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A Tour of the Thymus: A Review of Thymic Lesions With Radiologic and Pathologic Correlation

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Abstract

The thymus is routinely encountered on cross-sectional imaging studies of the chest. It has a variable appearance, undergoes dynamic changes during periods of stress, and demonstrates numerous different pathologic lesions. Understanding the imaging characteristics of these different lesions facilitates accurate radiographic diagnosis and can prevent unnecessary follow-up imaging and intervention. This article will review normal thymic anatomy and development, thymic hyperplasia and associated medical conditions, and the imaging and pathologic features of various benign and malignant thymic lesions.

Résumé

Les études d'imagerie transversale du thorax permettent souvent d'observer le thymus. Or le thymus peut prendre un aspect variable, faire l'objet de changements dynamiques au cours d'une période de stress et présenter bon nombre de lésions pathologiques différentes. Le fait de comprendre les caractéristiques d'imagerie de ces diverses lésions favorise l'établissement d'un diagnostic radiographique exact et peut éliminer les examens d'imagerie et les interventions inutiles. Cet article examine les particularités anatomiques et développementales normales du thymus, l'hyperplasie thymique et d'autres affections connexes, ainsi que les caractéristiques d'imagerie et les particularités pathologiques de lésions bénignes et malignes du thymus.

Key Words: Thymus; Thymic mass; Thymic tumour; Thymic lesion

The thymus is encountered on all cross-sectional imaging studies of the chest, unless ectopic or surgically absent. In younger patients, it may demonstrate predominantly soft-tissue attenuation, whereas, in older patients, it may be entirely fatty replaced. Despite its ubiquitous nature, however, the thymus remains an enigmatic organ that undergoes dynamic changes and demonstrates numerous different pathologies (Table 1). Understanding the radiologic features of normal variants, benign conditions, and different thymic tumours can help prevent unnecessary imaging and intervention. In this pictorial essay, we will review normal thymic anatomy and development, thymic hyperplasia and its associated medical conditions, and the imaging and pathologic features of various benign and malignant thymic lesions.

Thymic Development and Anatomy

The thymus is the primary site of T-lymphocyte maturation. Together with the parathyroid glands, it arises from the third and fourth pharyngeal pouches during the sixth gestational week [1–5]. Over the next few weeks, this tissue migrates caudally and medially along the thymopharyngeal duct (deep to sternocleidomastoid muscle) to the anterior mediastinum (Figure 1). Subsequently, lymphoid cells from the liver and bone marrow migrate to the thymus, after which the thymus differentiates into a cortex and medulla [1,2]. Ectopic thymic tissue or thymic lesions can occur anywhere along the thymopharyngeal duct.

The normal thymus is generally located in the anterior mediastinum; however, it can be found anywhere from the

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Table 1
Various types of thymic abnormalities that may be encountered on imaging of the thorax

Masses of thymic origin
Benign
Thymic hyperplasia
Thymic cyst
Thymolipoma
Thymoma (Masaoka-Koga stage I/II)
Malignant
Thymoma (Masaoka-Koga stage III/IV)
Thymic carcinoma
Thymic lymphoma
Thymic carcinoid
Rare lesions
Metastatic disease
Langerhans cell histiocytosis
Thymic germ cell tumour
Follicular dendritic cell sarcoma

level of the thyroid to the level of the diaphragm [2]. The thymus is usually bilobed and arrowhead or quadrilateral shaped, although other configurations can exist, sometimes with slightly bulging or concave contours (Figure 2) [6]. In infants, the thymus can appear as a large mediastinal soft-tissue mass. During childhood and adolescence, it generally demonstrates predominantly soft-tissue attenuation and undergoes fibrofatty involution with aging. This fatty atrophy has been described to occur more rapidly in young adult men compared with women [6].

On histologic examination, the thymus is organized into multiple lobules that are arranged into an outer cortex and an inner medulla (Figure 3). The outer cortex is composed of immature T-lymphocytes and thymic epithelial cells; the medulla contains maturing lymphocytes and whorls of spindle-shaped epithelial cells, which create Hassall corpuscles with keratinized cores [6].

