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STUDY OF EFFICACY AND SAFETY OF BRONCHIAL ARTERY EMBOLIZATION IN CONTROLLING HAEMOPTYSIS

Radiodiagnosis

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ABSTRACT

Hemoptysis can be 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 hemorrhage. Massive hemoptysis is an emergent and life-threatening condition with a broad range of underlying causes. Various treatment options for hemoptysis include conservative medical management, bronchial artery embolization and definitive surgical resection. Surgical resection is not possible in those patients associated with poor pulmonary reserve. Alone conservative management also carries higher risk of mortality rate in these cases. Early management with bronchial artery embolization can significantly reduce the mortality in these patients. Proper techniques, results, and possible complications of BAE should be taken in mind and the same applies for the characteristics of the various embolic agents used in the procedure. In cases of recurrences, the procedure can be repeated effectively.This study done to know efficacy and safety of bronchial artery embolization in controlling hemoptysis. Study was done in Department of Radiology Lokmanya Tilak Medical College and Lokmanya Tilak Municipal General Hospital Sion Mumbai India over a period of 3 years. With its low recurrence rates and low procedure related complications BAE remains one of the best palliative and minimally invasive procedure for management of patients with hemoptysis including those who are unfit to undergo or unwilling for more invasive managements such as surgery.

KEYWORDS

BAE, hemoptysis, embolization, DSA.

INTRODUCTION

The first selective bronchial angiogram was performed in 1963 by Viamonte (1). Remy et al (1973) (2) were first to perform bronchial artery embolization to control hemoptysis. Remy et al (1984) (3) published a large series of 104 patients who were treated by bronchial and non bronchial artery embolization to control hemoptysis.Gelatine sponge was used as embolization material(3).The bronchial arteries have variable anatomy in terms of origin, branching pattern, and course.They arise as a pair or as a common trunk, from descending thoracic aorta below the origin of left subclavian artery.Cauldwell et al (4) reported four classic bronchial artery branching patterns:Type I - Two on the left and one on the right that presents as an intercosto-bronchial trunk (ICBT) (40% of cases);Type II- One on the left and one ICBT on the right (21%); Type III-Two on the left and two on the right (one ICBT and one bronchial artery) (20%)Type IV- One on the left and two on the right (one ICBT and one bronchial artery) (9.7%).They provide systemic blood supply to the trachea, bronchi, bronchial branches, esophagus, and visceral pleura (5). Also they supply blood to the vasa vasorum of the thoracic aorta and pulmonary arteries as well as to the nerves, pulmonary veins, and lymph nodes in the thorax. Because of their small diameter, the bronchial arteries are a high-resistance and low-capacitance or low-distensible circulation. They undergo smooth muscle wall hypertrophy or dilate to direct more oxygenated blood to ischemic lung tissue in patients with systemic hypoxemia, alveolar hypoxia, pulmonary infarction, and various inflammatory disorders that affect the thorax(6).

Hemoptysis is a common clinical problem which is reported to be the cause of attendance in significant number of patients coming to chest OPDs.Expectoration of even relatively small amount of blood can be a marker for potentially dangerous cancers like Bronchogenic carcinoma.Also, massive hemoptysis can represent an acutely life threatening problem.Therefore,hemoptysis of any degree needs thorough evaluation.The severity of hemoptysis divided into mild, moderate, severe or massive depending upon the amount of bleeding (7).Mild- If less than 30 ml of blood is expectorated per day or there is only streaking or flecks of blood in the sputum.Moderate- If bleeding is between 30 to 200 ml/day Severe- If bleeding occurs in excess of 200 ml/day.Massive- It has been variably defined as blood loss of 200-600 ml or more within 48 hours or as much as to cause hemodynamic disturbance (9).Reported volumes defining massive hemoptysis range from 200 to 1000 mL over a 24-hour interval, but volume documented as > 300 mL appears to be most frequently accepted(9,10). In addition, particular attention must be paid to patients with chronic hemoptysis averaging >100 mL per day for 3 or more days. Asphyxia due to the flooding of the airways rather than exsanguination is usually the cause of death, and it is commonly accompanied by cardiovascular collapse. Imaging plays a relevant role in managing this clinical condition.

