Original Article

Control of Massive Hemoptysis in Pulmonary Tuberculosis Patients with Bronchial artery Embolisation

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Abstract

Background: Massive and untreated haemoptysisin pulmonary tuberculosis patients is a medical emergency. Conservative management of massive hemoptysis carrieshigh mortality rate. Bronchial artery embolization has become an established procedure in the management of massive and recurrent hemoptysis. The present study was undertaken to evaluate the efficacy of bronchial artery embolization in controlling massive hemoptysis in pulmonary tuberculosis patients. **Material and Methods:** Total 120 patients of pulmonary tuberculosis and its sequelae presenting with massive haemoptysis between age group of 18- 65 yearswere included for bronchial artery embolisation. Bronchial artery embolisationwas performed using high resolution DSA unit andgel foam as embolising agent. Percutaneous transfemoral arterial puncture was performed using Seldinger technique was used. **Results:** Out of 40 patients, 4 had recurrence and 36 showed no recurrence. Minor complication occurred during and post procedure including transient chest pain and dysphagia. Technical success rate of our study was 100%. The efficacy of bronchial artery embolisation in controlling haemoptysis proved to be 90%. **Discussion:** Bronchial artery embolisation is effective and safe technique to control and manage massive haemoptysis in pulmonary tuberculosis patients.

Keywords: massive haemoptysis, pulmonary tuberculosis, bronchial artery embolization, efficacy

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INTRODUCTION

Haemoptysis is defined as the coughing of blood or blood tinged sputum derived from the bronchial airways or lung parenchyma as a result of bronchial or pulmonary haemorrhage. Massive bleeding (more than 250-300 ml/24 hr)and untreated haemoptysis is a medical emergency with high mortality rate of more than 50%[1,2]. In India, pulmonary tuberculosis and its sequelae such as cavities, bronchiectasis and aspergillomas are one of most common underlying causes of massive haemoptysis. The source of massive hemoptysis is usually the bronchial circulation (90% of cases) rather than the pulmonary circulation (5%)[3]. Various treatment options for haemoptysis include conservative medical management, bronchial artery embolisation and definitive surgical resection. Though surgical resection appears definitive management, it is not possible in those patients associated with poor pulmonary reserve. Alone conservative management also carries higher risk of mortality rate in these cases[4]. Asphyxiation due to aspirated blood is mainly responsible for mortality in these patients[5]. Bronchial artery embolisation is a logical therapeutic approach in patients with massive haemoptysis. It is also useful in recurrent haemoptysis. It is minimally invasive and carried out under localanaesthesia. Ramey *et al*[6] firstly used this procedure in 1973 for control of haemoptysis. Subsequently many studies are carried out to show efficacy, safety and utility of bronchial artery embolisation in control of haemoptysis. Early management with bronchial artery embolisation can significantly reduce the mortality in these patients. The present studywas undertaken to evaluate the efficacy of

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bronchial artery embolization in controlling massive hemoptysis in pulmonary tuberculosis patients.

MATERIAL AND METHODS

The study was conducted after approval from institutional ethical committee in our institution which is a tertiary care hospital over period of January 2013 to November 2014. Total 120 (52 males and 68 females) patients of pulmonary tuberculosis and its sequelae presenting with massive haemoptysisbetween age group of 18- 65 years were included for bronchial artery embolisation. Patients with prior severe allergic reaction to iodinated contrast agent,renal insufficiency and coagulopathy were excluded from the study. Massive haemoptysis was defined as bleeding more than 250-300 ml/24 hr. But patient's pulmonary reserve was taken into consideration for functional approach. Chest X-ray and HRCT thorax were done in these patients prior to embolisation. Bronchial artery embolisations were done in all cases. Post embolisation; follow up for recurrence done for 6-9 months. The recurrent haemoptysis was noted in 4 patients. Repeat embolisation done in all these cases.

RESULTS

We evaluated 120 pulmonary tuberculosis patients with massive haemoptysis in whom bronchial artery embolisation was performed in our department. It includes 68 men and 52 women. Their mean age was 37 yrs (18-65yrs) (Table 1).

