Hemoptysis: bronchoscopic-computed tomographic correlation in ninety eight cases

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Objective: **To retrospectively evaluate the efficiency of the fiberoptic bronchoscopy (FOB) examination compared to computed tomography (CT) in the evaluation of patients with hemoptysis.**
Methods: **We retrospectively reviewed 98 patients who underwent FOB and CT for hemoptysis. There were 78 male and 20 female. The mean age was 46 years with a range from 18 to 80 years**
Results: **Hemoptysis was attributed bronchiectasis in 19 (19.4%) cases, bronchogenic carcinoma in 18 (18.3%) cases, bronchitis in 23 (23.4%) cases, tuberculosis in 7 (7%) cases, cryptogenic causes in 28 (28.5) cases and miscellanous causes in 3 (3%) cases (a perforated hydatid cyst, a mitral stenosis and an intrabronchial foreign body).**
Endobronchial abnormalities were seen on CT but not at FOB in 4 of the 18 patients with malignancy. In contrast endobronchial abnormalities were identified at FOB but not seen by CT in 3 patients. CT and FOB agreed on only 11 of these 18 patients.
Conclusion: **FOB can be used for patients with hemoptysis with reduced cost compared to CT and frequently may lead to a precise histologic diagnosis and subsequent early surgical management. But both FOB and CT should be used for a complete diagnosis and appropriate therapy planning in most patients with hemoptysis.**

Key words: *Hemoptysis, computed tomography, fiberoptic broncoscopy.*

Hemoptysis is a common clinical problem with many potential etiologies(1). It is significant and sometimes an alarming symptom which requires thorough investigation (2).

Investigation of hemoptysis is important because this symptom may be due to a malignant disease, particularly in patients who are smokers and aged over 40 years (3). Ten to 30 percent of all fiberoptic bronchoscopy (FOB) examinations are performed in patients with hemoptysis, primarily to exclude cancer as a cause(4).

In order to assess the roles of both FOB and computerized tomography (CT) in evaluation of patients with hemoptysis, we retrospectivelly reviewed our records in the Turkish Social Security Administration (SSK) Antalya Hospital. Unlike most of the previous studies, we investigated all patients presenting with hemoptysis, in order to avoid selection bias and to detect distribution rates of the causes.

Material and Method

Between July 1991 and July 1996, 98 patients with hemoptysis were examined with FOB and CT at Thoracic Surgery Department of SSK Antalya Hospital. Seventy eight men and 20 women ranging in ages from 18 to 80 years (median age 46 years) were included in the study. In each case, correlation was investigated between the amount and duration of hemoptysis.

The FOB examination can produce shadowing on the radiograph which is spurious and deceptive, especially if biopsy has been attempted (5). Therefore, chest radiograms were obtained prior to FOB in all patients.

We performed FOB prior to CT in all patients. After obtaining informed consent, patients were maintained without oral intake for at least 8 hours before the FOB. For premedication, atropine 0.75 mg and diazepam 10 mg were administered intramuscularly 30 minutes before the procedure. Topical anesthesia was performed with 2% pantocain. An Olympus 1T2OD broncofiberoscope (Olympus Optical Co. Tokyo Japan) was introduced via transoral route. Entire tracheobronchial tree was inspected. In the presence of endobronchial lesions, brushings and visually directed biopsies were taken. When no endobronchial lesion could be visualized, washing and brushings were taken in the suspected area. Sofcor Trans Bronchial Needle Aspiration (STBNA) was performed through FOB in one patient who had subcarinal mass on CT but not on FOB.

Visualized findings on FOB were divided into 3 patterns as previously described by Colice et al. (6): Normal, endobronchial lesion and localized bronchial mucosal abnormalities (friable, edematous and/or erythematous mucosa, extrinsic compression).

CT scans were obtained with a scanner (Toshiba Express, Tokyo, Japan). In all cases CT studies were performed with standard 10 mm thick sections. In addition, in 3 patients in whom endobronchial lesion was seen during FOB but not on CT, repeated CT scans were obtained using a modified high resolution protocol.

Pathological records for each case were reviewed to evaluate success rate of FOB confirmed by cytological or histological analysis, the diagnosis of lung cancer with visual findings noted at FOB.

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Table I. Definitive diagnosis in patients with hemoptysis.

