Volume 3, Number 3, 2026 Pages 433-445

Bioscience Insights

ISSN: 3080-3489 (Print)
ISSN: 3080-3497 (Online)

BiosciInsights.com

IMAGING PHENOTYPES OF PEDIATRIC MEDIASTINAL MASSES ON MULTIDETECTOR COMPUTED TOMOGRAPHY AND THEIR ASSOCIATION WITH UNDERLYING ETIOLOGY."

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https://doi.org/10.5281/zenodo.23359371

Article Information

Article History

Received:	June 19, 2026
Revised:	August 19, 2026
Accepted:	September 07, 2026
Available Online:	October 14, 2026

Keywords:
Computed Tomography, Mediastinal Mass, Pediatric, Diagnostic Accuracy, Lymphadenopathy, Thymus

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Abstract

Background: *Pediatric mediastinal masses represent a diagnostically challenging entity due to their diverse etiologies and potential compromise of vital thoracic structures. Computed tomography (CT) is pivotal for anatomical characterization; however, its diagnostic accuracy in the pediatric population requires validation against histopathological reference standards.*

Objective: *To determine the diagnostic accuracy of multidetector computed tomography (MDCT) in evaluating mediastinal masses in pediatric patients using histopathology as the gold standard, and to describe the spectrum of mediastinal pathologies encountered.*

Methods: *This descriptive cross-sectional study was conducted at the Radiology Department of Ali Medical Centre, Islamabad, Pakistan, over four months. A total of 30 pediatric patients (aged 1–7 years) with clinically or radiographically suspected mediastinal masses were enrolled through non-probability consecutive sampling. All participants underwent contrast-enhanced MDCT (Toshiba Aquilion 64-slice). CT findings were compared with histopathological results. Sensitivity and specificity were calculated for individual mass categories.*

Results: *The mean age was 5.2 ± 1.8 years, with a male predominance (n=16, 53.3%). Anterior mediastinal masses were more common (70%) than posterior (30%). Thymus masses were the most frequent pathology (43.3%), followed by lipoma (30%),*

lymphadenopathy (26.7%), and sarcoma (10%). CT demonstrated 100% sensitivity for sarcoma, anterior mediastinal mass, and posterior mediastinal mass; 89% for lipoma; and 76% for thymus mass. Specificity was 100% for thymus mass and posterior mediastinal mass, 89% for anterior mediastinal mass, 74% for sarcoma, 68% for lymphadenopathy, and 38% for lipoma.

Conclusion: *MDCT demonstrates high diagnostic accuracy for mediastinal masses in pediatric patients, with excellent sensitivity and variable specificity across lesion subtypes. It remains an indispensable tool for characterization, compartmental localization, and treatment planning in pediatric mediastinal pathology.*

INTRODUCTION

Mediastinal masses in the pediatric population constitute a heterogeneous group of congenital, infectious, inflammatory, and neoplastic lesions arising within the thoracic cavity between the pleural sacs [1,2]. The mediastinum is anatomically divided into anterior (prevascular), middle (visceral), and posterior (paravertebral) compartments, a classification endorsed by the International Thymic Malignancy Interest Group (ITMIG) in 2014 [3]. Each compartment exhibits a characteristic predilection for specific pathologies, which aids in radiological differential diagnosis.

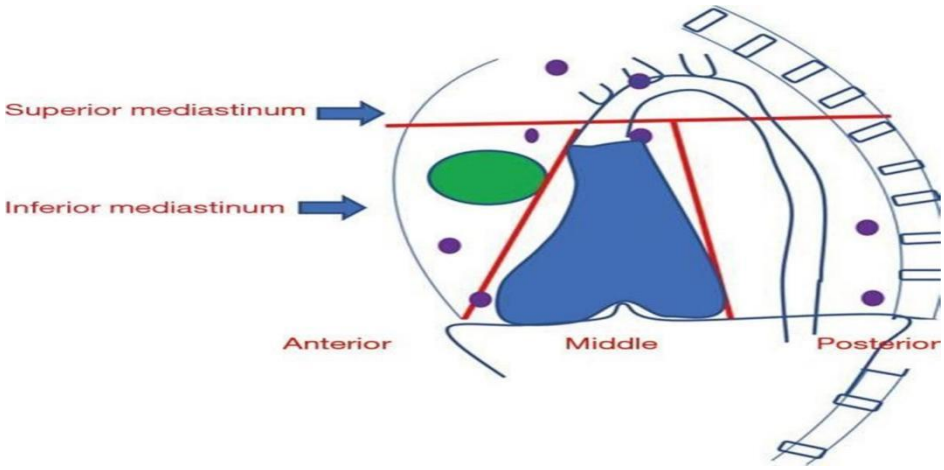


Figure 1: Anatomical Divisions of the Mediastinum

Clinical presentation varies widely, ranging from incidentally detected asymptomatic masses to life-threatening airway compression or superior vena cava syndrome [4,5]. In children, 70–75% of mediastinal masses are malignant, with lymphoma representing the third most common pediatric malignancy overall [6]. Neurogenic tumors predominate in the posterior mediastinum, while thymic lesions and lymphomas are more common anteriorly [7].

