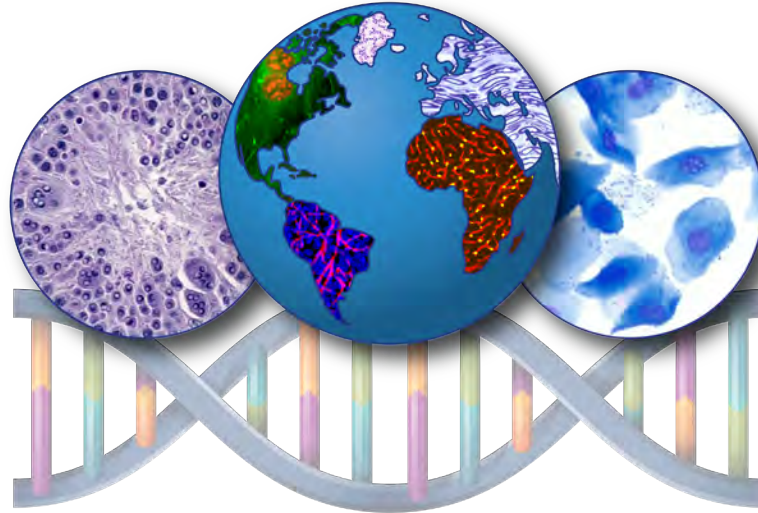




National Institute of
Environmental Health Sciences
Division of Translational Toxicology

Anatomy and Histology of the Normal Rodent Thyroid Gland



Division of Translational Toxicology Global Toxicologic Pathology Training Program

National Institutes of Health • U.S. Department of Health and Human Services

Overview

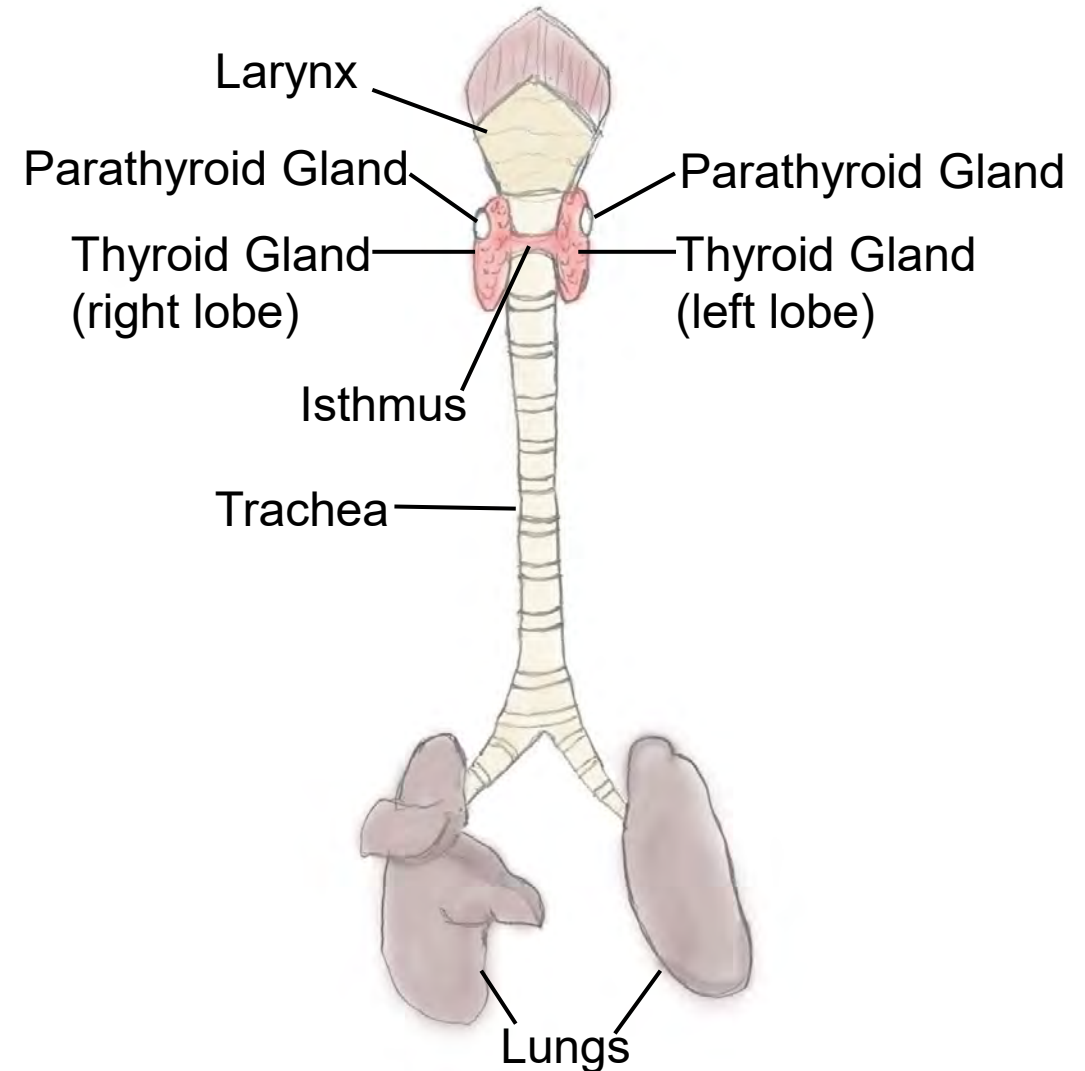
- Embryology and Development
- Gross Anatomy
- Cutting and Trimming
- Histology
- Immunohistochemistry
- Common Congenital Lesions

