

PEDIATRIC THYMUS – RADIOLOGICAL EVALUATION

Why Does It Matter? In neonates and infants, the thymus is often prominent. However, not every widened mediastinum indicates a mass.

1- Normal Thymus Clues:

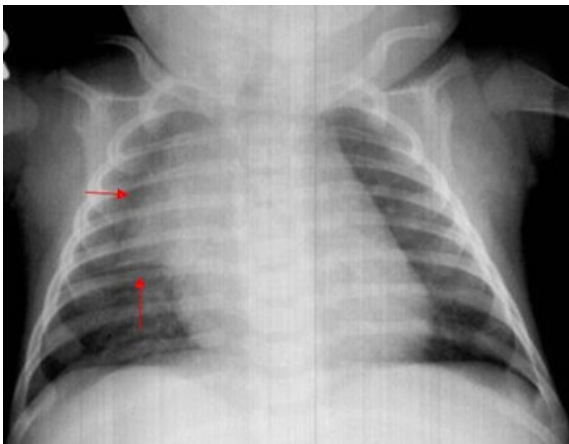
Soft, smooth contours/margins.

Bilateral symmetry or gentle contour notching.

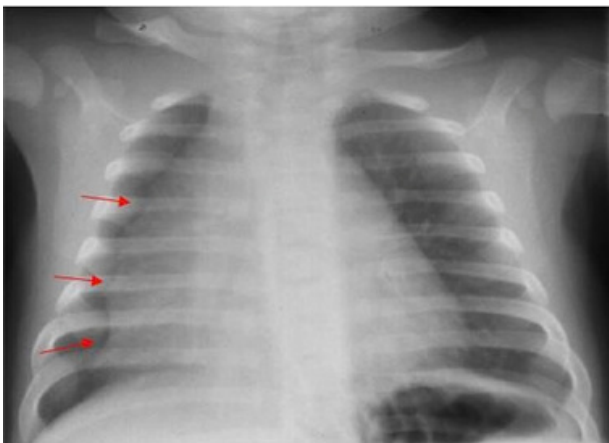
Does not cause tracheal deviation (displacement).

Frequently described as the **Sail Sign** or **Wave Sign**.

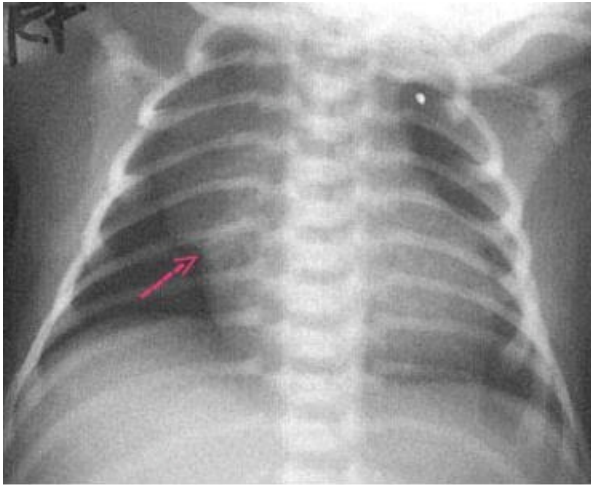
- **Sail Sign:** A triangular, "sail-like" soft tissue shadow in the left (or right) upper chest. Classic for a normal thymus; not seen in true masses.



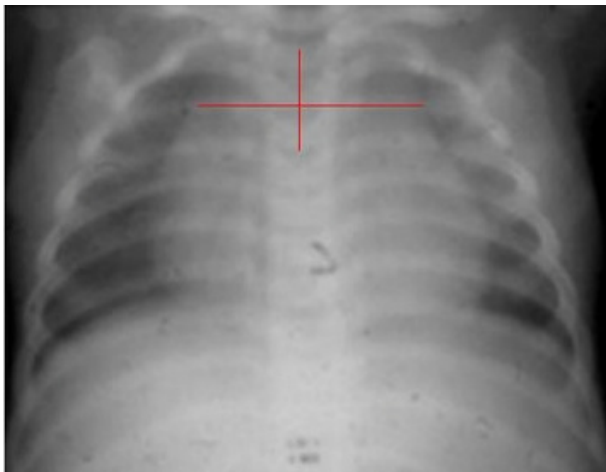
- **Wave Sign:** A wavy contour where the thymus overlaps ribs or cartilages. Indicates soft and compressible tissue. True masses, on the other hand, are typically rigid and firm.



- **Cardiothymic Notch:** A visible notch between the thymus and the cardiac border. Indicates a normal anatomical relationship; masses obliterate or displace this notch.



