Original Article

Diagnostic Role of Computed Tomography in Evaluation of Mediastinal Masses

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Abstract

The study was carried out in radiology department of Mayo Hospital, Lahore, in 2009. The objective of this study was to calculate the sensitivity and specificity of computed tomography in evaluation of mediastinal masses. All patients underwent helical CT with I/V contrast. Out of 100 patients 31 were having metastatic disease with sensitivity and specificity 67.0% and 84.0%, 24 patients were tuberculous with sensitivity and specificity 66.0% and 86.0%, 19 patients had lymphoma with sensitivity and specificity 47.0% and 90.0% respectively 26 patients had other masses. The overall sensitivity and specificity was 60.0% and 86.0%, respectively. It was concluded that although generally CT is unable to differentiate between various etiologies of mediastinal masses yet it cannot only support the diagnosis but often can lead to some specific diagnosis by certain attenuation factors like water, fat and calcium. So it is an investigation of choice after plain chest radiography.

Keywords: Helical CT, Mediastinal masses, histopathology.

Introduction

Mediastinum might be affected by tumors, cysts, vascular anomalies and lymph node masses. These lesions are challenging problems frequently faced by the radiologist and often a plain chest radiograph is inadequate for answering the queries posed by the physicians.[1]

Previously people have been using invasive procedures like aortography[2] or surgery (mediastinoscopy or thoracotomy). Now computed tomography (CT) has been described as a useful non-invasive modality in evaluation of mediastinal widening.[3-5]

CT scan accurately differentiates between vascular and non-vascular causes of mediastinal widening and often a specific and correct diagnosis can be made thus obviating further and more invasive diagnostic procedures.

The CT scan disclose the hidden mediastinal pathology when there is no obvious contour abnormality of mediastinum on plain chest radiography. CT demonstrates the exact size, shape, site, extent and contour of mediastinal masses. It differentiates vascular from neoplastic masses and is particularly useful for evaluating regions poorly demonstrated on conventional radiography e.g., the retrocrural, retrosternal or subcarinal areas. Moreover the dynamic contrast enhanced spiral CT is an excellent method of demonstrating vascular pathology in

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the mediastinum e.g., aneurysm thrombosis etc.[6-9]

CT demonstration of fat, calcium or water attenuation in a mediastinal mass often suggests a specific diagnosis.[10-13]

CT is very helpful for surgeons to know about the extent of the lesion and whether it can be resected or not, so greatly affecting the management of the patient.[14]

This study looks into the validity of CT for prompt diagnosis of the disease in patients presenting with mediastinal widening and / or hilar pathology on plain chest radiograph. Thus it would help the clinician to shortlist the other unnecessary investigations and provide early treatment to the patients.

Objectives

To calculate the sensitivity and specificity of computed tomography in evaluation of mediastinal masses using histopathology as gold standard.

Material and Methods

First 100 consecutive patients of all age groups including male and female with mediastinal widening and or hilar pathology on plain chest radiograph. The patients with congenital anomalies of chest, postoperative and trauma cases were not included. Every patient underwent helical CT chest and 10 mm contiguous axial slices were taken from thoracic inlet down upto the level of adrenals while patient lying supine on couch with his upper extremities above and alongside his head. I/V contrast of injection urograffin 1 ml/kg body weight was given in all cases. The obtained images were examined in both mediastinal and lung windows. The 3D saggital and coronal reconstruction was done in complicated and problomatic cases.

The mediastinal mass was defined as an abnormal soft tissue structure that exceeded 1cm in short axis thus avoiding confusion with normal sized mediastinal lymph nodes. The following information was recorded from acquired CT images: location of mass whether in anterior, middle or posterior mediastinum, size, number, margins and density of mass, then enhancement pattern, calcification within mass, involvement of surrounding structures, associated lung changes, bony involvement, pleural or pericardial effusion. All these findings were interpreted as CT diagnosis which was compared with histopathology (gold standard).

The data was analyzed while comparing the CT diagnosis with histopathologic diagnosis. The data was also exhibited in the form of different tables and graphs. Then at the end various percentages were calculated regarding sensitivity, specificity and predictive values of most frequently found mediastinal masses i.e. metastases, tuberculosis and lymphomas and not for other masses as the number was too small to give any statistically significant value. However an overall sensitivity, specificity predictive values for all masses were also calculated.

Results

Results are described in the form of tables as given below.

Table 1: Mediastinal distribution of masses according to number of cases.

