

## CT evaluation of patients with hemoptysis and normal chest radiograph

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### Abstract

**Background and objectives:** to study the diagnostic accuracy of Computed Tomography in evaluation of various etiologies of hemoptysis with normal chest radiographs.

**Methods:** Two hundred patients with hemoptysis and normal chest radiograph were evaluated with computed tomography from the period of December 2008 to October 2009. The patients were categorized according to the primary etiology and severity of hemoptysis.

**Results:** of the 200 patients with hemoptysis included in this study, 121 males and 79 females. Majority of patients had mild hemoptysis and pulmonary tuberculosis was the leading cause of hemoptysis (73.3%). CT showed diagnostic accuracy of 75%.

**Conclusion:** computed chest tomography plays an important role in assessing patients with hemoptysis.

**Key words:** CT, hemoptysis

### Introduction

Hemoptysis is defined as expectoration of blood derived from the lungs or bronchial tree as a result of pulmonary or bronchial hemorrhage<sup>1</sup>. Most of the lung's blood (95%) circulates through low-pressure pulmonary arteries and ends up in the pulmonary capillary bed, where gas is exchanged. About 5% of the blood supply circulates through high-pressure bronchial arteries, which originate at the aorta and supply major airways and supporting structures. In hemoptysis, the blood generally arises from this bronchial circulation, except when pulmonary arteries are damaged by trauma, or erosion of a granulomatous or calcified lymph node or tumor, or, rarely, by pulmonary arterial catheterization or when pulmonary capillaries are affected by inflammation<sup>2</sup>. Imaging is always done. A chest x-ray is mandatory. Patients with normal results, a consistent history, and non massive hemoptysis can undergo empiric treatment for bronchitis. Patients with abnormal results and patients without a

supporting history should undergo CT and bronchoscopy. CT may reveal pulmonary lesions that are not apparent on the chest x-ray and can help locate lesions in anticipation of bronchoscopy and biopsy. Ventilation/perfusion scanning or CT angiography of the pulmonary arteries<sup>3</sup> confirm the diagnosis of pulmonary embolism. CT and pulmonary angiography can also detect pulmonary arteriovenous fistulas.

### Methods

Two hundred patients with hemoptysis and normal chest radiograph were evaluated with computed tomography. The study was prospective started from December 2008 to October 2009. There were 121 males and 79 females in this study. Their age range from 15 to 80 years. Patients were grouped according to the amount of blood expectorated into three groups, mild hemoptysis (less than 100 ml/day), moderate (100-400ml/day) and massive (more than 400ml/day). The amount of expecto-

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rated blood converted into ml equivalent, one teaspoonful equals to 30ml and one small glass is about 100ml and patients with only streaking in the sputum was excluded. Computed tomography was done using Siemens emotion 16 slice machine. All CT scans obtained within one week prior of doing bronchoscopy. Scans were obtained using high resolution protocol. These scans were prospectively reconstructed with a high spatial resolution. Native and contrast CT were performed using iodinated contrast media to assess the hilum and mediastinum with both pulmonary and mediastinal windows. The following are the details of CT technique parameters.

Parameter	16 detector row CT
Volume of interest :	from base of the neck to the level of L2 (level of renal arteries)
KV & mAs	100-140 & 90-140 respectively
Collimation	16* 0.75mm
Pitch	1.5

Contrast Media 120 ml with concentration of 350 mg/dL and injection rate of 4ml/second and scanning delay of about 15 seconds.

The chest radiographs were labeled as normal when fulfilled all the criteria of normality as shown in figure 1.

An attempt was made to reach the diagnosis depending on computed tomography finding in correlation with clinical features and the result of other investigations. The diagnosis was confirmed by bronchoscopy, histopathology and biochemical parameters.



Figure 1 : (Normal chest X-ray).

## Results

A total of 200 patients with hemoptysis and normal chest radiograph were included in this prospective study. The mean age was 36 years. Computed tomography provided diagnosis in 150 patients (75 %). The various etiologies are shown in (Table 1).

