Multi-Detector Computed Tomography for Evaluating Characteristics, Distribution and Extension of Mediastinal Masses.

Abstract:

Background: The area in the thorax between the lungs is Mediastinum which is surrounded above by thoracic inlet, in front by sternum, below by diaphragm, back by vertebral column laterally by pleura of both lungs. Multiple classification systems are used by doctors. Shields classification system is most commonly used, however the conventional Fraser and Paré, Felson, and other categorization are in daily use in radiology. The present schemes used in practice of radiology is more of nonanatomic divisions based primarily on the chest radiograph. So a typical classification based on multi detector CT is demanded to describe mediastinum and make to the purpose differential diagnoses. This study aims to assess characteristics, distribution and extension of Mediastinal masses by MDCT and correlate the histopathological diagnosis to CT scan findings.

Methodology: This will be a prospective study conducted at AVBRH, Wardha. Total 100 patients with Mediastinal Masses diagnosed clinically and on Chest X ray will be enrolled in the study. Contrast CT scan of all patients will be done. Histopathology reports of masses (FNAC/Biopsy) will be collected.

Results: Significant accuracy of mediastinal CT in diagnosing the mediastinal masses and a significant corelation to FNAC/biopsy reports is expected.

Conclusion: MDCT will prove to be an useful evaluation method for diagnosis and classification of mediastinal masses.

Keyword: International Thymic Malignancy Interest Group, mediastinal mass, Computed Tomography, Extension, Classification.

Introduction:

Mediastinum is the area in the thorax in between the lungs and surrounded above by thoracic inlet, in front by sternum, below by diaphragm, back by vertebral column laterally by pleura of both lungs. Multiple classification systems are available and used by doctors. Shields classification system is most commonly used, however the conventional Fraser and Paré, Felson, and other categorization are in daily use in radiology. The present schemes used in practice of radiology is more of nonanatomic divisions based primarily on the chest radiograph, so a typical classification based on multi detector CT is demanded to describe mediastinum and make to the purpose differential diagnoses .Hence to resolve this issue the experts have come up with International Thymic Malignancy Interest Group (ITMIG) have come up with classification of Mediastinal Compartments into the three-divisions as Prevascular, Visceral, and Paravertebral compartments.[1]

MDCT along with intravenous contrast is the diagnostic technique of choice for assessment and depiction of many mediastinal masses. Hence the ITMIG uses MDCT as a gold standard for defining mediastinal compartments.[2] Mediastinal lesions include a wide range of pathologies namely tumours, benign or malignant they can be cysts, vascular congenital anomalies, lymph node pathologies and diaphragmatic hernias .These lesion are

challenging for a radiologist and often a plain x ray is inadequate to locate and identify the lesion. CT is preferred for defining the accurate location, size, extent and characterizing the nature of mediastinal lesions. Both CT and MRI have cross-sectional description of the mediastinum, CT has greater spatial resolution and shorter imaging time than MRI, besides being less expensive and more widely available. In addition CT guided biopsies further help in identifying the lesion .[3] Hence we propose to study the role of MDCT in identifying, localising mediastinal masses and to determine the differential diagnosis .

Epidemiology:

Frequent aetiology for anterior mediastinum pathology are thymic malignancies, lymphoma with occurrence near too that of 35% and 25% correspondingly. Some other origin of anterior mediastinal masses belong to thyroid, endocrine background, benign teratomas, malignant germ cell tumours and benign thymic lesions having incidence of 15%, 10%, 10%, 5% respectively. [4]

Noriyuki Tomiyama et al [5] in their study about anterior mediastinum masses accuracy of CT, MRI in diagnosis quoted that mediastinal masses account for 3% of the chest tumours and nearly 50% of all mediastinal masses are anterior mediastinal tumours.

Nicholas C. Saenz et al [6] studied posterior mediastinal masses in children and quoted that most tumours were arising from nervous system in 89% of cases, in that neuroblastoma had much higher incidence and 60% had malignancy.

Ramakant Dixit et al [7] in their study stated that 68.3% cases are confined to the anterior mediastinum, 16.5% cases to the middle, and 2.5 % cases to the posterior mediastinum. In 7.1%cases two or more than two compartments of the mediastinum were simultaneously involved.

In a study conducted by Aroor et al. [8] mediastinal masses were morecommon in the anterior mediastinum (42.86%) then in middle mediastinum (11.43%), posterior mediastinum (8.57%), and multiple compartments (37.14%)

Guang-Shing Cheng et al [9] stated that the occurrence of primary mediastinal masses was hard to find out. In their survey of 9000 plus cases of a lung cancer CT screening the rate of a coincidentally recognized mediastinal mass was 0.77%, on repeat annual examination, the rate was 0.01%. Commonest masses in adult age group were thymoma, developmental cysts accompanied by neurogenic tumours and lymphoma, according to the data by Silverman and Sabiston in around 2400 subjects. Recently studies indicated a similar trend, also Cohen and associates observed the increasing occurrence of mediastinal masses. An increasing number of lymphoma and malignant neurogenic tumours was also observed by them over a span of 45-years.Among all mediastinal masses 60% were thymoma, neurogenic tumors and developmental cysts. Lymphomas and germ cell tumors were about 25% and rest 15% included other benign as well as malignant tumours.

