

## HEMOPTYSIS : HOW TO MANAGE ?

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### ABSTRACT

Hemoptysis is the expectoration of blood coming from tracheobronchial tree or pulmonary parenchyma. It is one important symptom which brings the patient to a doctor quickly as it frightens the patient and his family very much. It may be streaky or massive (more than 600ml in 24 hrs) which can be dangerous to life. Pulmonary tuberculosis remains number one cause of hemoptysis in developing countries. CT Scan chest and bronchoscopy can give most of information in these patients. Massive hemoptysis is life threatening and requires prompt treatment. Number of endobronchial techniques like ice cold saline lavage, balloon tamponade and bronchial artery embolization have been devised to temporarily control hemoptysis. Surgery remains the treatment of choice and pulmonary resection has been the most effective method for control of massive hemoptysis and prevention of recurrent hemoptysis in majority of patients. Surgical rather than medical methods reduce patient's mortality rates due to massive hemoptysis. Newer technique of physiological lung exclusion<sup>2</sup> has given much better results than standard lung resection for hemoptysis with minimal mortality and morbidity.

**KEY WORDS:** Endobronchial measures; Hemoptysis; Physiological lung exclusion; Pulmonary; Tuberculosis

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**INTRODUCTION**

Hemoptysis is the expectoration of blood originating from the tracheobronchial tree or pulmonary parenchyma. For centuries hemoptysis was regarded as pathognomonic of tuberculosis. The spitting of pus follows the spitting of blood. Now we know that there is hardly any disease of chest which may or may not cause hemoptysis directly or indirectly. It is one important symptom which brings the patient to doctor quickly. It can occur before diagnosis of tuberculosis, during treatment and even after completion of treatment of this disease. It can be seen as streaks or may be massive (more than 600ml in 24 hrs. These patients may go into hypovolemic shock and adequate ventilation is difficult to maintain leading to hypoxia. Massive hemoptysis can lead to asphyxia, cardiac arrest and sudden death of the patient

**ETIOLOGY**

The common causes of hemoptysis are:

1. Pulmonary tuberculosis- active or late sequallae
2. Bronchiectasis
3. Bronchogenic carcinoma
4. Lung abcess
5. Aspergilloma
6. Pulmonary infarct
7. Necrotizing Pneumonia
8. Chest trauma Lung or airways injury
9. Pulmonary AV malformation and telangiectasis
10. Iatrogenic -
  - a. Complications of pulmonary artery catheterization (Swan Ganz) in ICU or during open heart surgery
  - b. Bronchoscopy- Brush, endobronchial or transbronchial biopsy can cause hemoptysis, rarely it can be massive
11. Diffuse parenchymal disease involving pulmonary vasculature as in immunological diseases e.g. SLE, polyarteritis nodosa, Wegner's granulomatosis
12. Cardiac disorders Mitral stenosis, Eisenmenger's syndrome, systemic pulmonary collaterals in severe cyanotic heart diseases and venous hypertension due to L V failure (due to CAD or Valvular diseases)
13. Cryptogenic or idiopathic massive hemoptysis- Cause remains unknown, it happens in 8-15% patients of massive hemoptysis

**CLINICAL FEATURES**

Hemoptysis may be in streaks, recurrent or massive. Although it can occur in any age group but it is more common in age group of 20-40 yrs. In various series it was seen more in males than females ( 3 to 1 ratio). It has to be differentiated from hematemesis which can be difficult at times. It can be

further confused when a patient with hemoptysis may swallow the blood and later on it is vomited out. Epistaxis and bleeding from gums or nasopharynx can be confused with hemoptysis. Therefore one must carefully examine cardio-respiratory system besides G I tract for final assessment of a case. In hematemesis usually the color of the blood is changed to brownish and blood having acidic reaction

**Table 1: Differences Between Haemoptysis and Haematemesis**

	<u>Haemoptysis</u>	<u>Haematemesis</u>
<b>Past complaints</b>	Chest disease is usually present	Abdominal disorder is usually present
<b>Present History</b>	Cough ,breathlessness, pain chest	Nausea ,vomiting and pain abdomen
<b>Character of blood sputum</b>	Fresh, frothy, pink, alkaline,	Altered black, clotted, acidic, mixed with food
<b>After bleeding</b>	Blood tinged sputum may come as streaks for 5-7 days	Sputum is clear

