Sonographic appearances of intrathyroid thymus

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Purpose

Intrathyroid lesions in children are uncommon before puberty and are considered to occur in less than 1.5% of scrutinized children. Palpable thyroid nodules in children should be thoroughly investigated due to the higher risk of malignancy, compared to adults. With the advent of high-resolution Ultrasonography (US), incidental intrathyroid abnormalities have been encountered in 17% of children scanned for cervical lymphadenopathy; intrathyroid ectopic thymus accounted for 17% of these incidentalomas, exhibiting a prevalence of 3.1%. Other investigators consider intrathyroidal thymus a rarer occurrence, with a prevalence of 0.4%.

The US hallmark of intrathyroid thymic tissue is a hypoechoic lesion with linear or punctate internal echoes, the so-called "starry sky appearance". These lesions have been shown to involute with growth and do not require treatment.

The objective of this study is to thoroughly describe the ultrasonographic findings of intrathyroid thymus in a relatively large number of children.

Methods and Materials

The clinical data and US (Gray scale and color images) findings of children younger than 14 years, referred for US of the thyroid and/or neck and having a diagnosis of intrathyroid thymus were retrospectively reviewed.

- During a period of 3 years 22 children (12 males, 10 females), aged 3.5-14 years (mean age 7.4 years) were diagnosed with intrathyroid thymus with or without perithyroid thymus.

The diagnosis was based on:

a. comparison with the visible mediastinal thymus in 22 children,

b. fine needle aspiration biopsy (FNAB) in 1 patient,

c. correlative MRI in 1 patient,

d. US and/or clinical follow-up in 19 children.

Follow-up lasted between 2 months and 2 years (mean 8 months). Following the cumulative experience of the examiners, in the last 3 patients, the echo-pattern of the
lesions identical to the one of the mediastinal thymus of the same patient, combined with
the remaining US characteristics, was considered sufficient for the diagnosis.

Clinical - laboratory data

- 19 children were euthyroid
- 3 children exhibited increased TSH of a mean of 6.8 µU/ml, (normal range
  0.2-3.5 µU/ml,) one of them with a diagnosis of Hashimoto’s disease
- None had a palpable thyroid nodule or a history of previous irradiation in the
  neck.
- Serum parathyroid hormone and calcitonin concentrations were within
  normal limits in all patients.

Indications for US imaging:

a. suspected lymphadenopathy 9 children
b. evaluation of a thyroid nodule seen elsewhere 4 children
c. question for obesity-related thyroid disease 3 children
d. positive family history of thyroid disease 4 children
e. follow-up of Hashimoto’s thyroiditis 1 child
f. raised TSH 1 child

- Patients with intrathyroid thymus were recorded as having:
  # single or multiple lesions
  # unilateral or bilateral lesions
  # central or peripheral lesions

- Thymic rests were recorded as:
  # left or right depending on the involved side,
  # superficial, at the middle third of the respective lobe or deep, depending on the position
    of the lesion in the anteroposterior direction,
  # upper, middle or lower depending on the location of the lesion in the long axis of the
    thyroid’s lobe.
The size of each lesion was measured on sagittal scans and the maximal longitudinal and anteroposterior diameters of the intrathyroid component of the lesion(s) were recorded.

The following characteristics of each lesion were assessed:

- shape
- the presence of angulated borders
- echogenicity compared to the thyroid
- the presence and thickness of a complete or incomplete hypoechoic rim
- the presence of linear or punctate internal echoes (speckles), which were subjectively characterized as thin or thick.
- the distribution of bright spots was assessed as
  - **a)** random, covering the entire area of the lesion, the so-called starry sky pattern
  - **b)** curvilinear, with prominent spots at the periphery of the lesion forming a necklace pattern
  - **c)** uneven with few spots here and there and areas without spots
- the presence and amount of color dots inside the lesions on color Doppler,
- the presence of extrathyroid extension of the lesion
- the presence of visible connection between the intrathyroid and the mediastinal thymus
- the presence of neighboring to the thyroid cervical thymic tissue without connection to the intrathyroidal thymus
- the echogenicity and speckle pattern between the intrathyroid lesion and the mediastinal thymus were directly compared in each patient.

Results

Twenty-four (24) intra-thyroidal thymus lesions were identified in 22 children.

