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Role of Multidetecter CT in Diagnosis of Mediastinal Masses

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ABSTRACT

Background*:* The mediastinum is a vital sector of the thorax that contains vital intrathoracic structures such as the heart and great vessels, trachea and main bronchi, esophagus, thymus, venous and lymphatic structures, and nerve tissue. CT is the imaging modality of choice in diagnosis of mediastinal masses. The multiplanar capability of multidetector computed tomography (MDCT) is extremely helpful in delineating the full extent and source of vascularity thus helping in pre-operative planning of these patients.

Objective: Detection of the role of multidetector CT in diagnosis and differentiation of mediastinal masses.

Patients and methods: Forty patients were included in this study (20 females and 20 males), who presented with signs and symptoms suggestive for mediastinal masses. All patients were subjected to detailed history taking, clinical examination, laboratory studies, chest xray and MDCT examination. The correlation was done between the MDCT findings and the final diagnosis. The final diagnosis was made by operative procedures, CT guided biopsy, histopathological results and conservative management

Results: Lymphoma was the commonest mediastinal mass forming 20% of cases , followed by neurogenic tumors (neuroblastoma, , neurofibroma , ganglioneuroma and schwannomatosis) forming about 17.5 % , then retrosternal thyroid (10%), teratoma (5%), thymoma (5%), metastatic lymphadenopathy (5%), esophageal carcinoma (5%), aortic aneurysm (5%), Bochdalek hernia (5%), hiatus hernia (5%), morgagni hernia (5%), esophageal achalasia (5%), esophageal leiomyoma (5%) and paraspinal abscess (2.5%). MDCT sensitivity was 92.86% & MDCT specificity was 100%.

Conclusion: MDCT has a major and reliable role to play in the evaluation and assessment of the mediastinal masses; regarding the organ of origin, its density and mass effect upon adjacent structures, distribution pattern and extent of the lesion.

Key*w*ords: Mediastinal masses, MDCT, Lymphoma, Neurogenic tumors.

INTRODUCTION

The mediastinum is a vital section of the thorax that contains vital structures within the chest such as the heart, large blood vessels, trachea, major airways, esophagus, thymus and venous, lymphatic and neural structures. The division of the equator into specific compartments helps generate differential diagnoses in the initial presentation and facilitates surgical treatment plans. The most common classification is divided into three sections: front, middle and posterior divisions [(1)].

The frontal shear is drawn by the anterior shear, vertical brachial vessels, pericardium, and posterior ascending aorta [(2)]. Its upper and lower limits are the thoracic portal and diaphragm respectively. Its contents include thymus, lymph nodes, fatty tissue and internal mammary vessels [(3)].

The middle mediastinum starts anteriorly from the pericardium and ends posteriorly with the trachea. Important contents of the middle mediastinum are the heart, pericardium, the ascending aorta and arch, the superior vena cava and inferior vena cava, the brachiocephalic vessels, the pulmonary vessels, the trachea, main bronchi and lymph nodes [(4)].

The posterior mediastinum is the anatomical region bordered superiorly by the thoracic inlet, inferiorly by the diaphragm, anteriorly by the pericardium and the great mediastinal vessels, posteriorly by the anterior longitudinal ligament, and laterally by the right and left parietal pleura folds [(5)]**.** It contains the descending thoracic aorta, esophagus, azygos and hemiazygos veins, thoracic duct, lymph nodes, adipose tissue, vagus and splanchnic nerves and autonomic ganglia. Masses arising in the posterior mediastinum are often neurogenic tumours [(6)]**.**

Available modalities for mediastinal mass evaluation include conventional radiography (CR), ultrasound (US), MDCT, magnetic resonance imaging (MRI), and nuclear medicine studies [(7)]**.** Combining the characteristic imaging appearances with clinical information (age, physical examination findings, and laboratory analysis) often can provide a precise diagnosis [(8)].