Pulmonary tuberculosis was found to be the leading cause (55 %) of hemoptysis in our patients. 93 of 110 patients (84.54%) with active tuberculosis and 17 of 110 patients (15.45%) with inactive tuberculosis. 40 patients (20 %) were with hemoptysis due to non tuberculosis lesions shown in (Table 1). The CT findings in pulmonary tuberculosis include nodular opacities, broncho vascular distortion, fibrotic changes, parenchymal calcifications, and tree in bud appearance. (Figure 2) Bronchiectasis was observed in 22 patients (11 %), two of them being a case of allergic broncho pulmonary aspergillosis and one of them were due to cystic fibrosis. The rest showed changes most commonly in the posterior segments of the lower lobes followed by right middle lobe. The two patients with allergic broncho pulmonary aspergillosis, 32 and 41 years old, both were females and known cases of bronchial asthma for the past 10 years. CT showed

central bronchiectasis with almost sparing of the distal bronchi in both lungs (Figure 3).

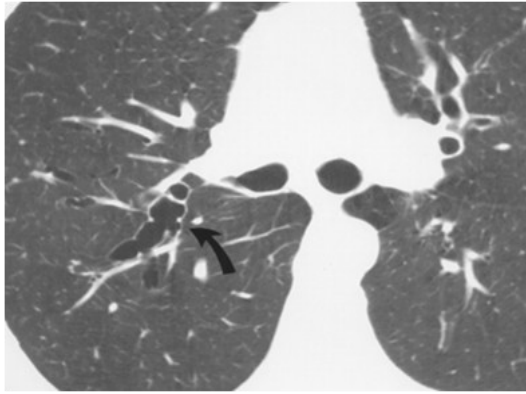
Cystic fibrosis diagnosed in a 17 years old, male, presented with cough and sputum and asthma like symptoms in addition to sinusitis and nasal polyposis. CT showed central and upper lobe cystic bronchiectasis (Figure 4). In 15 (7.5%) patients consolidation without volume loss and no obstructive bronchial lesion was diagnosed on computed tomography and diagnosis of pneumonia was suspected. Follow-up examinations showed complete resolution and no residual changes left. Pulmonary infarction diagnosed in 2 cases 32 year old male presented with mild sudden onset chest pain. He had injured his right ankle 2 weeks previously and had noticed recent pain in his calf muscle. The chest X-ray at the time of admission was normal. CT performed and showed a filling defect in the right pulmonary artery (Figure 5) with patchy subtle parenchymal opacifications suggestive of hemorrhagic consolidation. The second patient was 54 years old developed hemoptysis and had history of progressive dyspnea over the last 4 months. Chest x-ray was normal apart from changes suggest chronic obstructive airway disease. CT done and showed soft tissue attenuating filling defect suggestive of saddle thrombosis of pulmonary artery (figure 6). The patient with telangectasia diagnosed by bronchoscopy was 27 years old male with moderate hemoptysis and with repeatedly normal chest radiographs and CT scan. Of the 50 (25%) patients with hemoptysis where both chest X-ray and CT were normal, 38 had mild hemoptysis and 12 had moderate hemoptysis. All patients with normal CT proved to have normal bronchoscopy and cytological examination of the bronchial wash except the patient with telangectasia. Most of patients in this study had mild hemoptysis.

**Table 1:** Etiology of hemoptysis

Primary diagnosis	Total No (%)
Pulmonary tuberculosis	110 (55 %)
Active	93 (84.5)
In active	17(15.45)
Bronchiectasis	22 (11 %)
Pneumonia	15 (7.5 %)
Infarction	2 (1%)
Vascular (telangectasia)	1 (0.5%)
Total	150 (75%)



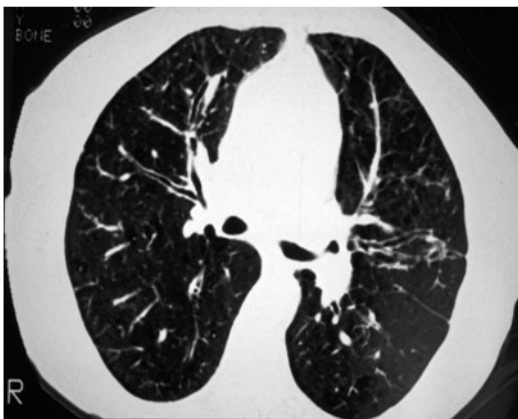
**Figure 2:** Consolidation of active pulmonary tuberculosis