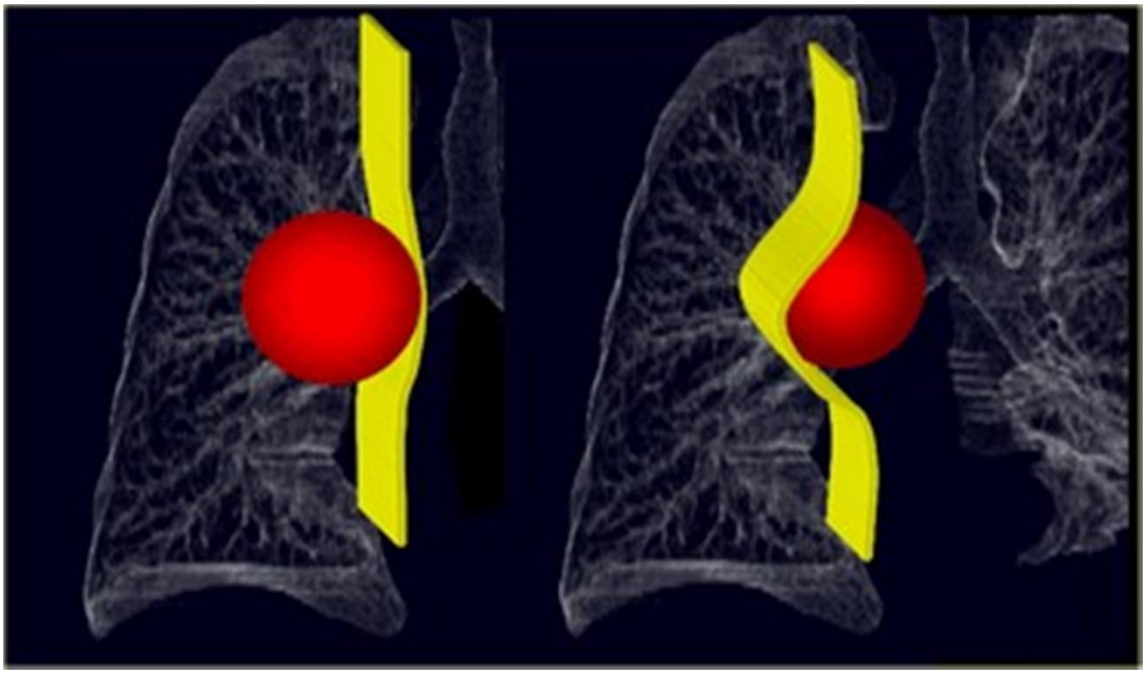


Figure 2: Mass Effect on Adjacent Structures

Computed tomography (CT) has emerged as the primary cross-sectional imaging modality for evaluating mediastinal masses due to its high spatial resolution, rapid acquisition, and ability to characterize tissue composition (fat, fluid, soft tissue, calcium) [8,9]. However, the use of CT in children raises concerns regarding ionizing radiation exposure, necessitating careful justification and optimization [10].
Despite the widespread use of CT in pediatric imaging, there is a paucity of regional data on its diagnostic accuracy in pediatric mediastinal masses. This study was therefore designed to evaluate the diagnostic performance of MDCT in this population and to describe the spectrum of mediastinal pathologies encountered in our setting.

2. Literature Review

Taka et al. (2023) emphasized that evaluation of internal characteristics and localization is crucial for mediastinal mass differentiation, and that the ITMIG classification into prevascular, visceral, and paravertebral compartments optimizes diagnostic and treatment planning [3].
Lingaraju et al. (2022) studied 60 patients with mediastinal masses and reported dyspnea as the most common symptom (34%), with anterior mediastinum being the most frequent location (46.7%). Thymic masses accounted for 32% of anterior masses, and solid lesions were the most common consistency (68%) [11].
El Bargisy et al. (2021) correlated MDCT findings with final diagnosis in 40 patients and reported 92.86% sensitivity and 100% specificity, with lymphoma being the most common mediastinal tumor (20%) [12].
Aroor et al. (2024) found that 68.57% of mediastinal lesions were malignant, with lymphoma accounting for 50% of malignancies and the anterior mediastinum being the most commonly affected compartment (42.86%) [13].
Asgary et al. (2024) reported that 78.2% of mediastinal tumors were located anteriorly, with dyspnea and cough as the most frequent symptoms. Significant association was found between tumor type and location ($P<0.001$) [14].
Gun et al. (2025) reviewed 120 pediatric mediastinal masses and found 86 malignant and 34 benign lesions. Neurogenic tumors (38.3%) and lymphomas (18.3%) were the most common malignancies, and surgery remained the primary treatment modality [15].
These studies collectively support the central role of CT in mediastinal mass evaluation while highlighting the need for pediatric-specific accuracy data.

3. Materials and Methods

This descriptive cross-sectional study was conducted at the Radiology Department of Ali Medical Centre, Islamabad, Pakistan, over four months following approval of the research synopsis. Using a 5% significance level and 95% test power, a sample size of 30 patients was calculated meeting the inclusion criteria which were analyzed for the final analysis. Non-probability consecutive sampling was employed to enroll patients aged less than 7 years of either gender with clinically suspected mediastinal masses or lesions visible on chest radiograph, while patients older than 7 years and those with known cardiac history were excluded. All participants underwent contrast-enhanced multidetector computed tomography (MDCT) using a Toshiba Aquilion 64-slice scanner. Ethical considerations included obtaining written informed consent from all participants' guardians, maintaining confidentiality and anonymity, ensuring voluntary participation with the right to withdraw at any time, and securing institutional review board approval. Data were collected using structured data collection sheets that recorded demographic information (age, gender), clinical presentation (cough, chest pain, dyspnea), chest X-ray findings, and CT findings. All data were stored in Microsoft Excel and analyzed using SPSS version 25, with descriptive statistics computed for continuous variables (mean ± standard deviation) and categorical variables (frequency and percentage), while sensitivity and specificity were calculated for each mass category against histopathology as the reference standard.