CT is the imaging modality of choice in diagnosis of mediastinal masses [(9)]**.** The multiplanar capability of multidetector computed tomography (MDCT) is extremely helpful in delineating the full extent and source of vascularity thus helping in pre-operative planning of these patients [(10)]**.**

Specialized 3D reconstruction techniques of MDCT permit the visualization of anatomical details, which would be difficult to evaluate using axial

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reconstructions alone. Such details may require the use of oblique or curved reconstructions [11].

Aim of the work

The aim of this work was to detect the role of multidetector CT in diagnosis and differentiation of mediastinal masses.

PATIENTS AND METHODS

Forty patients were included in this study (20 females and 20 males). Their age ranged between 6 to 71 years with a mean age of 39.85 ± 21.13. The patients were referred to the Radio-diagnosis and Medical Imaging Department, Faculty of Medicine, Tanta University and National Cancer Institute from the Outpatient Clinics. The study included patients who presented with signs and symptoms suggestive for mediastinal masses. The research started on May 2017. **The study protocol was approved by the Research Ethics Committee of Faculty of Medicine, Tanta University. All patients signed an informed consent.**

Inclusion criteria:

Patients suspected to have mediastinal masses, which are totally or partially included in mediastinum .

Exclusion criteria

- Pregnant women.
- Patients with chronic renal impairment if contrast media is necessary.
- Patients with previous allergy to contrast media.

All the studied patients were subjected to the following:

1- Detailed history taking and examination

- The patient's history included personal data, history of presenting complain, any relevant past history, menstrual and obstetric histories.
- General, neck and abdominal examination.

2- Laboratory Investigations

- Including renal function tests (urea and serum creatinine), CBC, thyroid function tests.

3- Plain x-ray of the chest.

4- Multi-Detector CT of the chest including both pulmonary and mediastinal windows.

5- The feedback of the medical, surgical and histopathological data that obtained either after surgical operation or CT guided biopsy.

The MDCT equipment:

The study was carried out by using General electric Optima CT660 128 slice and Toshiba Asteion 4 slice CT scanner. The scanning parameters used were: 200-350 mAs, 120 KVP, tube rotation time of 0.3 s/rotation for 128 slices MDCT machine and 0.75 s/rotation for 4 slices MDCT machine, 1.5-2 mm slice thickness and 1 mm reconstruction increment.

MDCT imaging protocol:

At first, we explained the examination to the patient. Total immobilization of the patient during the examination is of vital importance.

Before starting the imaging, the following steps should be considered:

- For the display of soft tissues, a window level of 40 HU and a window width between 400 and 700 HU were selected; these provided enough contrast between fat and air. A window level between 40 and 300 HU and a window width between 2400 and 3200 HU were selected for imaging of bony structures.
- Patients were placed in the supine position and headfirst position.
- Scanning was planned from the level of the lung apex down to end of both costophrenic angles in a single breath hold.
- Pre-contrast scan was obtained followed by IV contrast injection. Contrast administration was performed using power injector (Vistron CT injector). Nonionic water soluble contrast (Ultra vist) was used in all patients using wide bore cannula (18-20 G) inserted in peripheral vein. The injected amount ranged from 100-140 ml at rate of 3-3.5 cc/sec.
- Use of intravenous contrast material had been shown to improve CT evaluation of alternative diagnoses. Oral contrast material was used in cases with suspected esophageal lesions (4 cases) and 2 cases of suspected diaphragmatic hernia.

Post processing:

Image reconstruction and manipulation were performed on a workstation (Vitrea). Many post-processing techniques, such as MPR, MIP, curved MPR and VRT were done in many cases. However, inspection of the axial source images remains an essential part of the assessment.

Final Diagnosis:

The final diagnosis was made by the following:

- **Biopsy and histopathological examination** (19 cases).
- **Conservative:** Patients who were successfully managed conservatively (10 cases).
- **Histopathological examination:** of the operatively excised pathological lesions (11 cases).

Correlation:

The correlation was done between the CT findings and the final diagnosis.

