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Diagnostic utility of fiberoptic bronchoscopy in hemoptysis patients with unremarkable chest radiographs

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ABSTRACT

Background: Blood expectoration from the lower respiratory tract is known as hemoptysis. It possesses a diagnostic conundrum, especially when chest radiographs appear normal. The etiology may vary from infective pathologies to life-threatening diseases such as malignancies. **Aims and Objectives:** The study aimed to evaluate the diagnostic yield of fiberoptic bronchoscopy (FOB) in patients with hemoptysis having unremarkable chest radiograph, to localize bleeding sites and identify underlying pathologies. **Materials and Methods:** This prospective observational study was conducted at a tertiary care facility enrolling 52 hemodynamically stable patients aged ≥18 years who reported with hemoptysis and normal chest radiographs. Meticulous clinical history, physical examination, and pertinent investigations were performed following informed consent and institutional ethical authorization. Patients underwent FOB to detect bleeding sites and collect diagnostic samples such as bronchoalveolar lavage, which were then examined by cartridge-based nucleic acid amplification test, acid-fast bacilli smear/culture, potassium hydroxide mount, and cytology. Data were evaluated with acceptable statistical procedures. **Results:** The study cohort's mean age was 44.6 ± 16.5 years, and 53.9% of them were male. Cough was the most common reported symptom (88.5%). FOB successfully localized the bleeding site in 40.4% of cases. Pulmonary tuberculosis emerged as leading etiology, accounting for 44.2%. In 13.5% of cases, no definitive diagnosis was established, necessitating further evaluation by other specialties. **Conclusion:** FOB was well tolerated even in patients with moderate disease severity. FOB is a valuable and safe diagnostic tool. It facilitates localization of bleeding and identification of underlying causes.

Key words: Hemoptysis; Fiberoptic bronchoscopy; Normal chest X-ray; Bronchoalveolar lavage; Tuberculosis

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INTRODUCTION

Hemoptysis is the expectoration of blood from the lower respiratory tract (airways or lungs).[1-3] It is a common presentation at pulmonary medicine departments, worldwide. However, it should be considered that events of expectoration of blood-tinged sputum or pure/only blood in small quantities (mild-to-moderate hemoptysis) are non-life-threatening,[4] majority (>90%) of the reported events of hemoptysis among are mild, self-limiting, and have a good prognosis with conservative management.[5] Massive hemoptysis is considered to be life threatening and has a mortality rate of >50%.[1,6,7]

Hemoptysis is often caused by acute respiratory infections, chronic obstructive pulmonary disease (COPD), cancer,

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and bronchiectasis.[8,9] However, 20–50% of cases are cryptogenic, with no cause found on computed tomography (CT) or bronchoscopy.[1,6] Most common cause remains to be, tuberculosis (TB).[2] Most of the patients having severe hemoptysis are often found to have origin of bleeding from the bronchial arteries[10] while bleeding from the pulmonary arteries and non-bronchial systemic arteries is less common.[3,10]

Bronchial arteries supply the intrapulmonary airways and are connected to pulmonary arteries by anastomoses. When pulmonary arterial perfusion is impaired (e.g., pulmonary embolism, vasculitis, and hypoxic pulmonary vasoconstriction), increases in bronchial arterial flow result in greater flow through the anastomoses, which can hypertrophy, become thin-walled, and break into alveoli and bronchi, causing hemoptysis.[3] Bleeding from pulmonary arteries usually results from pseudoaneurysms that are created by erosion of the artery caused by the destruction of nearby pulmonary parenchyma from chronic inflammation.

For the successful management of patients, localization of bleeding sites is utmost importance. The effective ways for bleeding origin's diagnosis and localization are CT and bronchoscopy.[1,11] Bronchoscopy is an endoscopic procedure allowing to directly view the airways using a bronchoscope, usually inserted through the nose, mouth, or tracheostomy. It helps in diagnosing anomalies such as endobronchial malignancies, bleeding, or foreign bodies and enables sample collection.[12] Unlike CT, which is better for vascular and parenchymal issues, bronchoscopy excels at identifying endobronchial abnormalities. Fiberoptic bronchoscopy (FOB) also visualizes upper airways and can collect tissue or fluid samples, aiding both diagnosis and endobronchial treatment.

Aims and objectives

The study was conducted with an aim to observe the role of FOB in cases of hemoptysis with a normal chest radiograph. Its objectives were to evaluate the diagnostic yield of FOB in cases of hemoptysis with a normal chest radiograph and also to localize the bleeding site using FOB.

MATERIALS AND METHODS

This prospective observational study was conducted on 52 patients attending the outpatient department (OPD)/inpatient department of department (IPD) of respiratory medicine/department of medicine at a tertiary care center, after taking clearance from the ethical committee. The duration of the study was 1 year.

Inclusion criteria

- Age 18 years and above of either sex
- Hemodynamically stable patients presenting with hemoptysis and a normal chest X-ray.

Exclusion criteria

- The patient not giving consent
- Patient with hemoptysis where a definite diagnosis is already established
- Patients with contraindications to bronchoscopy like:
  - Patients with unstable cardiovascular status, such as recent myocardial infarction and life-threatening arrythmias
  - Hemodynamically unstable patients
  - Patients with bleeding disorders
  - Neurological disorders like active seizures
  - Severe hypoxemia that is likely to worsen during FOB.

