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Research Article

COMPARISON OF MAGNETIC RESONANCE IMAGING AND MUTIDETECTOR COMPUTER TOMOGRAPHY FOR THE DIAGNOSIS OF MEDIASTINAL TUMORS

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ABSTRACT

Objective: The aim of this study is to identify the diagnostic accuracy of mediastinal masses using multidetector computed tomography (MDCT) and magnetic resonance imaging (MRI).

Method: A total of 30 cases were referred to the Department of Radiodiagnosis for clinically suspected mediastinal masses for 2 years were included and MDCT and MRI were done.

Results: Lymphoma in 37.5% of cases, lymphoma and thymic masses in 31.25% of cases, Ca. esophagus and Schwannoma were the common mediastinal masses in the anterior, superior, middle, and posterior mediastinal compartments, respectively. MDCT sensitivity was 100% and MDCT specificity was 75%. MRI sensitivity was 100%, and MRI specificity was 80%. It was concluded that MDCT is a highly useful modality for the investigation of the mediastinal masses. It has the major role to play in the evaluation of a mediastinal mass regarding the organ of origin, its density, mass effect on adjacent structures, distribution pattern, and extent of the lesion diagnosis. MRI accurately well-characterized mediastinal mases such as thymoma, lymphoma, neurogenic tumor, Schwannoma, and ganglioneuroma.

Conclusion: MRI was useful in the characterization of the normal thymus and differentiation of hyperplastic thymus and thymictumors.

Keywords: Computed tomography, Mediastinal tumors, Magnetic resonance imaging.

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INTRODUCTION

Mediastinal masses have a broad histopathological and radiological spectrum. Thymoma, neurogenic tumors, and benign cysts were the most common lesions in the mediastinum, accounting for 60% of all cases with mediastinal masses [1]. Cough, chest pain, fever/chills, and dyspnea were among the most common symptoms. Secondary mediastinal tumors are more common than initial tumors and most often represent lymphatic involvement from primary lung or infra-diaphragmatic organ cancers such as pancreatic, gastroesophageal, and testicular cancer. Malignant masses in the anterior mediastinum are more common than those in other compartments [2] Mediastinal space is narrow; any mass arising from there will compress the adjacent structures leading to life-threatening emergencies. Symptoms at presentation are seen in 60% of the cases [3]. Symptoms are caused by compression or direct invasion of nearby structures, or by paraneoplastic diseases [4-6].

In most cases, computed tomography (CT) is used to evaluate mediastinal tumours. Magnetic resonance imaging (MRI), on the other hand, frequently offers findings that allow for detailed assessment of the location, pattern of extension, and anatomical interaction with surrounding structures. To get particular findings of mediastinal illnesses, in addition to traditional T1 and T2-weigh spin-echo images, a dynamic study with first gradient echo 2D/3D sequence, chemical shift picture, and diffusion weight image was provided.

Mediastinal tumors are typically categorized into 3 or 4 types based on their original location in the thorax. Each tumor has a distinct pathologic propensity, and therapy strategies are chosen based on tumor features. Pathology of posterior mediastinal tumors differs between children and adults. Most of the posterior mediastinaltumorsin adults are benign lesions; they are mostly malignant in children. The indications for thoracoscopic surgery, including robotic surgery for the management of posterior mediastinal tumors, have been extended with the improvement and refinements of the instruments [6,7].

Multi detector row computed tomography (MDCT) is a potential 3D imaging method for covering large anatomical areas with isotropic sub millimetre spatial resolution. With the ability of high resolution-MDCT to localise lesions and biopsy needles, as well as delineate nearby structures, diagnostic FNA for both benign and malignant disease processes has become a very safe and accurate treatment.

The current study aim is to compare the MDCT and MRI imaging evaluation of mediastinal tumors.

METHODS

A prospective observational study conducted in 30 cases, those referred to the department of Radio-Diagnosis for clinically suspected Mediastinal masses at Narayana Medical College over a period of 2 years.