In one patient two separate thymic lesions were identified at the right side and in a second child two thymic rests, one in each thyroid lobe were recorded Fig. 1 on page 15
Fig. 1: Fig. 1. Bilateral intrathyroid thymus lesions showing a relatively elongated configuration on longitudinal scans. a: Transverse scan through the thyroid shows one semilunar hypoechoic lesion (arrowheads) containing sparse thin echogenic dots and another rounded lesion (arrow) at the posterior-medial aspect of the left lobe, exhibiting the starry sky pattern. b: Longitudinal scan of the right thyroid lobe with color Doppler application. The lesion (*) is hypoechoic, avascular, is surrounded by a thin rim and has an elongated configuration with a geographical shape and angulated pointed edges (arrows). c: Longitudinal scan of the left thyroid lobe. The lesion is ovoid, hypoechoic, especially at its peripheral rim (arrowheads), contains echogenic areas representing medulla (open arrow) and echo-bright dots in a random and peripheral distribution (long arrows) representing interlobular septa and vessels.

References: Department of Radiology, University Hospital of Iraklion, Faculty of Medicine - Iraklion/GR

In total, 8 right-sided and 16 left-sided lesions were noted.

Regarding location:

-21 lesions (87.6%) were located posteriorly, 13 of which were confined to the posterior third of the thyroidal lobe and 8 extended to the neighboring middle third as well
-3 lesions were located exclusively at the middle third of the respective lobe
-0 lesions were located anteriorly

With respect to the long axis:

-1 lesion (4.17%) was located at the upper third of the lobe
-16 (66.67%) at the middle third
-1 (4.17%) at the borders of middle and lower third
-6 (25%) at the lower third of the thyroidal lobe.

In total, 23 lesions (95.8%) were located at the two lower thirds of the respective lobe of the thyroid.

Contact with the thyroid's periphery occurred in 18 lesions (75%) while the remaining 6 (25%) were central or eccentric but not in contact with the thyroid's contour.

The lesion's longitudinal diameter ranged from 0.3 cm to 0.9 cm (mean 0.57 cm) and the antero-posterior diameter ranged from 0.1 to 0.6 cm (mean 0.31 cm). At follow up, a decrease of the lesion's size by 3 mm in the antero-posterior diameter was noted in one case while the remaining lesions were stable in size and shape.
With regard to the shape of the intrathyroid lesions evaluated on longitudinal and axial scans:

- 12 lesions had a geometric/geographic shape (50%) accordingly:
  - 2 were triangular
  - 2 were like a scimitar
  - 8 were more like a map (geographic) with flat and round portions (Fig. 1 on page 15, Fig. 2 on page 17, Fig. 3 on page 19).
Fig. 2: Multiple characteristics of intrathyroid thymus. a: longitudinal scan of the left thyroid lobe shows a geometric lesion with a flat anterior aspect and angulated borders (open arrow). The lesion is isoechoic to the thyroid (t), is surrounded by a pencil-thin hypoechoic rim (arrowheads) and contains scattered thick speckles. Note the band of thymic tissue (*) connecting the thyroidal lesion to the neighbouring cervical thymus (C Th). b: Transverse scan through the mediastinal thymus (Th) of the same patient. The speckles forming the starry sky pattern are equally thick to the ones of the thyroidal lesion. Also note the thin hypoechoic rim at the anterior-right aspect of the mediastinal thymus (open arrowhead) beneath the echogenic capsule (white arrowhead) and the angulated contours (open arrow). c: Another image of the same lesion as in a, in duplicate, without and with arrows. The speckles (long arrows) are arranged peripherally below the thin hypoechoic rim (open arrowheads) like a necklace.

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Fig. 3: Extrathyroid extension, geographic shape and internal echotexture of intrathyroid thymus. a: duplicated same axial US image of the left lobe of the thyroid. There is a rounded deep hypoechoic lesion that extends posteriorly beyond the thyroid's borders with a narrow segment of tissue (arrows) and opens into a triangular extrathyroidal posterior segment with angulated contours. Note the starry sky pattern and the complete thin rim (arrowheads). b: transverse scan through the mediastinal thymus. The internal echo-pattern between the intrathyroid and the mediastinal thymus
is identical. The mediastinal thymus is also characterized by a peripheral thin rim (arrowheads) between the starry-sky pattern (*) and the echogenic capsule (arrow).