Thyroid Gland: Embryology and Development

- Thyroid gland is the first endocrine gland to develop in the rat and mouse
- Begins as an epithelial mass on the ventral primitive pharynx in the region of the first and second pharyngeal (branchial) pouches
- Attached to pharyngeal pouch by the thyroglossal duct, which undergoes involution, causing caudal migration of thyroid into the neck
- Fuses with ultimobranchial body containing precursors of C-cells that originated from the neural crest
- Early follicular cells arrange in cords or rosettes and later form follicles containing colloid (a glycoprotein that stores thyroid hormone), and secretory activity begins
- The parathyroid gland embeds in the thyroid, and the thyroid gland encloses the ultimobranchial body

Thyroid Gland: Gross Anatomy

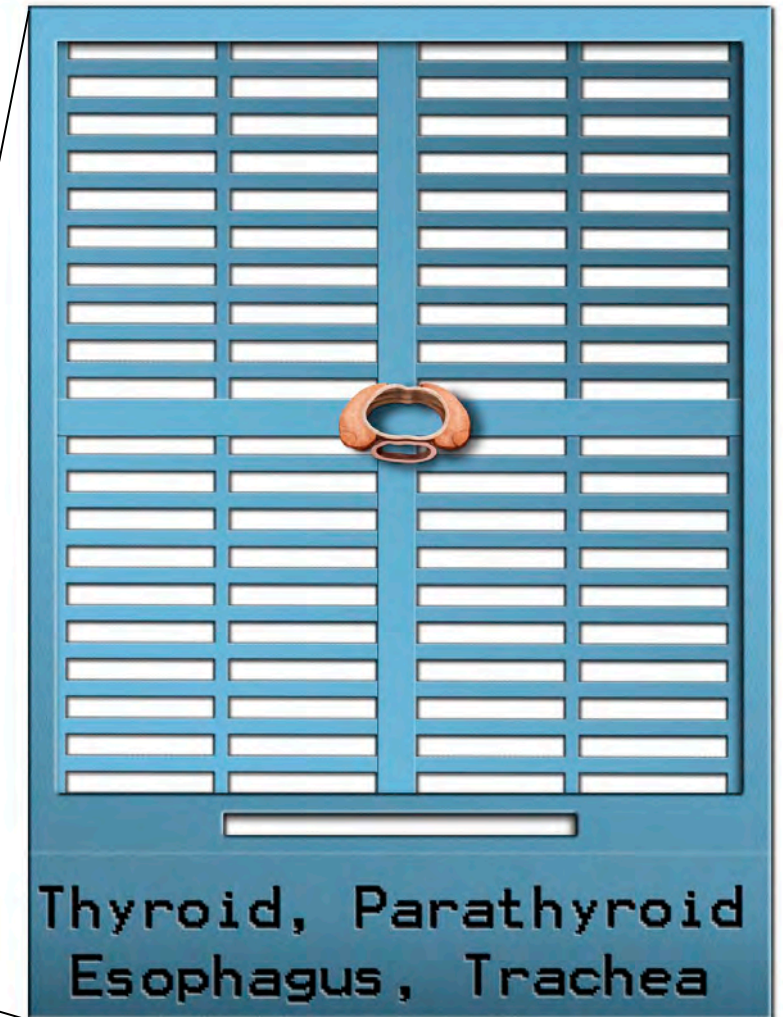
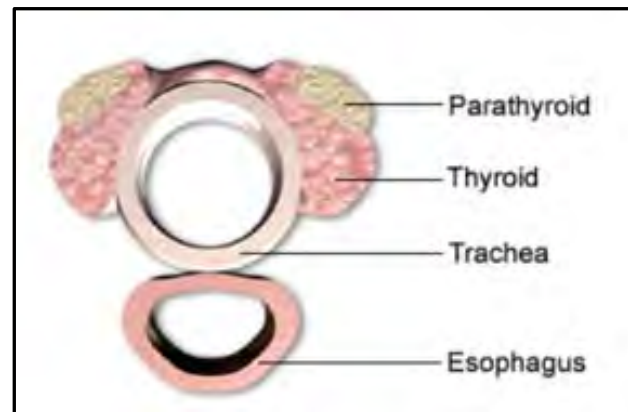
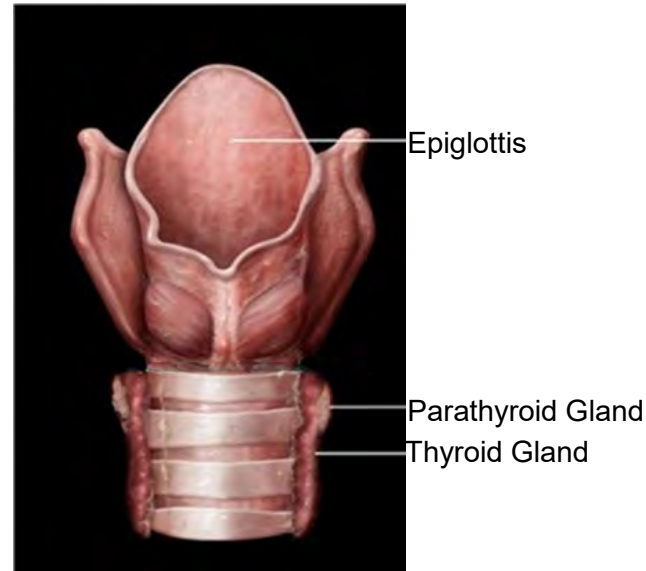
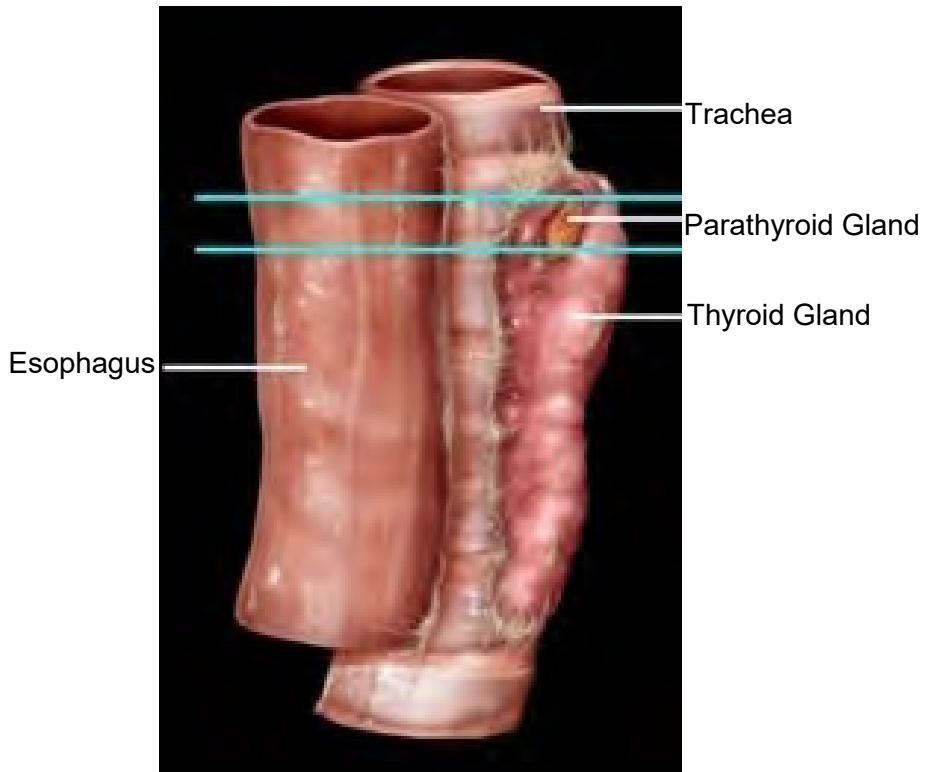
- Located in lower neck along the sides and front of the trachea just caudal to (below) the larynx
- Two lateral (right and left) lobes along the trachea connected by a flattened band of tissue (isthmus) crossing the ventral (front) portion of the trachea
- Each lobe contains one parathyroid gland in rats and mice
 - The location of parathyroid glands within each lobe may vary