Mediastinum	= n	% age
Anterior Mediastinum	31	31
Middle mediastinum	33	33
Posterior mediastinum	8	8
Anterior and middle	21	21
Middle and posterior	3	3
Anterior, middle and posterior mediastinum	4	4

Table 2: Distribution of disease by diagnosis.

Disease	= n	% age
Metastatic	31	31
T.B.	24	24
Lymphoma	19	19
Thyroid masses	9	9
Lung masses directly invading mediastinum	6	6
Ca-oesophagus	4	4
Thymoma	2	2
Lipomatosis	1	1
Anterior – chest wall Sarcoma	1	1
Teratoma	1	1
Right Atrial Myxoma	1	1

Fibrosacoma spine	1	1

Table 3: Net Results.

Disease	Sensitivity	Specificity	Positive Predictive Value	Negative Predictive Value
Metastasis	67.0%	84.0%	63.6%	85.3%
Pulmonary TB	66.0%	86.0%	61.5%	89.2%
Lymphoma	47.0%	90.0%	52.9%	87.9%
Overall masses	60.0%	86.0%	59.4%	86.3%

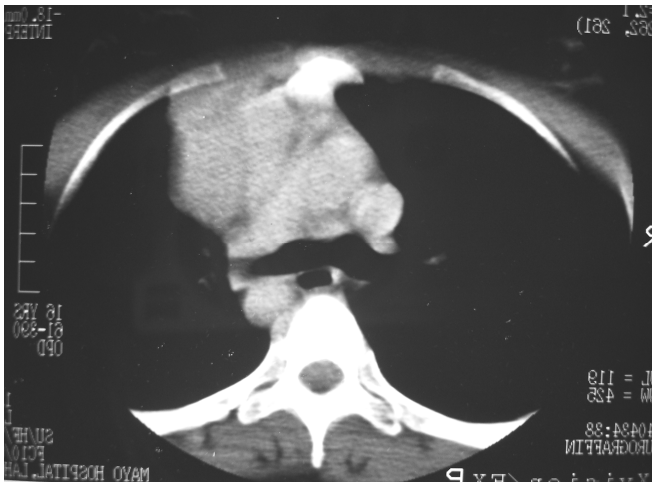

Fig. 1: Anterior Mediastinal Mass—Thymoma

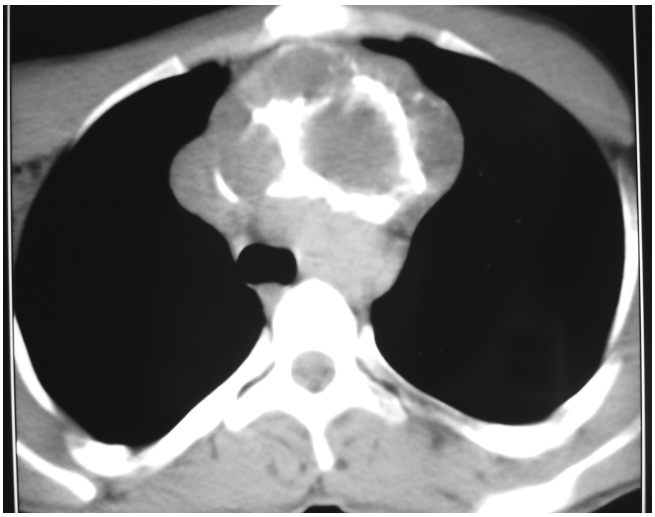

Fig. 3: Anterior Mediastinal Mass--Teratoma

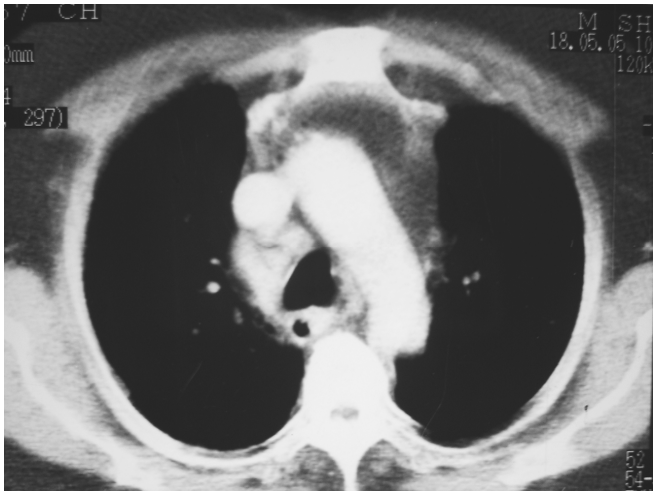

Fig. 2: Anterior Mediastinal Mass—Lipomatosis

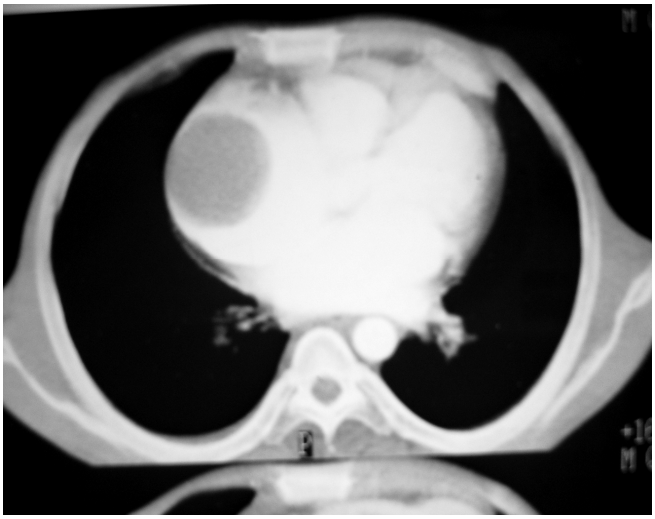

Fig. 4: Middle Mediastinal Mass—Right Atrial Myxoma

Discussion

There are many types of mediastinal masses but majority of them are metastatic, tuberculous and lymphomas and this was seen in our study as well which shows metastatic masses 31/100 (31%), tuberculous 24/100 (24%) and

lymphomas 19/100 (19%).

Plain chest radiography is the usual screening tool for detecting mediastinal masses but a limited differential diagnosis can be made based on abnormal chest radiograph[14] because it has got limited contrast resolution. In a study carried out by Fon GT, Bein ME and Mancuso demonstrated in the CT the thymoma in 14 out of 16 patients with myasthenia gravis while conventional radiograph detected the lesion in only 9 of 16.[15]

