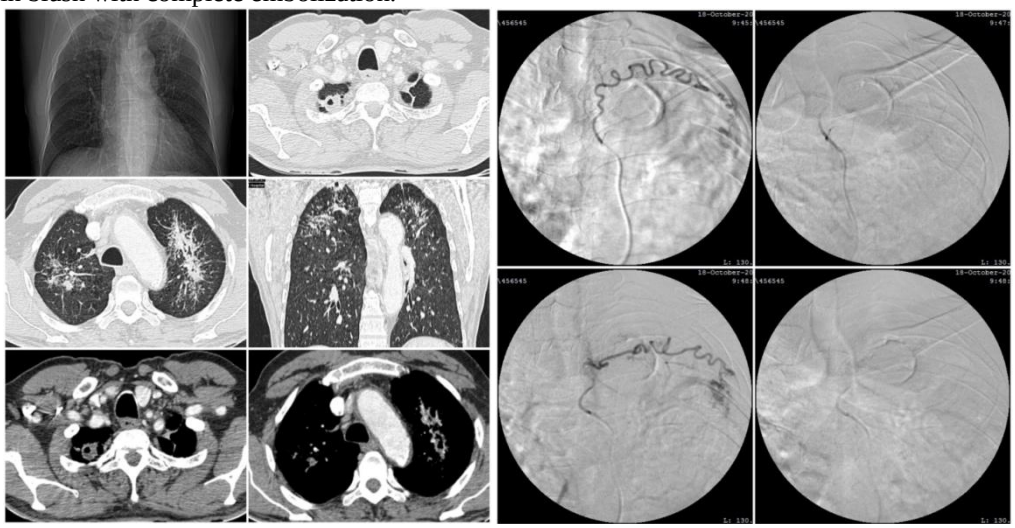

Figure 7: CECT chest showing thick walled cavitory lesion in right apical lobe. Fibrocavitory lesions with traction bronchiectasis in both upper lobes. s/optbsequalae. Super selective angiography of left SICA and left MICA showing vessel hypertrophy, abnormal blush and parenchymal staining. Post embolization shows significant decrease in blush with complete embolization.

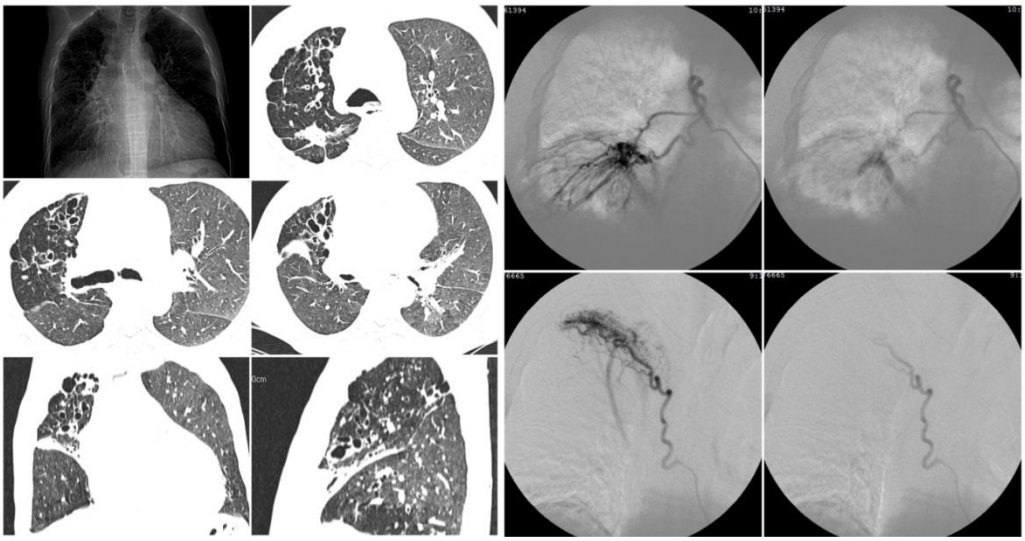

Figure 8: HRCT chest showing cystic and traction bronchiectasis in right upper and middle lobes. Volume loss of right upper and lower lobe is noted. Super selective angiography of right BA and right ICA showing vessel hypertrophy, abnormal blush and parenchymal staining. Post embolization shows significant decrease in blush with complete emolization.

## V. Discussion

Bronchial artery embolization is a well-established procedure for control of massive hemoptysis [13,14,15]. There are only few studies which have assessed possible prognostic factors that determine outcome in patients who have undergone BAE (54). Studies describing long term outcome and the factors that influence outcome in patients who have undergone BAE for massive hemoptysis due to tuberculosis or its sequel are conspicuously absent. Thus assessment of long term outcome and factors influencing outcome of BAE in these patients was the purpose of this study.

Limited embolization of the abnormal arteries seen in aortogram was undertaken, and extensive search for abnormal vessels was not our protocol, hence anatomy of bronchial arteries could not be studied in detail in our study.

Bronchial angiography and embolization was well tolerated by our patients. Vessel hypertrophy and toruosity was seen in all our patients. Rare angiogram abnormality such as bronchial artery aneurysm and active contrast extravasation was seen in one patient each. We considered immediate control of hemoptysis as no recurrence till 2 weeks after embolization since recurrence during this period is usually due to incomplete embolization of non-bronchial systemic artery collaterals, which usually necessitates repeat BAE. Repeat BAE in this group of patients produces usually leads good outcome. Immediate control of bleeding was achieved in 95% i.e. 43 patients out of 45 patients. This result is similar to the immediate results reported in literature [16,17].

Hayakawa et al [18] have reported two peak times of bleeding recurrence. The first is from 1 to 2 months after BAE, which may reflect bleeding fromnon-bronchial systemic arteries not previously embolized. The second peak for recurrence of hemoptysis is from 1 to 2 years after the patient undergoes embolization. This appears to reflect the recruitment of blood supply and revascularization by the underlying pulmonary inflammation or progression of the underlying disease. However we did not find similar peak times of recurrence in our series. At one month hemoptysis control rate reported in literature varies between 51 – 85 %. In series reported by Uflacker et al, 91% of patients had hemoptysis due to tuberculosis. They had 39 of 75 patients i.e. 52% of patients free of recurrence after one month. Ramakanthan et al had studied only patients with tuberculosis and reported 30 days hemoptysis control rate of 51% (72 of 140 patients). In our series hemoptysis control rate at one month was 93%, much higher than the above studies. This could be explained by the fact that though limited embolization was undertaken by us, attempt to embolize the visualized non-bronchial systemic artery collaterals was always made even if extensive search for collaterals was not made. However after one month we did not observe increase in hemoptysis control rate as observed by Ramakanthan et al since the number of patients in our series was small. Effective anti-tuberculosis chemotherapy available these days explains the less number of patients with active tuberculosis presenting with massive hemoptysis.

There has been no study till date analyzing the outcome by the type of embolization material that was used. Swanson et al, described their experiences of BAE at the Mayo clinic and concluded that different embolic materials did not alter recurrence rates. Ramakantan et al so determined that the use of longer lasting embolic

agents, such as polyvinyl alcohol foam, does not result in markedly better hemoptysis control. But in our study, type of agent used for embolization influenced the chance of recurrence. Patients who were embolized with only gelfoam particles shown more recurrence than who were embolized with PVA particles.

## VI. Conclusion

Our study confirms the already proven effectiveness of bronchial artery embolization in the immediate control of life threatening hemoptysis. BAE may be the only life saving treatment option in patients who are poor surgical candidates. Repeat BAE in patients with early recurrence improves outcome. BAE is relatively safe procedure and most complications related to the procedure are minor.

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