Thyroid Gland: Cutting and Trimming

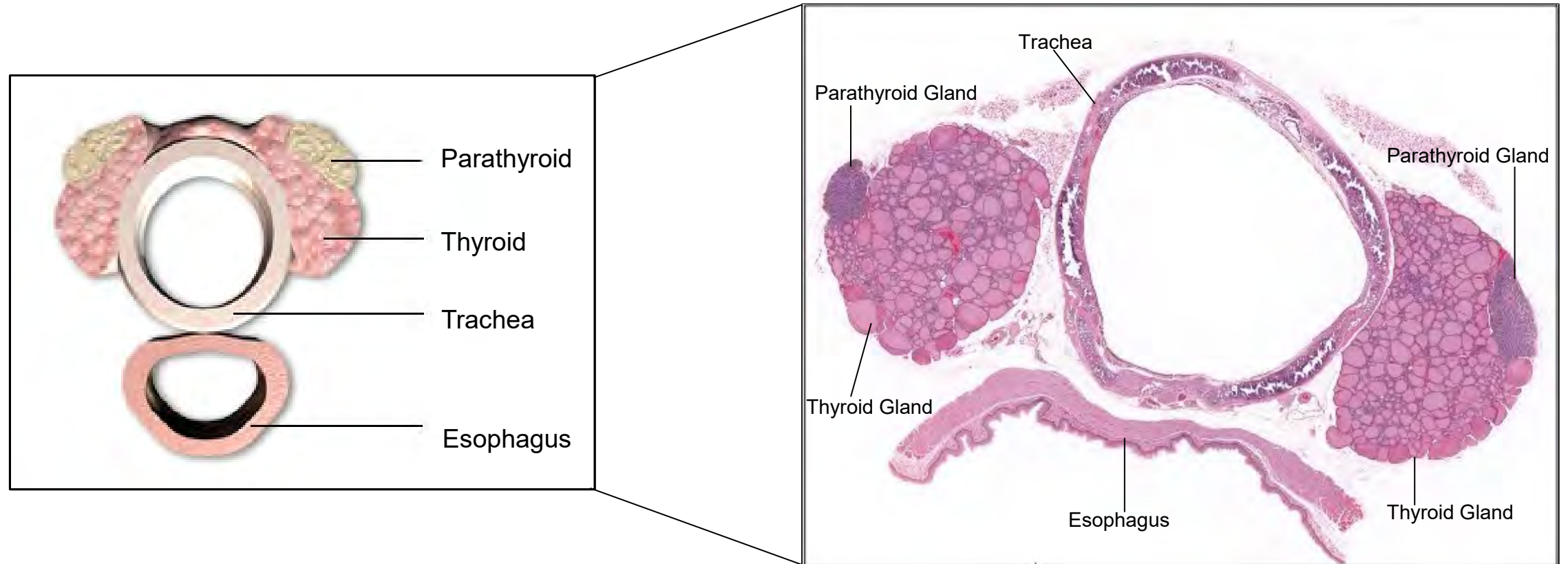
Transverse Sectioning

Section is taken through the trachea, esophagus, thyroid gland, and parathyroid glands



