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Research Article

To assess the role fiberoptic bronchoscopy in the evaluation of hemoptysis

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ABSTRACT

Background: To prospectively evaluate the efficiency of the fiberoptic bronchoscopy (FOB) examination in the evaluation of patients with hemoptysis.
Methods: We prospectively reviewed 50 patients who underwent FOB for hemoptysis. There were 39 male and 11 female. The mean age was 46 years with a range from 21 to 83 years. The patients were divided between two groups on the basis of their chest roentograms (46% with normal and 54% with abnormal findings).
Results: Hemoptysis in normal and abnormal chest roentograms was respectively attributed to bronchiectasis in 5 (21.7%) and 3 (11.1%) cases, bronchogenic carcinoma in 2 (8.6%) and 9 (33.3%) cases, bronchitis in 2 (8.6%) and 3 (11.1%) cases, tuberculosis in 2 (8.6%) and 5 (18.5%) cases, cryptogenic causes in 8 (34.7%) and 4 (14.8%) cases and pseudohemoptysis in 2 (8.6%) cases (bleeding from upper respiratory tract).
Conclusions: Fob plays a pivotal role in the evaluation of hemoptysis. It was found that left upper lobe followed by right upper lobe was the site most consistent with the findings, with bronchogenic carcinoma being the most common non- infectious cause. Infectious etiology was the most common pathology behind hemoptysis and bronchiectasis was the most important risk factor.

Keywords: Fiberoptic bronchoscopy (FOB), Hemoptysis, Bronchogenic carcinoma

INTRODUCTION

Hemoptysis is defined as the expectoration of blood that originates from the tracheobronchial tree or pulmonary parenchyma. In most cases hemoptysis is a self-limiting event but in fewer than 5% it may be severe or massive, representing a life-threatening condition that warrants urgent investigations and treatment.[1] Most cases are benign, self-limiting events. However, the presentation of hemoptysis may be a harbinger of significant underlying trachea-pulmonary pathology. Common causes of hemoptysis include chronic bronchitis, bronchiectasis, pneumonia, fungal infections, tuberculosis and malignancy. Rarely hemoptysis can be caused by pulmonary vasculitis.[2]

Various categorizations of hemoptysis severity have been proposed. In our study we considered following classification system; <100 cc/day of hemoptysis as mild, 100–150 cc/day as moderate, 150-200 cc/day as severe, and >500 cc/day of expectorated blood in 24 hours or rate of blood loss >150ml/hr or 200ml blood loss/day for more than 3 days as massive hemoptysis.[3-6] The source of bleeding is usually from erosion of systemic rather than pulmonary arteries. Notable exceptions are arterio-venous malformations and pulmonary artery aneurysms.

Cryptogenic hemoptysis, for which no cause can be identified, is responsible for 3.0%-42.2% of episodes of hemoptysis. The most frequent diseases causing hemoptysis are bronchiectasis, tuberculosis, fungal infections, and cancer.[7-10]

When pulmonary circulation is compromised (e.g. in thromboembolic disease, vasculitic disorders or in hypoxic vasoconstriction) the bronchial supply gradually increases causing a hyperflow in the anastomotic vessels, which become hypertrophic with thin walls and tend to break into the alveoli and bronchi, giving rise to hemoptysis.

Bronchoscopy

Bronchoscopy is an endoscopic technique of visualizing the inside of the airways for diagnostic and therapeutic purposes. An instrument, bronchoscope, is inserted into the airways, usually through the nose or mouth, or occasionally through a tracheostomy. This allows the practitioner to examine the patient's airways for abnormalities such as foreign bodies, bleeding, tumors or inflammation. Specimens may be taken from inside the lungs.

Flexible Bronchoscope is longer and thinner than a rigid bronchoscope. It contains a fiberoptic system that transmits an image from the tip of the instrument to an eyepiece or video camera at the opposite end. Using cables connected to a lever at the hand piece, the tip of the instrument can be oriented, allowing the practitioner to navigate the instrument into individual lobe or segment bronchi. Most flexible bronchoscopes also include a channel for suctioning or instrumentation, but these are significantly smaller than those in a rigid bronchoscope. In hemoptysis once airway protection and volume resuscitation are ensured, bronchoscopy plays a pivotal role with regard to -

- Localization of the anatomic site of bleeding,
- Isolation of the involved airway,
- Control of hemorrhage and
- Treatment of the underlying cause of hemoptysis in case of visible endoluminal lesions.