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- 12 lesions (50%) exhibited a somehow nodular configuration accordingly:

-10 lesions were ovoid (Fig. 4 on page 21) and also rounded in some images

**Fig. 4**: Direct US comparison with ovoid-shape intrathyroid and mediastinal thymus. a: Longitudinal scan of the left thyroidal lobe shows an ovoid, hypoechoic, peripheral lesion (open arrow) at the posterior aspect of the middle part of the thyroid (T). The lesion contains multiple fine internal spots and lines (long thin arrow) in a random and uniform distribution, the starry sky appearance, except for a hypoechoic rim (arrowheads) which is relatively thick at this example. b: Transverse scan at the superior mediastinum shows the mediastinal thymus (Th) being of the same
echogenicity and containing echogenic spots (long thin arrows) equally thin as the intrathyroid lesion.

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-2 had a lentiform shape, i.e. ovoid with pointed upper and lower edges.

#When comparing the shape of the same lesion between axial and longitudinal scans, 18 lesions (75%) appeared more elongated on longitudinal scans (Fig. 1 on page 15, Fig. 5 on page 21).
Fig. 5: Extrathyroid extension and uneven distribution of internal speckles. a: Transverse US scan of the thyroid. At the deep part of the middle third of the thyroid’s left lobe, there is a geographic-shape hypoechoic lesion extending medially and cranially (arrows). The anterior part of the lesion exhibits a thin hypoechoic rim thought to represent cortex (arrowhead). Note the uneven distribution of the scattered bright spots (long arrow) and an isoechoic area considered to represent medulla, without such spots at the posterior aspect of the lesion (open arrowhead). b: Longitudinal scan of the same lesion which exhibits an extrathyroid component (*), the starry sky appearance (open arrowheads) and an incomplete hypoechoic rim (white arrowhead). c: Transverse US scan of the mediastinal thymus. The same uneven distribution of speckles is present.

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# Angulations of contour in at least one point was noted in 14 lesions (62.5%) (Fig. 1 on page 15, Fig. 2 on page 17, Fig. 3 on page 19).

# Regarding the echogenicity of the lesion's matrix when compared to the echogenicity with the thyroid

- 17 were hypoechoic (70.8%)
- 7 were isoechoic (29.2%) (Fig. 1 on page 15, Fig. 2 on page 17, Fig. 3 on page 19, Fig. 4 on page 21, Fig. 5 on page 21).

# The intrathyroid thymic tissue invariably contained bright spots or lines, the speckles.

- Speckles were scattered through the entire lesion randomly and uniformly, the so-called starry-sky appearance in 22 lesions (92%) (Fig. 1 on page 15, Fig. 2 on page 17, Fig. 3 on page 19, Fig. 4 on page 21, Fig. 5 on page 21).

- Two (2) lesions contained speckles together with areas void of speckles.

- In 1 lesion images with the starry sky pattern and images with this uneven distribution pattern coexisted (Fig. 5 on page 21).

- In 5 lesions, images with the starry sky pattern coexisted with images with the necklace pattern. In the latter, speckles were more prominent in a peripheral location forming a sub-marginal string of beads (Fig. 2 on page 17C).

- Speckles were thin in 21 lesions (87.5%) and thick in 3 (12.5%) and were always identical to internal spots of the mediastinal or cervical thymus of the same patient in all cases (Fig. 2 on page 17, Fig. 3 on page 19, Fig. 4 on page 21, Fig. 5 on page 21).
A peripheral hypoechoic rim (Fig. 1 on page 15, Fig. 2 on page 17, Fig. 3 on page 19, Fig. 4 on page 21, Fig. 5 on page 21) was present in at least one of the available images in 20 lesions (83.3%),

- was complete in 8
- incomplete in 12.
- was pencil-thin in 19 lesions
- was thicker but less than 2 mm in 1 (Fig. 4 on page 21).

Color Doppler performed in 11 lesions didn't recognize internal color spots in any image (Fig. 1 on page 15B).

Extrathyroid extension beyond the borders of the thyroid occurred in 8 lesions (33.33%), (Fig. 3 on page 19, Fig. 5 on page 21).

A visible tongue of thymic tissue connecting the intrathyroid thymus with the proximal cervical thymus (Fig. 2 on page 17) was observed in 5 thymic rests (20.5%).

Cervical thymus neighboring the respective thyroid lobe without connection to the intrathyroid thymic tissue occurred in 13 lesions (54.2%).

