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Extended-Thoracic Imaging of Multi-slice Computed Tomography Technique in the Evaluation of Hemoptysis Resulting from Neoplastic Lesions: Two Cases Study

Shereen E. Amin[1], Ahmed M. Hamed[2], Ehab M. Mohamed[2], Sherief A. Abdelwahab[2]

[1] Department of Radio Diagnosis for Oncology, South Egypt Cancer Institute, Assiut University
[2] Department of Diagnostic Radiology, Faculty of Medicine, Assiut University

Correspondence should be addressed to Shereen Ezzat Amin at Department of Radio Diagnosis for Radiology, South Egypt Cancer Institute, Assiut University Egypt, shereenezzat@yahoo.com

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Abstract

Objective: This study aimed to evaluate the role of multi-detectors computed tomography in patients suffering from hemoptysis, resulting from neoplastic lesions, and aiming to reach proper diagnosis and subsequent proper management.

Methods: This study was carried out on consecutive 13 patients suffering from hemoptysis resulting from malignant thoracic lesions. All patients were subject to complete clinical assessment, laboratory study, roentgen graphic study including Plain chest X-Ray and Multidetector Computed Tomography (MDCT), Multidetector Computed Tomography Angiography (MDCTA), Minimum intensity projection (MIP), 3D volume –rendering images and Virtual Bronchoscopy (VB). VB was also compared with the report of Fiber-optic Bronchoscopy (FOB). Conventional Angiography was performed in selected indicated patients with a digital subtraction technique (DSA). (2 patients only).

Results: 9 male (70%), and 4 female (30%). Based on clinical chest X-RAY, MDCT, DSA , FOB and Histopathology , a source and etiology for bleeding could be identified applying a diagnostic work up in 12 /13 (92%).

Plain radiography was considered successfully contributing in the identification of the cause of hemoptysis in only 38.5% of patients. CT angiography showed enlarged tortuous bronchial feeding vessels in 42% of patients. Bleeding from pulmonary artery was identified in 20%. DSA was performed in 2 patients 15%, indicated for embolization. Fibrooptic bronchoscopy findings were evaluated in 13/13 patients with histopathological confirmation in 12 patients.

Conclusion: The study concluded that MDCT using VB is considered a primary non-invasive imaging modality in the evaluation of patients with hemoptysis resulting from neoplastic lesions.

Introduction:

Hemoptysis is a common clinical problem reported to be the cause of attendance in 10-15% of all pulmonary consultation (1).

Hemoptysis is defined as the spitting of blood that originates from the lower respiratory tract. It is a symptom of potentially serious or even life threatening thoracic disease and warrants urgent and comprehensive evaluation of the lung parenchyma, airways and thoracic vasculatature.(2)

There are wide spectrum etiologies that may cause hemoptysis; in most reports are Malignancy, Bronchiectasis and TB (3)

Recent important technologic advances in CT particularly the development of multi-detector row C.T, have introduced a comprehensive non invasive method of evaluating the entire thorax, allowing detail assessment of the mediastinum and lung parenchyma . At the same time these technologic advances allow high – resolution angiographic studies of the thoracic and upper abdominal vasculature which are useful prior to anticipated bronchial artery embolization or surgical intervention (4).

A hypertrophic bronchial artery larger than 2 mm at CT is most likely abnormal and visualized as enhancing nodular or tubular structure within the mediastinum and around the central airway on contrast –enhanced CT scan (4).

Patients and Methods:

A prospective study was conducted to 13 patients all of them complain of hemoptysis due to neoplastic lesions , they were 9 male and 4 female , their age range 50-85 years old. This study done in South Egypt

Cancer Institute and in Assiut University Hospital from May 2011 to August 2013.

All patients included in the study were subject to plain chest x-ray and MDCT for assessment of the integrity of pulmonary and/or systemic circulation.

Patient's selection:
Inclusion criteria: All patients complain of hemoptysis resulting from neoplastic lesions.

Exclusion criteria: Patients admitted to ICU regardless of amount of bleeding.