Indications

While there are no set criteria for performing bronchoscopy, several indications are widely accepted.[11-15] These may be broadly divided into the following Categories:

Diagnostic

- Evaluation of symptoms (e.g. haemoptysis, localized wheeze, unexplained cough).
- Evaluation of endobronchial disease (tumour, foreign body, stricture, fistula, mucous plug, thermal injury).
- Evaluation of an abnormal chest radiograph (lung mass, focal or diffuse pulmonary infiltrates, lung atelectasis)
- Evaluation of mediastinal and hilar lymph nodes by endobronchial ultrasound.
- Staging lung cancer.

Therapeutic/interventional

- Removal of foreign body.
- Assisted intubation.
- Endobronchial laser treatment.

METHODS

All the 50 patients underwent bronchoscopy using KarlStorz (BF Te2e) model. For the purpose of this study, a definitive (or endoscopic) diagnosis for hemoptysis was made if FOB revealed a specific bleeding lesion, endobronchial mass or positive and specific microbiology, cytology or histology. An endoscopic diagnosis of bronchitis was made on account of presence of generalized inflammation of the airways (redness and swelling of mucosa), indistinct cartilage rings, and presence of small diverticula in the bronchial mucosa and dilatation of the mucous gland ducts in the bronchial wall. A non-bleeding abnormality was not considered a definitive lesion but was consistently recorded. A final diagnosis for the hemoptysis was based on the definitive diagnosis and/or review of subsequent historical, radiological, surgical, or autopsy information, if sufficient to establish a probable cause of bleeding.

Respiratory samples were gram-stained and homogenized. Undiluted and serial-diluted secretions were plated on blood, macconkey agar and selective media (containing vancomycin, bacitracin, and clindamycin). The growth of cultures was evaluated after 24 h and 48 h. Microorganisms were identified using standard methods.[11,12]

RESULTS

The study shows of the 50 cases screened for hemoptysis the males were the dominant afflicted group comprising of 78%, while females comprised only a mere 22% of the total group of 50 patients the maximum cases belonged to the age group of 50-59 years of age (32%). Followed by 40-49 years age group (26%).

The patients in the age group of 30-39 and above 60 years comprised 16% of the group patients.

The age group 20-29 comprised the least i.e. 10%. There were a total of 48% active smokers, while 16% had quit smoking for more than 6 months or more and 36% had never had any smoking addictions.

Hemoptysis the patients were grouped into four classes of clinical severity.

The maximum no. of presenting cases were of moderate hemoptysis 26 (52%) of recurrent nature, ranging from 2 to 7 times.

8 (16%) of the cases presenting with hemoptysis were of massive category, also who had multiple episodes of hemoptysis. There were 16 (32%) patients with mild hemoptysis.

Based on the clinical history and the initial work up investigations a working diagnosis was made and the study group was divided into two

- Infectious etiology: were 41 patients
- Non infectious etiology: were 9 patients

In our study there were a total of 35 cases whose culture was positive, of which there were 4 patients who had a mass in the lung along with it and the remaining 31 were under the suspicion of infectious etiology

- True positives: 31
- False positive: 4
- False negative: 10
- True negative: 5
- Sensitivity = TP/TP+FN=75.61%
- Specificity = TN/FP+TN=55.56%
- Positive predictive value = TP/TP+FP*100= 88.57%
- Negative predictive value = TN/FN+TN*100=33.33 %

Of the 50 cases, 46 % i.e. 23 patients chest roentograms were within normal limits. Amongst abnormal CXR=6 (12%) cases had a mass like lesion depicted in their C X-ray in the central region. 6 (12%) had parenchymal infiltrate involving one or more lobes of the lung.

- 4 (8%) had cavitory lesion.
- 4 (8%) had bronchiectatic changes.
- 3 (6%) changes suggestive of collapse.
- 3(6%) fibrosis.

And only in 1 (2%) case there was pleural effusion seen.

