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EVALUATION OF MEDIASTINAL MASSES ON COMPUTED TOMOGRAPHY

Radio-Diagnosis

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ABSTRACT

Background: Mediastinal masses comprise a heterogeneous group of congenital, inflammatory, infectious, and neoplastic lesions that often pose a diagnostic challenge because of their varied clinical presentation and overlapping imaging features. This study aimed to evaluate the role of computed tomography (CT) in the characterization of mediastinal masses, determine their compartmental distribution and pathological spectrum, and correlate CT findings with the final diagnosis.**Methods:** This prospective observational study included 28 patients with clinically suspected or radiologically detected mediastinal masses who underwent contrast-enhanced CT over one year at a tertiary care hospital. CT findings were analyzed for lesion location, morphology, enhancement pattern, calcification, necrosis, invasion, and associated findings. Histopathological diagnosis, wherever available, served as the reference standard. Data were analyzed using IBM SPSS Statistics version 29.0, and the Chi-square test was used to assess the association between mediastinal compartment and diagnosis.**Results:** The majority of patients were aged 41–60 years (42.9%) and were male (57.1%). Benign mediastinal lymphadenopathy was the most common histopathological diagnosis (21.4%), followed by lymphoma/lymphoproliferative disease (17.9%), while thymoma and metastatic mediastinal lymphadenopathy each accounted for 10.7% of cases. The anterior mediastinum was the most frequently involved compartment (60.7%). A statistically significant association was observed between the mediastinal compartment and histopathological diagnosis ($p = 0.001$). CT most commonly demonstrated heterogeneous enhancement (64.3%), ill-defined margins (53.6%), necrosis/cystic degeneration (39.3%), lymphadenopathy (35.7%), and adjacent structure invasion (32.1%). **Conclusion:** Contrast-enhanced CT is a reliable and valuable imaging modality for the evaluation of mediastinal masses. It accurately characterizes lesion morphology, identifies compartmental distribution, and provides important diagnostic information that facilitates differential diagnosis and guides appropriate clinical management.

KEYWORDS

Mediastinal masses; Contrast-enhanced CT; Mediastinal compartments; Histopathology.

INTRODUCTION

Mediastinal masses comprise a diverse group of congenital, inflammatory, infectious, and neoplastic lesions arising within the mediastinum. Although relatively uncommon, they present a significant diagnostic challenge because of their varied clinical manifestations and overlapping imaging features. Patients may present with symptoms like chest pain, cough, dyspnea, dysphagia, superior vena cava syndrome, or may remain asymptomatic, with lesions detected incidentally during imaging performed for unrelated conditions. Accurate characterization of mediastinal masses is essential for determining appropriate management, prognosis, and the need for surgical intervention or tissue diagnosis.[1]

Computed tomography (CT) has become the imaging modality of choice for the evaluation of mediastinal masses owing to its excellent spatial resolution, rapid image acquisition, and ability to provide detailed anatomical information.[2] Contrast-enhanced CT accurately identifies the location, size, extent, morphology, attenuation characteristics, enhancement pattern, calcification, cystic degeneration, fat content, vascular involvement, and invasion of adjacent structures.[3] CT also facilitates compartment-based classification of mediastinal lesions into anterior, middle, and posterior mediastinal masses, thereby narrowing the differential diagnosis and guiding further management.[4]

The spectrum of mediastinal masses varies with age and anatomical compartment. Thymic lesions, lymphomas, germ cell tumors, and retrosternal goiters commonly involve the anterior mediastinum, whereas bronchogenic cysts and lymphadenopathy are frequently seen in the middle mediastinum, and neurogenic tumors predominate in the posterior mediastinum.[1] Despite advances in imaging techniques, histopathological examination remains the gold standard for definitive diagnosis.[5]

The present study was undertaken to evaluate the role of computed tomography in the assessment of mediastinal masses, to determine their distribution according to mediastinal compartment and pathological diagnosis, and to assess the diagnostic accuracy of CT by correlating imaging findings with the final diagnosis.

METHODOLOGY

This prospective observational study was done in the Department of Radiodiagnosis at a tertiary care teaching hospital over a period of one year after obtaining approval from the Institutional Ethics Committee. The study was aim to evaluate the role of computed tomography (CT) in the diagnosis and characterization of mediastinal masses and to correlate CT findings with the final histopathological diagnosis whenever available. Written informed consent was obtained from all study participants prior to enrollment.