Patients with symptoms of clinically suspected or known case of Mediastinal tumors referred to radiology department and patient willing to Consent for investigation were included. Patients with metallic implants in the body and ferromagnetic foreign bodies in eye and cardiac pacemakers, pregnants, post-operative cases, cases with traumatic and cardiac causes were excluded.

Procedure

All the cases undergoing MDCT scans and MRI as a part of standard protocol. CECT scans was then done in all the subjects in whom mediastinal mass suspected except cases with suspected neurogenic tumor or para vertebral lesions. MRI was done in cases in whom neurogenic tumor or para-vertebral lesion was suspected. CECT scans were done using Spirit dual slice CT. MRI performed using 1.5–T MR imaging system.

Patients were fasted for 4 h prior to the CT scan in order to provide the contrast medium. All subjects were supine when an anteroposterior topogram of the thorax was obtained. An axial segment of 10 mm thickness was obtained from the thoracic inlet to the suprarenal level. All pre-contrast instances were followed by post-contrast studies, and images were acquired using intermittent suspended inspiration. For the post-contrast study, 80–100 mL of dynamic intravenous Omnipaque (Iohexol USP) was given at a dose of 1.2 mL/kg body weight, and axial sections were collected from the thoracic inlet to the level of the suprarenals. Sagittal and coronal reconstructions were performed when needed. The scans were analysed on a direct display console at different window settings (mediastinal window, Lung window, and Bone window) to examine the vast variety of tissue density and also to look for osseous involvement. Pre-and post-contrast attenuation values, mass location, calcification, mass adjacent structures, and other findings were investigated.

Statistics

To assess the diagnostic capability of two imaging techniques for mediastinal masses, the differences between groups were investigated using a Student's t-test and ROC analysis. $p<0.05$ were deemed significant. SPSS version 21.0 was used for statistical analysis.

RESULTS

In the study, 56.67% were males and 43.33% were females. Majority (63.34%) of cases were seen in 4th and 5th decade. Cough was the common symptom constitutes 73.33 %, followed by Dyspnoea in 50%, chest pain in 33.33%, and fever in 20% cases respectively 93.33% study cases were symptomatic (Table 1).

Study findings

Isolated compartmental involvement was common in the posterior mediastinum in 23.4% of cases, followed by the superior mediastinum in 13.3%, the middle mediastinum in 13.3%, and the anterior mediastinum in 10% of instances. In 40% and 6.7% of instances, the anterior mediastinal was implicated in trans-compartmental lesions. The anterior mediastinum (56.7%) was the most commonly implicated compartment, followed by the superior mediastinum (53.3%), the posterior mediastinum (30.1%), and the middle mediastinum (20%).

Table 1 : CT diagnosis of mediastinalmases

Mediastinal masses	Frequency (%)
Lymphoma	20
Thymoma	10
Carcinoma lung metastatic lymph node	10
Schwannoma	10
Neurogenic tumour	6.7
Carcinoma thyroid	6.7
Neuroblastoma	3.3
Teratoma	10
Thymiccarcinoma	6.7
LM of oesophagus	3.3
Carcinoma oesophagus	6.7
Ganglioneuroma	3.3
Germ cell tumour	3.3

CT: Computerized tomography

Lymphoma was found in 37.5% of cases, Lymphoma and Thymic masses in 31.25% of cases, Ca. oesophagus and Schwannoma were found in the anterior, superior, middle, and posterior mediastinal compartments, respectively.

Calcification is observed in 33.3% cases. Schwannoma, Teratoma and Ca. Thyroid show calcification consistently. Fat attenuation is detected in 6.7% of instances. Teratomas all have zones of fat attenuation. In 70% of cases, a mass effect on surrounding mediastinal structures is found, with a focus on mediastinal vessels.

MR imaging is more reliable than CT at distinguishing between cystic and solid lesions. Thymoma, Neurogenic tumour, Lymphoma, Schwannoma, and Ganglioneuroma were all well-characterized by MRI. In comparison, the sensitivity of MDCT and MRI were both 100%, while the specificities were 75% and 80%, respectively (Tables 2-4).