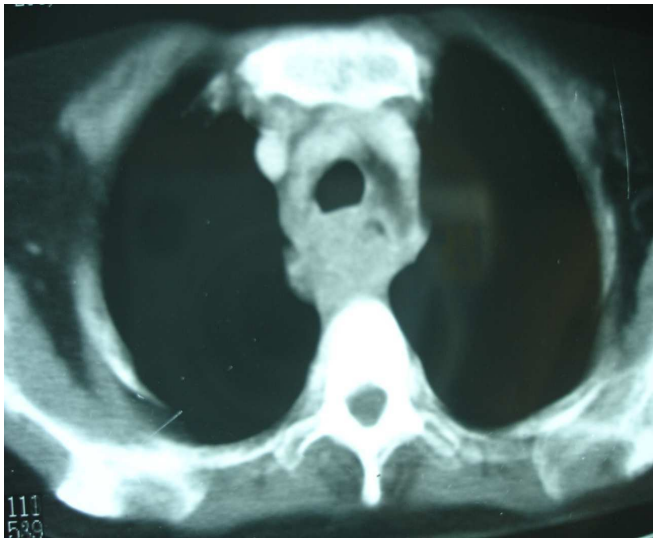

Fig. 5: Posterior Mediastinal Mass—CA Oesophagus

CT provides better contrast resolution depicting the exact size, shape, number and contour of mediastinal masses, so it has higher sensitivity in detecting the lesion. It can show multiplicity of the masses thus excluding the diseases such as thymoma, teratoma or thyroid masses. Moreover it can clearly quote specific anatomic location of mediastinal masses and can show associated abnormalities of chest in upper abdomen like focal lesion in liver, adrenals or spleen thus helping in diagnosis.

But CT generally could not distinguish between lymphoma and metastasis. Histological examination of the lymph nodes is the only 100% accurate method of detecting metastatic disease. Even the pathologist cannot predict the lymph node involvement by tumor after examining these macroscopically because enlarged lymph nodes may be free of tumor and nodes of normal size may contain metastases. Moreover the accuracy of CT in detection of hilar involvement by tumor is limited.[16]

A study was carried out in 2003 by Schillaci O and Colleagues on mediastinal lymph node involvement in non-small cell lung cancer which showed CT sensitivity and specificity 68.6% and 75.0% respectively for metastatic lymph nodes.[17] The sensitivity and specificity for nodal metastasis in my study was 67.0% and 84.0% respectively.

In another study by Olivetti L and others regarding evaluation of metastatic spread to hilar and mediastinal lymph nodes the false negative rate was higher with traditional radiology than with CT; on the other hand there was a higher false positive rate with CT[18]. This was also seen in our study as well.