A total of 28 consecutive patients with clinically suspected or radiologically detected mediastinal masses who were referred for contrast-enhanced CT (CECT) chest during the study period were included in the study. Patients of all age groups and either sex presenting with symptoms suggestive of mediastinal pathology, like chest pain, cough, dyspnea, dysphagia, hoarseness of voice, superior vena cava syndrome, or incidental mediastinal masses detected on chest radiography or ultrasonography, were eligible for inclusion. Patients with contraindications to iodinated contrast media, severe renal dysfunction precluding contrast administration, pregnancy, traumatic mediastinal lesions, or those unwilling to provide informed consent were excluded.

All CT examinations were performed using either a SOMATOM Definition Flash multidetector CT scanner or a SOMATOM Scope multidetector CT scanner (Siemens Healthineers, Germany), depending on scanner availability. Patients were positioned supine with both arms elevated above the head. Initial non-contrast images were obtained whenever indicated, followed by contrast-enhanced CT of the thorax. Non-ionic iodinated contrast medium (300–370 mg

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I/mL) was administered intravenously through an 18–20 G cannula using a power injector at a flow rate of 3–5 mL/s. The contrast dose ranged from 1.5 to 2.0 mL/kg body weight (maximum 100 mL), followed by a 20–30 mL normal saline flush. Image acquisition was performed from the thoracic inlet to the upper abdomen during a single breath-hold in the venous phase approximately 60–70 seconds after contrast administration. Images were reconstructed with thin sections (0.6–1.5 mm) and reviewed in axial, coronal, and sagittal planes using mediastinal and lung window settings.

CT images were independently evaluated by experienced radiologists. The following imaging characteristics were recorded using a structured data collection proforma: anatomical compartment of the lesion (anterior, middle, or posterior mediastinum), size, shape, margins (well-defined or ill-defined), attenuation characteristics, pattern of contrast enhancement (homogeneous or heterogeneous), presence of calcification, fat density, cystic or necrotic components, vascular encasement, invasion of adjacent structures, airway compression, pleural or pericardial effusion, lymphadenopathy, and associated pulmonary abnormalities. Based on these findings, a provisional CT diagnosis was established.

Whenever feasible, the CT diagnosis was correlated with histopathological findings obtained from image-guided biopsy, surgical excision, or postoperative specimens, which served as the reference standard for definitive diagnosis. Lesions were subsequently categorized according to histopathological diagnosis and mediastinal compartment for analysis. All demographic, clinical, imaging, and histopathological data were entered into Microsoft Excel and analyzed using IBM SPSS Statistics version 29.0. The association between mediastinal compartment and histopathological diagnosis was assessed using the Chi-square test. A two-tailed p-value of less than 0.05 was considered statistically significant.

RESULT:

Table 1. Baseline Demographic Characteristics of Study Participants (n = 28)

Variable	Frequency (%)
Age Group (years)	
≤20	2 (7.1)
21–40	10 (35.7)
41–60	12 (42.9)
>60	4 (14.3)
Gender	
Male	16 (57.1)
Female	12 (42.9)

As shown in Table 1, the majority of patients belonged to the 41–60 years age group (42.9%), followed by 21–40 years (35.7%). Patients aged over 60 years and ≤20 years accounted for 14.3% and 7.1% of the study population, respectively. Male patients constituted 57.1% of the study population, while females accounted for 42.9%.

Table 2. Distribution of Mediastinal Masses According to Histopathological Diagnosis

Diagnosis	Frequency, n (%)
Benign mediastinal lymphadenopathy	6 (21.4)
Lymphoma/Lymphoproliferative disease	5 (17.9)
Thymoma	3 (10.7)
Metastatic mediastinal lymphadenopathy	3 (10.7)
Germ cell tumour	2 (7.1)
Retrosternal goitre	2 (7.1)
Thymic hyperplasia	1 (3.6)
Thymic neoplasm	1 (3.6)
Schwannoma	1 (3.6)
Neurogenic tumour	1 (3.6)
Bronchogenic cyst	1 (3.6)
Paravertebral abscess	1 (3.6)
Malignant thyroid lesion	1 (3.6)
Total	**28 (100.0)**

Table 2 shows that benign mediastinal lymphadenopathy was the most common diagnosis, accounting for 21.4% of cases, followed by lymphoma/lymphoproliferative disease (17.9%). Thymoma and metastatic mediastinal lymphadenopathy each constituted 10.7% of cases, while germ cell tumour and retrosternal goitre each accounted for 7.1%. The remaining diagnoses, including thymic hyperplasia, thymic neoplasm, schwannoma, neurogenic tumour, bronchogenic cyst, paravertebral abscess, and malignant thyroid lesion, each represented 3.6% of the study population.