Contraindication to CT i.e allergy to iodine contrast, impaired renal function, pregnancy etc.

MDCT examination protocol:

All MDCT studies were performed using 16 multislices system (GE Bright Speed). Stored raw data transferred to a workstation (Dedicated Commercial available work station advantage window 4.4),

Pre and post contrast CT studies were performed to all patients. CT imaging was performed with patients in the supine position at maximal inspiration during a single breath hold.

Acquisition:

First, a scout view of the thorax is used to plan CT data acquisition.

Image acquisition was performed in a craniocaudal direction. A 28-33 cm field of view, 512 x 512 matrix size, a collimation of 1.25mm and 1.5-2 pitch were used. The mean acquisition time was 12-18 seconds.

Every patient received 1.5-2ml/kg of contrast material, at a rate of 3 ml/s with an automated injector device through a 18-20 gauge peripheral intravenous catheter located in the antecubital vein.

Manipulation and interpretation:

For analysis of CT findings, the stored raw data of the 1.25-mm-thick transverse CT scans were transferred to a workstation and interpreted by scrolling through the images. Sequential transverse images were reconstructed at 0.65mm. Multiplanner coronal, coronal oblique and sagittal reformations were reproduced routinely, two dimensional maximum intensity projection (2D MIP) and various three dimensional rendering techniques were applied to be interpreted and subsequently reconstructed. Mediastinal soft tissue, parenchymal lung window and bone window settings were adequately evaluated with section of 5mm and thin section for detailed analysis of airways and lung interstitium.

Stored raw data transferred to a workstation, where 1.25mm-thickness trans-axial images with mediastinal window settings (width, 400HU: level, 20 HU) were evaluated.

A bronchial artery with a diameter of greater than 2mm was considered as abnormal and a source of hemoptysis. Other important aspects, traceability of bronchial artery and extra-vasation of contrast, were considered as specific signs of bronchial bleeding.

Virtual bronchoscopy (VB) performed applying either post or non-contrast axial, coronal and sagital MDCT images.. The VB images of each patient are studied together with the regular axial CT images and other imaging planes. VB was also compared with the report of FOB**.**

Results:

The study included 13 patients. All patients were clinically complaining of hemoptysis resulting from neoplastic lesions. The studied patients included 9 male (70.0%) and 4 female (30.0%). The mean age of patients was 67.15 years (SD 15.67), with a max of 85 years and a min of 50 years.

Final diagnosis was established applying chest X-ray, MDCT, Bronchoscopic examination. Chest radiograph was carried out in all 13 patients , plain radiograph was considered successfully contributing in the identification of cause of hemoptysis in only 5 cases out of 13 cases (38.5%) , MDCT was performed in 13 patients out of 13 patients with positive findings were found in 13 cases out of 13 cases (100%). FOB was performed in 13 patients out of 13 patients had tracheal and bronchial lesions show positive findings in 12 cases out of 13 cases and histopathological confirmation was diagnostic in 12 cases.

Table: Diagnostic Positivity in study group.

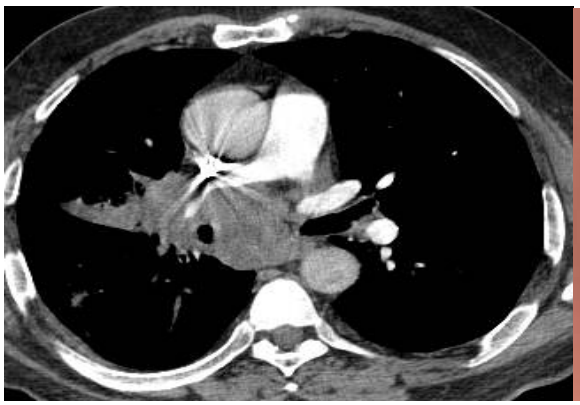
Item	Performance	Positivity
Chest radiography	13	5 (38.5%)
MDCT	13	13 (100.0%)
Fibroptic bronchoscopy ”FOB”	13	12 (92.3%)

Case I:

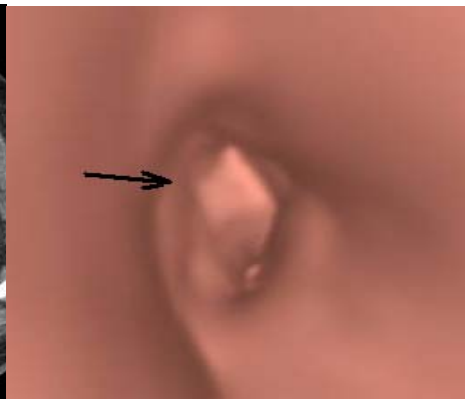
A male patient, 53 years old, known smoker, ***C/O*** of dyspnea and attack of hemoptysis.

Findings:

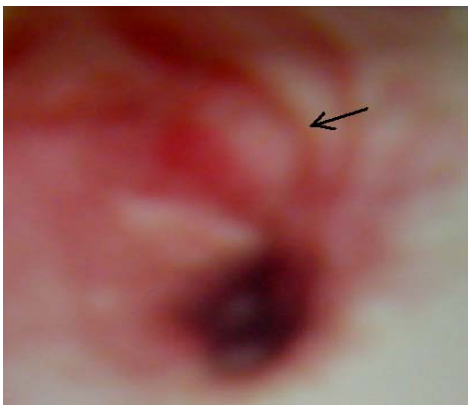
- **A.** Axial CT image showing a large right sided ill defined mass encasing and attenuating the inferior branch of the right main pulmonary artery as well as the bronchus intermedius**,**
- **B.** VB image shows complete occlusion of the middle lobe bronchus and attenuated bronchioles of the lower lobe bronchus,
- **C.** FOB image shows a mass completely obstructing the middle lobe bronchus associated with circumferential narrowing of subsegments of the lower lobe bronchus **,**
- **D.** Coronal reformatting using (IPmin) showing attenuated distal right bronchus intermedius and lower lobe bronchus with complete obstruction of the middle bronchus.



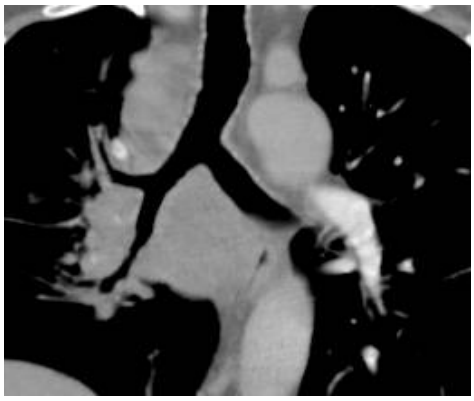
A. Axial CT image (mediastinal).



B.VB image



c. FOB image



D. Coronal reformatted image.

Case II :

- A male patient, 52 years old, ***C/O*** of recurrent attacks of hemoptysis.

Finding:

- Plain X- ray (PA view) : (A) is normal.
- MDCT of the chest: (B,C,D,E &F).*B:* Axial CT image showing pre-vascular lymphadenopathy. *C&D:* Axial CT images showing a large well defined irregular left hilar mass abutting the descending thoracic aorta. A distal consolidation patch is noted. *E & F:* Coronal reformatting using minimum intensity projection (IPmin) showing subtotal occlusion of the left lower lobe bronchus with patent distal bronchioles .Virtual bronchoscopy images: (G,H &I). G: normal appearance of the carina. H: normal appearance of the left main stem bronchus. I: an endo-bronchial mass protruding from the left lower lobe bronchus causing almost total occlusion of the left lower lobe bronchus (arrowed).

Pathology:

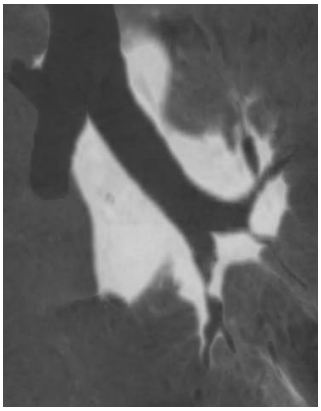
- *FOB:* revealed total obstruction of the left lower lobe bronchus by a mass lesion with inability to bypass the lesion .Bronchoscopy guided biopsy revealed squamous cell carcinoma.