3.1 Selection Criteria

Inclusion Criteria:

- Age < 7 years
- Both male and female patients
- Clinically suspected mediastinal mass or lesion
- Mediastinal mass visible on chest radiograph

Exclusion Criteria:

- Age > 7 years
- Patients with known cardiac history

3.2 Equipment

Toshiba Aquilion 64-slice CT scanner.

3.3 Ethical Considerations

Written informed consent was obtained from all participants' guardians. Confidentiality and anonymity were maintained throughout. Participation was voluntary with the right to withdraw at any time. The study protocol was approved by the institutional review board.

3.4 Data Collection Procedure

Data were collected using structured data collection sheets after informed consent. Demographic data (age, gender), clinical presentation (cough, chest pain, dyspnea), chest X-ray findings, and CT findings were recorded. All data were stored in Microsoft Excel and analyzed using SPSS version 25.

3.5 Data Analysis

Descriptive statistics were computed. Continuous variables were expressed as mean ± standard deviation; categorical variables as frequency and percentage. Sensitivity and specificity were calculated for each mass category against histopathology as the reference standard.

4. Results

4.1 Demographic Characteristics

A total of 30 pediatric patients aged 1–7 years were included. The mean age was 5.2 ± 1.8 years. Males constituted 53.3% (n=16) and females 46.7% (n=14).

Table 1: Age Distribution (n=30)

Age (years)	Frequency	Percentage
1	2	6.7%
2	1	3.3%
3	1	3.3%
4	5	16.7%
5	1	3.3%
6	8	26.7%
7	12	40.0%
Total	**30**	**100%**

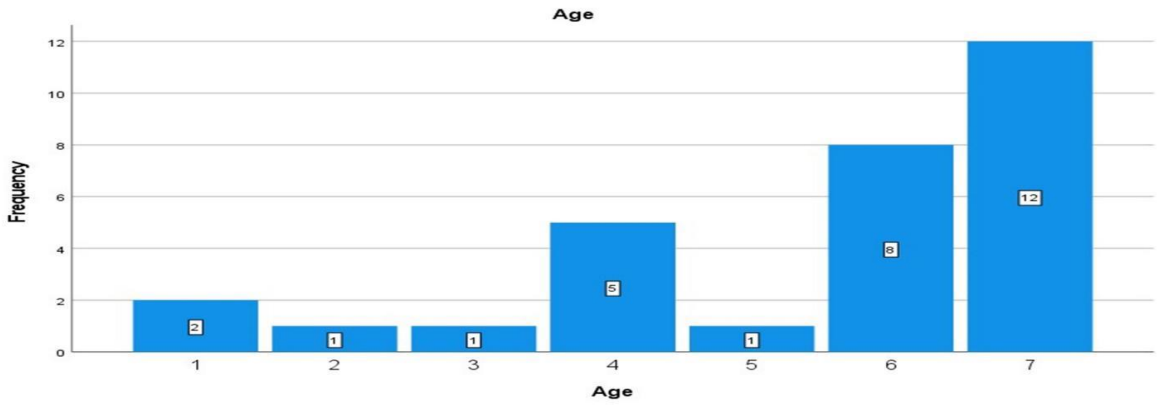


Figure 3: Bar Chart Showing Age Distribution of Pediatric Patients (n=30)

Table 2: Gender Distribution (n=30)

Gender	Frequency	Percentage
Male	16	53.3%
Female	14	46.7%
Total	**30**	**100%**

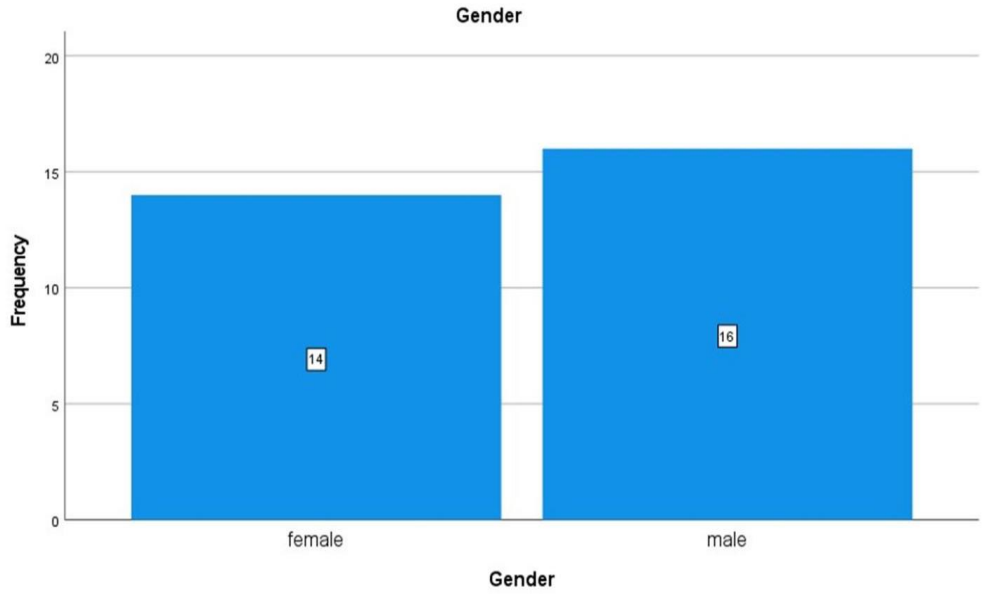


Figure 4: Bar Chart Showing Gender Distribution of Pediatric Patients (n=30)