- **Normal Thymus:** Varies with respiration and position (narrows/elongates during inspiration, shortens/widens during expiration).



Key Differentiating Features (Normal Thymus)

- ✓ Homogeneous soft tissue
- ✓ No tracheal shift/displacement
- ✓ Does not contain calcifications
- ✓ Decreases in size with age (undergoes involution)
- ✓ Shape/size changes with respiration or crying
- ✗ True masses frequently do the exact opposite

Suspicious Features (Red Flags)

When the following findings are present, a true mediastinal mass should primarily be considered:

- Asymmetry
- Sharp angles or lobulated margins
- Tracheal deviation (tracheal displacement)
- Bone destruction (erosion)
- Calcification → Consider a true mediastinal mass (e.g., Teratoma)
- Cyst → Consider a true mediastinal mass (e.g., Lymphangioma / Lymphatic Malformation)

Quick Memory Trick

"Sail, Wave, Notch"

If you observe these signs, you are most likely looking at a normal thymus.

Practical Tip

Lateral Chest Radiograph May Help: A normal thymus does not displace posterior vascular and tracheobronchial structures posteriorly; however, a true mediastinal mass may displace these structures posteriorly.

Ultrasonography (US) Findings

Ultrasonographic Finding	Diagnostic / Clinical Significance
Homogeneous structure	Compatible with normal thymic parenchyma.
Multiple echogenic foci or strands ("Starry Sky" appearance)	Characteristic appearance of normal thymic architecture (connective tissue septa).
Shape changes with cardiac and respiratory motion	Indicates soft and compressible tissue; rules out (does not suggest) solid tumors and infiltrative diseases.
Point to consider: Does it contain fat or calcification?	If present, further evaluation for teratoma or other mixed lesions is required.

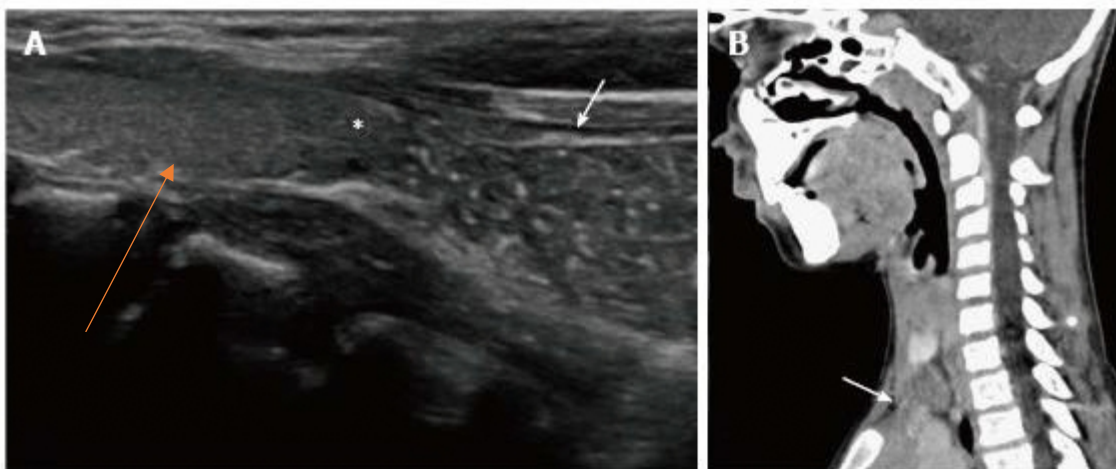
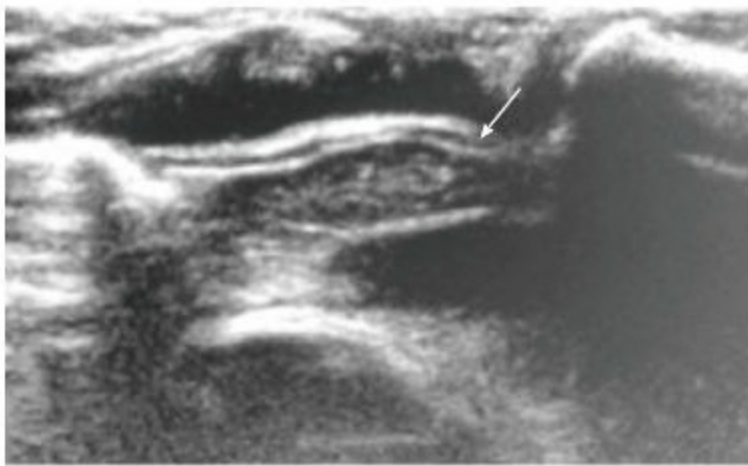