Thyroid Gland: Cutting and Trimming

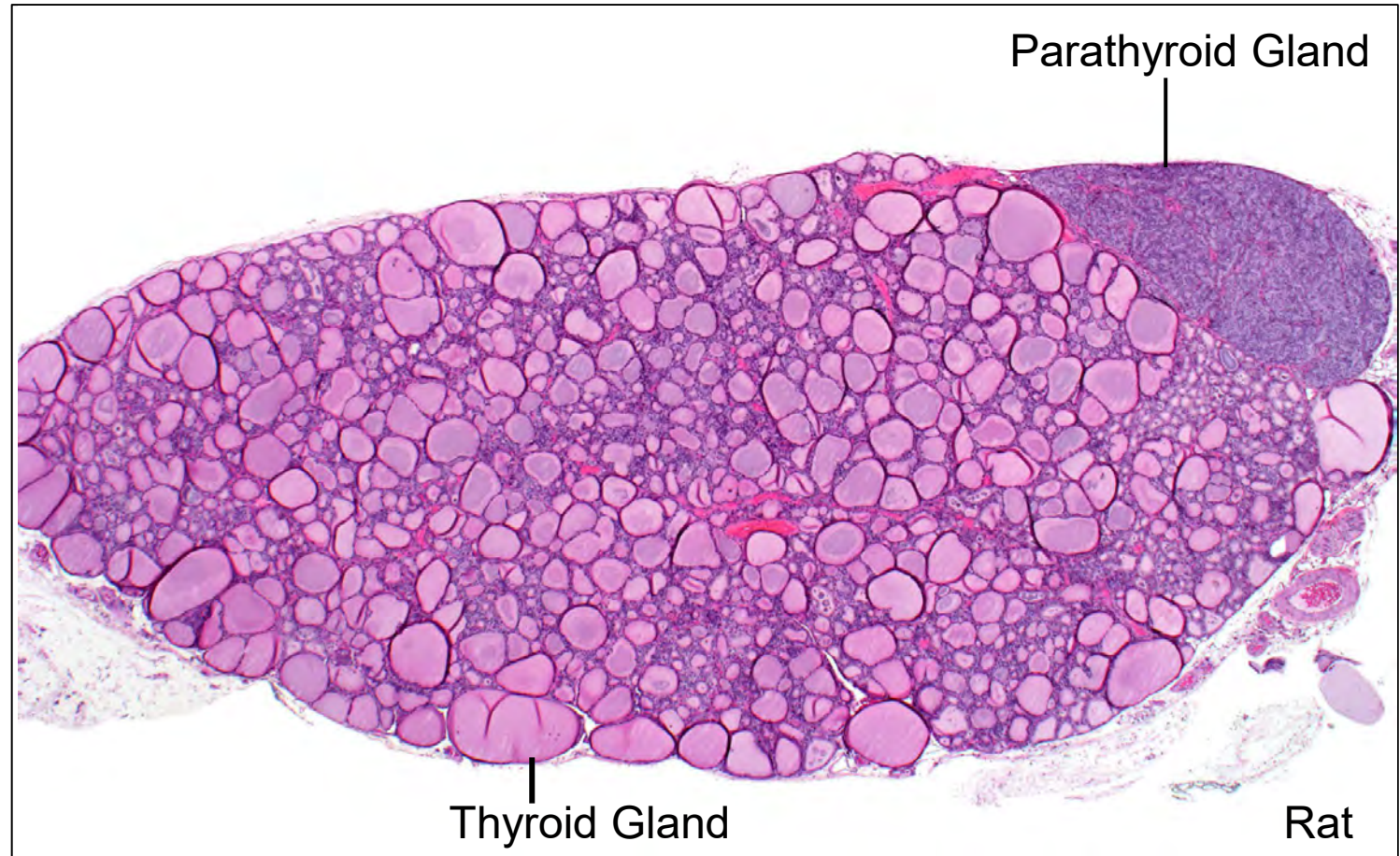
Transverse Sectioning



Thyroid Gland: Trimming and Histology

Longitudinal Sectioning

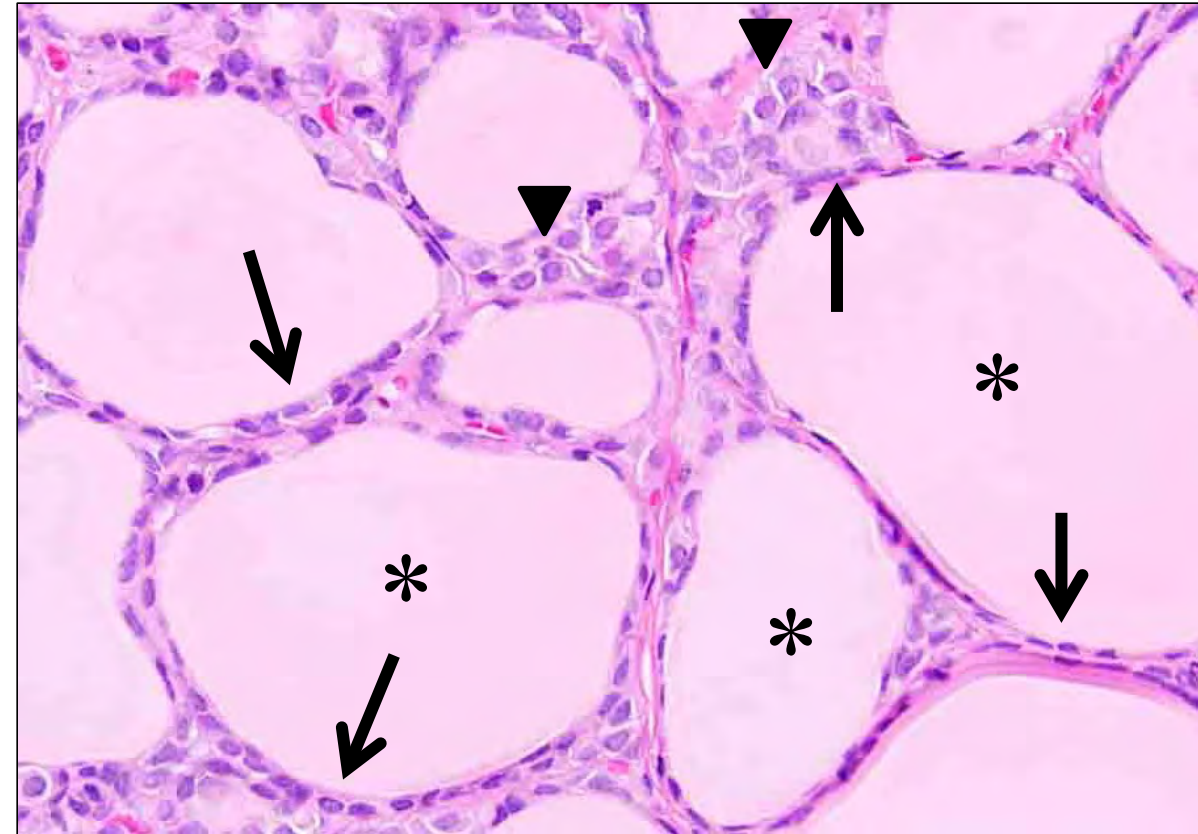
- Longitudinal sections may be necessary when thyroid gland weights are required
- Both lobes of thyroid gland (with parathyroids) are removed and weighed together
- Section is taken through the largest area of thyroid lobe to include the parathyroid gland