4.2 Clinical Presentation

Table 3: Presenting Symptoms (n=30)

Symptom	Present	Absent
Cough	20 (66.7%)	10 (33.3%)
Chest Pain	21 (70.0%)	9 (30.0%)
Dyspnea	25 (83.3%)	5 (16.7%)

4.3 CT Findings and Pathological Spectrum

Table 4: Distribution of Mediastinal Pathologies (n=30)

Pathology	Present	Absent
Lipoma	9 (30.0%)	21 (70.0%)
Sarcoma	3 (10.0%)	27 (90.0%)
Lymphadenopathy	8 (26.7%)	22 (73.3%)
Thymus Mass	13 (43.3%)	17 (56.7%)

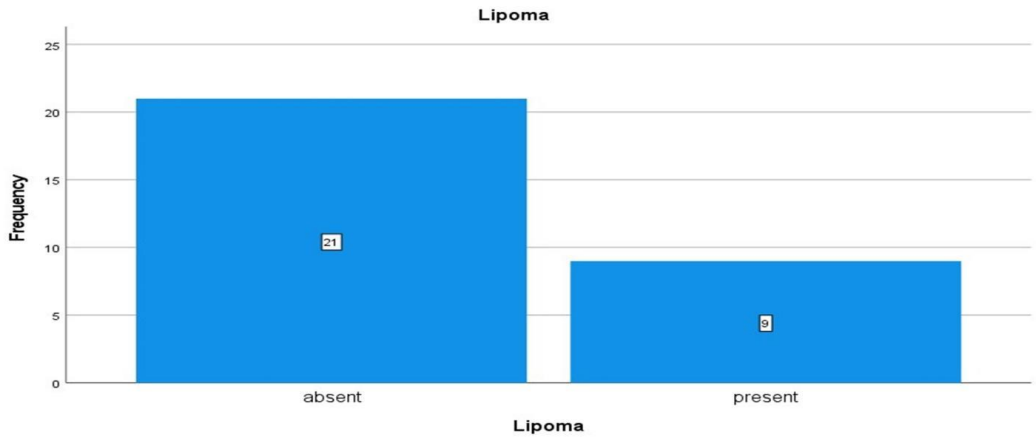
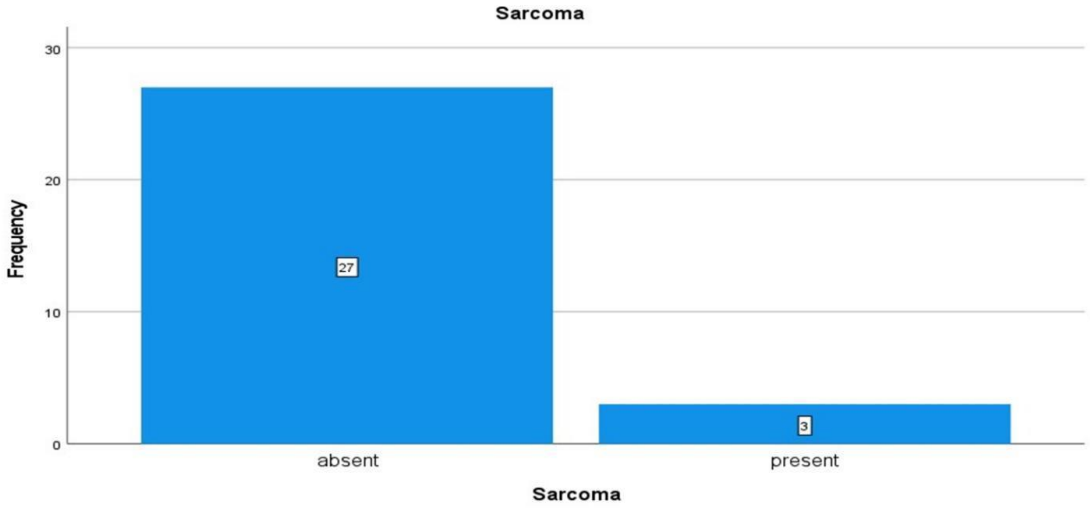
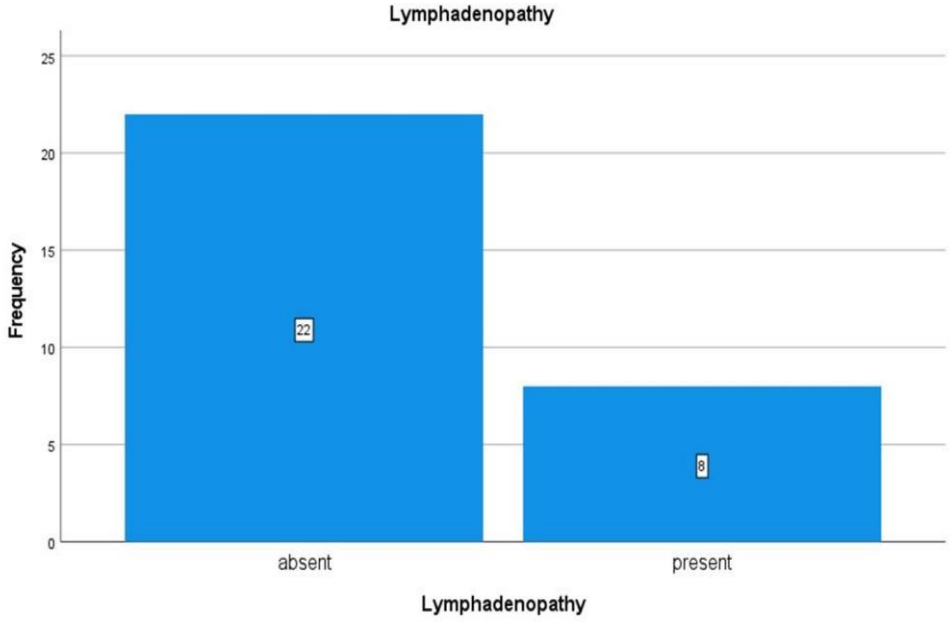