**INVESTIGATIONS**

1. Sputum Cytology - Sputum should be examined for tubercle bacilli, and malignant cells. Culture and sensitivity should be done for bacteria and fungus.
2. X-ray Chest - In a typical case of tuberculosis X ray chest may show cavities in upper zones, infiltrates, fibroatelectasis, homogenous opacities and destroyed lobe or lung. It may be unilateral in more than half the patients and in rest it is bilateral. X ray may show other lesions like bronchogenic carcinoma and bronchiectasis.
3. C T Scan - It is second order diagnostic procedure. CT Scan during active bleeding may be misleading because aspirated blood may obscure underlying disease or incorrectly appear as a mass in the parenchyma. It should be done after stoppage of hemoptysis. C T Scan is more sensitive test than chest x ray and will pick up small lesions like lung carcinoma, localized bronchiectasis, old healed tuberculosis or any other pathology.
4. Bronchoscopy This is done to find out any intrabronchial pathology (tumour or T.B.) and to find out site of bleeding especially in bilateral disease. Both fiberoptic and rigid bronchoscopy should be used in a case of hemoptysis. Rigid bronchoscope is better in massive hemoptysis when active bleeding is going on. It allows better ventilation and easy passage of suction catheters, ballon tipped catheters and cold infusions. Bronchoscopy enables the clinician to decide whether patient requires medical management, endoscopic control measures or surgical treatment.
5. Angiography- Massive hemoptysis involves bleeding

from the bronchial artery system in most of patients. With selective bronchial arteriograms precise anatomic diagnosis is possible. If bronchoscopy fails to localize bleeding then bilateral bronchial arteriograms and pulmonary angiograms should be done. Pulmonary angiography is useful in about 10% patients of massive hemoptysis in which it originates from pulmonary circulation.

6. In some patients the tuberculin test or ELISA tests may be required to differentiate between tuberculosis and bronchogenic carcinoma. This is done when hemoptysis stops

### MANAGEMENT<sup>3,4</sup>

The management of a patient with massive hemoptysis has the following main objects-

1. To prevent asphyxiation
2. To localize site of bleeding
3. To arrest the bleeding
4. To find out cause of hemoptysis
5. Definitive treatment of the patient

A patient with hemoptysis should be treated in an ICU<sup>1</sup> for monitoring of vital signs and treatment

### MEDICAL THERAPY

1. Patient should be positioned in bed with head lower than the chest and keeping the side of bleeding in dependent position to prevent aspiration and asphyxiation.
2. Patient is usually apprehensive so verbal reassurance is important. Some sedation (non respiratory depressants like diazepam) should be given.
3. In massive hemoptysis volume replacement by I V fluids and blood transfusion should be given. Airways should be cleared gently of blood. If there is severe cough give cough suppressants like codeine phosphate syrup
4. Anti tubercular drugs:- In active tuberculosis with hemoptysis start standard ATT. If patient has completed the course of ATT and hemoptysis occurs later on, there is no need of restarting the ATT drugs. Give broad spectrum antibiotics in all patients to prevent or control infection.

### METHODS TO CONTROL HEMOPTYSIS

**Endobronchial measures:** These measures have revolutioned the management of massive hemoptysis and

one gains time for the restoration of massive hemoptysis and one gains time for the restoration of clinical stability of patient and the performance of essential diagnostic and management procedures.

**A. Ice Cold Saline Lavage :** The mural musculature of the bronchial vessels respond to cold by vasoconstriction. The systemic lavage of bleeding lung with large volume of ice cold saline solution can induce slowing and ultimately cessation of bleeding by hypothermic vasospasm of bronchial arteries. Under topical anesthesia and light sedation using rigid bronchoscope tracheobronchial tree is cleared of blood and clots with large bore suction catheters. The bleeding side is irrigated with large volume of iced cold saline. This will stop bleeding in majority of patients. It is a transitory holding procedure and definite therapy should not be delayed.<sup>1,3</sup>

**B. Balloon Tamponade:** Massive hemoptysis can be controlled by the placement of Fogarty type balloon embolectomy catheters in the bleeding segmental bronchus using flexible fiberoptic bronchoscope and inflating the balloon.<sup>4,5</sup> This technique is useful in patients who are unfit for surgery e.g. bilateral extensive tuberculosis, terminal malignant disease, severe cystic fibrosis, associated co-morbid factors (cardiac, hepatic, renal or metabolic disease). Rigid bronchoscopy may be needed to place balloon catheters as flexible bronchoscopy has limitations during active massive hemoptysis. Different types of double lumen bronchus blocking catheters (Marsico) have been developed for control of hemoptysis. These can be used during surgery as bronchial blockers.