The patients who presented with hemoptysis with normal and abnormal chest X-rays. The diagnostic intervention could achieve a diagnosis in 56.5% of the patients with normal chest X-rays whereas a diagnosis was made in 74.1% of the patients with abnormal chest X-ray films.

In patients with normal chest roentograms the cause was idiopathic in 34.7%, followed by bronchiectasis in 21.7% and bronchogenic carcinoma, bronchitis, pseudohemoptysis (i.e. bleeding from upper airways), tuberculosis in 8.6% each. In 8.6% of the cases there was clot visualization but no anatomical site could be singled out as the cause.

Of all the 23 cases with normal chest X-ray, FOB could locate at the specific bronchoscopic finding and probably the lobe involved in hemoptysis in 13 patients. One patient had both RUL and RML involved.

In the patients with the normal chest roentogram the right upper lobe was normal in 78.26%, clots visualized in 17.39%, infiltration in 4.34%, inflammation in 8.69%, purulent secretion in 8.69%. Right middle lobe was normal in 82.6%, clots visualized in 13.04%, inflammation in 17.39% and purulent secretion in 8.69%. Right lower lobe was normal in 95.65%, inflammation and purulent secretions in 4.34%. The left upper lobe was seen to be normal in 91.3%, clots visualized in 8.69%, infiltration and purulent secretion in 4.34%, and signs of inflammation in 8.69%. The left lower lobe was seen to be normal in 95.65%, clots and purulent secretion were noted in 4.34%.

The Table 1, thus suggests that via bronchoscopy the highest strength of association between a valid clinical finding coherent with a bronchoscopic finding is for right upper and right middle lobe followed by left upper lobe and the least for left lower lobe followed by right lower lobe.

Table 1: Showing the lobes involved in patients with normal chest X-ray.

	RUL	RML	RLL	LUL	LLL
Normal	18	18	22	21	22
Findings in no of cases	5	5	1	2	1

The patients who presented with hemoptysis and an abnormal chest roentogram

The right upper lobe was found to be normal in 59.27%, clots were visualized in 18.51%, infiltration in 11.1%, inflammation in 7.4%, and purulent secretions in 7.4%. In the right middle lobe 74.07% were normal findings, clots in 14.81%, signs of inflammation in 14.81% and purulent secretions and infiltration in 7.4%. In the right lower lobe 88.88% and purulent secretions was only in 11.11%.

In the left upper lobe there were 55.55% normal findings, clots in 8.69%, infiltration in 4.34%, inflammation in 14.81% and purulent secretions in 11.11%. In the left lower lobe there were normal findings in 92.59% with clots, inflammation and purulent secretion visualized in 3.7%.

Table 2 depicts the strength of association between a clinical diagnosis and bronchoscopic finding is more than as compared to the previous table for normal chest roentograms.

Table 2: Showing abnormal chest X-ray with FOB finding in respective lobe.

X ray finding	RUL	RML	RLL	LUL	LLL
Bronchiectasis (4)	2	0	0	2	0
Fibrosis (3)	1	0	0	2	0
Cavitary lesion (4)	2	1	0	2	1
Pleural effusion (1)	0	0	0	1	0
Parenchymal infiltrations (6)	3	1	2	2	0
Mass of parenchymal origin (6)	3	2	0	3	0
Collapse (3)	1	2	1	1	0

The highest being in left upper lobe followed by right upper lobe and right middle lobe and the least in left lower lobe and followed closely by right lower lobe.

In patients with abnormal chest roentograms the cause was bronchogenic carcinoma in 33.33%, followed by tuberculosis in 18.5%, idiopathic in 14.8% and bronchitis, bronchiectasis in 11.1%. In 11.1% the clot was visualized but the anatomical site was not. The FOB could help making a diagnosis in 56.5% (13 out of 23) of the cases with normal chest X-rays as against a 74.1% (20 out of 27) diagnosis made in patients with abnormal chest X-ray films. The bleeding site could be localized in 17.3% patients with normal chest X-ray films as compared to 62.9% in patients with abnormal chest X-ray films.

Table 3: Showing the percentage of cases in which bronchoscopy could guide the final diagnosis.

