Original Article

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Role of Computed Tomography in the Evaluation of Mediastinal Masses and its Correlation with Histopathological Diagnosis

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Abstract

Background: To assess the role of Computed Tomography in the Evaluation of Mediastinal Masses and its correlation with the histopathological diagnosis. **Subjects and Methods**: A prospective study done in the Radiodiagnosis department, Narayana medical college. The study population included 30 patients who underwent CT evaluation in our institution from January 2018 to December 2020. Patients of clinically suspected mediastinal masses with symptoms and incidentally detected mediastinal masses on chest radiograph were investigated by CT scan and subsequently proved by histopathology where possible. **Results**: Out of the thirty cases, the most commonly involved compartment was the anterior mediastinum (19 cases), followed by the posterior (8 cases) and middle mediastinum (3 cases). Among the 30 cases, 28 cases (94%) were predicted accurately by CT compared with histopathology. **Conclusion**: CT yields diagnostic information that facilitates the distinction of disease processes and tumours involving the mediastinum. In a specific clinical setting, variables such as attenuation, calcification, contrast enhancement, relationship to adjoining mediastinal structures, and related intrathoracic findings can be suggestive of a selected diagnosis.

Keywords: CT - Computed Tomography, MDCT- Multidetector Computed Tomography, MPR- Multi-planar reforms).

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Introduction

Mediastinal masses comprise a wide spectrum of tumours seen within the chest and remain an engrossing diagnostic challenge affecting people of all ages.[1] A compelling increase in the incidence of malignant mediastinal tumours has been reported over the past decades. The evaluation of mediastinal abnormalities often poses a challenge in the radiographic diagnosis due to its complex anatomical location. The various conditions affecting the mediastinum include tumours, cysts, vascular anomalies, lymph node masses, and mediastinal fibrosis.[2]

Computed tomography (CT) imaging of the mediastinum is the investigation of choice for the mediastinal lesions, which determines accurate anatomic details aiding precise localization of lesions along with delineation of the adjacent structures.

Multidetector computed tomography (MDCT) is useful in the investigation, specification, and demonstration of the stretch of a mediastinal mass. MDCT following administration of intravenous contrast medium with multi-planar reforms (MPR) provides an admirable assessment of the mediastinal structures, including vessels, and has largely headed off the need to proceed to other investigations.[3]

The anatomical classification system aids to meticulously confine and characterize mediastinal lesions. Based on MDCT, the mediastinum is diverged as anterior, middle, and posterior compartments. The present study was endured to analyze the MDCT peculiarities in the evaluation of mediastinal masses in pediatric and adult patients, based on the anatomical classification. Diagnostic fine-needle aspiration or core biopsy for benign and malignant disease processes are safe and highly accurate procedures.[4]

Subjects and Methods

Subjects: A two-year prospective study was conducted on 30 patients at Narayana Medical College and Hospital from

January 2018 to December 2020 after taking informed consent. The study included patients of clinically suspected mediastinal mass with symptoms or incidentally detected mediastinal masses on chest radiograph.

All the patients were investigated by CT scan and subsequently proved by histopathology where possible. Patients with prior treatment elsewhere on presentation, recurrent mediastinal masses after treatment, abnormal renal function test, and contrast sensitivity were excluded from our study.

Preparation of the patient

Patients were advised nil per oral 4 hrs before the CT scan to avoid complications after contrast injection. The patients were explained priorly about the risk of contrast administration, and consent was obtained for the contrast study.

Technique

To begin with, a routine anteroposterior topogram of the chest was taken in all patients in the supine position. Axial sections were acquired from the thoracic inlet to suprarenal level. In all the patients, the pre-contrast study was followed by a post-contrast study; image acquisition was made with intermittent suspended inspiration. For the post-contrast study, 80-100ml of dynamic intravenous injection of IOHEXOL (OMNIPAQUE) at a dose of 1ml/kg was given.Wherever necessary, sagittal and coronal reconstructions were used. The magnification mode was commonly employed. The scans were assessed on a console display at various window settings (i.e., soft tissue, lung, and bone windows) to examine the variety of tissue density and look for osseous involvement. Diversified findings were studied, in particular, the pre and post-contrast attenuation values, size, location of the mass, presence of calcification and mass effect on adjoining structures.