Table 3. Distribution of Mediastinal Masses According to Mediastinal Compartment

Compartment	Frequency (n)	Percentage (%)
Anterior mediastinum	17	60.7
Middle mediastinum	8	28.6
Posterior mediastinum	3	10.7
Total	**28**	**100.0**

Table 3 shows that the anterior mediastinum was the most frequently involved compartment (60.7%), followed by the middle mediastinum (28.6%), whereas the posterior mediastinum accounted for 10.7% of cases.

Table 4. Association Between Mediastinal Compartment and Diagnosis

Diagnosis	Anterior	Middle	Posterior	Total
Benign mediastinal lymphadenopathy	0	6	0	6
Lymphoma/Lymphoproliferative disease	5	0	0	5
Thymoma	3	0	0	3
Metastatic mediastinal lymphadenopathy	0	3	0	3
Germ cell tumour	2	0	0	2
Retrosternal goitre	2	0	0	2
Thymic hyperplasia	1	0	0	1
Thymic neoplasm	1	0	0	1
Bronchogenic cyst	0	1	0	1
Malignant thyroid lesion	1	0	0	1
Neurogenic tumour	0	0	1	1
Schwannoma	0	0	1	1
Paravertebral abscess	0	0	1	1
P value (Chi-square)	**0.001***			

As shown in Table 4, most anterior mediastinal lesions consisted of lymphoma/lymphoproliferative disease, thymoma, germ cell tumours, retrosternal goitre, thymic lesions, and malignant thyroid lesion. Benign mediastinal lymphadenopathy, metastatic mediastinal lymphadenopathy, and bronchogenic cyst were predominantly located in the middle mediastinum, whereas neurogenic tumour, schwannoma, and paravertebral abscess were confined to the posterior mediastinum. A statistically significant association was observed between the mediastinal compartment and histopathological diagnosis (Chi-square test, $p = 0.001$).

Table 5. CT Characteristics of Mediastinal Masses (n = 28)

CT Finding	Frequency (n)	Percentage (%)
Well-defined margins	13	46.4
Ill-defined margins	15	53.6
Homogeneous enhancement	10	35.7
Heterogeneous enhancement	18	64.3
Calcification	5	17.9
Necrosis/Cystic degeneration	11	39.3
Adjacent structure invasion	9	32.1
Lymphadenopathy	10	35.7
Pleural effusion	6	21.4

Table 5 shows that ill-defined margins (53.6%) and heterogeneous contrast enhancement (64.3%) were the most common CT characteristics observed. Necrosis or cystic degeneration was present in 39.3% of lesions, while lymphadenopathy (35.7%) and adjacent structure invasion (32.1%) were also frequently identified. Calcification and pleural effusion were seen in 17.9% and 21.4% of cases, respectively.

DISCUSSION

In the present study evaluating mediastinal masses on computed tomography (CT), the baseline demographic profile of the 28 participants majority were males (57.1%, n = 16) and mostly belonged to the 41–60 years age group (42.9%), Our findings of male predominance are similar to multiple studies. In a study of 102 patients with mediastinal mass lesions by Singh et al. (2022), 71% were male (72/102) with a mean age of 44.7 ± 21.3 years, and lesions were most common in the 46–60 years age bracket. Similarly, Ahmed et al. reported a pronounced male preponderance (72%, 36/50 cases) with the highest frequency in patients >61 years. In a large multi-institutional cohort of 3,308 cases analyzed by Roden et al., demographic patterns also varied by compartment and age, with overall trends supporting higher detection in middle-aged adults. [6–8] Regarding age distribution, our study's peak in the 41–60 years group is similar to other studies where mediastinal masses show bimodal or increasing prevalence with age in many cohorts. Nam et al. (2019) analyzed 549 patients with anterior mediastinal lesions (mean age 50.6 ± 14.9 years) and noted age- and gender-specific patterns, with malignancy proportions showing a V-shaped relationship with age (lowest in the 50s at 52.7%). Thymomas became more prevalent in the 40s–50s, similar to our middle-age peak. In incidental detection studies during the COVID-19 era, prevalence of mediastinal masses increased significantly with age ($P < 0.001$), from 0.22% in ≤24 years to 1.59% in ≥85 years. [9,10]