Figure 6: Bar Chart Showing Distribution of Mediastinal Pathologies (n=30)





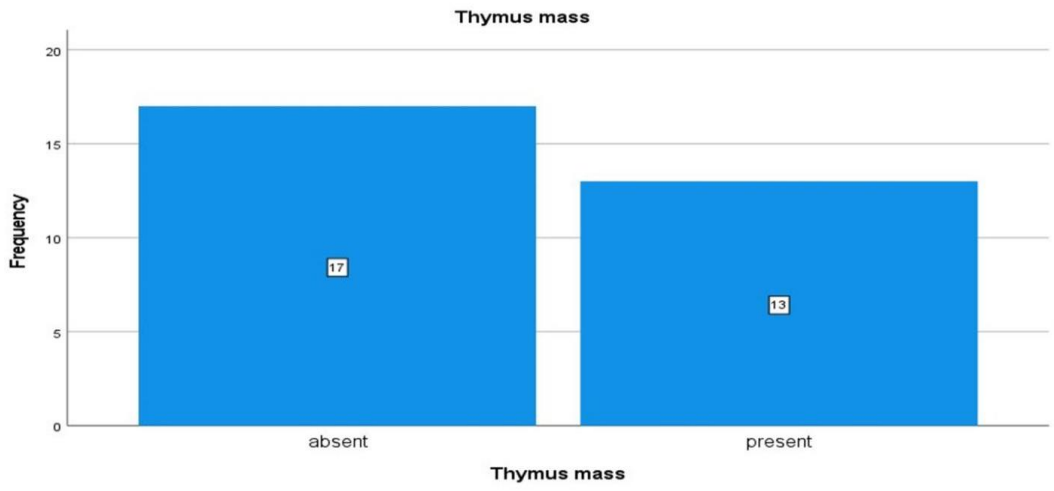


Table 5: Compartmental Distribution (n=30)

Location	Frequency	Percentage
Anterior Mediastinal Mass	21	70.0%
Posterior Mediastinal Mass	9	30.0%

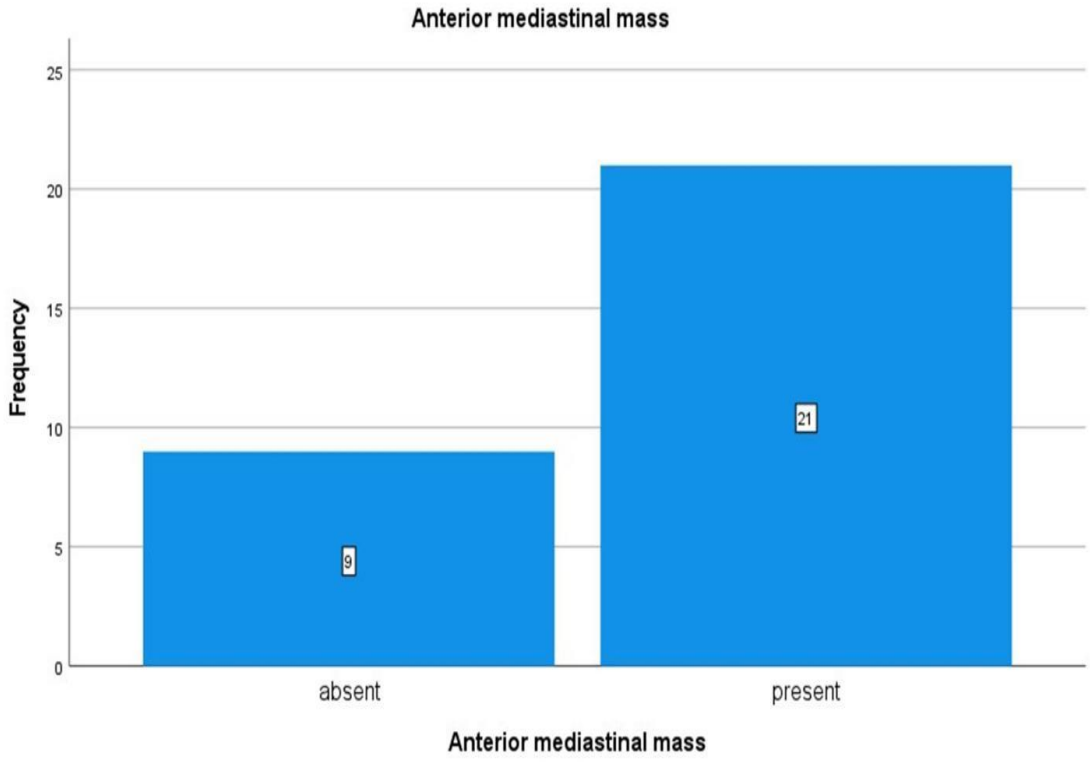
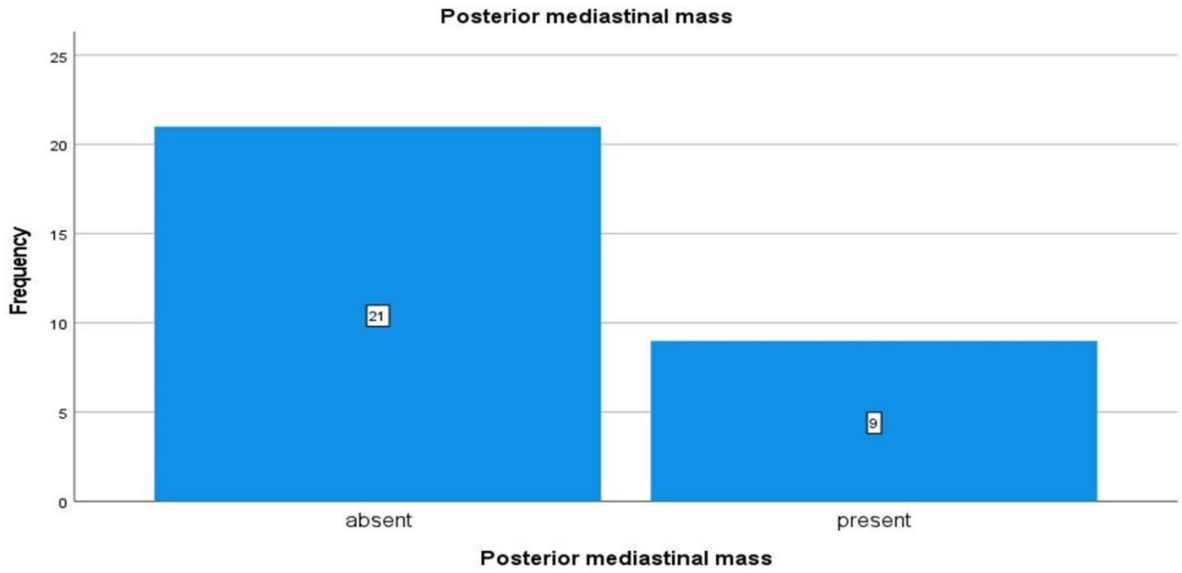