CXR	Idiopathic	Brochi-ectasis (purulent secretions)	Bronchogenic ca	Bronchitis	Pseudo-hemoptysis	T.B.	Clot visualized
Normal	34.7%	21.7%	8.6%	8.6%	8.6%	8.6%	8.6%
Abnormal	14.8%	11.1%	33.3%	11.1%	0	18.5%	11.1%

Of a total of 50 patients who underwent FOB for diagnosis of hemoptysis 35 cases were positive for brocho-alveolar lavage gram culture and AFB by Z-N stain. *Pseudomonas aeroginosa* was seen to grow in 15 (42.8%) cases, which was in majority of the cases of extended spectrum beta lactamases producing group and Amp C group sensitive universally to colistin and tobramycin followed by meropenem and amikacin, imipenems and occasionally cefepime.

- *Mycobacterium tuberculsosis* in 7 (20%) cases was isolated via the L-J media slant at 37° C for upto weeks. *Acinetobacter baumanii* a pleomorphic aerobic gram negative bacillus was noted in 5 (14.2%) cases of carbapenemase producing variety sensitive to levofloxacin and colistin.

- *Klebsiella pneumoniae* another gram negative organisim of the enterobacteriacae group was grown in 6 (17.14%) cases of the ESBL group, sensitive to amikacin, chloramphenicol, colistin, cephoxitin, tetracycline and levofloxacin.

- *Saphylococcus aureus* a gram positive cocci was isolated in 2 (5.71%) of the cases which was predominantly sensitive to linezolide, doxycycline, cotrimoxazole and chloramphenicol.

- *Citrobacter freundii*, a gram negative bacilli and a facultative aerobe was seen to grow in only 1 (2.85%) which was sensitive to cotrimoxazole, imipenems, colistin and chloramphenicol.

- *Streptococcus pneumonia*, a gram positive cocci was isolated in a mere single case 1 (2.85%) sensitive to ampicillin, linezolide, gentamycin and streptomycin.

- *Escherichia coli*, a gram negative bacillus in 1 (2.85%) of ESBL and Amp C group sensitive to amikacin, chloramphenicol, imipenem, doripenem and tobramycin.

DISCUSSION

The aim of our study is to ascertain the diagnostic role of fibreoptic bronchoscopy in hemoptysis.

Hemoptysis is the coughing up of blood from a source below the glottis. The material that is produced varies from blood tinged sputum to virtually pure blood. It is a common but non-specific clinical symptom reported in over 100 different diseases.[16] Bronchoscopy is commonly performed, both for anatomic localization of bleeding site and to exclude neoplasm.

Hemoptysis was commonly (32%) found in the age group 51-60 years, followed by 41-50 years age group (26%). Male female ratio in the present study was found to be 3.54:1, concluding males are more than three times susceptible to develop hemoptysis than females. Abal et al found it 4.2 times more common in males than in females.[17] Our findings were very similar to those found by later and Fidan et al (2.72:1).[18]

In our study there were maximum of 52% patients in the category of moderate hemoptysis, followed by mild

hemoptysis comprising 32 % and massive being in 16%. The results of the study conducted by Hirshberg et al, were quite similar to ours, with hemoptysis being classified as mild 32% of the patients, moderate in 52% and massive in 16%.[19] This demonstrates once again that our study presents results that are very similar to those found in the literature.

In our study, the diagnostic yield of FOB in patients with hemoptysis with a normal or nonlocalizing chest radiograph was 56.5%. This was comparable with the results of O'Neil et al that made a definitive diagnosis in 52.1% of his patients.[20] Adelman et al in his study on cryptogenic hemoptysis bronchoscopically confirmed bronchitis in 64%; rest had either bleeding only (16.4%) or a normal tracheobronchial tree (19.4%).[21] In our study, malignancy was found in only 8.6% of the patients. This was comparable with the data from the previous studies which have reported bronchogenic carcinoma to be present in 4% to 22% of patients with hemoptysis and normal or nonlocalizing chest radiographs. Specifically, Lederle and coworkers found bronchogenic carcinoma in 4.7% of 106 bronchoscopies performed in men over age 40 with normal and nonlocalizing chest radiographs. In our study, the 2 patients diagnosed as neoplasm (squamous cell carinoma) were males in the age group of 50-69 years, having a significant history of smoking and presenting with recurrent hemoptysis. Although uncommon, bronchogenic cancer has been described in patients younger than age 40 and bronchoscopy should be considered in these patients as well. Snider reported that 5% of 955 patients with bronchogenic carcinoma were less than 45 years of age 19.[23] The causes of tuberculosis vary in different literature and in different parts of the world. Tuberculosis was reported as an important cause in many literature published previously. Some of previous studies have shown that the most common causes of hemoptysis are lung cancer, bronchiectasis, bronchitis, and infection.[24,25] In the present study, bronchiectasis was found to be most common cause of hemoptysis in 21.7% of patients. Abal et al also found bronchiectasis as most common cause in 20% of patients.[17] Hirschberg et al also found same findings.[19]