In contrast, some population-based studies report lower overall prevalence and slightly different demographics. The Framingham Heart Study identified anterior mediastinal masses in 0.9% (23/2,571) of participants (mean age of those with masses: 62.1 years, 52% female), with no strong demographic risk factors identified. Larger screening cohorts, like one with 38,861 participants, reported a 1.68% prevalence of incidental mediastinal masses, with significant association to older age but not strongly to gender. [11,12]

In the present study benign mediastinal lymphadenopathy was the most common diagnosis, accounting for 6 cases (21.4%), followed by lymphoma/lymphoproliferative disease in 5 cases (17.9%). These findings are similar to a study by Eldho Sajeev et al. (Computed Tomography Imaging in Evaluating Mediastinal Masses–A Diagnostic Approach with Histopathological Correlation), lymph nodal masses formed the majority (30%), with lymphoma constituting 66.7% of those, showing its prominence in their cohort of patients evaluated by CT. [13]

A large multi-institutional international radiology database study by Roden et al. involving 3,308 cases reported thymomas as the most common (27.8%), followed by benign mediastinal cysts (20.0%) and lymphomas (16.1%). Compartmental distribution was notable: thymomas predominated in the prevascular compartment (38.3%), while neurogenic tumors were common in the paravertebral area (53.9%). The relatively higher proportion of benign mediastinal lymphadenopathy and lymphoma in our smaller cohort may show referral bias toward patients requiring tissue diagnosis, compared with broader imaging databases that include more incidental benign lesions. [8]

Thymoma accounted for 10.7% of cases in our study and is similarly reported as a leading anterior mediastinal tumor across studies. In large reviews and institutional series, thymomas often comprise 20–30% or more of anterior mediastinal masses, with age-related shifts showing greater prevalence in middle-aged and older adults. Our finding is lower than some radiology-based databases but similar to smaller histopathology-focused studies. [8,9]

Germ cell tumours (7.1%) and retrosternal goitre (7.1%) also showed concordance with expected frequencies. Previous studies have reported germ cell tumours in approximately 6–15% of mediastinal masses, particularly among younger patients, while thyroid-related lesions are commonly encountered in the superior or anterior mediastinum. Neurogenic tumours and bronchogenic cysts (3.6% each) were infrequent in our study but are well recognized lesions of the posterior mediastinum in larger series. [6,8]

In the present study, the distribution of lesions across mediastinal compartments showed a predominance of the anterior mediastinum, with 17 cases (60.7%), followed by the middle mediastinum with 8 cases (28.6%) and the posterior mediastinum with 3 cases (10.7%). This finding is similar to previous studies of mediastinal masses, where the anterior (prevascular) compartment contains the majority of lesions. In a large international multi-institutional study by Roden et al. involving 3,308 cases identified on CT, PET-CT, or MRI, the prevascular compartment accounted for approximately 69.8% of lesions, with the visceral (middle) and paravertebral (posterior) compartments comprising 13.5% and 5.4%, respectively. Thymomas were the most common overall (27.8% of cases) and predominated in the prevascular space (30.8%). [8]

Our findings of anterior compartment predominance (60.7%) are similar to previous reports, although the relatively higher proportion of middle mediastinal lesions (28.6%) may be explained by the inclusion of benign and metastatic mediastinal lymphadenopathy in our cohort. Similar anterior predominance has been reported in other studies. The ITMIG CT-based classification (prevascular/anterior, visceral/middle, paravertebral/posterior) facilitates compartmental analysis and differential diagnosis, as anterior lesions frequently include thymic tumors, lymphomas, germ cell tumors, and thyroid extensions, while middle lesions often involve lymphadenopathy or cysts, and posterior lesions are dominated by neurogenic tumors. [14]