Bleeding may originate from small or large lung vessels.(11) Bleeding from the small vessels usually causes a focal or diffuse alveolar hemorrhage and is mainly due to immunologic, vasculitic, cardiovascular, and coagulatory causes.Bleeding from the large vessels include infectious,cardiovascular,congenital,neoplastic and vasculitic diseases However the most frequent diseases causing hemoptysis are bronchiectasis,tuberculosis,fungal infections and cancer.(12,13)

There are various modalities for studying and evaluation of hemoptysis.These include chest radiography(CXR), Bronchoscopy, MDCT, MDCT angiography (MDCTA) and digital subtraction angiography (DSA).CXR is considered the initial and one of the most important imaging modality for evaluating a patient with hemoptysis.It is quick, cost effective, and easily available. In a study by Herth et al.(14) nearly a quarter of patients presenting with hemoptysis due to malignancy showed normal CXR. Therefore in patients presenting with hemoptysis, a negative CXR warrants other diagnostic studies, including Bronchoscopy and/or MDCTA. Bronchoscopy is considered the primary method for diagnosing and localizing hemoptysis for many years, especially if massive. Bronchoscopy is mainly performed for identification of active bleeding and for checking the airways(15).

MDCT has the ability to uncover the potential underlying causes of bleeding such as bronchiectasis, pulmonary infections, lung cancer etc and remains superior to Bronchoscopy in this regards(16).Remy-Jardin et al. (19)demonstrated that MDCTA provides more detailed depiction of bronchial and non bronchial systemic arteries than DSA.

DSA plays a marginal role as a diagnostic tool in detecting the origin of hemoptysis.If angiography is performed as the first diagnostic step, non-bronchial or extra thoracic feeders may be missed or not sought as the main source of bleeding. DSA is done where endovascular treatment is needed (17).

Mild or moderate hemoptysis can be managed by conservative treatment of the underlying pathology. During anticoagulation treatment, coagulation status should be optimized with stabilizing

coagulation and thus stopping the bleeding(14).

In bronchoscopic management of hemoptysis two important aspect are:(I) clearing the airway of blood to maintain adequate ventilation .(II) establishing a clear vision of the bleeding site to enable implementation of bronchial blocker or other endobronchial techniques.(18)Up to the 1980s the treatment of choice for hemoptysis was surgery, associated with a mortality of 37 to 42% in the emergency scenario and 7 to 18% in the interval between bleeding events.

Minimally invasive endovascular treatment 'Bronchial artery embolization (BAE)', has become technique of choice for the treatment of massive and recurrent hemoptysis. High-resolution digital subtraction angiography unit should preferably be used. In cases of hemoptysis, generally the diameter of the bronchial arteries increases to several millimeters in patients with chronic inflammatory lung disease, especially cystic fibrosis (20). Active bleeding is demonstrated in only 3.6 to 10.8% of cases (21). A variety of embolic materials are used for BAE. There is wide use of absorbable gelatin sponge as it is inexpensive, easy to handle, and has a controllable embolic size. Disadvantages of absorbable gelatin sponge as it lacks in resolvability and lack of radiopacity. There may be recanalization of the embolized artery causing recurrent bleeding (22). Polyvinyl alcohol particles are non-absorbable embolic materials, and particles 350–500 m in diameter are the most often used worldwide (6). It prevents early recurrence of hemoptysis due to recanalization of the embolized artery.

Chest pain is the most common complication of BAE (23).In addition, dysphagia due to embolization of esophageal branches reported in 0.7%–18.2% of cases (23, 21).Subintimal dissection of the aorta or the bronchial artery during BAE is the other minor complication. The most serious complication of BAE is spinal cord ischemia due to the unnecessary occlusion of spinal arteries. when the anterior medullary artery (artery of Adamkiewicz) is visualized at angiography, embolization should not be performed. Other rare complications include aortic and bronchial necrosis, bronchoesophageal fistula, non–target organ embolization (eg ischemic colitis), pulmonary infarction, referred pain to the ipsilateral forehead and orbit, and transient cortical blindness.

Literature Survey

In 1996 Ramakantan et al(21) done BAE in 140 cases with immediate control achieved in 102 cases (72%). Of the remaining 38 patients with a notable amount of bleeding after the procedure. Cremaschi et al(24) evaluated 209 patients who had been embolized for hemoptysis and noted that immediate control was achieved in 205 (98%).

Method

30 Patients with relevant clinical features and laboratory parameters were taken in Study and subjected to imaging modalities like chest x-ray, HRCT chest and BAE after taking valid consent form. Procedure done in supine position under local anaesthesia with proper premedication and patient preparation. Percutaneous transfemoral arterial approach by Seldinger technique used.

Inclusion Criteria

Patients who have
-Hemoptysis more than 300 ml of blood in a day
- Patients having recurrent bouts of hemoptysis in a day (total volume more than 300 ml)

Exclusion Criteria

- Patients not consenting for the study
- Pregnancy
- Patients with known h/o contrast allergy
- Patients with raised renal function test values
- Patients with deranged coagulation profile

RESULTS AND DISCUSSION

Our study mainly consisted of young adult population with majority (36.0%) being less than or equal to 25 years of age, 33.0% each of age less than or equal to 40 years, 20% between 41 to 55 yrs of age and 1% greater than 55 years of age. Around 66.7% of the cases were males and 33.3% of the cases were females. In about 53.3% cases volume of hemoptysis in 24 hr period was about 400-500 ml and in 6.7 % cases it was >500ml. most common cause of hemoptysis in our study was active tuberculosis seen in about 36.6% cases.