DISCUSSION

In this study, we attempted to compare CT and MRI to characterise distinct mediastinal masses and their connection.

Males made up 56.67% of the cases, while females made up 43.33% of the cases. The majority of instances (63.34%) were seen in the fourth and fifth decades. Dutta *et al.* observed 50 mediastinal mass lesions in their investigation. There were 33 male patients (66%) and l7 female patients (34%). The most typical age range was 60–69 years [8].

Cough was the most common clinical symptom in our sample of 30 cases, accounting for 80%, followed by dyspnea (53.3%), chest discomfort (23.3%), and fever (16.6%).

According to Rai *et al.*, [9] the majority of patients, 46%, had cough symptoms and about 23% have chest pain. Mediastinal masses are uncommon cases, where 50% of cases were asymptomatic.

In our study, the anterior mediastinum was the commonly involved compartment i.e. 56.7%, followed by superior mediastinum i.e. 53.3%, posterior mediastinum i.e. 30.1%, and the middle mediastinum in 20%. Lymphoma was most common lesion in anterior mediastinum in 37.5% and superior mediastinum in 31.2%, Teratoma in 40% in middle mediastinum and Schwannoma in 33.3% in posterior mediastinum.

Felson in 1978 in a series of 550 cases reported, there is no predilection for the masses to occur in the anterior mediastinum. But he reported more number of cases being seen in the anterior mediastinum followed by posterior and middle mediastinum [10].

Table 2: Differences of the study subjects between both CT/MRI diagnosis and pathology

Pathology	No of cases	CT Diagnosis	No of cases	MRI Diagnosis
Thymoma	3	Thymoma	3	Thymoma
Lymphoma	6	Lymphoma	6	Lymphoma
Schwannoma	3	Schwannoma	3	Schwannoma
Neurogenic tumour	2	Neurogenic tumour	2	Neurogenic tumour
Carcinoma thyroid	2	carcinoma thyroid	2	
NB	1	NB	1	
Carcinoma lung metastatic lymph node	3	Carcinoma lung metastatic lymph node	3	
Thymiccarcinoma.	2	Thymiccarcinoma.	2	Thymiccarcinoma.
Teratoma	3	Teratoma	3	
Germ cell tumour	1	Germ cell tumour	1	
LM of oesophagus	1	LM of oesophagus	1	
Carcinoma oesophagus	2	Carcinoma oesophagus	2	
Ganglioneuroma	1			Ganglioneuroma

CT: Computed tomography, NB: Neuroblastoma, MRI: Magnetic resonance imaging

In our study, isolated compartmental involvement was the common in posterior mediastinum i.e. 23.4% followed by superior i.e., 13.3%, middle 13.3%, and the anterior mediastinum in 10% cases respectively.

However the anterior mediastinal is most commonly involved in trans-compartmental lesions (40% and 6.7%).

Hence anterior mediastinum (56.7%) was collectively the most common compartment involved, followed by superior mediastinum (53.3%), posterior mediastinum (30.1%), and middle mediastinum (20.0%).

A study by El Bargisy *et al.* shows that anterior mediastinal masses were found in 16 cases, middle mediastinal masses were found in 8 cases, posterior mediastinal masses were noted in 16 cases [11].

In our study, Lymph nodal masses formed majority of the cases with 30% and Lymphoma (66.7%) being most common lymph nodal mass. Thymus lesions forms total 16.7% of the cases and Thymoma being the most common thymic mass. Neural tumors forms 16.7% of the cases and Schwannoma being most common neural tumor.

Cohen *et al.* [12] observed that thymic lesions as prevalent mediastinal lesions in a comparable study. In a study of 34 instances with CT diagnosis of thymic mass conducted by Chen *et al.*, thymoma formed 91% of cases and thymic cyst constituted 2.9% of cases. According to Naidich *et al.*, thymoma formed 60% of the 5 patients with thymic mass in our study, while thymic carcinoma constituted 40% [13].

Thymictumors constituted the majority (18%) in our current investigation, which was similar to Cohen *et al.* [12].