Thyroid Gland: Normal Histology

Normal Rodent Thyroid

- The follicle is the structural unit of the thyroid gland
 - Irregularly spheroid and filled with colloid
 - Separated by vascular interfollicular connective tissue (interstitium)
- Thyroid gland contains 2 main cell types
 - Follicular cells
 - Produce thyroxine
 - Line follicles in a single layer of epithelial cells
 - C cells (parafollicular cells)
 - Produce calcitonin
 - Occur as single cells or in small clusters between the follicular epithelium and basement membrane of the follicle
 - Are typically concentrated in central portions of the lobes

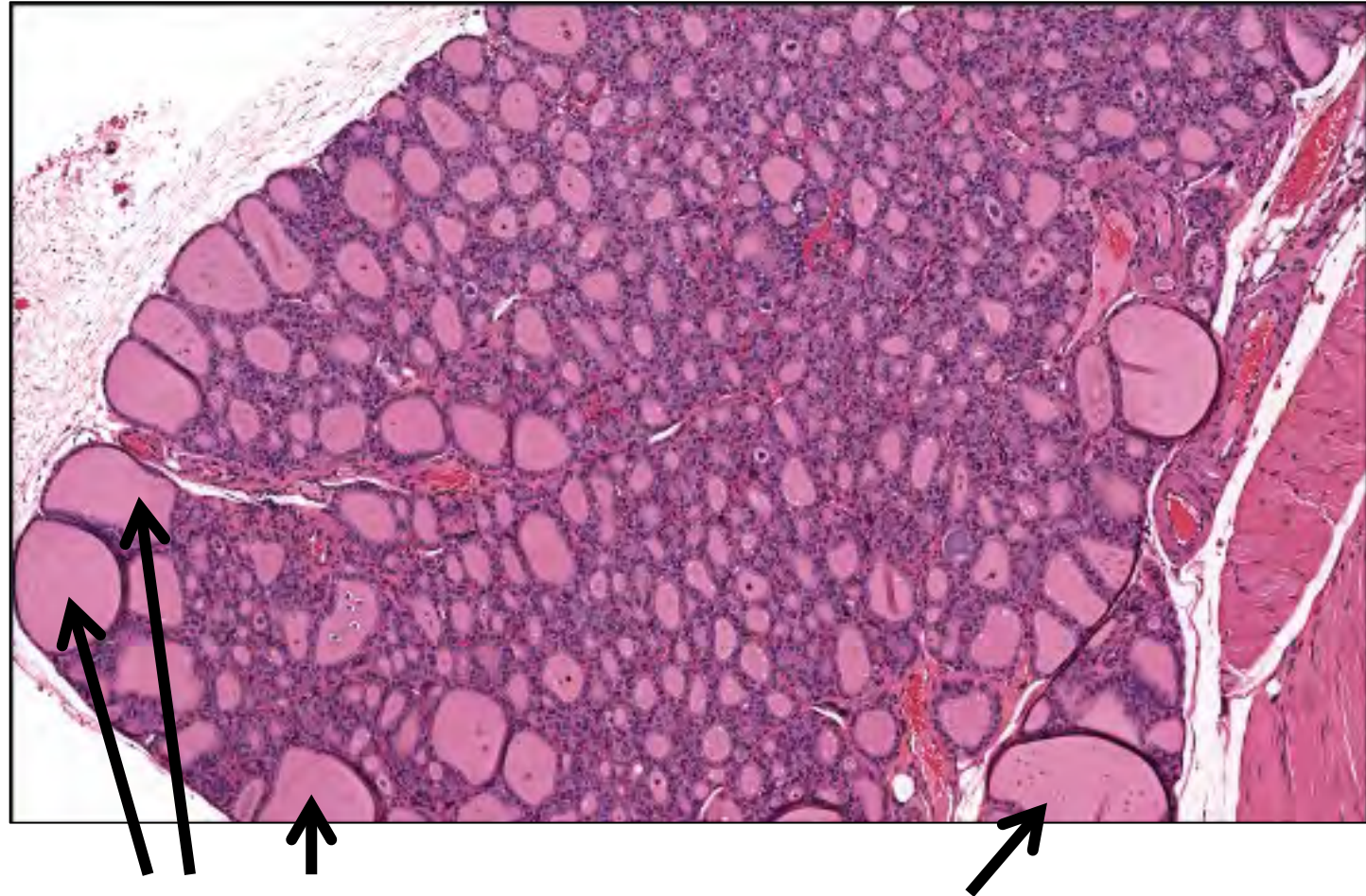


Thyroid gland from a rat. Follicles are lined by follicular epithelium (black arrows) and filled with colloid (*). Clusters of C cells (black arrowheads) are present.