Table 1: Demographic data of study population (n=120)

Characteristics		No. of patients (%)
Age group (yrs)		
	18-25	18 (15%)
	26-35	30 (25%)
	36-45	48(40%)
	>45	24(20%)
Sex		
	Male	52 (45%)
	Female	68 (55%)

Unilateral bronchial artery was involved in majority of the cases 28 (70%), whereas onlysystemic collaterals were involved in only 2 patients (5%) (Table 2). Right intercostobronchial and right bronchial artery were mainly involved in majority of cases i.e., 20 cases, which may be due to greater involvement of right-side lung parenchyma in comparison to left side. Left bronchial artery was concurrently involved in only 8 cases. (Fig. 1a,b, 2a,b, 3a,b, 4a,b).

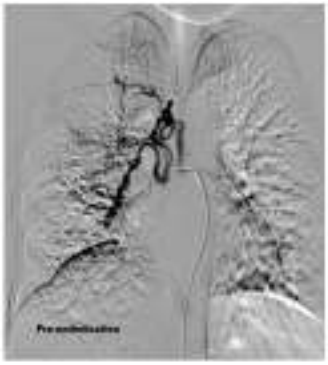
Table 2: Vessels embolised during the study

Vesselembolised	No. of vessels (%)
Unilateral bronchial	28 (70%)
Bilateral bronchial	6 (15%)
Bronchial systemic collateral	4 (10%)
Systemic collaterals only	2 (5%)

A total of 12 patients were followed up for less than 3 months, 20 were followed up to 6 months whereas 8 patients were followed up to 9 months.Out of 40 patients embolised, 4 had recurrent haemoptysis during follow up period. Of these 4 recurrent cases 2 patients had aspergillosis and 2 had bronchial arteries of anomalous origin. Procedure related complications were noted. Two were reported in our study in the form of groin hematoma and subintimal dissection. The most common subacute complication noted in our study was transient chest pain (25%) which was managed conservatively with analgesics. Neurological complications were not observed in any of the patient. The immediate control of haemoptysis was achieved in 14 cases. No recurrence noticed in all 14 cases. No major complications noted and procedure was well tolerated. Technical success rate of our study was 100%. There was no recurrence in total 36 cases. Thus, efficacy of bronchial artery (clinical success rate) embolisation can be calculated as-

Efficacy of embolization = Total patients- recurrence x 100 / Total patients = 90%

The efficacy of bronchial artery embolisation in controlling haemoptysis proved to be 90%.



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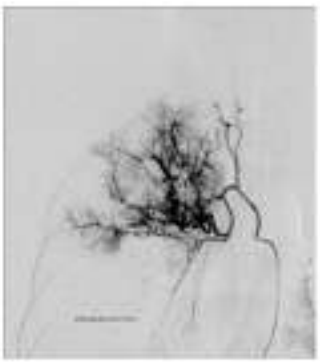

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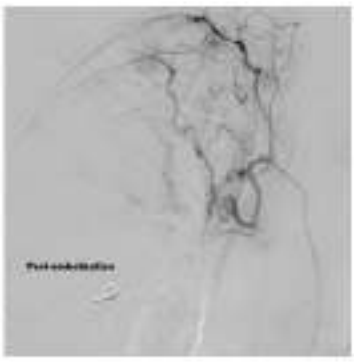

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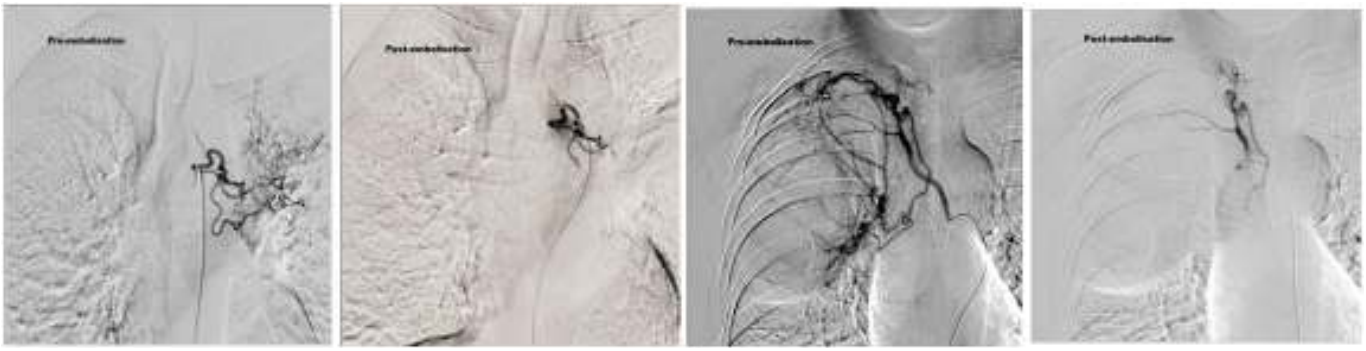