In a Japanese study using an earlier JART classification, most tumors (77.1%) were located in the anterior mediastinum, with neurogenic tumors comprising approximately 80% of posterior lesions. Our posterior compartment frequency (10.7%) is similar to the range reported in previous series, where posterior lesions generally account for 10–25% of mediastinal masses. [15,16]

Variations across studies can arise from differences in patient demographics, imaging modalities, inclusion criteria (e.g., incidental versus symptomatic lesions), and geographic factors. The relatively small sample size of our study limits direct statistical comparison but supports the general observation that anterior mediastinal masses constitute the majority of CT-evaluated mediastinal lesions. [8,14,17] In the present study evaluating mediastinal masses on computed tomography (CT), a statistically significant association was observed between the mediastinal compartment and the final histopathological diagnosis ($p = 0.001$). The predominance of anterior compartment involvement in our study is similar to large series. For instance, in a multi-institutional international radiology database analysis of 3,308 mediastinal lesions by Roden et al. (2020), the prevascular compartment housed 69.8% of lesions, with thymomas being the most common (30.8% of prevascular cases), followed by benign cysts (24.0%) and lymphomas (14.4%). [8] Similarly, Fujimoto et al. analyzing 445 pathologically proven mediastinal masses found 77.1% in the anterior compartment, with nearly all thymic epithelial tumors (99%) and most germ cell neoplasms (93%) localized there. [15]

In our study, lymphoma/lymphoproliferative disease, thymoma, germ cell tumours, retrosternal goitre, thymic lesions, and malignant thyroid lesions were predominantly located in the anterior mediastinum. Benign mediastinal lymphadenopathy, metastatic mediastinal lymphadenopathy, and bronchogenic cyst were mainly found in the middle mediastinum, whereas neurogenic tumour, schwannoma, and paravertebral abscess were confined to the posterior mediastinum. These findings are similar to the characteristic compartmental distribution described in previous studies. [8,18]

Posterior compartment lesions in our study were limited to neurogenic tumour, schwannoma, and paravertebral abscess, similar to studies reporting neurogenic tumours as the hallmark of the paravertebral compartment. In the JART series, approximately 80% of posterior mediastinal masses were neurogenic tumors. [15]

Our findings show the significant compartmental association ($p = 0.001$), showing the diagnostic utility of CT-based compartment classification systems like ITMIG and JART. These systems improve differential diagnosis by utilizing anatomic boundaries visible on transverse CT images, thereby facilitating more accurate characterization of mediastinal masses. [14,19]

In our study ill-defined margins were commonly seen (53.6%) is similar to a study by Reddy et al. (comparative MDCT evaluation), where the majority of mediastinal masses were well-defined (72%), but heterogeneous or invasive lesions frequently showed ill-defined features. [6] Similarly, Kaur et al. (2014) in their analysis of 120 cases reported varied margin characteristics, with many malignant lesions showing ill-defined interfaces.[20]

Heterogeneous enhancement was the predominant enhancement pattern (64.3%) in our study is similar to Reddy et al. finding of heterogeneous enhancement in 44% of cases, while another MDCT study reported heterogeneous attenuation in 46% of patients, particularly in malignant lesions. The relatively higher frequency observed in our study may show the greater proportion of complex or necrotic lesions. [6,21]

Calcification was identified in 17.9% of cases, which falls within the

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range reported in previous studies (11–24%). Calcification is particularly useful in showing diagnoses like teratoma, treated lymphoma, or granulomatous disease and therefore contributes significantly to narrowing the differential diagnosis [2,6,21]

Necrosis or cystic degeneration was present in 39.3% of lesions, which is similar to earlier studies reporting necrosis in approximately 40–45% of mediastinal masses. Such findings commonly coexist with heterogeneous enhancement and are frequently encountered in malignant or aggressive lesions, showing the value of contrast-enhanced CT in lesion characterization. [6,21,22]

Adjacent structure invasion (32.1%), lymphadenopathy (35.7%), and pleural effusion (21.4%) show the ability of CT to accurately evaluate local disease extent and associated complications. These findings are similar to previous reports showing CT's role in assessing invasion and nodal involvement, both of which are essential for staging and treatment planning. [21]

Overall, our findings are similar to the established role of CT as the primary imaging modality for evaluating mediastinal masses, providing detailed morphological information that correlates well with histopathological diagnosis. The predominance of heterogeneous enhancement and moderate frequencies of calcification and necrosis are similar with previously published studies. Minor differences likely show our relatively small sample size and institutional case mix. These findings show the high diagnostic accuracy of CT, mainly combine with clinical findings, while showing the continued importance of histopathological confirmation in indeterminate lesions.