Thyroid Gland: Normal Histology

Normal Rodent Thyroid

- Variation in follicle size and shape is normal in mice and rats
- Larger, inactive follicles
 - Are often near the periphery
 - Are lined by low cuboidal to flattened epithelium
 - Are filled with colloid
- Smaller, active follicles
 - Are often more abundant in the central portion
 - Are lined by cuboidal epithelium
 - Contain scant colloid

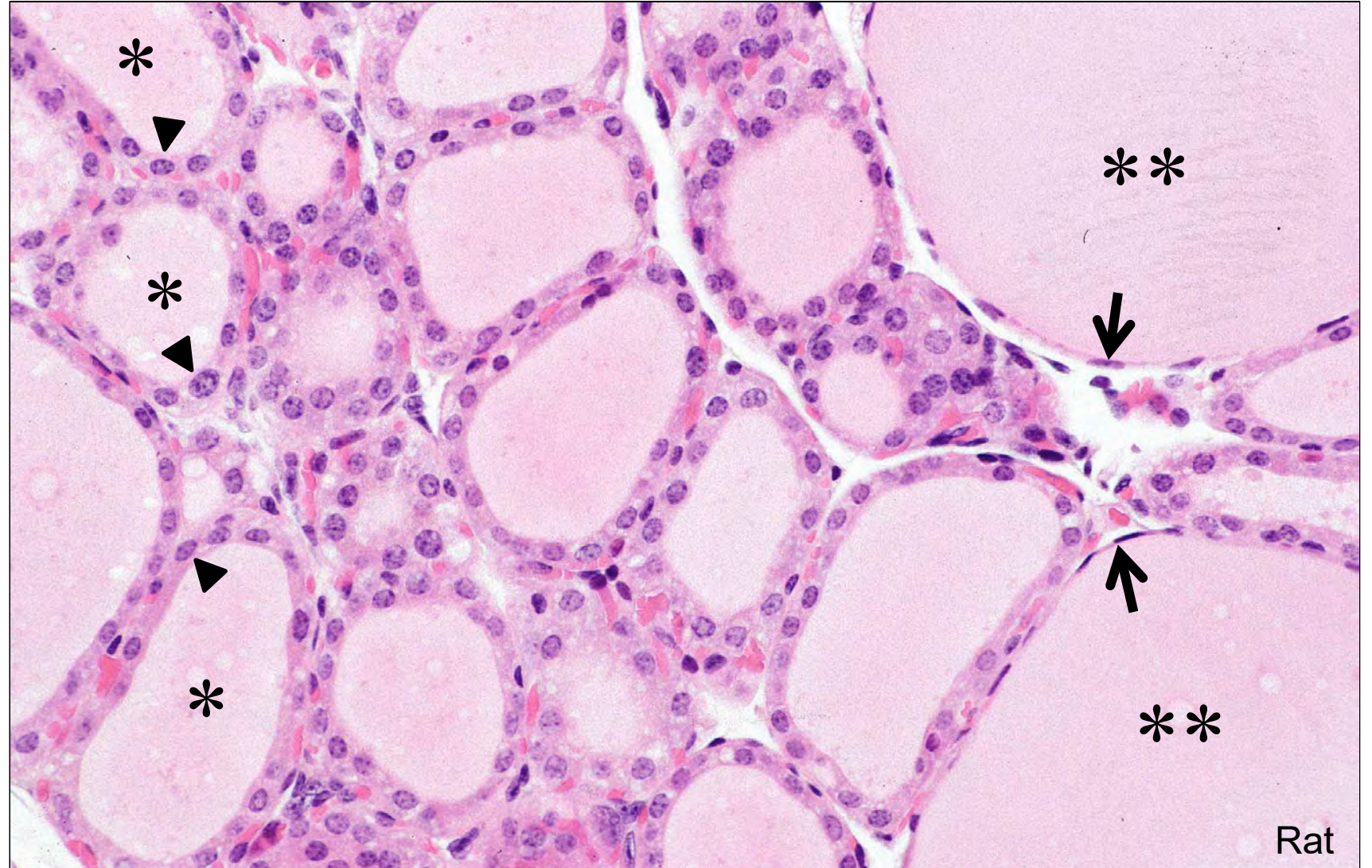


Larger follicles (black arrows) near the periphery of a normal thyroid gland from a rat from a chronic study