Figure. **Cervical extension of the thymus (cervical ectopia / cervical projection) in a 7-year-old male:** Ultrasound and CT sections demonstrate this ectopic/extending thymic tissue in the anterior neck, adjacent to the inferior aspect of the thyroid gland (red arrow), exhibiting identical echogenicity/density to the normal thymic parenchyma

2. Diagnostic Algorithm for Suspected Thymic Mass on Chest Radiograph

Initial Evaluation / Question	Appearance / Status	Next Step / Advanced Workup	Ultrasound / Tissue Characteristic	Cross-Sectional Imaging (CT/MRI) & Diagnosis
1. Sail, Wave, or Notch Sign	Present	Normal Thymus	—	No follow-up required.

Initial Evaluation / Question	Appearance / Status	Next Step / Advanced Workup	Ultrasound / Tissue Characteristic	Cross-Sectional Imaging (CT/MRI) & Diagnosis
Evaluation According to Age				
	Absent	Ultrasonography (US)	Homogeneous (Typical "starry sky" appearance, smooth margins, changes shape with cardiac/respiratory motion)	THYMIC HYPERPLASIA
			Heterogeneous	Cross-Sectional Imaging (CT/MRI) (Categorized into the mass types below)
2. Evaluation of Thymic Shadow Size Relative to Age	Normal for Age	Normal Thymus	—	No follow-up required.
	Increased (Enlarged)	Ultrasonography (US)	Heterogeneous → Mass-forming / Non-mass-forming	MRI Evaluation:

- Diffuse symmetrical enlargement
- Normal vasculature
- Smooth contour
- Presence of microscopic fat

→ **THYMIC HYPERPLASIA**

3. Differential Diagnosis Table Based on Cross-Sectional Imaging (CT/MRI) Findings

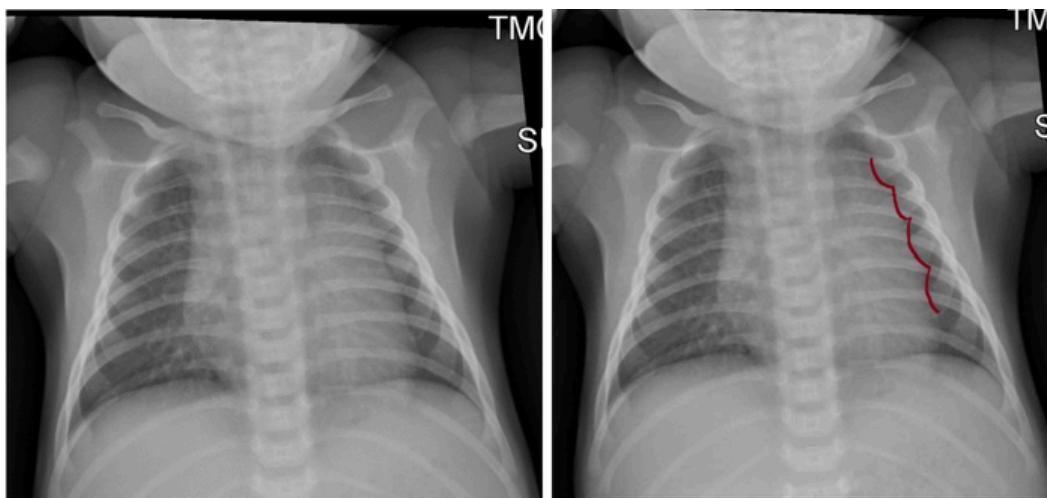
Sub-classification performed via CT / MRI when a heterogeneous or suspicious mass is detected following US:

Mass Architecture / Tissue Type	Lesion Characteristics	Potential Diagnosis / Pathology
CYSTIC	Unilocular	Cyst
	Multilocular	Lymphatic Malformation (Lymphangioma)
	Containing fat and calcification	Mature Teratoma
MIXED	With necrotic component	Infection (Tuberculosis, etc.)
	Solid component containing fat/calcification	Germ Cell Tumor
	Heterogeneous / Calcification / Cystic	Langerhans Cell Histiocytosis
SOLID	Prominent (intense) enhancement, lobulated, non-calcified	Hemangioma
	Prominent feeding vessels, lymph node involvement	Castleman Disease
	Necrosis and hemorrhage	Carcinoid Tumor

Mass Architecture / Tissue Type	Lesion Characteristics	Potential Diagnosis / Pathology
	Mild / Moderate enhancement, homogeneous, lymph node involvement	Lymphoma
	Homogeneous or irregular nodular	Thymoma (Non-invasive / Invasive)
	Containing fat and fibrous septa	Thymolipoma
	Invasive, aggressive lesion	Thymic Carcinoma