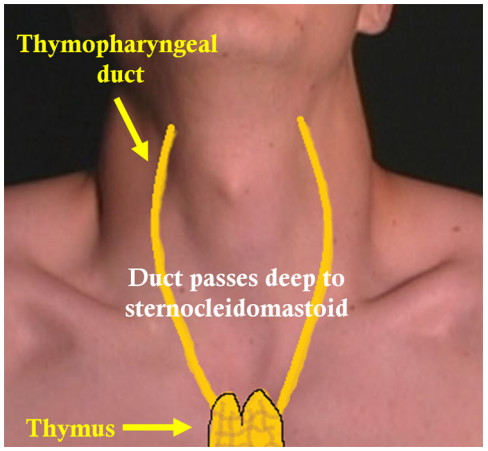

Figure 1. Thymic tissue migrates caudally and medially from its origin in the neck (originating in the region of the angle of the mandible) along the thymopharyngeal duct to the anterior mediastinum, where the thymic primordia generally fuse in the midline. The duct passes deep to the sternocleidomastoid muscle, and ectopic thymic tissue or thymic lesions can arise anywhere along the path of this duct.

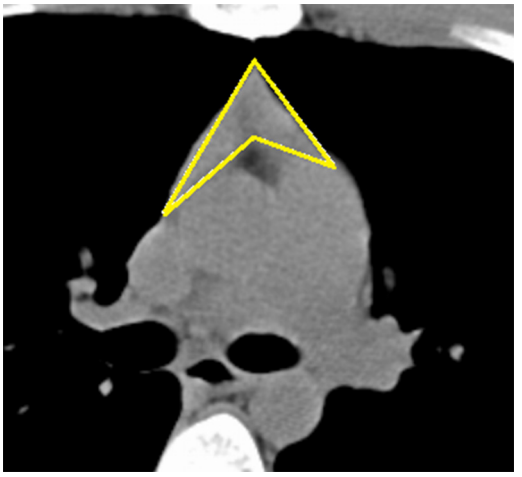

Figure 2. Noncontrast computed tomographic image in a young patient, demonstrating the normal configuration of the thymus, in this case, arrowhead shaped.

Thymic Hyperplasia

Two distinct histologic types of thymic hyperplasia exist: true thymic hyperplasia and lymphoid follicular hyperplasia (Figure 4). In true thymic hyperplasia, the gland is enlarged (ie, increased mass of tissue) with preserved microscopic and histologic architecture. In lymphoid follicular hyperplasia, enlarged lymphoid germinal centers account for the increased size of the gland. These 2 entities are indistinguishable from one another at imaging.

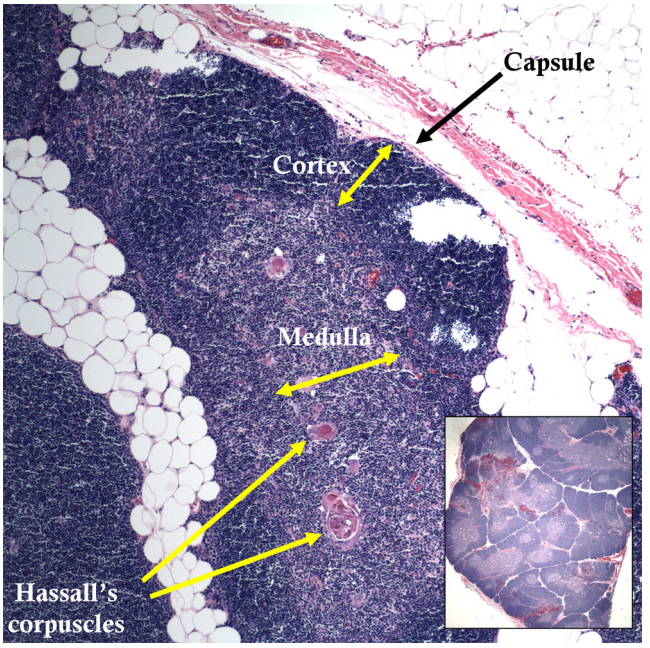

Figure 3. Photomicrograph of the normal thymus, demonstrating a thymic lobule (H&E, original magnification ×10). The cortex is mainly composed of immature lymphocytes, and the medulla is composed of thymic epithelial cells arranged in Hassall corpuscles (keratinized epithelial cell formations) and maturing lymphocytes. The thymic capsule with adjacent mediastinal fat is also visualized. (Inset) Lower magnification image, demonstrating multiple normal thymic lobules separated by invaginations of fat (H&E).