Statistical analysis of the data:

Statistical data of the present study were analyzed using IBM SPSS Statistics for Windows, Version 20.0. Armonk, NY: IBM Corp. Numerical data were expressed as a mean and standard deviation and range. Qualitative data were expressed as

frequency and percentage. Agreement of the different predictives with the outcome was used and was expressed in sensitivity, specificity, positive predictive value, negative predictive value, and accuracy. The P values of each predictive variable calculated by using the Chi-square test. The probability of error at 0.05 was considered significant, while at 0.01 and 0.001 are highly significant.

RESULTS

This study was conducted on 40 patients, their ages ranged from 6 to 71 years. 20 patients (50%) out of the 40 patients were females and the remaining 20 (50%) were males. Mean age was 39.85 years. 20% of them were below 20 years old, 25% ranging from 20-40 years old, another 25% from 40-60 years and 30% above 60years old (Table 1).

Table (1): Distribution of the studied cases according to demographic data (n=40)

	No.	%
Sex		
Male	20	50.0
Female	20	50.0
Age (years)		
< 20	8	20.0
20 -	10	25.0
40 -	10	25.0
≥ 60	12	30.0
Min. – Max.	6.0 – 71.0	
Mean ± SD.	39.85 ± 21.13	
Median	46.0	

Patients were presented with different presentations and history; cough was the most common clinical symptom in 15 patients (37.5%), weight loss in 13 patients (32.5%), respiratory insufficiency (e.g. dyspnea, difficulty of breathing, respiratory distress, tachypnea…etc) in 12 patients (30%), Dysphagia in 12 patients (30%), and fever in 7 patients (17.5%) Table (2).

Table (2): Distribution of the studied cases according to clinical presentations (n=40)

Clinical presentations	No.	%
Cough	15	37.5
Fever	7	17.5
Dyspnea	12	30.0
Weight loss	13	32.5
Dysphagia	12	30.0

As regards the classification of mediastinal masses according to anatomical site; anterior mediastinal masses were found in 16 cases (40%), middle mediastinal masses were found in 8 cases (20%), posterior mediastinal masses were noted in 16 cases (40%) (Table 3).

Table (3): Distribution of the studied cases according to anatomical site (n=40)

Anatomical site	No.	%
Anterior	15	37.5
Middle	12	30.0
Posterior	13	32.5

In our study, of anterior mediastinal masses, 6 mediastinal masses were lymphoma forming 37.5% , retrosternal thyroid were found in 4 cases (25%) and mature teratoma, Morgagni hernia & thymoma were found in 2 cases each (12.5%). In middle mediastinum, 2 cases were found for each aortic aneurysm, Hiatus hernia, lymphoma & metastatic lymphadenopathy forming 25% each. In the posterior mediastinum, neurogenic tumors were found in 7 cases (2 cases neuroblastoma, 2 cases shwannomatosis, 2 cases neurofibroma & 1 case ganglioneuroma) forming about 70% of cases, Bochdalek hernia in 2 cases (12.5 %), 2 cases (12.5%) for each esophageal carcinoma, esophageal leiomyoma & esophageal achalasia. Paraspinal abscess was found in one case (6.3%).

Lymphoma was the commonest mediastinal mass forming 20% of cases , followed by neurogenic tumors (neuroblastoma, neurofibroma, ganglioneuroma and schwannomatosis) forming about 17.5 %, then retrosternal thyroid (10%), teratoma (5%), thymoma (5%), metastatic lymphadenopathy (5%), esophageal carcinoma (5%), aortic aneurysm (5%), Bochdalek hernia (5%), hiatus hernia (5%), Morgagni hernia (5%), esophageal achalasia (5%), esophageal leiomyoma (5%) and paraspinal abscess (2.5%).