3(a) 3(b) 4(a) 4(b)

Figure 1a,b-4 a,b: Angiogram showing pre (a) and post embolization (b) of bronchial artery

DISCUSSION

In India, pulmonary tuberculosis and its sequelae are the major cause of haemoptysis. Haemoptysis can be life threatening condition with propensity to recur if definitive treatment is not instituted. Though surgical resection is curative, unfortunately many patients are not suitable surgical candidates due to poor clinical condition, extensive diseased lung and poor pulmonary functional reserve. Also many patients refuse surgical treatment. Bronchial artery embolisation has now established itself as an important management role in these situations. Pulmonary tuberculosis and its sequelae are the main etiological causes for haemoptysis in our study. The sequelae include bronchiectasis, cavitations and aspergilloma. Previous studies done by authors Ramakantan R *et al*[7], Tanaka *et al*[8], Mal *et al*[9] also predominantly included pulmonary tuberculosis patients presented with haemoptysis. In our institute bronchial arteriography and subsequent embolisation for cases of massive haemoptysis were performed in Digital subtraction angiography department. The procedure was well tolerated by our patients. An immediate control of active haemoptysis was achieved with embolisation in cases 30 (75%), but 10 patients had expectoration of dark red/black clots for less than 7 days after the procedure, suggestive of expectoration of retained secretions. Similar results were observed in previous studies.

Table 3: Comparisons of success rate with previous studies

Study	Clinical success rate	Clinical recurrence rate
Remy *et al* [6]	84%	28.60%
Rabkin *et al*[10]	91%	33.70%
Cremaschi *et al* [11]	98%	12%
Ramakantan *et al* [7]	73%	27.10%
Mal *et al* [12]	77%	55%
Present study	90%	10%

Bronchial arteries are the most common source of life-threatening haemoptysis; however bronchial systemic collaterals and non-bronchial systemic circulation may also contribute to haemoptysis. The prevalence of bronchial systemic collaterals and abnormal non-bronchial systemic artery in our study were 4 and 2 respectively. Keller *et al*[13] published a series of 20 cases of haemoptysis studied during 1979 to 1986. They embolised bronchial as well as nonbronchial systemic collaterals including subclavian and axillary arteries, intercostal arteries and phrenic arteries. They concluded that recognition and occlusion of nonbronchial systemic collaterals providing blood to hypervascular pulmonary lesions is essential for successful percutaneous embolisation of haemoptysis. Similar studies were presented by Yu-Tang *et al*[14] in controlling haemoptysis in 134 cases. It was observed that in one third cases non bronchial systemic vessels were responsible for haemoptysis. Thus non bronchial systemic collaterals also contribute for haemoptysis and should be taken into consideration. We performed thoracic aortography after transarterialembolisation in all patients to identify additional arteries responsible for haemoptysis. Chun HJ *et al*[15] performed thoracic aortography after transarterialembolisation in 76 patients keeping the tip of the catheter just distal to the origin of the left subclavian artery. They identified 200 arteries either at the initial embolisation or on thoracic aortography as being responsible for causing haemoptysis. Among them, 29 arteries (14.5%) that were not included on the initial selection for embolisation were later identified on post embolisation thoracic aortography. The inferior phrenic and intercostal arteries were often missed on routine transarterialembolisation in patients with haemoptysis, hence a post embolisation thoracic aortography aids in detecting of arteries contributing to haemoptysis and increasing efficacy of bronchial artery embolisation.