Results

In our study, the most commonly involved compartment was the anterior mediastinum (19 cases, 63.3%), followed by the posterior (8 cases, 26.7%) and middle mediastinum (3 cases, 10.0%) respectively. Lymphoma was the most familiar lesion in the anterior mediastinum (6 cases, 31.6%), Carcinoma Oesophagus in the middle mediastinum (2 cases, 66.7%), and Schwannoma (3 cases, 37.5%) being common in the posterior mediastinum. The peer group of our cases were within 45 to 60 years, with only 4 cases of the pediatric age (i.e., up to 18 years of age).

Amid all 30 cases of mediastinal masses, 53.3% malignant, and 46.7% benign. Malignant lesions were predominant over benign in our analysis with a male population preference, whereas benign lesions have almost equal distribution.

There were also age group differences, with a high incidence of benign lesions between the $2^{nd}$and 4^{th} decades while malignancy between the 4^{th} and 6^{th} decades.

It was observed that the most common clinical symptom is the cough constituting about 75 %, followed by dyspnea 52 %, chest pain 21.4%, and fever 14.6%. The most frequent symptoms were vague, like cough, chest pain, fever, dysphagia, etc. Symptoms were relative to the location or the mass and predominantly due to the mass effect from the mediastinal lesions. Cough and dyspnoea were common presenting symptoms in the anterior mediastinal masses, presumably as a result of tracheal compression, whereas middle mediastinal lesions presented with dysphagia owing to either involvement of the esophagus or its compression.

On contrast enhancement, out of 30 patients, 5 (16.7%) cases show homogenous enhancement, and 25 cases (83.3%) show heterogeneous enhancement.

Among the 30 cases, 26cases (87%) endured CT-guided biopsy of the lesions. One case of oesophageal leiomyoma had an endoscopic ultrasound-guided biopsy. Histopathology was procured from a surgical resection specimen in the remaining three patients.

Thirty cases of mediastinal lesions: 28 cases (94%) were predicted accurately by CT on comparision with histopathology.

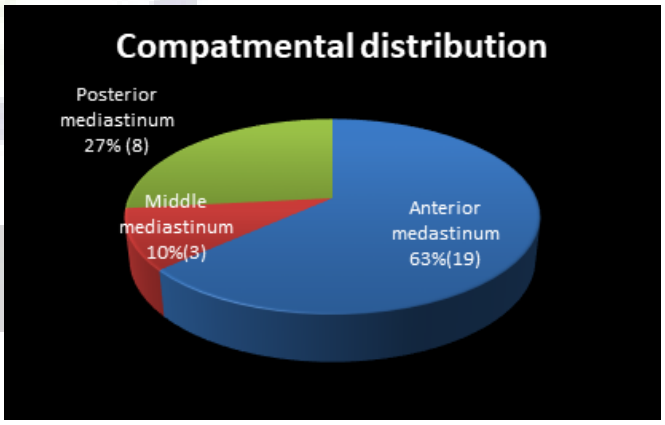

Chart 1: **A chart demonstrating the compartmental distribution of mediastinum masses**

Discussion

The mediastinum is the extrapleural space amid the two pleural spaces within the thorax. It spreads out anteriorly from the sternum to the vertebral column posteriorly. The thoracic inlet forms the upper limit, and the diaphragm forms the lower limit. The mediastinum is split into many compartments in an attempt to evolve a differential diagnosis. This study followed the CT based anatomical classification for mediastinum into anterior, middle, and posterior compartments involving various anatomical structures in those compartments.

Table 1: Anterior Mediastinal Lesions distribution

	No of cases	Percentage
Thymoma	3	15.8
Thymic Carcinoma	2	10.5
Lymphoma	6	31.6
Ca. lung with MLN	3	15.8
TB Lymphadenopathy	1	5.3
Teratoma	2	10.5

Table 2: Middle mediastinal Lesions distribution

	Number	Percentage
Ca. Oesophagus	2	66.7
LM of Oesophagus	1	33.3

Table 3: Posterior mediastinal masses distribution

	Number	Percentage
Schwannoma	3	37.5
TB Lymphadenopathy	1	12.5
NB	1	12.5
Chondrosarcoma	1	12.5
Teratoma	1	12.5
Ganglioneuroma	1	12.5

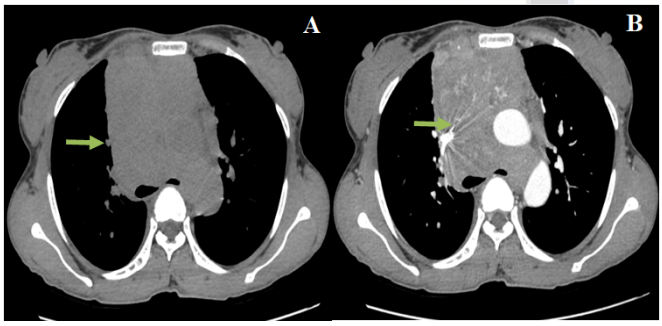

Figure 1: A) Axial plain CT image showing lobulated, soft-tissue attenuating, hypodense mass (arrow) in the anterior mediastinal compartment. B) Axial contrast-enhanced CT image showing mild homogenous enhancement of the lesion encasing mediastinal vessels. It was proved positive for Lymphoma by histopathology.