Rationale: Computed Tomography has good role in diagnosis of mediastinal lesions. It is one of the best non-invasive imaging modality available for thoracic imaging. Computed Tomography has good spatial resolution and shorter imaging time, besides being less costly and being more widely available. It is possible in defining the accurate anatomical details and characterizing the nature, site and extent of the disease. Mediastinal abnormalities, changes such as calcification, necrosis within the lesions can be easily appreciated with the use of MDCT. It gives more details of disease. This also underlines the importance of close cooperation with the histo-pathologist and the clinicians in diagnosis and management**.**

Objectives:

1. To study the characteristics of Mediastinal masses by MDCT

2. To study the distribution of mediastinal masses according to classification by ITMIG.
3. To determine the accurate extension of the tumours.
4. To correlate the FNAC/biopsy diagnosis to the findings of CT scan where ever possible.

Methods:

Study area: Acharya Vinoba Bhave Rural Hospital, Sawangi (Meghe) Wardha .

Type of study: Prospective Study.

Study duration: 2 years.

Sampling procedure : All patients referred to the department of Radio diagnosis (Acharya Vinobha Bhave Rural Hospital, Datta Meghe Institute of Medical Sciences, Sawangi(Meghe), Wardha , for CT scan with clinical suspicion of mediastinal mass .

Sample size : Formula for sample size determination

$N=א^2 \times N \times p(1-p)/ C^2(N-1)+ א^2 p(1-p)$

Where ,

$א^{2=}$ chi square test value for I degree of freedom at desired probability level is 3.84 at 5% level of significance

P = 50% proportion

C= confidence interval of choice (95% CI)

Sample size = **100** patients needed in the study.

Inclusion Criteria:

1. Patients of all age group presenting with symptoms of clinically suspected Mediastinal Masses.
2. Patient who's Chest X ray shows signs of a mediastinal mass.
3. Patients willing to give consent for the study.

Exclusion Criteria:

1. Patients with prior treatment elsewhere on presentation.
2. Patient with abnormal renal function test.
3. Patients with knows history of contrast sensitivity.
4. Patients not willing to give consent for the study.

Methodology:

Equipment: CT siemens 16 slice.

Preparation of patient:

Patients will be kept nil orally 6 hrs prior to the CT scan to avoid complications , due to administration of contrast medium. Risks of the procedure and contrast administration will be explained to the patient and consent will be obtained prior to the study.

Technique: Initially, routine anteroposterior topogram of the thorax will be taken in the supine in all patients. An axial section of 5 mm thickness will be taken from the level of

thoracic inlet to the level of suprarenal glands. In all cases pre-contrast study will be followed by post-contrast study, image acquisition will be done with intermittent suspended inspiration. For post-contrast study, 80-130ml of dynamic intravenous injection of iopromide will be administered with pressure injector and axial section taken from thoracic inlet to the level of suprarenal arterial phase will be after 35 to 40 seconds after contrast infusion , venous phase after 80 seconds of contrast infusion and delayed phase after 3 -5 mins. Sagittal section and coronal section reconstruction images will be used wherever necessary. The scan will be studied on console at different window width settings i.e. soft tissue/mediastinal window of level 30 HU-50 HU ,width 350 HU-500 HU. Lung window of level 700 HU along with width of 1500 HU. Similarly, bone window level of 2400 HU and width 200 HU to study different tissue density. The pre and post contrast findings will be studied.[10]

STANDARD IMAGING PROTOCOL

Scout image: Anteroposterior
Landmark: lung apices
Slice plane: Axial or spiral
Oral Contrast: Yes
Intravenous contrast: 80-130ml
Rate 1.5-2ml/sec for 15 sec Followed by 1 ml/sec,
Arterial phase : 35 - 40 secs. after contrast infusion
Venous phase : 80 secs. after contrast infusion
Delayed phase : 3-5 minutes after contrast infusion
Breath hold: Suspended Respiration
Slice thickness: 5mm sections from apices to base of lung
Slice interval: Continuous
Start location: lung apices
End location: Through lung bases[10]

Expected Outcomes: This study aims at knowing the accuracy of MDCT in diagnosing and describing the features of the mass based on imaging features and classifying different mediastinal masses in 3 compartments as compartmentalized by international thymic malignancy interest group (ITMIG)

Discussion:

In a study by Sergi Juanpere et al [11] in 2012 in their article A diagnostic approach to the mediastinal masses described various lesion of mediastinum including fatty masses , cystic masses, thymic hyperplasia, thymoma, lymphoproliferative disorders, uncommon mediastinal masses and concluded that location and composition of a mass is important in diagnosing ruling out differentials all this could be done much more easily with help of CT.