Our data revealed that thymoma accounted for 12.5% of mediastinal masses and germ cell tumors accounted for around 3.3% of mediastinal masses. While intrathoracic extension of thyroid tumors accounts for 6.7% of total mediastinal masses. These findings were consistent with the findings of Azizad *et al.*, who reported that thymoma accounts for 15–20% of primary mediastinal masses, germ cell tumors account for 10% of primary mediastinal masses, and intrathoracic extension of thyroid lesions accounts 10% of mediastinal masses [14].

CT characteristics

In our study majority of the masses are well-defined, hypodense, and show moderate and heterogeneous contrast enhancement. All the lesions were soft tissue attenuating. However, other attenuations such as calcification (33.3%), fluid and fat (6.7%) were seen. Mass effect on adjacent structures is seen in 70% cases. Metastasis is seen in 16.7% cases.

Thymic masses

Thymoma was the common primary tumor in the entire mediastinum. In our study, thymoma observed in 3 patients with 41–50 years age group, which was similar to studies by Cohen *et al.* In Chen *et al.* [15] study on 34 patients with CT diagnosis of thymic mass, thymoma constituted 91%, thymic cyst accounts 2.9%. Whereas, our study shows seven cases with thymic mass, thymoma accounts 42%, and thymichyerplasia 28%.

A study by Dutta *et al.*, reported 18% of thymic tumors, Cohen *et al.*, reported 24.3% of thymic tumors, Wychulis *et al.* [16] reported 19.4% of thymic tumors, and Davis *et al.* [17] reported 17% of thymic tumors.

In our study, on CT scan, thymomas were present as sharply demarcated round/oval soft tissue masses in the thymus. Tumors reveal soft-tissue attenuation and mild-to-moderate contrast enhancement.

On MR image, the signal intensity of cystic regions was variable, depending on protein content of the cyst fluid/presence of hemorrhage.

Table 3: Differences of study subjects between both CT diagnosis and MRI diagnosis

	CT	MRI
AUC	0.875 (95%CI: 0.473, 0.997)	0.880 (95%CI: 0.531, 0.995)
Sensitivity	100%	100%
Specificity	75%	80%
S.D	0.14	0.13
p-value	0.009	0.003

CT: Computed tomography, MRI: Magnetic resonance imaging, AUC: Area under curve, CI: Confidence interval, SD: Standard deviation

Table 4: Diagnosis accuracy of CT and MRI diagnosis

	MRI diagnosis	
	PPV	NPV
CT diagnosis	100	96.5
p-value (Fisher Exact)	<0.001	

CT: Computed tomography, MRI: Magnetic resonance imaging, PPV: Positive predictive value, NPV: Negative predictive value, χ^2: Chi-square test

MRI was superior to CT in patients with invasive thymoma for defining invasion of contiguous structures: pleura, lung, and pericardium.

In our investigation, CT revealed thymoma in three individuals with 100% sensitivity and 75% specificity. MRI revealed thymoma in 3 patients, with 100% sensitivity and 80% specificity. MRI classification is superior to CT classification.

In a study of 104 patients with MG, CT revealed thymoma in 46 of 52 instances (sensitivity of 88.5% and specificity of 95%) and thymic hyperplasia in 16 of 44 cases (sensitivity of 36% and specificity of 95%). A recent study found that chemical shift MRI was useful in differentiating thymomas from thymic hyperplasia in non-MG individuals. In MG instances, MRI produced comparable results [18].

Thymic carcinoma

In our study, thymic carcinoma was observed in two cases. Thymic carcinoma was thymic epithelial tumor with a high degree of anaplasia, obvious cell atypia, and increased proliferative activity with immature T cells.

On CT scan, thymic carcinomas usually show heterogeneous internal attenuation due to necrosis and hemorrhages and have poorly defined margins.

On MRI scan, thymic carcinoma shows the intermediate signal intensity slightly higher than muscle on T1-weighted image, and the high signal intensity on the T2-weighted image. Thymoma has a greater tendency to show a multinodular appearance separated by fibrous septa on MRI than thymic carcinoma.