Diagnosis	No. of patients
Bronchogenic Carcinoma	18
Bronchiectasis	19
Foreign Body	1
Tuberculosis	7
Mitral Stenosis	1
Perforated Hydatid Cyst	1
Bronchitis	23
Cryptogenic	28
Total	98

Table II. Chest radiogram findings.

Findings	No of patients
Normal	16
Localising Abnormalities	28
Atelectasis	5
Intrapulmonary Mass	23
Nonlocalizing Abnormalities	54
Cardiomegaly	10
Costophrenic Angle Blunting	8
Pleural Changes	12
Tortous Aorta	3
Elevated Hemidiaphragma	2
Hilar Fullness	4
Minimal Fibrosis	13
Minimal Atelectasis	2

The final diagnosis for each patient was established by means of apropriate clinical and/or histopatological evaluation of the bronchoscopic sampling and/or surgical specimens.

The follow-up period ranged between 6 months to 5.5 years (average 33 months).

Student's t test was used for statistical analysis.

Results

Hemoptysis was attributed to bronchiectasis in 19 (19.4%) cases, bronchogenic carcinoma in 18 (18.3%) cases, tuberculosis in 7 (7%) cases, bronchitis in 23 (23.4%) cases, cryptogenic causes in 28 (28.5%) cases and miscellaneous causes in 3(3%) cases (including cases of a perforated hydatid cyst, a mitral stenosis and an intrabronchial foreing body). Table I shows the definitive diagnosis of the patients with hemoptysis.

Most patients had of hemoptysis (not more than 2 cc per day) and many of these were observed only as streaks. Of patients, 56 (57%) had mild, 41 (41.8%) had moderate and 1 (1%) had severe hemoptysis.

The mean age of patients with localizing chest radiographs was 56 years, significantly greater than other groups ($p<0.05$). All patients with lung cancer were older than 50 years of age except one. Cancer patients also had significantly longer smoking histories (mean 87 packs/year) $p<0.05$.

Hemoptysis for a period longer than a week in duration was noted in 12 (66.6%) patients having lung cancer. However, only 4 (22%) patients having lung cancer produced more than 2mm of blood per day compared with 42 (52.5%) patients without lung cancer.

Chest Radiogram Findings

Sixteen (16%) chest radiograms were interpreted as normal, while 54 (55%) radiograms were abnormal, nonlocalising. Altogether a total of 70 (71.4%) patients presented either with normal or abnormal nonlocalising chest radiograms. Table II shows chest radiograms findings.

Of the 16 patients with normal chest radiograms, bleeding was localized by FOB in only 7 patients. Specific diagnosis was established endoscopically in only 2 of these patients (including 2 cases of cancer and tuberculosis).

Of 54 patients with abnormal nonlocalising chest radiograms, etiologies were established in a total of 19 (37%) patients, including 16 patients with bronchiectasis 1 patients with tuberculosis and 2 patients with bronchogenic cancer. Bleeding was localized by FOB in only 30 of these patients.Twentyeight patients had localizing radiographic findings. Fifteen (53.5%) of these patients were shown to have bronchogenic carcinoma; 5 patients had tuberculosis, 3 patients had bronchiectasis and 1 patient had perforated hydatid cyst.

Bronchoscopic Findings

Focal endobronchial abnormalities were visualized in a total of 38 (38.7%) patients at FOB, 15 of whom had endovegetative lesions whose etiologies were established by means of FOB sampling, including 14 patients with cancer and 1 patient with tuberculosis. In the remaining 23 patients, edematous and eryhematous mucosal changes suggesting bronchitis were visualised, one of whom had false positive cytologic findings which were similar to adenocancer.

Although blood was identified endoscopically in a total of 39 (40%)cases hemorrhage proved to be the only significant endoscopic findings in 20 (20.4%) cases, 14 of whom were proved to have bronchiectasis at CT.

CT findings

Abnormalities involving the airways were depicted by CT in a total of 66 (67%) cases.

In 30 (30.6%) cases, CT showed focal central airway abnormalities involving the trachea, main stem or lobar or segmental bronchi, while peripheral airway abnormalities were identified in 36 (36.7%) cases. In 7 cases, CT and chest radiograms were interpreted as normal. In 6 of these cases, hemoptysis was assumed to be cryptogenic, while in the remaining one case, hemoptysis was attributed to carcinoma focally involving the left lower lobe bronchus.

Among the 23 cases in which FOB showed diffuse

bronchitis, CT scans were normal in all except 3, which suggested mild, diffuse bronchial wall thickening.