**C. Pulmonary Isolation :** Isolation of bleeding lung from the healthy one can be done by use of either a double lumen endotracheal tube (Carlens type) or an ordinary long cuffed endotracheal tube to selectively intubate the non bleeding lung. The lumen is small for suctioning, can cause traumatic laryngitis, rupture of tracheobronchial tree and dislodgement of tube can occur. Selective intubation of the main bronchus with a cuffed long endotracheal tube is an attractive and useful option. Packing of the bronchus with swabs or tampons soaked in vasoconstrictive drugs can be used in emergency situations when other effective therapy is not available. However the danger of uncontrolled mobile endotracheal foreign body (swab) must be weighed against possible benefits.

**D. Arterial Embolization:** Bronchial artery embolization has been used both as a temporary and definitive treatment of massive hemoptysis. Bleeding site is identified by arteriography followed by embolization. Various embolic

agents like Gelfoam, Ivalon, ethibloc, tissue adhesives and the metallic minicoils (Gianturco)<sup>6</sup> have been used. Hemoptysis can be controlled in 50-70% patients but the recurrence rate of hemoptysis is quite high (20-60%). Transverse myelitis is a known complication of bronchial artery embolization due to shared origin of bronchial arteries with intercostal vessels which supply radiculomedullary branches to the anterior spinal circulation.

**E. Mechanical Ventilation with PEEP:** Some authors believe that patient with massive hemoptysis should be intubated for cleansing of his tracheobronchial tree. Mechanical ventilation with positive end expiratory pressure is used. It will enhance oxygenation but also increases the intrabronchial pressure which acts as a tamponade for control of bleeding.

**F. Vasoactive Drugs:** In critically ill patients with poor lung functions an intravenous infusion of vasopressin 20 U over 15 mts have been used with quick cessation of hemoptysis. Later on vasopressin infusion was given at a rate of 0.2 U/ min for 36 hrs with complete cessation of hemoptysis. Vasopressin acts by contraction of smooth muscles of arterioles. This technique seems simple and reliable enough and need further study.

**G. Radiotherapy:** This has been used in hemoptysis in cases of unresectable bronchogenic carcinoma and other lung tumours. There are case reports use of radiotherapy in massive hemoptysis due to fungal ball in tubercular cavities with good results.

**H. Intracavitary Treatment:** Life threatening hemoptysis from pulmonary aspergilloma (underlying disease being tuberculosis), bronchiectasis, sarcoidosis or histoplasmosis) in poor risk surgical patients have been managed by local intracavitary instillation of sodium or potassium iodide. It is injected by percutaneous or transcricothyroid approach with cessation of hemoptysis in 72 hrs in some patients.

## SURGICAL THERAPY

Over last so many years surgical treatment (pulmonary resection) has been shown to be most effective method for the control of massive and prevention of recurrent hemoptysis in majority of patients.<sup>1</sup> It has been proved that surgical rather than medical methods reduce mortality rates from massive hemoptysis. Comparison of series of medically and surgically treated patients is difficult for several reasons like hospital policy or personal bias of treating group emergency surgery still carries significant morbidity and mortality rates

compared with elective surgery. The mortality rate is related to ongoing bleeding at time of operation. The spillage of blood, pus or infected material into the dependent normal lung during the operation is the prime cause of death and post operative respiratory morbidity. Performance of lung resection in patients with poor lung functions is a major factor for postoperative mortality.

**Patient selection:** The criteria for selecting surgical therapy include<sup>1</sup>

1. Localized site of bleeding
2. Adequate pulmonary functions
3. No medical contraindications
4. Resectable Br. Carcinoma without distant metastases
5. No mitral valve disease (requiring cardiac surgery)

In elective cases patients are selected for lung resection when their FEV1 is around 2l. Lung resection is not done when FEV1 is less than 850ml. Surgery is contraindicated when there is CO2 retention at baseline, dyspnea at rest or severe dyspnea on exertion. Lung resection in patients with inadequate pulmonary reserve has no beneficial effect on outcome. It merely changes cause of death from asphyxiation or exsanguinations to respiratory insufficiency.