Images for this section:
**Fig. 1:** Bilateral intrathyroid thymus lesions showing a relatively elongated configuration on longitudinal scans. 

a: Transverse scan through the thyroid shows one semilunar hypoechoic lesion (arrowheads) containing sparse thin echogenic dots and another rounded lesion (arrow) at the posterior-medial aspect of the left lobe, exhibiting the starry sky pattern. 

b: Longitudinal scan of the right thyroid lobe with color Doppler application. The lesion (*) is hypoechoic, avascular, is surrounded by a thin rim and has an elongated configuration with a geographical shape and angulated pointed edges (arrows). 

c: Longitudinal scan of the left thyroid lobe. The lesion is ovoid, hypoechoic, especially at its peripheral rim (arrowheads), contains echogenic areas representing medulla (open arrow) and echo-bright dots in a random and peripheral distribution (long arrows) representing interlobular septa and vessels.
**Fig. 2:** Multiple characteristics of intrathyroid thymus. a: Longitudinal scan of the left thyroid lobe shows a geometric lesion with a flat anterior aspect and angulated borders (open arrow). The lesion is isoechoic to the thyroid (t), is surrounded by a pencil-thin hypoechoic rim (arrowheads) and contains scattered thick speckles. Note the band of thymic tissue (*) connecting the thyroidal lesion to the neighbouring cervical thymus (C Th). b: Transverse scan through the mediastinal thymus (Th) of the same patient. The speckles forming the starry sky pattern are equally thick to the ones of the thyroidal lesion. Also note the thin hypoechoic rim at the anterior-right aspect of the mediastinal thymus (open arrowhead) beneath the echogenic capsule (white arrowhead) and the angulated contours (open arrow). c: Another image of the same lesion as in a, in duplicate, without and with arrows. The speckles (long arrows) are arranged peripherally below the thin hypoechoic rim (open arrowheads) like a necklace.
**Fig. 3:** Extrathyroid extension, geographic shape and internal echotexture of intrathyroid thymus. 

a: duplicated same axial US image of the left lobe of the thyroid. There is a rounded deep hypoechoic lesion that extends posteriorly beyond the thyroid's borders with a narrow segment of tissue (arrows) and opens into a triangular extrathyroidal posterior segment with angulated contours. Note the starry sky pattern and the complete thin rim (arrowheads). 

b: transverse scan through the mediastinal thymus. The internal echo-pattern between the intrathyroid and the mediastinal thymus is identical. The
mediastinal thymus is also characterized by a peripheral thin rim (arrowheads) between the starry-sky pattern (*) and the echogenic capsule (arrow).

Fig. 4: Direct US comparison with ovoid-shape intrathyroid and mediastinal thymus. a: longitudinal scan of the left thyroidal lobe shows an ovoid, hypoechoic, peripheral lesion (open arrow) at the posterior aspect of the middle part of the thyroid (T). The lesion contains multiple fine internal spots and lines (long thin arrow) in a random and uniform distribution, the starry sky appearance, except for a hypoechoic rim (arrowheads) which is relatively thick at this example. b: transverse scan at the superior mediastinum shows the mediastinal thymus (Th) being of the same echogenicity and containing echogenic spots (long thin arrows) equally thin as the intrathyroid lesion.
**Fig. 5:** Extrathyroid extension and uneven distribution of internal speckles. a: Transverse US scan of the thyroid. At the deep part of the middle third of the thyroid’s left lobe, there is a geographic-shape hypoechoic lesion extending medially and cranially (arrows). The anterior part of the lesion exhibits a thin hypoechoic rim thought to represent cortex (arrowhead). Note the uneven distribution of the scattered bright spots (long arrow) and an isoechoic area considered to represent medulla, without such spots at the posterior aspect of the lesion (open arrowhead). b: Longitudinal scan of the same lesion which exhibits an extrathyroid component (*), the starry sky appearance (open arrowheads) and an incomplete hypoechoic rim (white arrowhead). c: Transverse US scan of the mediastinal thymus. The same uneven distribution of speckles is present.
Conclusion

- Intrathyroid thymus is an uncommon but possible finding in children of pre-school and school-age.
- It was typically less than 1 cm in diameter in our series, invariably had a characteristic internal echo-texture comparable to the visible mediastinal thymus of the same patient and no internal vascularity on color Doppler.
- Intrathyroid thymus was never anteriorly, was usually located at the mid- or lower portion of the respective thyroid lobe and abutted the thyroid's periphery in 75% of lesions.
- Variable ultrasonographic characteristics included a surrounding thin hypoechoic rim, a geographic shape, angulated borders and a more elongated configuration on longitudinal images.
- Identification of extrathyroid extension of lesions with the above US characteristics and possible connections between posterior thyroid lesions and the thymus strengthens the diagnosis, obviating unnecessary investigations.

References


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