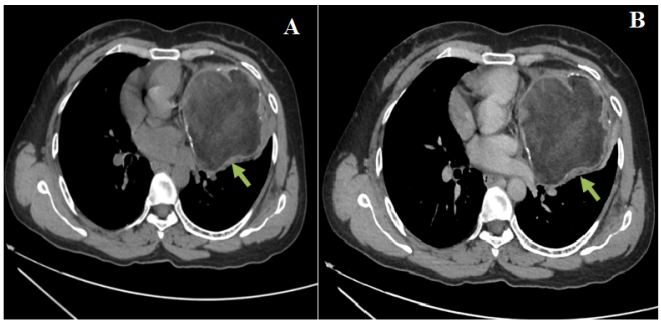

Figure 2: A) Axial non-enhanced CT image of the chest showing anterior mediastinal mass with heterogenous density (arrow) that indicates the presence of areas of fat attenuation associated with focal calcification. B) Axial contrast-enhanced CT image showing heterogeneous enhancement of the lesion.Histopathological examination confirmed the presence of Teratoma.

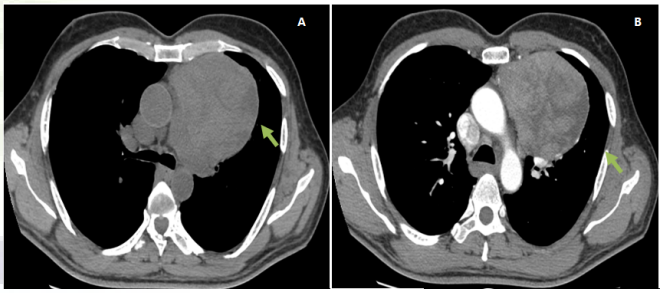

Figure 3: A) Axial non-enhanced CT image of the chest illustrating a well-defined, hypodense, soft-tissue attenuating mass (arrow) at the anterior mediastinal compartment. B) Axial contrast-enhanced CT image shows heterogeneous contrast enhancement. Histopathological examination revealed it as Thymoma.

An attempt has been made to study the characteristics of various mediastinal masses and correlate CT findings with the histopathology. On CT, mediastinal lesions are classified initially centered on their location (i.e., anterior, middle, and posterior mediastinum). Differential diagnosis can be narrowed based on the computed tomography findings like nature of lesion, origin, calcification, and post-contrast enhancement. CT evaluation of the mediastinumis used to define and characterize the mediastinal mass as cystic, fatty, or solid in nature and also relation to adjacent mediastinal structures, mediastinal and paraspinal widening.[5,6]

Additional CT findings taken into consideration include mass effect, mediastinal invasion and involvement of pleura, spine and chest wall. Eventually, a CT diagnosis is finalized considering the age, symptoms, and imaging findings, which

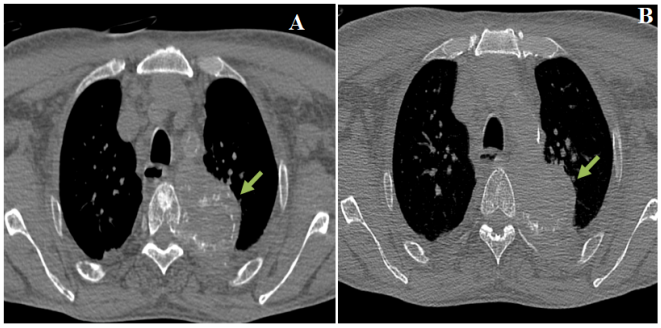

Figure 4: &B: Axial non-enhanced CT images demonstrate a well-defined, heterogenous lesion in the posterior mediastinum with multiple calcific foci and destruction of adjacent vertebral body. Histopathological evidence of Chondrosarcoma was noted.