Concerning masses that were preliminary diagnosed by MDCT chest (owing to the patient's clinical data), they were 40 masses including most frequently (8) cases lymphoma (4) cases retrosternal thyroid, (3) cases for neuroblastoma and teratoma, (2) cases for each of Morgagni hernia, aortic aneurysm, esophageal carcinoma, esophageal leiomyoma, metastatic lymphadenopathy, neurofibroma, shwannomatosis, Bochdalek hernia, hiatus hernia and esophageal achalasia. Only, one case for paraspinal abscess and thymoma. However, the case, which was proved pathologically to be ganglioneuroma, was diagnosed as neuroblastoma by MDCT and one case, which was proved pathologically to be thymoma, was diagnosed as teratoma by MDCT (table 4). Therefore, MDCT sensitivity was 92.86% & MDCT specificity was 100% (table 5).

Table (4): Differences of the studied cases between both CT diagnosis and pathology

Pathology	No.	CT Diagnosis	No.
Mature teratoma	2	**Mature teratoma**	3
Aortic aneurysm	2	**Aortic aneurysm**	2
Bochdalek hernia	2	**Bochdalek hernia**	2
Hiatus hernia	2	**Hiatus hernia**	2
Morgagni hernia	2	**Morgagni hernia**	2
Neuroblastoma	2	**Neuroblastoma**	3
Neurofibroma	2	**Neurofibroma**	2
Oesophageal achalasia	2	**Oesophageal achalasia**	2
Oesophageal leiomyoma	2	**Oesophageal leiomyoma**	2
Paraspinal abscess	1	**Paraspinal abscess**	1
Retrosternal thyroid	4	**Retrosternal thyroid**	4
Schwannomatosis	2	**Schwannomatosis**	2
Ganglioneuroma	1		
Lymphoma	8	**Lymphoma**	8
Metastatic lymphadenopathy	2	**Metastatic lymphadenopathy**	2
Esophageal carcinoma	2	**Esophageal carcinoma**	2
Thymoma	2	**Thymoma**	1

Table (5): Agreement (sensitivity, specificity and accuracy) for CT Diagnosis

		Pathological		Sensitivity	Specificity	PPV	NPV
		Benign	**Malignant**				
CT Diagnosis	**Benign**	26	1	92.86	100.0	100.0	96.30
	Malignant	0	13				
Total		**26**	**14**				
□□(FEp)		35.767*(<0.001*)					

χ^2: **Chi square test** FE**: Fisher Exact**

P: p value for comparing between the two categories, *: Statistically significant at $p \leq 0.05$