In 7 cases with tuberculosis, CT showed apical fibrotic changes in 5 cases, widespread acinar nodules in 2 cases. Six of these cases were treated with a short course of standard antituberculosis therapy. In the remaining one, left lower lobectomy was indicated due to massive hemoptysis and excessive destructive changes.

Of the 18 patients with malignancy, CT and FOB agreed on only 11 patients. In 4 patients abnormalities were seen on CT but not at FOB. In the other 3 patients, FOB identified endobronchial abnormalities not seen by CT. In all, endobronchial lesions were identified by repeated CT using a high resolution protocol of sequential thin (1.5-5mm) in bronchi corresponding to those identified as abnormal during FOB.

In 5 cases, chest radiograms revealed right upper lobe atelectasis in 3 cases and left upper lobe atelectasis in 2 cases. In all, CT and FOB findings confirmed the presence of obstructing tumors.

In one case presenting with wheezing, FOB revealed an endovegetative lesion in the right main bronchus. A biopsy was taken and its histologic examination revealed chronic inflamation of the submucosa and squamous metaplasia but there was no tissue continuity. Subsequent CT showed a calcified lesion compatible with foreing body. It was removed totally with rigid bronchoscopy, when shown to the patient she recalled aspirating chicken bone ten years ago.

Of the 3 cases with tortuous aorta, 2 had bronchial carcinoma and the other case was calcified mitral stenosis patient without diastolic murmur owing to calcified leaflet. Subsequent echocardiography confirmed the mitral stenosis.

No cause could be identified in the 28 patients. These patients were classified as cryptogenic.

There were only 2 complication of FOB sampling in our series. One patient had transient bronchial bleeding (more than 40 cc), and the other patient had a small pneumothorax which resolved spontaneously.

Twelve of the 18 lung cancer patients appeared to be operable. Remaining 6 patients were inoperable, including 1 patient with metastatic breast cancer, 3 patients with contralateral mediastinal nodal involvement and 2 patients with carinal involvement. Table III gives the distribution of the lung cancer patients according to histologic types.

Thirtythree patients underwent surgery. Twelve of 33 had bronchogenic cancer, 19 had bronchiectasis, 1 had cyst hydatid, and 1 had tuberculosis. Lobectomy was performed in 32 patients. Decortication and cystotomy-capitonnage was required in the remaining one patient with perforated hydatid cyst.

Bronchoscopic diagnosis was consistent with the surgical histologic typing in all patients except one. One patient diagnosed as having squamous cell cancer by FOB sampling was found to have oat cell cancer after resection. This case was considered as a mixed tumor.

Table III. Distribution of the operable and inoperable lung cancer patients according to histologic types.

Histologic Types	No of operable patients	No of inoperable patients	Total
Squamous Cell Ca	5	2	7
Adenocancer	4	2	6
Bronchoalveoler Ca	1	-	1
Giant Cell Ca	1	-	1
Oat Cell Ca	-	2	2
Mixed Type (Oat cell+Squamous cell)	1	-	1
Total	12	6	18

Discussion

Since the most likely causes of hemoptysis are either central tumors or bronchiectasis, hemoptysis is a well recognized indication for both FOB and CT.

Approximately 11 percent of patients with hemoptysis and normal chest radiographs havebronchogenic carcinoma, most of these patients have endobronchial tumors within the visible range of the fiberoptic instruments. In our series there were 70 patients who had normal or nonlocalizing chest radiographs, 3 (4%) of whom had endobronchial tumor obvious at FOB.

The diagnostic yield of endoscopic procedure depends on whether the lesions are predominantly outside the bronchial wall and covered by normal mucosa or project into the bronchial lumen (7). Bronchoscopy is also limited in the evaluation of bronchi located distal to a bronchial stenosis or occlusion. In addition, the extraluminal part of a lesion and its relationship to the bronchi and to the mediastinal structure cannot be assesed with bronchoscopy. For a complete diagnosis and apropriate therapy planning the intrabronchial and extrabronchial parts of the mass and its extention must be known at the same time, which can only be provided by imaging methods(8).

Apart from direct visualisation of endobronchial tumors, foreign bodies, granulomas and infiltration, FOB is valuable for collecting bronchial secretion for microscopy and for obtaining specimens for histologic examination(5). On the other hand, presumably, the greatest potential impact of CT might derive from the detection of curable neoplastic causes of bleeding that was not apparent by the chest radiograms and unrecognized at FOB(9).