In a study by Brett W. Carter et al [12] in 2017 in article ITMIG classification of mediastinal compartments described boundaries of mediastinal compartment according to ITMIG classification. All the compartment are bordered by thoracic inlet superiorly, diaphragm inferiorly. Prevascular compartment lies anteriorly by posterior surface of sternum, laterally by lung pleura on both sides, posteriorly by anterior aspect of pericardium. Visceral compartment is bordered anteriorly by anterior aspect of pericardium, posteriorly by a vertical line connecting a point on the thoracic vertebrae 1 cm behind the anterior margin of spine. Paravertebral compartment anteriorly by the posterior border of visceral compartment , postero-laterally by a vertical line lateral to the transverse process along the posterior margin

of the chest wall. Various lesions of mediastinum and their pattern on different radiological imaging modalities were also described.

In a study by Somshankar Pandey et al [13] in their study in 2018 with 60 patients and histopathology as gold standard to compare accuracy of MDCT concluded that dyspnoea was the most common clinical symptom 21.67%, fever and chest pain 15%, dysphagia 13.33%. Most common compartment being prevascular 33 % then visceral 32.1% and paravertebral space constituted 18.3 % and multicompartmental lesion 16.6%. Thymoma followed by lymph node mass formed majority of lesion in prevascular compartment. In visceral compartment lymph node mass along with oesophageal carcinoma were common and among posterior mediastinal masses neural tumour with paravertebral abscess were common. On correlation with histopathology MDCT showed 94.87 % accuracy in diagnosing and specifying size, site and other organ involvement.

In a study by VV Hattiholi et al [14] in their study role of MDCT in evaluation of mediastinal lesion conducted in 2018 with 45 patients concluded that majority of lesion were in prevascular compartment thymoma 20% , lymphoma 13.33%, thymic carcinoma 6.67 % , teratoma 2.22%, ectopic parathyroid 2.22 % , thymic cyst 2.22%. In visceral compartment aneurysm of arch of aorta 8.89%, carcinoma oesophagus 4.44%, foregut duplication cyst 4.44%, pseudoaneurysm 2.22%, lymphoma 2.22% and in paravertebral compartment carcinoma oesophagus 4.44%, schwannoma 6.66%, neuroenteric cyst 2.22% where observed .They stated that MDCT played a major role in evaluating mediastinal lesions and new ITMIG classification based on the three compartment division was relatively easy, and helpful in making diagnosis.

S Satbeer Singh et al [15] in their study CT evaluation of mediastinal mass lesions in 2019 concluded that cough 44% , dyspnoea 38% , fever 20% , chest pain 20% were among the most common symptoms along with few asymptomatic cases, lesions of anterior mediastinum 52%, middle mediastinum 18%, and posterior mediastinum 30%. thymic masses 26.9% was most common anterior lesion followed by metastatic lymph node 19.2%, tuberculous lymph node 15.4%, aortic mass 15.4%, lymphoma were 11.6%, thyroid mass about 7.7% and germ cell tumour were seen in remaining 3.8%. In middle mediastinum metastatic lymph node 44.5% had largest incidence, tuberculous lymph node 22.5%, neuroentric cyst 11.1%, oesophageal duplication cyst 11.1%, bronchogenic cyst 11.1%. In posterior mediastinum neural tumours 33.3%, paravertebral abscess 20%, tuberculous lymph node 13.3%, oesophageal mass 13.3%, hydatid cyst 6.7%, paravertebral hematoma 6.7%, lymphangioma 6.7%. Characteristic heterogeneous enhancement was shown by 44% followed by homogenous enhancement 28%, whereas non enhancing, rim enhancing and intense enhancement was shown by 12, 10, 6% respectively. Solid masses comprised of 54 %, solid and cystic masses 22%, cystic 12%, vascular masses 8%, fatty masses 2% , mixed type 2 % .

In a study by Utkarsha patil et al [16] in their study computed tomography evaluation of mediastinal masses in year 2019 with 51 patients concluded that anterior mediastinal mass formed majority of total masses 50.98% while middle and posterior mediastinal masses formed 25.49% and 23.52% respectively .Anterior mediastinal masses composed of lymphoma 36.46%, invasive thymoma 19.2 % , thymoma 15.38 % , sarcoma , malignant teratoma.. In middle mediastinum metastatic lymph node 11.53%, tuberculous lymph node 7.69% and rarely lymphatic malformation and bronchogenic cyst .Extra medullary hemopoiesis 33.33%, neural tumours 33.33%, para vertebral abscess 16.66% and tuberculous lymph node 8.33% were common in posterior mediastinum. Compared to histopathology examination CT was 95.83% accurate in diagnosing mediastinal masses. Related articles were reported in GBD study[17-19]. Related studies reported by Singh et al. [20], Dhamgaye et. al.[21] and Sharma et. al. [22] were reviewed.[23-30]

Hence this study is designed in such a manner that the outcome of this study will be compared with above mentioned research.

Conclusion: The data obtained through this study can be used to understand the importance of MDCT in conveniently diagnosing mediastinal masses and study their correlation with age, sex, clinical symptoms and FNAC/biopsy findings where ever possible.

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