Germ cell tumors

Germ cell tumor was found in one patient in our investigation. Tumors primarily appeared in the gonads but also in the midline of the body, including the pineal region, anterior mediastinum, retroperitoneum, and sacrococcygeal region. The majority of germ cell tumors appear between the 2nd and 4th decades of life.

In contrast, Dutta *et al.* found 4% of instances, Cohen *et al.* found 10% of cases, Wychulis *et al.* found 9.3% of cases, and Davis *et al.* found 11 cases.

Teratoma-mature teratoma, immature teratoma, and teratoma with malignant transformation; seminoma; and non-seminomatuos malignant germ cell tumors (embryonal carcinoma, endodermal sinus tumor, choriocarcinoma, and mixed type) are the three types of germ cell tumours. Less than 80% of germ cell tumors were benign, with a large majority of mature teratoma. Seminoma is the most common malignant sub-type.

Lymphoma

Lymphoma accounts for about half of all mediastinum neoplasms in adults. Lymphoma affects the mediastinum as a result of the generalized disease, but it can also be a primary lesion. Hodgkin's disease is the most frequent type of primary mediastinal lymphoma. Whereas Dutta *et al.* found 8%, Cohen *et al.* found 15.7%, Wychulis *et al.* found 10.1%, and Davis *et al.* found 16%. The most common CT finding was a massive mediastinal mass reflecting thymic and lymph node enlargement, which compresses the airway and cardiovascular systems.

Teratoma

Teratoma was found in three out of thirty instances. In contrast, Shruti Santosh Patilet colleagues observed teratoma in three cases in their investigation [19]. Teratomas contain elements from all 3 germinal layers: ectoderm (skin, teeth, and hair), mesoderm (bone, cartilage, and muscle), and endoderm (bronchial and gastrointestinal epithelium/ pancreatic tissue). The most prevalent location was the anterior mediastinum, however cases originating in the middle or posterior mediastinum have also been described. Teratomas often show heterogeneous signal intensity on MRI imaging, representing numerous internal constituents.

MR of mediastinum tumors

In mediastinal lymphomas, a residual mass is common after treatment, especially in cases with a bulky initial mass and MRI provides important information in distinguishing viable tumors from residual benign masses. On T1- and T2-weighted MR scans, residual tumors can show a variety of signal patterns. On T2-weighted images, both residual and sterilized tumors have heterogeneous signal intensity. High signal intensity on T2-weighted images and low signal intensity on T1-weighted images could be indicative of residual active lymphoma, necrosis, or inflammation.

Accuracy of CT and MRI

In our investigation, the sensitivity of CT and MRI were both 100%, but the specificities were 75% and 80%, respectively. In contrast, in a study by Dutta *et al.*, the sensitivity of CT was shown to be higher than that of MRI in their diagnoses.

In the current study, 22 of 30 instances were identified by CT scan and 8 of 30 cases were recognized by MRI, resulting in an enhanced sensitivity of CT by 12.5% and MRI by 28.6%. The multiplaner study, superimposition of bony and circulatory shadows is not an issue, and retrosternal and retrocardiac areas are well visualized with CT and MRI are the reasons for more accurate detection of mediastinal masses by CT and MRI.

MDCT is more accurate in detecting mediastinal lesions.

MDCT lowers the cost of the examination. Furthermore, it is quick, easy to use, and economical.

CT is accurate in differentiating mediastinal masses that differ in morphology and pattern of metastatic dissemination, both of which are easily seen by chest CT scans. MRI distinguishes between cystic and solid lesions more reliably than CT images.

CONCLUSION

It was concluded that CT has a significant role to play in evaluating mediastinal mass related to compartmental distribution, mass effect on neighboring structure, and preliminary diagnosis. MRI is useful in characterizing normal thymus and distinguishing hyperplastic thymus and thymic tumors. After therapy, a residual mass was common in mediastinal lymphomas, and the MRI gives significant information for separating live tumors from remaining benign masses. Depending on their content, some mediastinal cysts have high attenuation similar to solid lesions on MDCT, and MRI is effective in differentiating cystic masses from solid lesions.

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