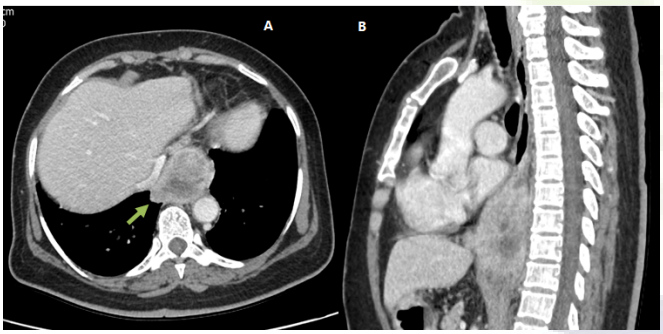

Figure 5: Axial (A) and sagittal (B) CT images of thorax showing an ill-defined hypodense lesion (arrow) with heterogeneous enhancement involving the lower third of the esophagus. Histopathologically it was proved as Carcinoma of esophagus.

is later correlated with histopathology. In 1987 Webb WR,[6] showed that CT allows the differentiation of mediastinal mass from typical mediastinal structures, characterization of its density, localization, and discrimination of vascular and avascular lesions.

In our study, most frequently involved compartment was the anterior mediastinum (n=19, 63.3%), followed by posterior mediastinum (n=8, 26.7%) and middle mediastinum (n=3, 10.0%). The common lesions in anterior, middle and posterior mediastinum were the Lymphoma (n=6, 31.6%), Carcinoma Oesophagus (n=2, 66.7%) and Schwannoma (n=3, 37.5%) respectively.

Among the 30 cases, 26 cases (87%) endured CT guided biopsy of the lesions. One case of oesophageal leiomyoma had an endoscopic ultrasound-guided biopsy. Histopathology was procured from a surgical resection specimen in the remaining three cases.

In our analysis, 53.3% of masses were malignant, whereas 46.7% were benign. Malignant lesions were dominant in our study. Benjamin et al., over a duration of 20-years, examined 215 patients with mediastinal masses, out of which 60% were benign and 40% were malignant.[7]

In our study of 30 cases, the most common symptom was cough comprising about 75%, followed by dyspnea 52 %, chest pain 21.4%, and fever 14.6%. Cough and dyspnoea were chief complaints in anterior mediastinal masses, probably due to tracheal compression. Middle mediastinal lesions presented with dysphagia due to either involvement of the esophagus or its compression.

According to study conducted by V. Arumugam et al, in 2015**,** most mediastinal masses were in the anterior mediastinum constituting 62%, followed by the middle and posterior mediastinum, which were 44% and 18%, respectively.

Our study is similar to the study conducted by Strollo et al. in 1997, wherein anterior mediastinum constituted 50% of the masses.[8]

Lymph nodal masses formed most cases with 36.7% and lymphoma being the most common lymph nodal mass of our study. Thymus lesions form 16.7% of the cases, and Thymoma being the most common thymic mass. Neural tumors form 16.7% of the cases, and Schwannoma was the most common neural tumor.

Our analysis included a case of invasive Thymoma of the anterior mediastinum, that was correctly interpreted on Computed Tomography. Features such as obliterated mediastinal fat planes, thickening of pleura, and irregular interface with the lung were noted, favoring invasive nature of the tumour. Among the thymoma cases, all the lesions were solid.[9]

As reported by Naidich et al. Thymoma was commonly seen between 50-60 years, which is almost equivalent to our study constituting three patients of Thymoma in 45-65 year age group respectively.[10]

The study of Totanarungroj et al. concluded that fat density within the anterior mediastinal mass was present in 57.1% of germ cell tumours, significantly greater than other anterior mediastinal tumors.[11] In our study, calcification was noted in 33.3% of cases. 10% of germ cell tumours displayed heterogeneous enhancement. Mass effect and involvement of pleura were also noticed. Amidst the three cases of mediastinal germ cell tumors of our study, all were teratomas.[12–15]

The result of Tian et al.'s study was that the characteristic findings of primary non-teratomatous germ cell tumors of the mediastinum include large, ill-defined, lobulated masses, heterogeneous attenuation with areas of low-attenuation and calcification on non-enhanced CT images. Contrast

administration revealed heterogeneous enhancement of the tumours.[16,17]

Our analysis had three cases (10%) of bronchogenic carcinoma with lymphadenopathy presenting as the mediastinal lesion. The lymphadenopathy of mediastinal bronchogenic carcinoma had an association with the primary lesion of lung parenchyma, which was identified on CT.