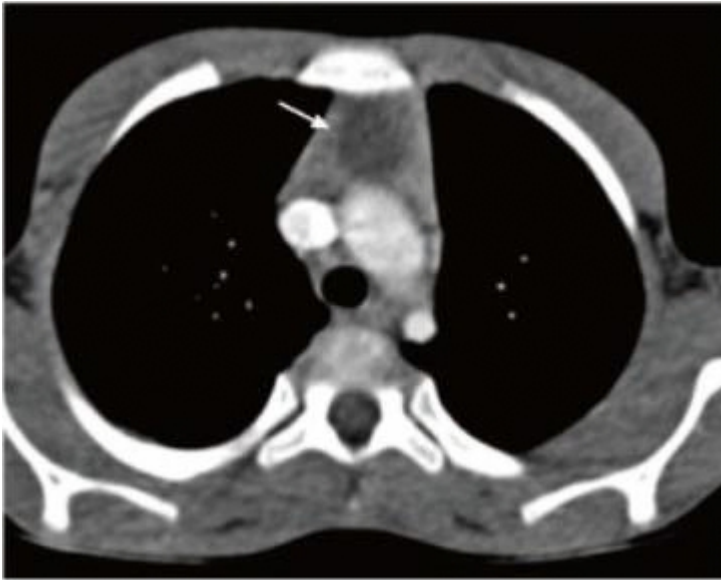
Case examples adapted/sourced from Radiopaedia.org.

Example 1.



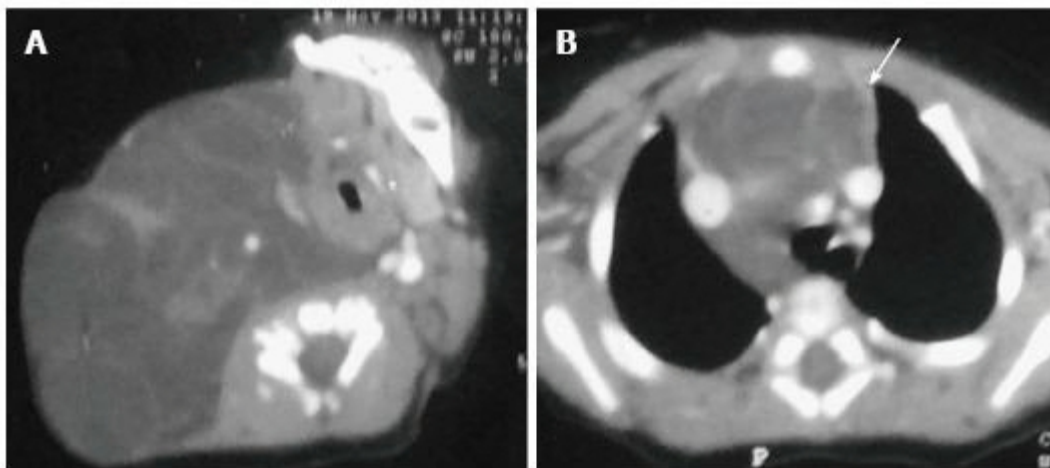
Wave Sign.

Example 2.