**Figure 3:** Central bronchiactasis



**Figure 5:** Right pulmonary artery embolism



**Figure 4:** Tram like bronchial dilatation and thickened bronchial wall



**Figure 6:** Saddle pulmonary artery embolism

**Table 2:** shows grading of hemoptysis due to various causes.

Grading	Tuberculosis	Bronchiactasis	Pneumonia	Infarction	Idiopathic	Vascular
Mild	80	7	9	2	38	0
moderate	30	15	6	0	12	1
Massive	0	0	0	0	0	0
Total	110	22	15	2	50	1

## Discussion

In the present study no malignancy was detected on computed tomography. Patients presenting with hemoptysis and normal chest radiograph are likely to have benign lesions as the cause of hemoptysis and this supports the suggestion of others that the incidence of bronchogenic carcinoma is low in patients with normal or non localizing chest radiograph<sup>4,5</sup>. Over the world there is a marked geographical variation between the causative agents of hemoptysis. Developing world are largely endemic to tuberculosis. Trials have shown tuberculosis to be the major source of hemoptysis in these nations<sup>6</sup>. In the present study the prevalence of tuberculosis is (55%). Occurrences of hemoptysis do not mean that active tuberculosis is present. Hemoptysis may occur as initial manifestation of active disease, during the course of treatment or even after the disease has been apparently cured. In the current study hemoptysis was found in 93 patients with active disease and 17 patients with inactive disease. CT can clearly differentiate active from old healed lesions and presence of centrilobular densities in and around the small vessels with tree in bud appearance are the most characteristic features of activity of the pulmonary tuberculosis on chest CT<sup>7</sup>. Chest radiograph is extremely good for the diagnosis of active pulmonary tuberculosis but minimal exudative tuberculosis can be overlooked on standard chest radiographs.<sup>7</sup> Computed tomography often detects occult parenchyma disease or adenopathy when the chest radiograph is otherwise negative<sup>6</sup>.

Naidich et al, 1990 were the first to describe CT findings in bronchiectasis<sup>8</sup> Because each bronchus is accompanied by a pulmonary artery, bronchiectasis frequently produces a signet sign. Genier et al described thin sections computed tomography findings in bronchiectasis and reported 99% sensitivity of computed tomography in bronchiectasis.

actasis when compared to bronchoscopy. Since then HRCT has almost replaced bronchography in the diagnosis and localization of bronchiectasis. In this study bronchiectasis was found in (11%) and has been reported to vary between 12-34% in various studies<sup>9</sup>. Millar et al, 1992 conducted a prospective study on the role of CT in the investigation of unexplained hemoptysis in 40 patients with normal chest X-ray. Abnormalities were seen in 20 of the CT scans. They suggested that CT scan should precede bronchoscopy in patients with hemoptysis and normal chest radiography, this suggestion is in accord with ours<sup>6</sup>. The chest radiograph is insensitive in diagnosing of the chronic bronchitis and emphysema, and many patients with clinically diagnosed chronic obstructive pulmonary diseases have normal chest radiographs<sup>10</sup>. Small airway disease cannot be visualized directly with current radiographic techniques. However, studies show that pulmonary densitometry parameters calculated on the basis of expiratory CT scans or paired inspiratory and expiratory CT scans allow the indirect evaluation of airway obstruction in patients with various types of obstructive lung disease<sup>11</sup>. Based on this study, the following conclusions made:

1. Pulmonary tuberculosis is still the major cause of hemoptysis in Iraqi Kurdistan.
2. Hemoptysis can occur in both active and inactive tuberculosis and during the course of anti tuberculous therapy.
3. The most characteristic features of activity of the pulmonary tuberculosis on chest CT are centrilobular densities in and around the small vessels with tree in bud appearance
4. Patients presenting with mild –moderate hemoptysis and normal chest radiograph are likely to have benign lesions as the cause of hemoptysis .
5. Patients with high risk of malignancy (more than 40 years and more than 40 pack/year smoking history) with negative chest radiograph, CT and bronchoscopy can be followed with observation

for following three years. This is because several articles have cited cases of hemoptysis with negative chest radiograph and bronchoscopy in which CT subsequently showed malignancy<sup>12,13</sup>.

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