Intrathoracic goiters are the common cause of mediastinal enlargement. A. Prasad et al. observed that the thyroid lesions account for 11-15 % of mediastinal masses.[18] As per our study, Thyroid masses represented only 6.7% of the cases.

In most instances, we feel that CT imaging helps in the identification of mediastinal goiter as the mediastinal mass evident on the chest radiograph. In each two of our cases, the mediastinal thyroid was in unbroken continuity with the cervical thyroid tissue. Although this was evident on images of axial plane, reconstructed coronal images could substantiate the continuity in difficult cases. Thus, we recommend that image acquisition can be extended to a higher level if more caudad scans indicate the possibility of retrosternal thyroid as the cause of the mediastinal mass. High attenuation value is the factor that helps in identification of mediastinal tissue as thyroid. CT attenuation greater than that of muscle is unusual for mediastinal masses such as lymphoma or Thymoma.

Kim et al. in their study concluded that the primary thyroid lymphoma should be included in the differential diagnosis when an old-aged female with a history of rapidly enlarging thyroid mass and with coexistent Hashimoto's thyroiditis had CT findings of homogeneous thyroidal mass isoattenuating to muscles without invasion of surrounding structures.[19]

In the present study, Tuberculous lymphadenopathy constitutes 6.7%, which is probably similar to the study conducted by Wychulis et al,[20] (i.e., 6.7%). According to Im et al.[21] series, right paratracheal lymph node enlargement was noted in 87% of cases, whereas the present study showed 54 % involvement.

Our analysis revealed that two cases of carcinoma of the oesophagus and 1 case of oesophageal leiomyoma presented as a middle mediastinal mass. The main role of CT in patients with carcinoma of the oesophagus is for staging of the disease precisely to determine the patients suitable for surgical resection.

The leiomyoma of the oesophagus presented as the posterior mediastinal mass on the chest radiograph in our study. On further evaluation, oesophageal leiomyoma was predicted on the CT with imaging features as a well-defined eccentric intramural mass in the middle third of the esophagus. This non-enhancing lesion had no mediastinal invasion. The key factor that helped us to pick out the lesion as leiomyoma was the coarse amorphous calcification in the intramural mass. Leiomyomas may contain amorphous coarse areas of calcification, and a calcified esophageal mass shall firmly suggest the diagnosis of a leiomyoma.

Among the 30 cases of our study, posterior mediastinal masses constitute 26.7% of all compartments. Schwannoma was the most commonest posterior mediastinal tumour, which constitutes 37.5%. Other cases include one case of Tuberculous lymphadenopathy, a case of Neuroblastoma, a case of chondrosarcoma, a case of Teratoma, and a case of Ganglioneuroma. Almost all were predicted correctly by Computed Tomography. But on histopathology, one case of Schwannoma was interpreted as a neuroendocrine tumour, and one case of Ganglioneuroma as neurofibroma.

The neurogenic tumour was the principal diagnosis in the posterior mediastinum, being slightly lower than in the study by Liu et al.[22] They spotted neurogenic tumour in 16.6% (n = 68) of cases, while our study had 10%.

In our study, the majority were well-defined masses (n=21, 70%), hypodense (n=26, 86.7%) and with moderate (n=26, 86.7%) and hypodense contrast enhancement (n=25, 83.3%).

All the lesions were soft tissue attenuating. However, other attenuations like calcification (33.3%), fluid (26.7%), and fat (6.7%) were also noticed. Mass effect on adjacent structures was appreciated in 70% of cases. Metastasis was observed in 16.7% of cases.

In the present study of 30 mediastinal lesions, 28 (94%) were predicted accuartely by CT on comparision with histopathological analysis. Totally 94% of cases were verified with histopathological examination. With an accuracy of 94% cases, CT is an exceptionally useful modality for evaluating mediastinal masses.

Conclusion

CT can yield helpful diagnostic information to facilitate the distinction of disease processes and tumors involving the mediastinum. In a specific clinical setting, variables such as attenuation, calcification, contrast enhancement, relationship to adjoining mediastinal structures, and related intrathoracic findings can be suggestive of a selected diagnosis.

In the present study, we adapted different CT features of each mediastinal pathology to anticipate the histological diagnosis of mediastinal lesions. CT is additionally an important tool for guidied biopsy of masses, drainage of the collections, for staging and following up of anterior mediastinal disease. From the above results, we infer that Computed Tomography obviously has a vital role to play in evaluation of a mediastinal masses concerning the compartmental dispersal, mass effect and provisional diagnosis which was correlated with histopathology.

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