Figure 7: Bar Chart Showing Compartmental Distribution of Mediastinal Masses (n=30)



4.4 Diagnostic Accuracy

Table 6: Sensitivity and Specificity of CT by Lesion Type

Condition	Sensitivity	Specificity
Lipoma	89%	38%
Sarcoma	100%	74%
Lymphadenopathy	100%	68%
Thymus Mass	76%	100%
Anterior Mediastinal Mass	100%	89%
Posterior Mediastinal Mass	100%	100%

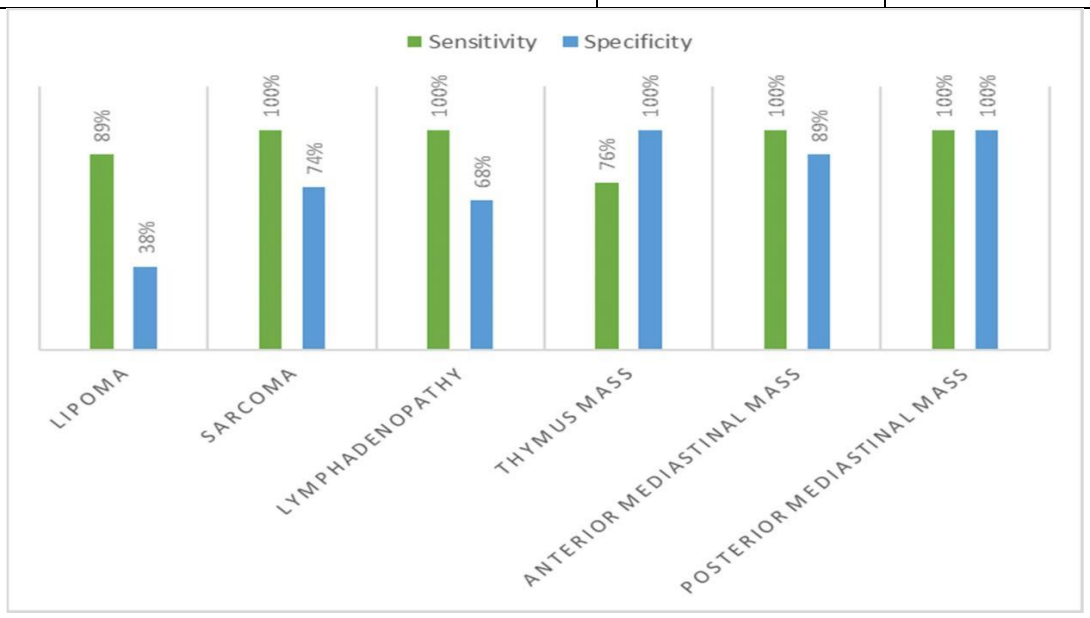
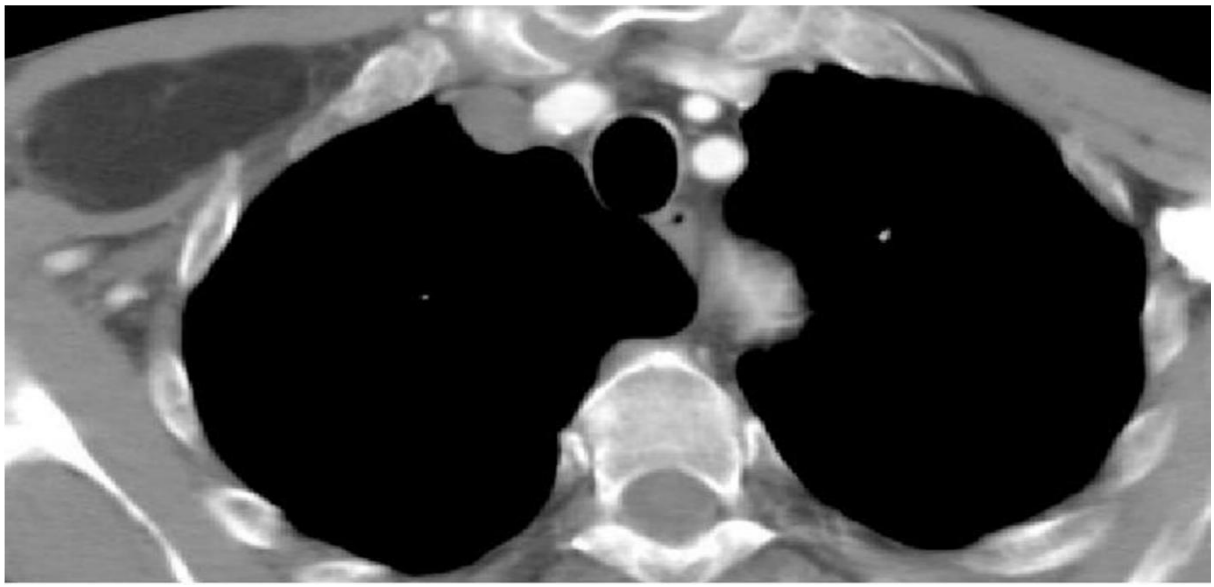


