A Comparative Study Between Virtual Bronchoscopy and Fibreoptic Bronchoscopy in Diagnosis of Lung Lesions

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ABSTRACT

Introduction: Fibreoptic bronchoscopy (FOB) remains the best modality for evaluation of endoluminal and mucosal lesions; however, endoscopy yields no information about the extent of extraluminal disease or airway patency distal to a high-grade stenosis. Virtual bronchoscopy is a novel technique making use of 3-dimensional reconstruction of 2-dimensional helical computed tomographic images for noninvasive evaluation of the tracheobronchial tree. The sensitivity of virtual bronchoscopy was 100% for obstructive lesions, 83% for endoluminal lesions, 0% for mucosal lesions, and 82% for all abnormalities; the specificity of virtual bronchoscopy was 100%. So the study was done to compare virtual bronchoscopy and fibreoptic bronchoscopy in diagnosis of lung lesions.

Material and Methods: The study was conducted in the department of Respiratory medicine in collaboration with department of Radiology and Radio diagnosis. Thirty patients admitted in department of respiratory medicine with respiratory complaints and suspicious chest x rays were considered for the study. The patients fulfilling the inclusion criteria and after verifying the exclusion criteria were finally taken up for the study.

Results: Fibreoptic bronchoscopy was carried out in all 30 patients admitted in the dept. of respiratory medicine MMIMSR, Mullana Ambala. The findings are as follows. 15 patients (50%) had endoluminal mass visible on fibreoptic bronchoscopy. 12 patients (40%) had airway obstruction due to external compression, either by an extra luminal mass or by an enlarged lymph node. 6 patients (20%) had mucosal changes along with obstruction or endoluminal mass. Virtual bronchoscopy was developed in all the 30 patients, after they had undergone contrast enhanced computed tomography (CECT) thorax. The findings were as follows. 12 patients (40%) were identified to have obstruction due to external compression. 12 patients (40%) were identified to have endoluminal growth. 6 patients (20%) had normal study while 0 (0%) mucosal lesions were identified in total 30 patients.

Conclusion: In the diagnosis of lung lesions, various modalities have been used, ranging from a standard chest xray, CECT and conventional Fibreoptic bronchoscopy (FOB), to more advanced modalities like positron emission tomography (PET) scan, endobronchial ultrasound (EBUS), Virtual bronchoscopy (VB) and Mediastinoscopy. Each technique has its own advantages and disadvantages. Two modalities, FOB and VB were taken in this study and their diagnostic abilities were compared from each other.

Keywords: Bronchoscopy, Fibreoptic, Virtual, Lung Cancer, Stenosis

INTRODUCTION

Bronchoscopy has become a routine procedure in the preoperative evaluation of thoracic and mediastinal tumors[1]. Although the results of a large study showed the risks of purely diagnostic bronchoscopy to be relatively low (0% mortality, with a 0.8% rate of milder complications), these risks cannot be completely ignored[2]. Furthermore, bronchoscopy is relatively unpleasant for the patient. New perspectives can be seen with so-called virtual bronchoscopy, which uses a computer to simulate a bronchoscopic examination based on data derived from helical CT scans. The most common causes of cancer death are cancers of Lung (1.69 million deaths) [3]. Lung cancer is the leading cause of cancer death in Europe, the USA and Japan[4-6]. FOB remains the best modality for evaluation of endoluminal and mucosal lesions; however, endoscopy yields no information about the extent of extraluminal disease or airway patency distal to a high-grade stenosis[7]. The flexibility of the bronchoscope allows the operator to inspect most of fourth order and often up to sixth order bronchi. In addition, the operator may directly assess mucosal details, such as color and vascularity. Visualization of color and vascularity allows the observer to see any inflammatory or bleeding sites directly or any neoplastic changes that are present in the airway. Virtual bronchoscopy is a novel technique making use of 3-dimensional reconstruction of 2-dimensional helical computed tomographic images for noninvasive evaluation of the tracheobronchial tree. The sensitivity of virtual bronchoscopy was 100% for obstructive lesions, 83% for endoluminal lesions, 0% for mucosal lesions, and 82% for all abnormalities; the specificity of virtual bronchoscopy was 100%[8]. *So the study was done to* compare virtual bronchoscopy and fibreoptic bronchoscopy in diagnosis of lung lesions.

MATERIAL AND METHODS

The study was conducted in the department of Respiratory medicine in collaboration with department of Radiology and Radio diagnosis. Thirty patients admitted in department of respiratory medicine with respiratory complaints and

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suspicious chest x rays were considered for the study. The patients fulfilling the inclusion criteria and after verifying the exclusion criteria were finally taken up for the study.

Inclusion criteria

1. Patients with Chronic cough.
2. Patients with Hemoptysis.
3. Patients with Persisting or recurrent pulmonary infections (cough, fever, sputum),
4. Patients with Suspicion of foreign-body aspiration.
5. Patients with Abnormal findings at physical examination (abnormal breathing sounds, stridor, dyspnoea)
6. Patients with Chest X-ray abnormality.