Thyroid Gland: Normal Histology

Normal Rodent Thyroid

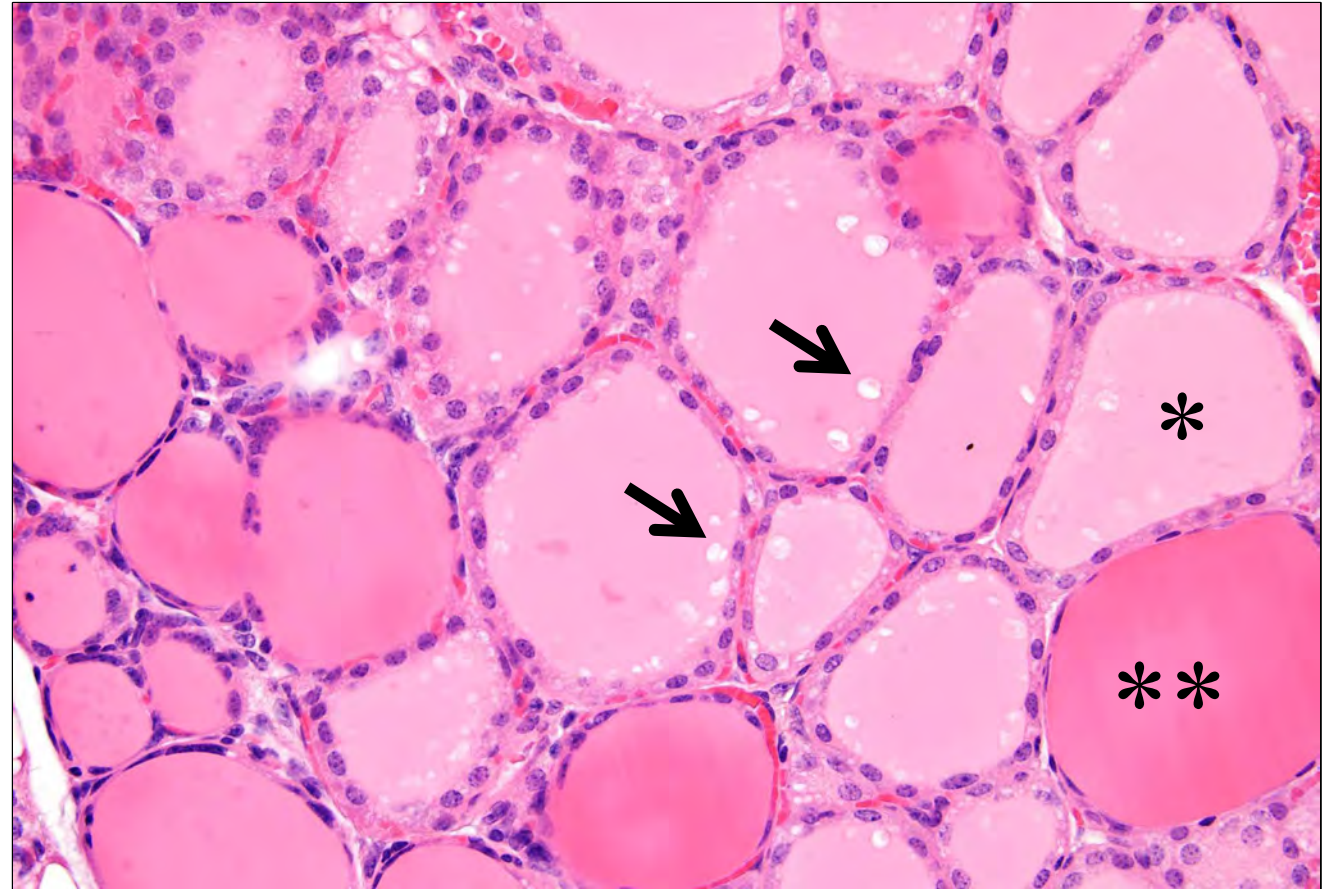
- Active follicles (*) lined by cuboidal follicular epithelium (black arrowheads)
- Larger inactive follicles (**) lined by flattened follicular epithelium (black arrows) and distended with colloid



Thyroid Gland: Normal Histology

Normal Rodent Thyroid

- Tinctorial variation in colloid is common
 - Pale pink-staining colloid (*) fills active follicles lined by cuboidal epithelium in this mouse thyroid
 - Dark pink-staining colloid (**) fills inactive follicles lined by flattened epithelium
- Active follicles may contain peripheral resorption vacuoles (black arrows)
 - Non-staining vacuoles associated with the luminal membrane of thyroid follicular cells
 - The number of resorption vacuoles is a general indicator of thyroid activity