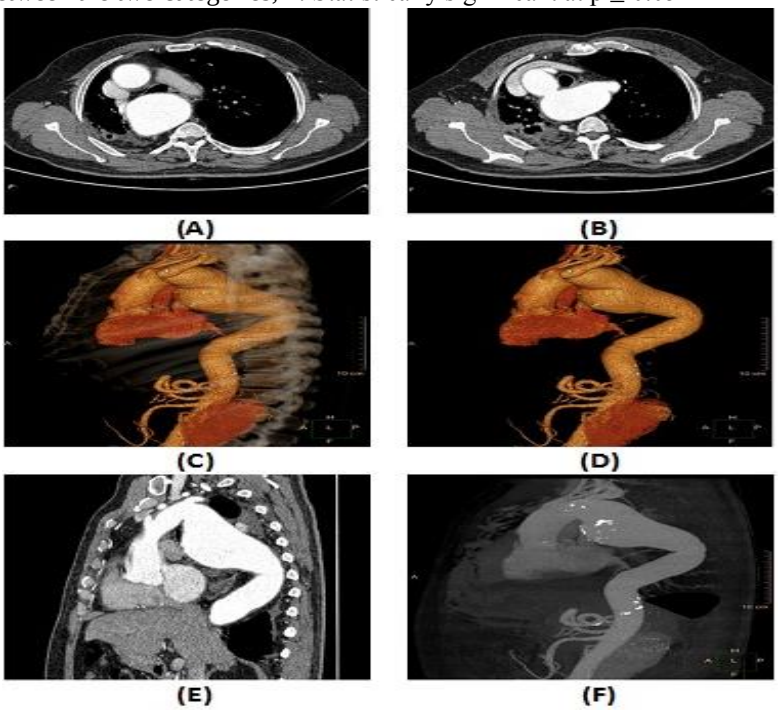

Figure (1): Case of right sided aortic arch with aberrant left subclavian artery and aortic aneurysm in a male patient aged 60 years old presented with dyspnea, dysphagia and chest pain. (A, B) post-contrast axial CT images showed right sided aortic arch with aberrant left subclavian artery and aneurysmal dilatation of proximal part descending aorta and first centimeters of left subclavian artery. Mild atherosclerotic changes are also noted. No dissection could be detected. (C, D) volume rendering imaging technique. (E) sagittal reconstructed image with curved image technique. (F) MIP imaging technique.

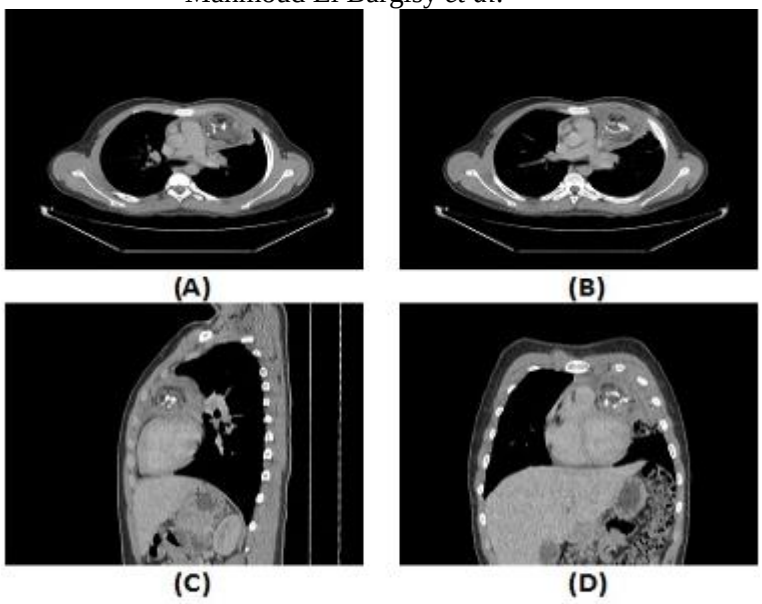

Figure (2): Mediastinal teratoma in a female patient aged 30 years old presenting with cough. (A, B) axial post contrast CT images showed well defined anterior mediastinal mass lesion with fat density and calcification inside measuring about 8.5 x 6.5 cm in maximal axial dimensions with adjacent left lower lung lobe pneumonitis. (C, D) coronal and sagittal reconstructed images.