Data were collected in a pre-designed pro forma, complete history of the patient including demographic data, medical profile, history of smoking, history of hemoptysis and its frequency, history of drug use, and radiological findings was documented.

Protocol

A comprehensive clinical history and physical examination focused on respiratory symptoms were conducted for all patients. Detailed evaluation of complaints such as hemoptysis (including its amount, onset, and duration), cough, sputum production, chest pain, dyspnea, fever, weight loss, hoarseness of voice, and dysphagia was performed. Relevant history, including smoking, cardiopulmonary conditions, nasopharyngeal disorders, and other potential sources of hemoptysis (ear, nose, and throat/dental causes), was carefully assessed and excluded. Hemoptysis associated with hemodynamic instability was classified as life-threatening. Routine laboratory investigations were carried out, and when indicated, sputum samples were sent for acid-fast bacilli (AFB) smear, GeneXpert, potassium hydroxide (KOH) preparation, cytology, and culture. All patients underwent chest roentogram, and a CT scan of the thorax was performed when necessary. FOB using the OLYMPUS BF-1TQ170 model was performed in cases where a definitive diagnosis could not be established through non-invasive methods. FOB was utilized to visualize the tracheobronchial tree, localize the site of bleeding, and collect diagnostic samples such as bronchoalveolar lavage (BAL) fluid for microbiological analysis. In patients with endobronchial masses, biopsy samples were obtained for histopathological examination.

RESULTS

This prospective observational study was conducted among 52 patients either attending OPD or being admitted (IPD) in the department of Respiratory medicine having age >18 years. The male and female comprised 53.8% males and 46.2% females (Table 1).

Bronchoscopy localizes the bleeding site among 40.4% of the subjects, while it fails to do so in 60.6% of the subjects. In terms of BAL assessment, 12 (23.1%) were Cartridge-based nucleic acid amplification test (CBNAAT) +ve, 23 (44.2%) were found positive by AFB, while 5 (9.6%) were positive for fungal (Table 2).

Overall, diagnostic yield of FOB is 86.54%. Among 52 enrolled subjects, the etiology of hemoptysis was ascertained among 47 subjects, and the remaining, 5 subjects were referred to otorhinolaryngology, dental, or medicine department for further evaluation.

Pulmonary TB was the most common etiology (44.2%), followed by pneumonia (17.31%), allergic bronchopulmonary aspergillosis (ABPA), and Mass (7.7% each). Bronchiectasis was reported in 2 (3.8%) cases, whereas aspergilloma, chronic bronchitis, and pulmonary embolism were reported in 1 case each (1.9%) (Table 3).

Table 1: Age and sex profile of patients (n=52)

Age group	Male		Female		Total	
	No.	%	No.	%	No.	%
≤20 Years	1	1.9	2	3.8	3	5.8
21–40 Years	8	15.4	9	17.3	17	32.7
41–60 Years	12	23.1	8	15.4	20	38.5
>60 Years	7	13.5	5	9.6	12	23.1
Mean age±SD (Range) in years	46.14±16.25 (18–75)		42.79±16.90 (19–74)		44.60±16.48 (18–75)	

t=0.728, P=0.470, SD: Standard deviation

Among 25% subjects, no organism was isolated by bronchoscopy.

While *Mycobacterium tuberculosis* was isolated among 44.23%, followed by *Pseudomonas aeruginosa,* 11.54% and other organisms accounted for the rest (Table 4).

DISCUSSION

Hemoptysis defined as the expectoration of blood originating from the lower respiratory tract. Etiology of hemoptysis ranges from benign causes such as bronchitis to more severe and potentially life-threatening diseases such as bronchogenic carcinoma or pulmonary embolism. The most common etiologies of hemoptysis include chronic bronchitis, bronchiectasis, TB, pneumonia, lung malignancies, and fungal infections.

Chest radiography is frequently used for the initial assessment of hemoptysis due to its accessibility and non-invasive nature. However, 10–40% of cases may show normal findings, creating a diagnostic dilemma, potentially delaying diagnosis of serious conditions. In such cases, FOB becomes essential, providing direct visualization of the airways and offering both diagnostic and therapeutic advantages.

Fibreoptic bronchoscopy is crucial in evaluating hemoptysis, especially when chest radiographs are unremarkable. It allows precise localization of the bleeding site, guiding further interventions like surgery or embolization. In addition, FOB facilitates endobronchial abnormalities such as tumors, infections (e.g., TB), or foreign bodies not visible on imaging. It also permits sample collection –via washings, brushings, or biopsies – for cytological and microbiological evaluation, thereby improving diagnostic accuracy. Timely bronchoscopy can lead to early diagnosis and management, thereby improving clinical outcomes and potentially reducing mortality in high-risk populations.