Figure 8: Bar Chart Comparing Sensitivity and Specificity of CT for Various Mediastinal Pathologies

ILLUSTRATIVE CASES

CT Images of Pediatric Mediastinal Masses:

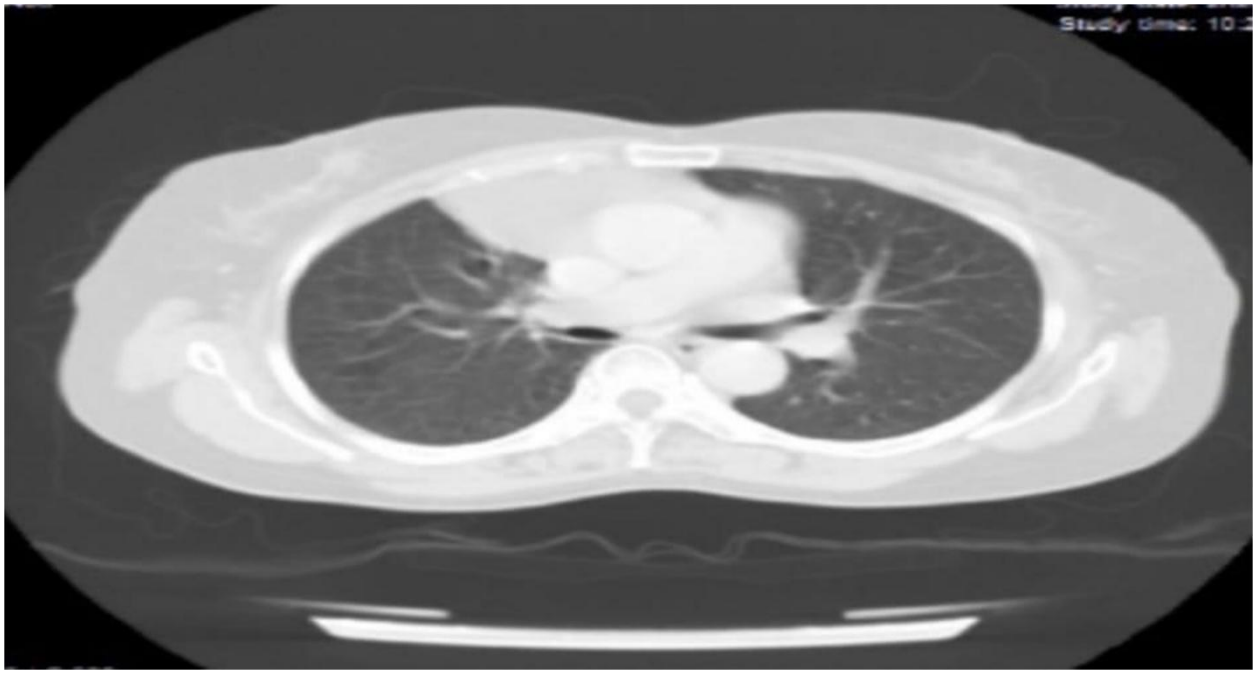
A: CT image of 4-year-old male with right anterior chest wall lipoma.