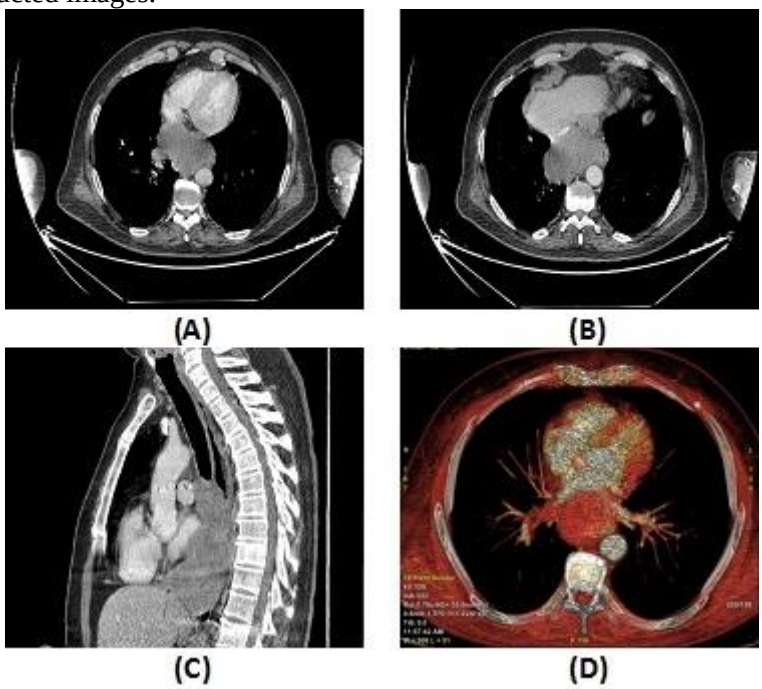

Figure (3): Esophageal carcinoma in a male patient aged 51 years old, condition started with dysphagia. (A, B) post IV and oral swallow contrast axial CT images show irregular well defined large irregular shaped enhanced soft tissue mass lesion. (C) sagittal reconstructed image showed extension of the mass lesion. (D) volume rendering technique image.

DISCUSSION

Mediastinal tumours are uncommon lesions encountered in clinical practice. There has been a significant increase in the incidence of malignant mediastinal tumours over the past four decades [(12)]. The presentation varies from asymptomatic lesions detected incidentally on imaging to severe life threatening presentations [(13)].CT is the standard imaging study if there is any suspicion of a mediastinal mass in X-ray. CT of the chest provides identification of the nature of the mass, its relation with the surrounding tissues and density of the mass. MDCT has greater accuracy in detection of mediastinal lesions. MDCT allows detailed evaluation of the all thorax in a breath hold without loss of the resolution and more consistent contrast enhancement with a single bolus of the contrast. Thus, MDCT decreases

the cost of examination. Moreover, it is rapid, available and inexpensive [14].

In our study, 40 cases of mediastinal masses were evaluated most of them were in the 3rd and 5th decade, with a mean age of 39.85 years. This is consistent with **Aroor *et al.*** [12] who had 35 cases of mediastinal masses and mean age was 45.4 years.

In our study, the majority of masses were in the anterior mediastinum 40% and posterior mediastinum 40% then middle mediastinum 20%. This was in agreement with the study of **Tekada *et al.*** [15] where anterior mediastinal mass represented 43%, followed by posterior mediastinal mass 40% then middle mediastinal mass 18%. In addition, **Aroor *et al.*** [12] reported that anterior mediastinal masses represented 42.86%. While in the study of **Gun *et al.*** [16] posterior mediastinal masses represented 43.8%, followed by 31.4% in the anterior and 24.7% in the middle mediastinum. Cough and weight loss were the commonest symptoms seen in 28 cases (70%), followed by dyspnea in12 cases (30%) and dysphagia in 12 cases (30%). This was consistent with the study of **Aroor *et al.*** [12] where cough and dyspnea seen in 20 cases (57.14%), followed by dyspnea and dysphagia in 16 cases (45.71%) each.

Our results demonstrated that thymoma accounted for 5% of mediastinal masses and germ cell tumors constituted about 5 % of mediastinal masses. While, intrathoracic extension of thyroid lesions represented approximately 10% of mediastinal masses. These results were comparable with those of ***Azizad et al. 2016*** [4] who stated that thymoma accounts for 15%-20% of primary mediastinal masses, germ cell tumors constitute approximately 10% of primary mediastinal masses and intrathoracic extension of thyroid lesions represents approximately 10% of mediastinal masses.

In patients with lymphoma, the most common thoracic abnormality is mediastinal lymph node involvement that was consistent with those of **Azizad *et al.*** [4] and **Bakan *et al.*** [17]**.**In our study, neurogenic tumours were the most common posterior mediastinal mass (43.8% nearly) that is in agreement with the study of **Gun *et al.*** [16] where neuroblastoma was 63% and ganglioneuroma was 13% .

CONCLUSION

We concluded that MDCT definitely has a major and reliable role to play in the evaluation and assessment of the mediastinal masses; regarding the organ of origin, its density and mass effect upon adjacent structures, distribution pattern and extent of the lesion.

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