Out of 40 patients embolised in our institute, 4 had recurrent haemoptysis during follow up period. Recurrent haemoptysis after successful bronchial artery embolisation is particularly a problem for patients with aspergillosis who tend to develop extrapulmonary systemic collateral arteries. Another major cause of recurrence is presence of bronchial arteries of anomalous

origin. Out of 4 recurrent cases 2 patients had aspergillosis and 2 had bronchial arteries of anomalous origin. 27 cases of recurrence out of 209 patients were noted by Cremaschi P *et al*[11]. Ramakantan R *et al*[7] noted 39 cases of recurrence out of 140 embolisation. Sancho *et al*[16] observed 25 bronchial arteries of anomalous origin in their 27 recurrent haemoptysis. Other causes of recurrence include inadequate embolisation, imprecise localization of initial bleeding, bronchial artery recanalization, and progression of underlying disease.

The embolisation material used in our study was gel foam. Various embolic materials such as polyvinyl alcohol particles, coils and microspheres have been used for selective bronchial and non-bronchial systemic arterial embolisation in patients with haemoptysis. Each material has its own advantages and disadvantages. Gel foam is cost effective, easily available and its size can be controlled. But as it is absorbed spontaneously, recanalization can occur faster than polyvinyl alcohol.Polyvinyl alcohol particles are biocompatible and non-biodegradable. They are considered to be a permanent embolic agent. However, they cause unpredictable proximal vessel occlusion and catheter blockage by clumping or aggregation of irregular-shaped particles. Baltacioglu F *et al*[17] evaluated efficacy of n-butyl-2-cyanoacrylate (NBCA) and coaxial micro catheter technique in bronchial artery embolisation.

The immediate control of haemoptysis was achieved in 14 cases. No recurrence noticed in all 14 cases. No major complications noted and procedure was well tolerated. It was concluded that ethylene vinyl alcohol copolymer as an embolisation material is effective particularly in recurrent haemoptysis, those with high risk during embolisation with microparticles and patients who need embolisation of large systemic arteries through small-calibre anastomoses. Razavi *et al*[18] evaluated the use ethylene vinyl alcohol copolymer as compared polyvinyal alcohol (PVA) particles with N-butyl cyanoacrylate as embolisation material for bronchial artery embolisation. They performed bronchial artery embolisation in 36 cases with polyvinyl alcohol (PVA) particles and 12 cases with N-butyl cyanoacrylate. As compared with PVA, NBCA embolisations appear more durable, leading to fewer rebleeds.

During the initial phases of bronchial artery embolisation, use of non-ionic contrast agents and the inadvertent embolisation of the spinal arteries several patients developed neurological complications like transverse myelitis. To avoid such neurologic complications, super selective catheterization is performed. This refers to embolisation of more terminal branches of the arterial tree, beyond the origin of the spinal arteries. Tanaka and colleagues[8] concluded that by using super selective embolisation distal to the spinal or mediastinal branches, neurologic complications could be avoided and that the embolisation may be more effective. Cowling *et al*[19] performed bronchial arteriography in 2 case with massive haemoptysis. In these two cases, non bronchial systemic collateral which filled the right subclavian artery from the right intercosto-bronchial trunk noted. These vessels are at the risk of passage of embolic material into the subclavian artery and its branches during therapeutic bronchial artery embolisation. It was avoided by super selective catheterization with the positioning of the catheter tip well into the bronchial artery beyond the origin of the intercostal artery and any large collateral vessels. In our study, embolisation performed after super selective catheterisation of bronchial arteries and none of the patient developed neurological complications. Procedure related complications can be acute, subacute and chronic. Acute complications include allergic reaction to contrast media and catheter-related complications. Test dose of contrast and intravenous hydrocortisone played important role to reduce allergic reaction in our study. Two were reported in our study in the form of groin hematoma and subintimal dissection. The most common subacute complication noted in our study was chest pain (25%). There were no chronic complications during the course of our study due to super selective embolisation of the bronchial arteries. Surgical management of haemoptysis includes selective lobectomy, pneumonectomy, segmentectomy and bilobectomy. In 2005, Metin M *et al*[20] evaluated 29 cases of haemoptysis with surgical management, however rate of perioperative morbidity and hospital mortality were 27.5% and 11.5% respectively. Similarly, Erdogan A *et al*[21] published a report regarding surgical management of tuberculosis-related haemoptysis in 59 patients. Operative complications like empyema and bronchopleural fistula developed in 3 patients in this study and perioperative mortality rate was 6.8 %. Thus, comparing procedure related morbidity and mortality of bronchial artery embolisation with surgical management, bronchial artery embolisation proved an effective and safe treatment for massive haemoptysis.

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