Exclusion criteria

1. Patients with recent myocardial infarction or cardiac arrhythmias.
2. Patients with deranged urea and creatinine levels.
3. Patients who are sputum positive for pulmonary tuberculosis
4. Non-cooperative patients.

Investigations required

1. Fibreoptic flexible bronchoscope.
2. Transbronchial needle for aspiration.
3. Transbronchial biopsy needle.
4. CT scan.
5. Virtual bronchoscopy

Study sequence

In this study, thirty patients with abnormal chest X ray, chronic cough, hemoptysis, non resolving pneumonias were taken up and CECT thorax was done on MDCT (Philips Medical System, USA) in all patients, in only one or two 17 seconds breath holds time. The video and images were stored. Fibreoptic bronchoscopy (FOB) was used as "gold standard" technique for detection of airway disease. FOB was performed under local or general anaesthesia. Transbronchial needle aspiration (TBNA), Transbronchial lung biopsy (TBLB) and Bronchoalveolar lavage (BAL) samples were collected as and when required and sent for histopathological and cytological examinations. For each FOB the tracheobronchial tree was visualized in presence of an attending pulmonologist who was blinded to results of virtual bronchoscopy. FOB findings that were stored included the presence or absence of obstructive lesions due to external compression, endoluminal masses or mucosal lesions or normal anatomt of the tracheobronchial tree. The diagnostic results of FOB and virtual bronchoscopy will be compared in each patient.

3 - D reconstruction and analysis

VB images were reconstructed to 3-D endoscopic views of the tracheobronchial tree using commercial software (OsiriX software). Abnormalities in the tracheobronchial tree were recorded. The radiologist interpreted all VB images blind to the actual FOB results. The presence or absence of obstructive lesions due to external compression, endoluminal masses or mucosal lesions or normal anatomy of the tracheobronchial tree was stored for evaluation and comparison with FOB findings. Fibreoptic bronchoscopy (FOB) was used as "gold standard" technique for detection of airway disease. The results of VB were compared with actual FOB findings at the same anatomical sites. For VB, sensitivity, specificity, positive predictive value and negative predictive value were calculated.

STATISTICAL ANALYSIS

The data collected was entered into Microsoft excel and analyzed using Statistical Package for Social Sciences (SPSS) version 21 (IBM Chicago, USA). Sensitivity, specificity were calculated as follows sensitivity: true-positive/false-negative + true-positive; specificity: true-negative/false-positive + true-negative.

RESULTS

A total of 30 patients fulfilling the inclusion criteria were admitted in Dept of Respiratory Medicine, MMIMSR and were taken up for the study and following results were obtained. Cough was present in maximum of 24 patients (80%), followed by dyspnoea which was present in 21 patients (70%). It was followed by chest pain, seen in 18 patients (60%) and least common symptom was hemoptysis which was present in 12 (40%) patients. Out of the 30 patients studied, the histopathological distribution was as follows. 12 patients (40%) were diagnosed Adenocarcinoma of the lung, 7 patients (23.33%) were diagnosed Squamous cell carcinoma of the lung. 4 patients (13.33%) were diagnosed Small cell carcinoma of the lung followed by 3 patients (10%) diagnosed as Large cell carcinoma of the lung. 2 patients (6.66%) had infective pathology, while 1 patient (3.33%) was of tubercular bronchial stenosis and 1 patient (3.33%) was diagnosed as Malignant Mesothelioma.

Fibreoptic bronchoscopy was carried out in all 30 patients admitted in the dept. of respiratory medicine. The findings are as follows. 15 patients (50%) had endoluminal mass visible on fibreoptic bronchoscopy. 12 patients (40%) had airway obstruction due to external compression, either by an extra luminal mass or by an enlarged lymph node. 6 patients (20%) had mucosal changes along with obstruction or endoluminal mass. Mucosal changes can be described as haemorrhage, erythema, abnormal colour or tissue friability. 3 patients (10%) did not have any occlusion due to external compression, any endoluminal growth or any mucosal changes. These 3 patients were labelled as normal study in fibreoptic bronchoscopy. Thus, fibreoptic bronchoscopy was able to find a total of 33 abnormalities in 30 patients (table-1).

Virtual bronchoscopy was developed in all the 30 patients, after they had undergone contrast enhanced computed tomography (CECT) thorax. The findings were as follows. 12 patients (40%) were identified to have obstruction due to external compression. 12 patients (40%) were identified to have endoluminal growth. 6 patients (20%) had normal study while 0 (0%) mucosal lesions were identified in total 30 patients.