Table 4: Comparison of our study with the previous studies.

Study	Year	No. of patients with normal chest roentorams	No of patients with malignancy
Zavala et al[26]	1975	55	9 (16.3)
Adelman et al[21]	1985	67	1 (1.4)
Heaton et al[28]	1987	41	4 (9.7)
Lederle et al[22]	1989	106	6 (5.6)
Suri et al[27]	1990	60	4 (6.6)
Sharma et al[29]	1991	53	0
Present study	2015	23	2 (8.6)

Table 4 shows the comparison of the present study with that of the previous studies. The yield of bronchoscopy may be increased in the presence of several clinical features (especially when cancer is suspected) including age over 40, bleeding duration exceeding 1 week, volume of expectorated blood greater than 30 mL, a smoking history over 40 pack-years, and male gender.[30,31]

The diagnostic yield of flexible fibreoptic bronchoscopy in patients with hemoptysis and a localizing abnormality on chest x-ray was 74.1%, with carcinoma in 33.3% of the cases. This was comparable with the yield of 80% from previous studies, with carcinoma comprising one-third of cases.[32]

The common diagnostic evaluations usually consist of a plain chest radiograph; but it fails to localize the lesion in 20% to 46% of patients with hemoptysis.[14] Although there is agreement that patient with focal roentgenographic abnormalities (suggestive of malignancies) require bronchoscopic evaluation, the indication for patients with normal or nonlocalizing roentgenographic abnormalities remains controversial. Previous studies have been at odds regarding the risk of bronchogenic carcinoma in this group of patients. Zavala et al identified bronchogenic carcinoma in 22%.[26] These authors recommend early bronchoscopy in all patients with unexplained hemoptysis and normal chest roentograms. Others have reached a different conclusion. In our population, bronchogenic carcinoma was an uncommon finding, presented in only 8.6% (2/23). This rate was comparable to 2.5% by Heimer et al and 3% by Jackson et al.[33,34] Some authors carried out a thorough investigation to find other causes of hemoptysis such as infection. Mcguinnes et al found bronchiectasis in 25 of 57 of patients as the most common cause of hemoptysis.[32] Haro et al found bronchiectasis in 20% and in our study it was 21.7%.[35]

In the current study, bacteria were isolated from the bronchial washing fluids of 70% patients. The most common bacteria detected were *P. aeruginosa* and *K. pneumoniae*, similar to previous reports. The identification of microorganisms in bronchial washing fluids may assist the treatment of future complications such as hemoptysis and pneumonia. Antibioitcs are recommended when patients with bronchiectasis have purulent sputum. Meanwhile, when hemoptysis is the main presentation, the additional role of bronchial washing fluid to sputum exam could be low due to relatively small amount of bacterial load. In our study, only about 40% of patients received antibiotics before bronchoscopy, which could also affect reduced bacterial isolation rate from bronchial washing.

Bronchoscopy had sensitivity of 75.61%, specificity of 55.56%, positive predictive value of 88.57% and negative predictive value of 33.33% in diagnosing causative organism responsible for infectious exacerbation in

already diseased lung, which manifested in form of hemoptysis as one of prominent symptoms.

CONCLUSION

FOB plays a pivotal role in evaluating hemoptysis. Left upper lobe has been found to be the most common lobe involved in hemoptysis followed by right upper lobe. Infectious etiology was the most common pathology behind hemoptysis. Bronchiectasis per se was the most important risk factor. We strongly recommend FOB in all the individuals with hemoptysis whether chest X-ray is normal or abnormal.

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