With the introduction of ice cold saline lavage and arterial embolization hemoptysis can be controlled temporarily in majority of cases and later on surgery can be done electively. Urgent surgery (within 24-48hrs) is required in following circumstances

1. Fungus ball (almost all cases will rebleed after any control method).
2. Lung abscess (due to erosion of a large vessel)
3. Failure of control methods
4. Cavity- with a movable mass, emptying and quick refilling, persistent radiodensity
5. Obstruction of main or lobar bronchus due to a clot which can not be removed during rigid bronchoscopy.

**Surgical techniques:** When urgent surgery is required for continuing bleeding major lung resections are avoided as patient do not tolerate these well. Conservative techniques (minimal resections) are preferred.

- A. Pulmonary Resections- Lobectomy, Segmentectomy or pneumonectomy
- B. Physiological Lung Exclusion<sup>2</sup> - A new technique (Dhaliwal et al. 2001) with excellent results in massive or recurrent hemoptysis
- C. Collapse Therapy Thoracoplasty or plombage

- D. Cavernostomies  
E. Intrathoracic Vascular ligatures

**Anesthesia-** These patients are a challenge for the anesthetist bleeding lung has to be isolated so single lung ventilation is essential. Various types of double lumen tubes have been devised for this purpose. If these are not available or it is not possible to place them, standard cuffed endotracheal tubes can be used to ventilate normal lung. Use of endobronchial blocking catheters or gauze tamponade of bleeding bronchus through bronchoscope have also been used in these patients. A dequate blood should be available for these patients as there is significant blood loss during surgery, beside that patient is loosing it through hemoptysis.

**Pulmonary Resection-** Since long tme lung resection is the standard treatment for hemoptysis (massive or recurrent due to any cause). Removal of bleeding diseased lobe or lung (if possible) is the ideal. Posterolateral thoracotomy is the usual approach to enter the chest, other incisions like vertical axillary thoracotomy and anterolateral thoracotomy are also used. Diseased lobe or lung is carefully mobilized as the adhesions between lung and chest wall are very vascular causing significant blood loss. Surgeon may have to work between endothoracic fascia and parietal pleura (pleuropneumectomy). Once the hilum is reached vessels and bronchus supplying the diseased lobe or lung are ligated and divided carefully and specimen is removed. Lung resection may not be possible always technically due to very dense vascular adhesions with chest wall. This is especially seen in cases of tuberculosis where marked fibrosis and calcification in pleural cavity makes lung mobilization very difficult and time consuming with lot of blood loss during the procedure. Due to marked fibrosis around hilar area makes control of lung vessels difficult and even hazardous.

**Physiological Lung Exclusion<sup>2</sup>-** Tuberculosis is the main cause of (up to 80%) of massive or recurrent hemoptysis in developing countries like India. The higher incidence of disease is due to factors like low socioeconomic status, ignorance, delayed diagnosis, failure with compliance of anti tubercular drugs and presence of multi drug resistant tuberculosis. In the process of chronicity of disease, damage to lung parenchyma is quite extensive causing dense fibrosis, calcification and vascular adhesions between the lung and chest wall. Lungs have a dual blood supply originating from the bronchial and pulmonary circulation and blood vessel anastomosis is present between two systems ients.

Lung resection is the standard surgical treatment for massive or recurrent hemoptysis but it may be technically very difficult

or even hazardous in these patients. This is due to marked fibrosis and dense vascular adhesions between the lung and the chest wall causing marked blood loss and control of hilar vessels become difficult due to marked fibrosis in that area. This is especially seen in cases of tuberculosis where marked fibrosis and calcification in pleural cavity make lung mobilization difficult and time consuming with lot of blood loss. In such situations this technique of Physiological Lung Exclusion 2 is very useful and important alternative/adjunct to a standard lung resection (which is technically not possible).

This technique has been developed and published by the author. This was devised on OT table ( in a desperate situation) to save a patient having massive hemoptysis where an emergency left pneumonectomy was planned. On opening the chest the lung was found to be very densely adherent to chest wall and apex of pleura, on attempted mobilization of lung there was marked blood loss. The blood bank could not supply more blood of that group. In order to save the patient dying from massive hemoptysis it was decided to ligate the left pulmonary artery and divide the left main bronchus so that the lung was isolated from the airway and circulation, the pulmonary veins were kept intact for venous return from the lungs. To our surprise hemoptysis stopped, patient surived and recovered completely. This technique was used later on in some more patiens and every time it worked . Now we use this method as a routine in all cases of massive or recurrent hemoptysis. Lung resection is done only in bronchogenic carcinoma if it is resectable. Since 1995 this procedure has been used in over 150 patients of massive or recurrent hemoptysis without any complication.