A total of 12 obstructions were seen on FOB. FOB was able

S. No	Finding	No. of patients	Percentage (%)
1.	Normal study	3	10
2.	Obstruction due to external compression	12	40
3.	Endoluminal mass	15	50
4.	Mucosal changes along with obstruction or endoluminal growth	6	20
Total abnormalities found after fibreoptic bronchoscopy = 33			

Table-1: Fibreoptic bronchoscopy findings in patients studied

S. No	Finding	No. of patients	Percentage (%)
1.	Normal study	6	20
2.	Obstruction due to external compression	12	40
3.	Endoluminal growth	12	40
4.	Mucosal changes	0	0
Total abnormalities detected on Virtual Bronchoscopy = 24			

Table-2: Virtual bronchoscopy findings in patients studied

S. No	Finding	Senstivity (%)	Specificity (%)
1.	Normal study	100	88.89
2.	Obstruction due to external compression	100	100
3.	Endoluminal mass	80	100
4.	Mucosal changes	0	100

Table-3: Sensitivity and specificity of virtual bronchoscopy as compared to fibreoptic bronchoscopy assessment

	Visualisation beyond airway obstruction	Percentage
FOB	3 cases	25%
VB	9 cases	75%

Table-4: Visualisation beyond airway obstruction due to external compression, BY FOB AND VB.

to visualize airway distal to obstruction in only 3 cases while VB was able to visualize airway distal to obstruction in 9 out of 12 cases. Thus success rate of FOB was 25% while that of VB was 75% in visualizing airways distal to obstruction (table-2,3).

DISCUSSION

FOB was able to detect a total of 33 abnormalities in 30 patients while VB was able to detect only 24 out of 33 abnormalities in 30 patients. Thus the sensitivity of VB for overall detection of abnormalities was 78.57% with a confidence interval of 63.19 – 89.70% and specificity was 100% with a confidence interval of 29.24 – 100%. The positive predictive value of VB was 100% and negative predictive value of 25% with a confidence interval of 15.74 – 37.30%. Out of the 9 abnormalities not detected by VB, 3 were endoluminal growths and 6 were mucosal changes in the airway walls.

A similar study was conducted by M. Beker Acay et al, on" Can virtual bronchoscopy be a complementary method for fibreoptic bronchoscopy?"In which a total of 44 pathologies were detected in 37 patients (88%) by FOB. It showed that VB was less sensitive in detecting overall abnormalities and missed all the mucosal abnormalities visible on FOB. This shows that FOB has advantage over VB in directly visualising mucosal changes like haemorrhage, erythema, abnormal colour or tissue friability. Small surface irregularities were also missed on VB. These mucosal changes were not appreciated on VB which is its major disadvantage[9]. VB was not able to detect the 6 cases having mucosal changes in FOB. Thus the sensitivity of VB for mucosal changes was 0% with a confidence interval of 85.75 - 100% and specificity was 100% with negative predictive value of 80% with a confidence interval of 80%. F. Liewald' et al conducted a study on "Comparison of Virtual and Fibreoptic Bronchoscopy"and found that Using FOB 23 patients showed tumorous changes in the mucosa. 6 patients with sleeve resection and 1 patient with external tumor compression showed no abnormal mucosal defects. Mucosa could not be examined at all by VBS[10].

FOB was able to visualize airway distal to obstruction either by external compression or by endoluminal mass in only 3 out of 12 obstruction cases while VB was able to visualize airway distal to obstruction in 9 out of 12 obstruction cases. Thus success rate of FOB was 25% while that of VB was 75% in visualizing airways distal to obstruction. Hafez SA et al conducted a study "Virtual versus fibreoptic bronchoscopy in the evaluation of tracheobronchial neoplasms". They found that visualization distal to obstruction in the airways by VB was possible in 61.8% of the cases and only in 32.4% of the cases by FOB[11].

T.Fleiter et al assessed "Comparison of Real-Time Virtual and Fibreoptic Bronchoscopy in Patients with Bronchial Carcinoma: Opportunities and Limitations" and found out that in 20 lung cancer patients with bronchial stenosis and high grade stenosis were identified equally well by both FOB and VB. However, VB provided the advantage of viewing the airway distal to the site of stenosis in 5 out of 20 patients (25%) in whom bronchoscope cannot be negotiated beyond the stenosis[12]. VB provides an excellent opportunity to explore the segments of the airways distal to even high

grade stenoses and obstructions, which cannot be done by conventional FOB as it cannot pass the stenosed or obstructed segment. In such cases, VB has major advantage over FOB

CONCLUSION

In the diagnosis of lung lesions, various modalities have been used, ranging from a standard chest xray, CECT and conventional Fibreoptic bronchoscopy (FOB), to more advanced modalities like positron emission tomography (PET) scan, endobronchial ultrasound (EBUS), Virtual bronchoscopy (VB) and Mediastinoscopy. Each technique has its own advantages and disadvantages. Two modalities, FOB and VB were taken in this study and their diagnostic abilities were compared from each other.

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