Table 2: Fiberoptic bronchoscopy (n=52)

Finding	Male		Female		Total		Stat. Sig.	
	No.	%	No.	%	No.	%	Chi-square	P
Bleeding site identified	13	25.0	8	15.4	21	40.4	0.920	0.337
Left lower	1	1.9	2	3.8	3	14.3		
Left upper	3	5.8	2	3.8	5	23.8		
Right lower	3	5.8	0	0.0	3	14.3		
Right middle	2	3.8	1	1.9	3	14.3		
Right upper	4	7.7	3	5.8	7	33.3		
BAL assessment								
CBNAAT +ve	4	7.7	8	15.4	12	23.1	2.641	0.104
AFB +ve	14	26.9	09	17.3	23	44.2	0.390	0.532
Fungal +ve	3	5.8	2	3.8	5	9.6	0.084	0.772

BAL: Bronchoalveolar lavage, CBNAAT: Cartridge-based nucleic acid amplification test, AFB: Acid-fast bacilli

Table 3: Etiology (n=52)

Finding	Male		Female		Total	
	No.	%	No.	%	No.	%
Pulmonary TB	14	26.9	9	17.3	23	44.2
ABPA	3	5.8	1	1.9	4	7.7
Mass	3	5.8	1	1.9	4	7.7
Pneumonia						
Klebsiella	1	1.9	2	3.8	3	5.8
Staphylococcus aureus	1	1.9	1	1.9	2	3.8
Pseudomonas	1	1.9	3	5.8	4	7.7
Pulmonary embolism	1	1.9	0	0.0	1	1.9
Unexplained/ idiopathic	3	5.8	4	7.7	7	13.5
Others						
Bronchiectasis	0	0.0	2	3.8	2	3.8
Aspergilloma	1	1.9	0	0.0	1	1.9
Chronic bronchitis	0	0.0	1	1.9	1	1.9

TB: Tuberculosis, ABPA: Allergic bronchopulmonary aspergillosis

Table 4: Findings of bronchoscopy investigations: Microorganisms isolated

Variables	Yes		No	
	n	%	n	%
Organisms isolated	39	75	13	25
Mycobacterium tuberculosis	23	44.23	29	55.77
Klebsiella pneumoniae	03	5.77	49	94.23
Staphylococcus aureus	02	3.85	50	96.15
Pseudomonas aeruginosa	06	11.54	46	88.46
Aspergillus fumigatus	05	9.62	47	90.38

This study assessed 52 patients (aged 18–75 years; mean age 44.60±16.48 years; 53.9% male) presenting with hemoptysis and normal chest radiographs using fiberoptic bronchoscopy to localize bleeding sources and etiology. Detailed clinical history and respiratory symptoms were assessed and documented. Bronchoscopy was performed in all cases, with bronchial lavage samples analyzed via CBNAAT, AFB smear and culture, and KOH mount for fungal elements. Post-bronchoscopy sputum was similarly examined. Final diagnoses were established based on the clinical profile in conjunction with bronchoscopic findings.

The demographic findings of the present study reveal a mean age of 44.6 years in over over-cohort, closely aligns with other Indian studies – Bondade et al.,[13] reported 43.9 years, and Poornima et al.,[14] found 44.5 years – indicating that hemoptysis in developing countries commonly affects individuals in their working years. This trend may be attributed to the higher prevalence of TB and its complications, as well as occupational exposure to respiratory irritants in this age group. In contrast, Western studies such as Quigley et al.[15] have reported higher mean ages around 60 years, likely due to a greater burden of age-related conditions such as lung cancer and COPD.

In the present study, cough (88.5%), breathlessness (63.5%), and expectoration (42.3%) accounted for the most common symptoms, consistent with findings from other Indian studies. Bondade et al.,[13] reported sputum production in 70% and dyspnea in 56.7% of patients, while Kaur et al.,[16] observed cough in 82% of cases. This consistent pattern highlights cough as the predominant symptom in hemoptysis, irrespective of the underlying cause, likely due to shared airway irritation mechanisms. Meanwhile, the occurrence of additional symptoms such as fever (common in TB-related studies) or weight loss (frequent in malignancy cases) can help in narrowing down the underlying diagnosis.

In the present study, investigated 52 patients with hemoptysis and normal chest radiographs using FOB, revealing pulmonary TB as the predominant etiology (44.2%), followed by pneumonia, ABPA and Mass. While FOB demonstrated an impressive diagnostic yield of 86.54%, the bleeding site could only be localized in 40.4% of cases. The findings of this study indicate that fiberoptic bronchoscopy is a prudent procedure, even in critically ill patients. Its safety and associated outcomes largely depend on meticulous patient recruitment, the expertise and experience of the bronchoscopist, and the availability of appropriate medical facilities.

Limitations of the study

This is single center study with small sample size.

CONCLUSION

FOB is a valuable and safe diagnostic tool. It facilitates localization of bleeding and identification of underlying causes.

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Authors' Contribution:
MT- Definition of intellectual content, literature survey, prepared first draft of manuscript, implementation of study protocol, data collection, data analysis; **KBG-** Concept, design, clinical protocol; **RK-** Design of study, statistical analysis, editing; **RS**- Review manuscript; **HR-** Review manuscript; **AS**- Literature survey, statistical analysis, interpretation, manuscript preparation and submission of article.

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