The present study included the small sample size limits generalizability, and the lack of direct histopathological correlation for all features in this discussion excerpt. Future multi-center studies with larger cohorts and integrated MRI/PET-CT could further refine these imaging criteria.

CONCLUSION:

Contrast-enhanced computed tomography is a valuable and reliable imaging modality for the evaluation of mediastinal masses. It accurately localizes lesions, characterizes their morphological features, and helps determine their mediastinal compartment of origin. CT findings showed a significant correlation with histopathological diagnosis, facilitating accurate differential diagnosis and appropriate treatment planning. Thus, CT serves as an essential tool in the diagnostic workup and management of patients with mediastinal masses.

Images

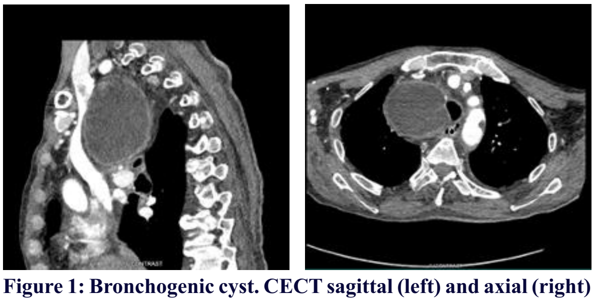

Figure 1: Bronchogenic cyst. CECT sagittal (left) and axial (right) images reveal well circumscribed fluid density poorly enhancing middle mediastinal lesion closely abutting the SVC anteriorly and trachea and esophagus medially.

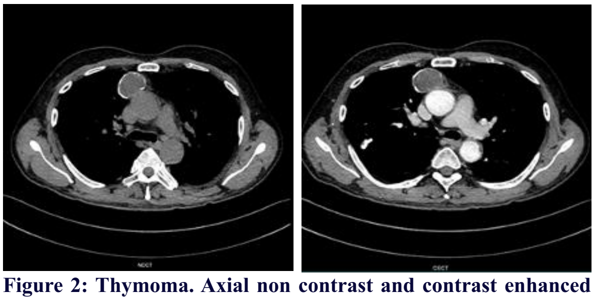

Figure 2: Thymoma. Axial non contrast and contrast enhanced (right) images reveal well circumscribed mildly enhancing anterior mediastinal lesion with rim calcification .

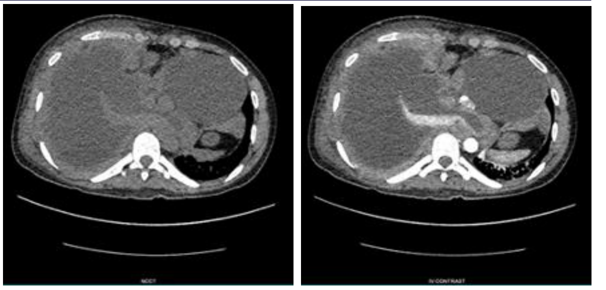

Figure 3: Lymphoma. Axial non contrast and contrast enhanced CT images reveal multiple homogenously enhancing mediastinal lymphadenopathy and large right pleural effusion with enhancing pleural thickening.

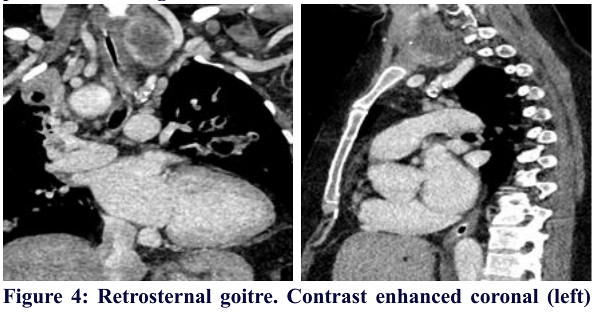

Figure 4: Retrosternal goitre. Contrast enhanced coronal (left) and sagittal (right) images reveal left lobe thyroid lesion showing superior mediastinal extension

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