A. Plain X ray image.

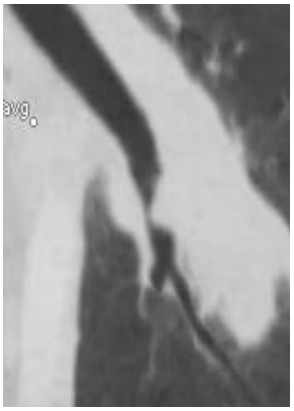
B. Axial CT image.

C. Axial CT image.

D. Axial CT image

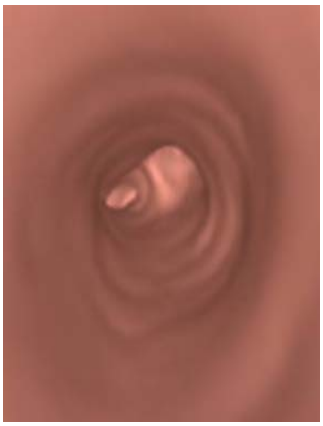


E. Coronal reformatted.



F. Coronal reformatted.

G.VB image.



H.VB image.

I.VB image.

Discussion:

In our study there were positivity of chest radiography showing (38.4%), also positivity of MDCT reached (100%). As regarding positivity for patients who were selected to do FOB were (92.3%). This agree with (5) which found that Potaro-anterior and lateral chest radiography accompanied with a detailed medical history and physical examination is the first step to evaluate a patient presenting with hemoptysis, contrarily finding that the chest radiography defines the site of bleeding only in 46% of patients. This nearly coincides with the results of our study, where chest radiography contributes to the diagnosis of hemoptysis in only 5 of 13 patients. (38.4%)

In the present study, the positivity of MDCT were (100%) this agrees with (6).The pulmonary arteries should always be examined to exclude pulmonary embolism causing hemoptysis. (7) Finding that VB had sensitivity of 100% for the detection of obstructive lesions and of 83 % for the detection of endoluminal non obstructive lesions, however its sensitivity for mucosal abnormalities was 0% and because VB is unsuitable for detection of subtle mucosal lesions, it cannot be used to identify premalignant lesions in the respiratory tract.

In the present study, MDCT with 3D-VB reconstruction was done in patients with tracheal and endobronchial lesions. VB located exactly the stenosis and /or obstruction in addition to underlying extraluminal pathology, it could also delineate the poststenotic or obstructed endoluminal lesions which could not reached by FOB. Limitation of VB in our study coincide with previous studies including inability to depict infraradilogical subtle mucosal lesions as in bronchitis and precancerous pathology.

Consequently (8) found that VB may also aid clinicians in visualizing external non mucosal compression on the bronchial wall that cause bronchial stenosis. These compression may be due to normal anatomic structures, such as the aortic arch and esophagus, or to pathological structures such as enlarged lymph nodes, fibrotic masses and extra luminal tumor. However small compressions are difficult to detect and may be underestimated in 25% of the patients. VB is also useful in patients who require endobronchial evaluation but cannot undergo FOB.

Conclusion:

Applying the findings of the current study, it is concluded that MDCT chest with bronchial and pulmonary angiography is considered a primary noninvasive imaging modality in the evaluation of patients with haemoptysis resulting from neoplastic lesions. It can replace FOB, as the first line of investigation in patient with haemoptysis where bronchoscopy, rigid or flexible fibro optic endoscope, is useful in indentifying a specific endobronchial site of bleeding, biopsy and bronchioalveolar lavage and controlling the airway in patients with catastrophic hemorrhage.

List of Abbreviations:

MDCT	:	Multidetector Computed Tomography.
MDCTA	:	Multidetector Computed Tomography Angiography.
MIP	:	Minimum Intensity Projection
VB	:	Visual Bronchoscopy.
FOB	:	Fiber-Optic Bronchoscopy
DSA	:	Digital Subtraction Angiography.

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