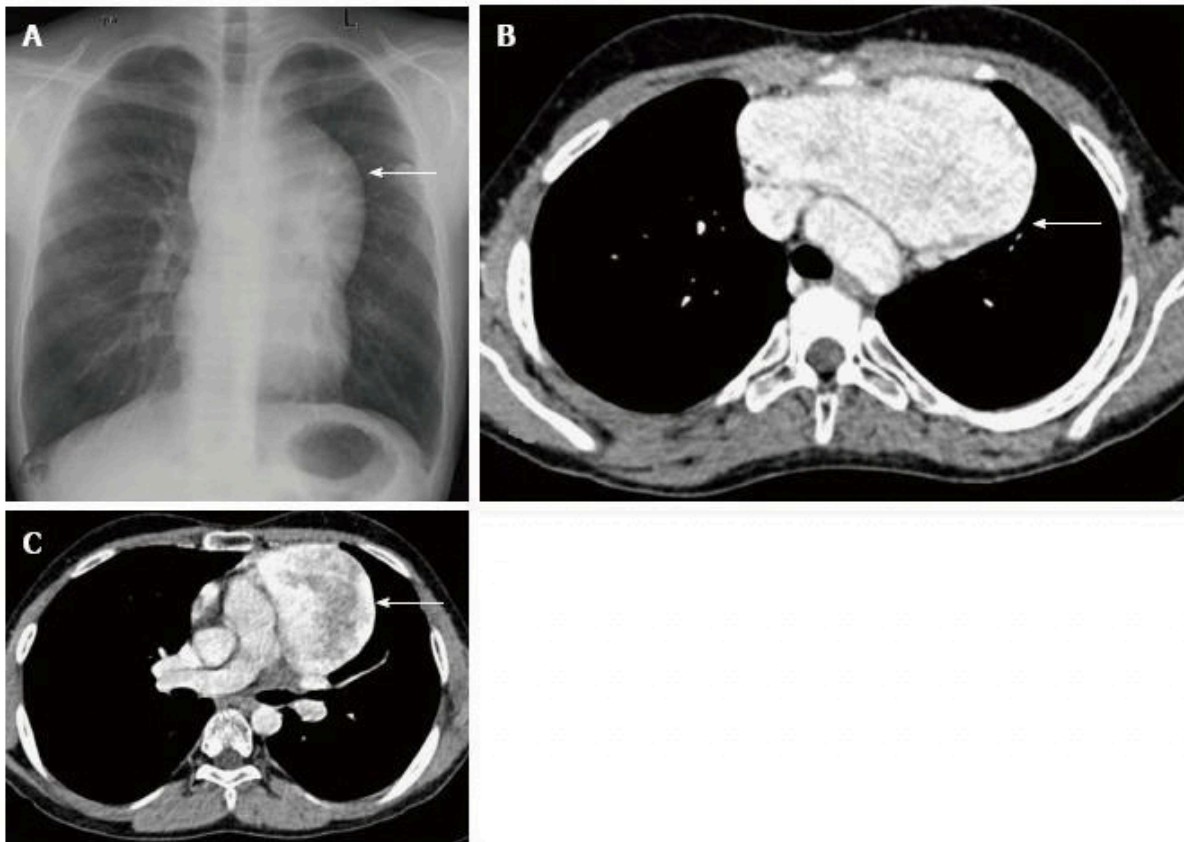
Thymic cyst in a 14-year-old male (CT): Homogeneous fluid-attenuating (density) lesion with thin, smooth walls. Contains no solid component. Occasional internal septations or mural calcification may be present.

Example 3.



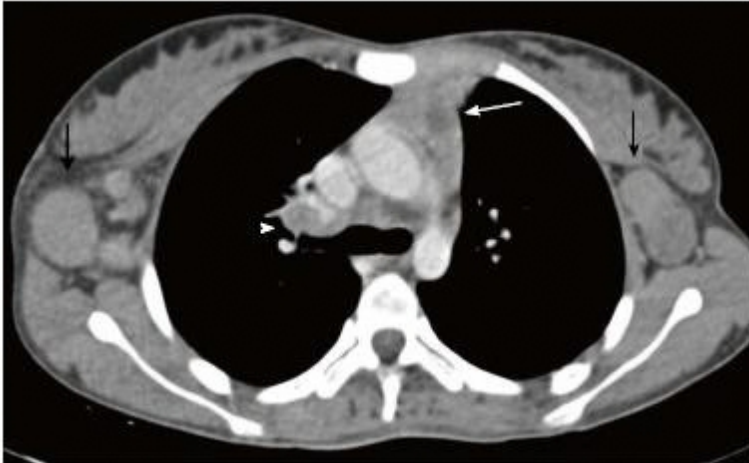
Lymphatic Malformation (previously known as lymphangioma or cystic hygroma): Post-contrast imaging demonstrates enhancement of the walls and septa, whereas no enhancement is observed in the internal cyst contents (lumen).

Example 4.



Cavernous Hemangioma: Incidentally detected cavernous hemangioma in a 16-year-old male. Mediastinal cavernous hemangiomas are extremely rare, benign vascular lesions. They are typically asymptomatic and detected incidentally on chest CT or MRI performed for other reasons. Following intravascular contrast administration, their characteristic prominent/intense homogeneous or peripheral nodular enhancement (with subsequent centripetal filling) is the most distinctive feature in differentiating the lesion from cystic structures and hypovascular solid neoplasms (such as lymphoma or thymoma).

Example 5.



Tuberculosis in a 12-year-old female: Central low-attenuation (hypodense) areas (arrow). Represents central caseous necrosis and parenchymal involvement. In the right hilar region, a necrotic right hilar lymph node (arrowhead) is present. This is a characteristic finding of tuberculous lymphadenitis featuring peripheral rim enhancement and central necrosis. Enlarged bilateral axillary lymph nodes (axillary LAM) (black arrows) indicate widespread reactive lymphatic involvement.