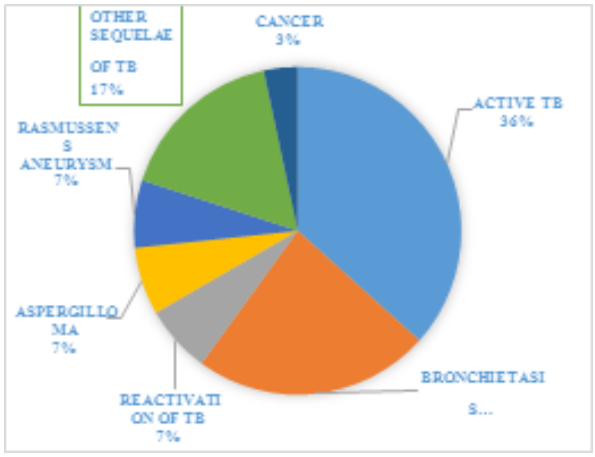

Figure - 1 Causes Of Hemoptysis In Our Study

According to Cauldwell's classification in our study majority of cases had type I circulation (15 out of 30, 50%) followed by type II circulation (33.3%). Type III circulation was 10% and type IV circulation was 6.7%. 27 cases had bronchial arteries are main source of hemoptysis. In our study 5 cases had bronchial feeder from right,12 cases had from ICBT & 10 cases had from left.

Table– 1 Non Bronchial Feeders In Our Study

Artery	No of cases
Internal mammary artery	9
Intercostal artery(IA)	7
Subclavian artery(SA)	2
IA & SA	1
Rasmussen's aneurysm	2
Abnormal arterial feeder(tumor)	1

In our study 18 cases had both bronchial & non bronchial feeders,9 cases had only bronchial feeders,2 had it from pulmonary artery and one case had only systemic feeders.

In our study, Gelatine sponge was mainly used as a embolizing material.Only gelatine sponge was used in 21 cases (70%). Gelatine sponge along with PVA particles were used in 6 cases (20%). Only PVA particles were used in 1 case. In two cases of Rasmussen's aneurysm was found and embolized using stainless coils and another one was embolized using glue (isobutyl -2 cyanoacrylate).

Bronchial artery embolization has minor as well as major complications. Minor complications in our study were chest pain,back pain,transient dysphagia.Few contrast related and puncture related complications were seen. Major complications of the procedure are mainly neurological complications.In our study, there was one case of transient paraparesis and one had permanent paraplegia.

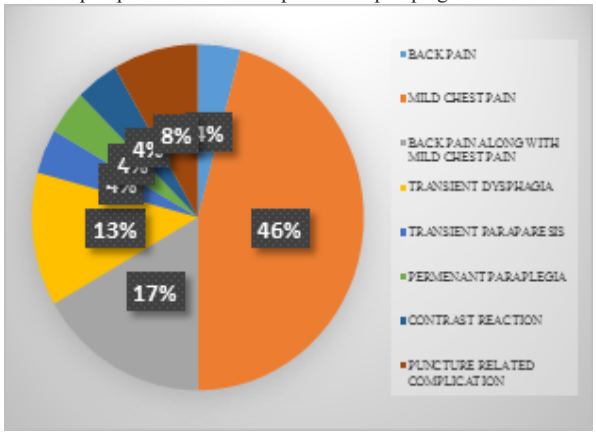

Figure - 2 Complication Of BAE

The outcome of our study was divided as immediate clinical success and recurrence. Recurrence was further divided into early (within 1 month of procedure) and late (1 to 6 months of the procedure) recurrences.In our study immediate success rate of BAE was found to

be 96.7 %, early recurrence rate of hemoptysis was found to be 6.7 % while late recurrence rate being 10 %.

CONCLUSION

BAE is a safe, effective and universally accepted procedure for control of hemoptysis of varying causes, consistent with previous studies (with immediate clinical success rate of 96.7% as found in our study). BAE can be safely performed under both emergent and elective settings.

With its low recurrence rates and low procedure related complications as described in different studies along with our study (major complication rate of 3% in our study), BAE remains one of the best palliative and minimally invasive procedure for management of patients with hemoptysis including those who are unfit to undergo or unwilling for more invasive managements such as surgery. The procedure can be repeated in patients who develop recurrence of hemoptysis.

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