CT may disclose tumors, both central and periferal, otherwise unapparent bronchoscopically. Furthermore, CT proved of considerable value in the diagnosis of bronchiectasis and predicting active pulmonary tuberculosis, based on the detection of lung cavitation and widespread acinar nodules (10). In our series 3 patients revealed intra-

cavitary defects, one of whom also had widespread acinar nodules (broncoalveolar cancer). In other 2 patients histologic examination revealed squamous cell cancer. Consequently, malignancy should be eliminated in all patients with intracavitary defects or widespread acinar nodules. We believe that diagnosis of malignancy or tuberculosis should not be based on data of CT or other imaging methods.

The conditions that can cause hemoptysis but which may not be apperent on the radiography include bronchitis, angiomas, bronchiectasis infarction, small areas of infection and any endobronchial lesion that is not large enough to cause occlusion of the bronchus (5). In our series 16 patients with hemoptysis had normal chest radiograms, 2 of whom had endobronchial lesions obvious at FOB (including cases of a cancer and a tuberclosis).

Active hemorrage could not be distinguished from aspirated blood at CT. We believe that FOB should be performed prior to CT in this circumstance. In our series active hemorrhage could be visualized in one patient by FOB. He underwent left lower lobectomy subsequent to CT. Its histological examination revealed tuberculosis.

Acute and chronic inflamation is the most frequently implicated cause of bleeding. Dilated mucosal capillaries are a common bronchscopic finding in this setting. CT is inaccurate in detecting diffuse mucosal disease. In case with bronchitis, CT scan may reveal unrelated peribronchial fibrosis (11). In our series 3 of the 23 patients with bronchitis revealed peribronchial fibrosis at CT.

In our series, cancer patients had significant increase in duration of hemoptysis, but had no significant increase in volume as previously reported by Mc Guinness et al. (10). But same study revealed that the relationship between the quantity and duration of hemoptysis and underlying malignancy remains unclear, particularly in patients with normal chest radiograms (10).

It is not suprising that discrepancies in histologic type occur because some tumors fail to show a single histologic type; in such mixed tumors a small biopsy may show one type only and so differ from the operative specimen. It has been demonstrated that at least three biopsies taken from the base of the tumor will improve the diagnostic yield to more than 95% (6). In our series, 1 patient diagnosed as having squamous cell cancer by means of bronchoscopic biopsy found to have oat cell cancer at resection.

Very seldom does a false positive cytology for malignancy occur. Particularly differantiation between adenocancer and severe inflamation may be very difficult (7). In our series, in one patient with bronchitis, cytologic examination revealed atipic cells which were similar to adenocancer, but CT findings and follow-up data have not supported this.

During the symptomatic phase of the foreign body aspiration, patients may present with bouts of fever, cough, expectoration, pleuritic chest pain and hemoptysis (sometimes massive). Bronchoscopy is often diagnostic unless the foreing body is surrounded by inflammatory tissue (12). We believe that rigid bronchoscopy should be used subsequent to diagnosis as was done in one our patient with foreign body surrounded by inflammatory tissue.

More advanced computer manuplation of the three dimensional (3D) imaging may extend the clinical application of virtual bronchoscopy (13). We believe that 3D relationship of the tracheobronchial tree to surrounding great vessels and mediastinal nodal sites may, in the future, assist, in particular, definitive staging of the lung cancer preoperatively, as well as confirming the vascular involvement of the neoplastic disease. We except that virtual bronchoscopy will be an alternative to FOB but not obviate its use, because FOB sampling frequently may lead a precise histologic diagnosis in patients with endobronchial abnormalities. Furthermore, in patients who had no visible lesions through FOB, FOB sampling may lead to definitive diagnosis.

Diagnostic yield depends on the location, size, character of the border of the lesion and the ability to perform all sampling methods (14). In our series, 4 patients with lung cancer had no endobronchial lesions at FOB, one of whom appeared to have a subcarinal mass at CT. Softcor transbronchial neddle aspiration was performed through repeated FOB and samples were taken. Its histologic examination revealed oat cell cancer.

Based on our data, it would seem that FOB can be used for patients with hemoptysis with reduced cost compared with CT and may often lead to a precise histologic diagnosis and subsequent early surgical management. But both FOB and CT together are indicated for a complete diagnosis and appropriate therapy planning in patients with hemoptysis.

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