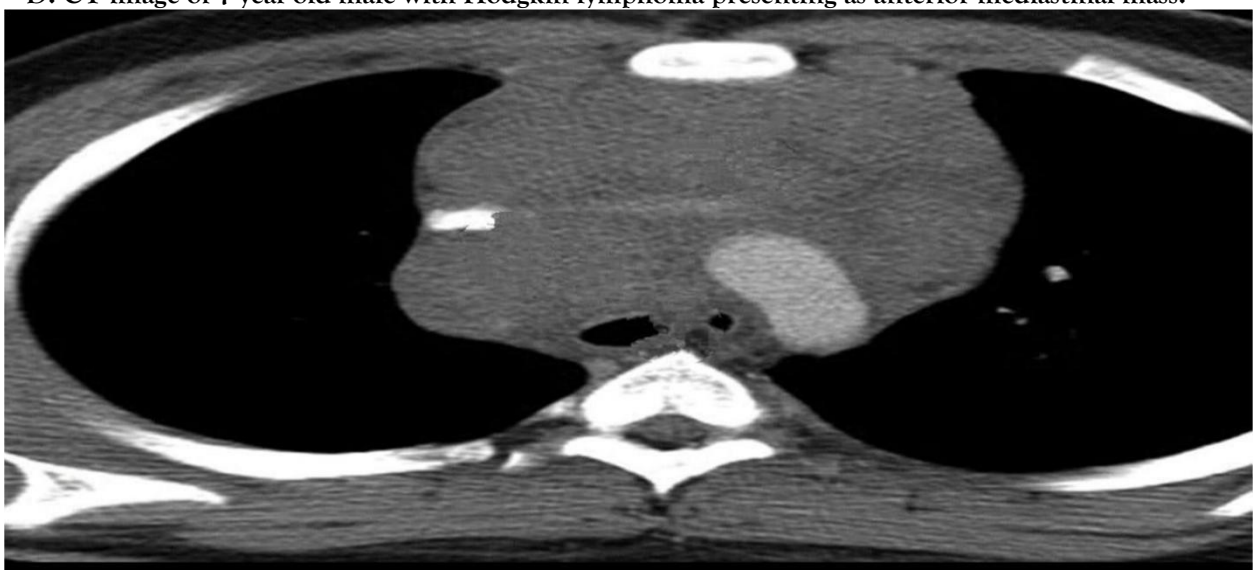
B: CT image of 6-year-old female with anterior mediastinal lipoma.



C: CT image of 7-year-old female with anterior mediastinal lipoma.



D: CT image of 7-year-old male with Hodgkin lymphoma presenting as anterior mediastinal mass.



5. Discussion

This study demonstrates that MDCT is a highly sensitive imaging modality for the evaluation of pediatric mediastinal masses, with sensitivity ranging from 76% to 100% across lesion subtypes. Specificity was more variable, ranging from 38% for lipoma to 100% for thymus mass and posterior mediastinal mass.

Anterior mediastinal masses predominated (70%), consistent with the literature. Lingaraju et al. reported 46.7% anterior masses [11], while Asgary et al. reported 78.2% [14]. This predominance reflects the higher incidence of thymic lesions, lymphomas, and germ cell tumors in the anterior compartment.

Thymus masses were the most common pathology in our cohort (43.3%), followed by lipoma (30%) and lymphadenopathy (26.7%). This distribution differs somewhat from El Bargisy et al., who reported lymphoma as most common (20%) [12]. The high proportion of thymic lesions in our study may reflect the younger age group (1–7 years) and the inclusion of thymic hyperplasia, which can mimic true masses in young children.

CT demonstrated perfect sensitivity (100%) for sarcoma, anterior mediastinal mass, and posterior mediastinal mass. The lower sensitivity for thymus mass (76%) likely reflects the challenge of distinguishing normal thymic tissue from hyperplasia or early neoplastic involvement in young children, a known diagnostic pitfall [16].

The low specificity for lipoma (38%) is notable. This may be explained by the fact that other fat-containing lesions (e.g., thymolipoma, teratoma with fat components) can be misclassified as simple lipoma on CT. This finding underscores the importance of histopathological confirmation even when CT suggests a benign fatty lesion.

Our results align with those of El Bargisy et al., who reported 92.86% sensitivity and 100% specificity for MDCT in mediastinal masses [12], and with Venkateshwaran et al., who demonstrated good diagnostic accuracy, sensitivity, and specificity for CT in mediastinal lesion characterization [17].

Clinical Implications: MDCT provides excellent anatomical detail, compartmental localization, and tissue characterization, making it indispensable for surgical planning and biopsy guidance. However, its limitations in specificity for certain lesions (particularly lipoma and lymphadenopathy) highlight the continued need for histopathological correlation. Radiation dose optimization strategies, including low-dose protocols and alternative modalities (MRI, ultrasound) where feasible, should be considered in pediatric patients [10].

Limitations:

The small sample size (n=30) limits generalizability. The single-center design may introduce selection bias. Histopathological confirmation was not available for all patients. The short study duration precluded assessment of long-term outcomes.

6. Conclusion

MDCT is a highly sensitive and reasonably specific imaging modality for the evaluation of pediatric mediastinal masses. It accurately localizes lesions to mediastinal compartments, characterizes tissue composition, and guides clinical decision-making. Anterior mediastinal masses, particularly thymic lesions and lipomas, were most common in our cohort. While CT sensitivity is excellent, specificity varies by lesion type, and histopathological confirmation remains essential for definitive diagnosis. CT should continue to be used judiciously in pediatric patients, with optimization of radiation dose and consideration of alternative modalities when appropriate

7. Recommendations

1. Larger multicenter studies with histopathological correlation are needed to validate these findings.
2. Low-dose CT protocols should be prioritized in pediatric imaging.
3. MRI should be considered as a problem-solving tool for equivocal cases, particularly for thymic and fatty lesions.
4. Structured reporting templates for pediatric mediastinal masses may improve diagnostic consistency.

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