The research performed by white PG and colleagues showed sensitivity 61% and specificity 76% for nodal metastasis.[19]

In still another study conducted by Man Fredi R and others revealed sensitivity and specificity for nodal metastasis as 82.0% and 88.0% respectively.[20]

A comparative study was done by Schillaci et al regarding nodal metastasis. Lymph nodes were evaluated both by 99 mTc tetrofosmin SPECT and CT. In this case CT showed sensitivity and specificity 68.6% and 75.0%.[21] The sensitivity of CT for metastasis in the detection of tumor involvement of higher structures is only 54%.[22]

CT can help in staging the mediastinal neoplasms[23] as this was also shown in a study conducted by Rendin EA and associates. In this the sensitivity and specificity was found to be 46% and 85% respectively with positive and negative predictive values of 78% and 58% respectively.[24]

The sensitivity and specificity in case of lymphomas was found to be 47% and 90% respectively in my study. Accuracy of chest radiographs in the detection of hilar involvement in patients with lung cancer has been reported to be 61 – 71%. Glazer et al reported 94% CT accuracy.[25]

The size of lymph nodes suggests whether it is benign or malignant. According to Lee TKT and Korobkin's experience the lymph nodes larger than 1.5cm are usually malignant, those between 1.0 and 1.5 cm are suggestive of malignancy and those less than 1.0 cm are benign. Moreover necrosis in lymph nodes indicates that disease is aggressive and has a high degree of malignancy.[26]

Generally tuberculosis is the commonest cause of lymphadenopathy in developing countries like in Pakistan. Also in my study there were fair number of cases (24/100) having tuberculous mediastinal lymphadenopathy. Lymphadenopathy with or without concomitant parenchymal lesion is a radiologic hallmark of TB. Sometimes even on high quality plain chest radiographs it is difficult to pick up the hidden lymph nodes and

parenchymal abnormality but CT is very sensitive to disclose these lesions. Moreover centrally caseating necrotic lymph nodes with rim enhancement is characteristic of TB.[27]

Off course it is very difficult to differentiate between various mediastinal masses on CT however certain attenuation factors have proven relative specificity like calcification in cases of teratoma,[28] metastatic ossifying osteogenic sarcoma[29] and benign toxic nodular goiter. The diagnosis of mediastinal teratoma is usually established by demonstration of thick walled cystic mass containing fat, soft tissue and calcification as it was also seen in this study.[30]

Calcified foci in a lesion give very important diagnostic clue e.g. calcified lymph nodes usually indicate PTB further supported by parenchymal lesion. CT has been proved more sensitive for the detection of calcification than plain film.[31] In my study calcification was seen in 17/100 cases (8 cases of thyroid – 7 benign and malignant, 5 cases of PTB and 4 cases of metastases and 1 case of teratoma).

CT is highly specific for fatty lesions. There was a single case of mediastinal lipomatosis in this study which had purely fat density pathognomic of fat lesion later on confirmed by histopathology.[32]

CT is very much helpful in diagnosing water attenuating lesions like bronchogenic cyst.[33]

CT can pick up rare middle mediastinal masses like cardiac myxomas and thrombotic masses.[34] There was one case of right atrial myxoma in my study, which was confirmed by histopathology.

CT accurately delineates tracheobronchial compromise which may be missed on plain chest radiograph. Tracheal compression was seen in my study in 16 out of 100 cases. The importance of this finding is that one can tell the anesthetist the degree or percentage of tracheal compression; more than 50% patency is safe for endotracheal intubation.[35]

No doubt that CT is a good investigation for most of mediastinal masses but in case of posterior mediastinal masses especially paraspinal tumors MRI is a preferred modality which clearly delineates intraspinal extension of mass as well. Now despite of increasing application of MR imaging this technique has limited role relative to CT in evaluation of mediastinal masses because of limitations in spatial resolution, prolonged scanning times and relatively high cost.[36] So CT is the choice of investigation after plain chest radiograph.

Conclusion

Off course generally CT is unable to differentiate between various etiologies of mediastinal masses yet it has got higher sensitivity in disclosing the exact size, shape, number, specific anatomic location and extent of disease with involvement of surrounding structures. Certain associated findings like focal lesions in lungs, liver, spleen and adrenals, then associated cervical, axillary or intra-abdominal lymphadenopathy greatly support the CT diagnosis. Moreover certain attenuation factors like fat, water and calcium present in a mass can often lead to some specific diagnosis. So CT is still an investigation of choice after plain chest radiograph.

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