Single lung ventilation is done with a double lumen endotracheal tube. Intially postolateral thoracotomy was used in few patients. Later on it was changed to anterolateral thoracotomy for its advantages like quick opening and closure, less blood loss, easy access to lung hilum and suitability to anesthetist regarding endotracheal tube. In all patients diseased lobe or lung was found to be markedly adherent to chest wall and apex. Lung was mobilized minimally near the pericardium to control the lobar branch or main PA which was doubly ligated and divided. The lobar or main bronchus of diseased lung was divided, proximal end was sutured using Vicryl or Prolene suture. Pulmonary veins were not ligated in all patients for proper venous drainage. Chest was closed after placing one or two chest tubes.

Hemoptysis was controlled in all these patients immediately and on long term follow up. There was no mortality and minimum morbidity. There was no BPF or empyema in any patient. This was very gratifying as 1/3<sup>rd</sup> patients were diabetic

with lot of infected secretions in the lungs and post operative empyema was a real threat. There was no worsening of dyspnea in any patient.

The term physiological lung exclusion (whole lung or lobe) explains the isolation of bleeding lung from pulmonary and bronchial circulation and airways by division of pulmonary artery and the bronchus. The pulmonary veins are preserved. Bronchial arteries run along the wall of the bronchi and there is a plexus in the peribronchial tissues. By dividing the bronchus this source of hemoptysis is abolished. The isolated lung continues to receive its blood supply through vessels present in the adhesions the lung surface and the chest wall, keeping lung parenchyma viable. The pulmonary veins are kept intact and drain the blood from the involved lung, so no necrosis of lung parenchyma occurs. We did not find empyema in any of the patient we operated using this technique due to absence of space in pleural cavity as it happens after any lung resection. None of the patient who had physiological lung exclusion required standard lung resection later on. The intraoperative blood loss was much less than standard lung resection as minimal lung mobilization near hilar area is done, this is main cause of blood loss in standard lung resections. Operating time was less as minimal lung mobilization is done near the hilum only and an anterolateral thoracotomy was used which is much quicker than postolateral thoracotomy.

The procedure 'Physiological lung exclusion'<sup>2</sup> is a very safe and useful alternative/adjunct to a standard lung resection (for massive or recurrent hemoptysis) which is technically difficult due to dense vascular adhesions between the lung and chest wall.

Cavernostomy, Collapse therapy and Ligation of Collaterals and Bronchial arteries<sup>7</sup> - In poor risk patients where lung resection is contraindicated due to poor PFT or some medical disease (co morbid factors) these methods have been tried to control hemoptysis with variable results and with high mortality and morbidity. In cavernostomy the bleeding cavity is directly opened and packed. In collapse therapy thoracoplasty (standard or plombage type) has been used. Ligation of bronchial arteries or collaterals between lung and chest wall have also been tried.

## CONCLUSION

Hemoptysis is an alarming symptom to a patient and brings him to a doctor quickly. It may be recurrent or massive (more than 600ml in 24hrs) which is life threatening. Tuberculosis is the commonest cause for it in developing countries (SARC countries). CT Scan and Bronchoscopy (FOB and Rigid) are

essential investigations for diagnosis. The treatment involves Endobronchial measures & Bronchial artery embolization, these two stop hemoptysis temporarily in most of the patients but rebleed is very common. Surgery is the definitive treatment and it has been proved that surgical rather than medical methods reduce mortality rates from massive hemoptysis. Lung resection i.e removal of bleeding lobe or lung is the standard surgical treatment in these patients. It may be very difficult or hazardous when lung is densely adherent to chest wall, there is marked fibrosis and lot of collateral blood vessels are coming from chest wall to lung parenchyma. Lung mobilization is very difficult and time consuming and marked blood loss occurs. In such situation the author has devised and published a new surgical technique named as "Physiological Lung Exclusion"<sup>2</sup> which has given excellent results with minimal morbidity and mortality. It should be kept in mind by every thoracic surgeon planning lung resection for hemoptysis. It can save him and his patient from a very tricky, dangerous situation.

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