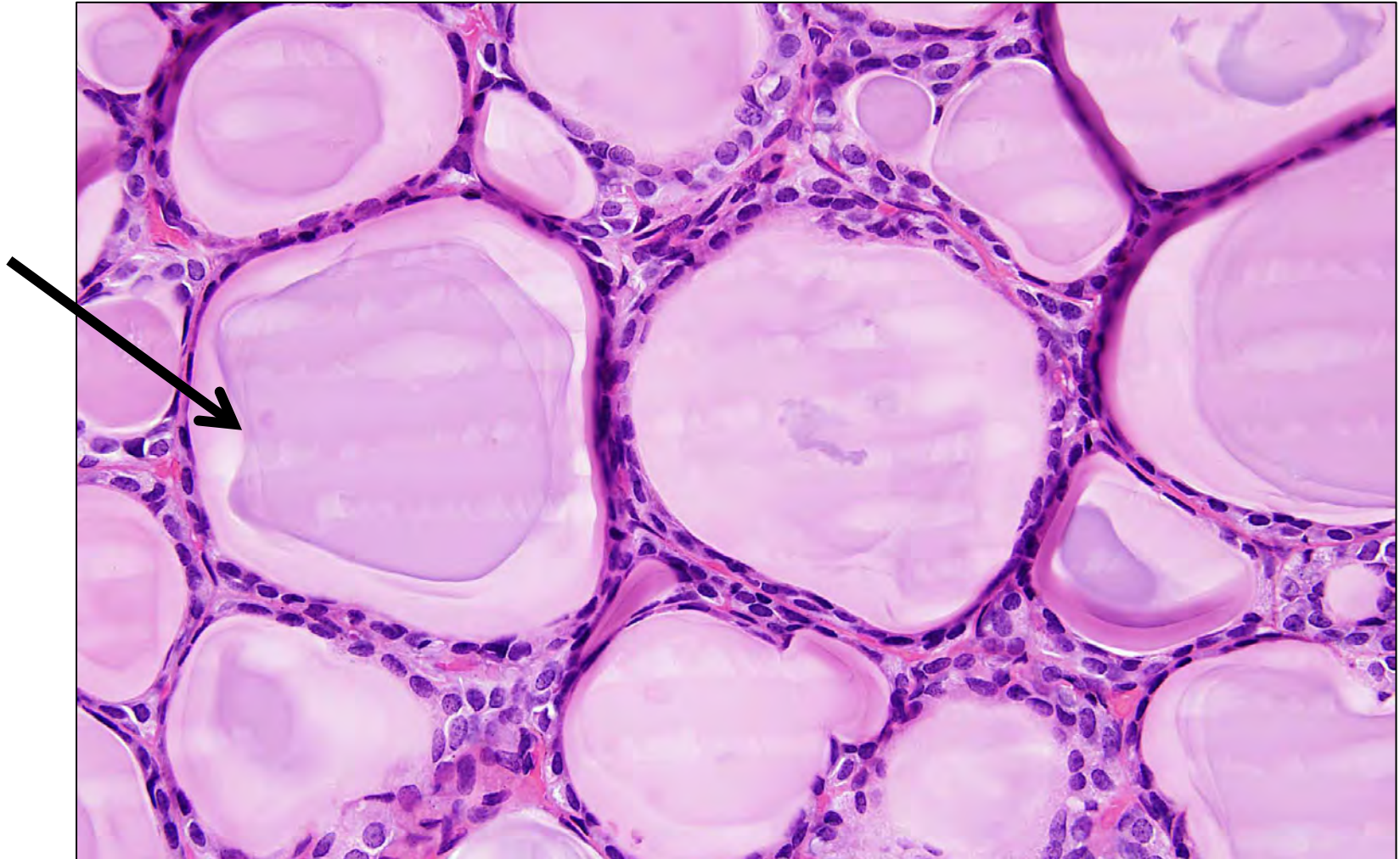


Mouse

Thyroid Gland: Normal Histology

Normal Rodent Thyroid

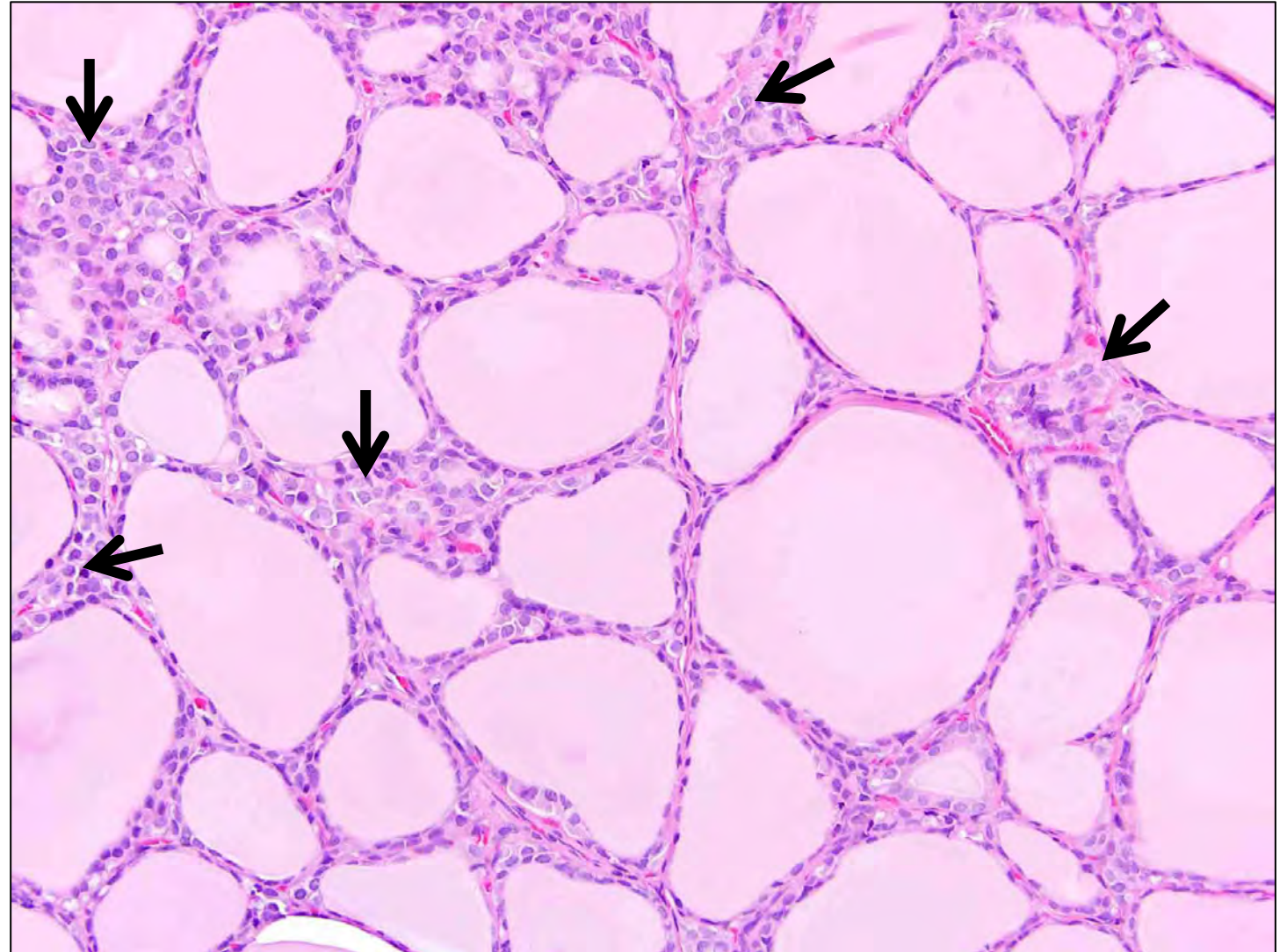
Normal thyroid gland from a rat showing tinctorial variation in colloid staining (black arrow)



Thyroid Gland: Normal Histology

Normal Rodent Thyroid

Clusters of C cells (black arrows) in a normal thyroid gland from a rat



Immunohistochemistry

- Immunohistochemistry may be helpful in the diagnosis of thyroid gland tumors
- Immunohistochemical markers based upon cell type
 - Follicular Cells:
 - Thyroglobulin – Specific marker for thyroid follicular cells, cytoplasmic staining
 - C Cells:
 - Calcitonin – Marker for C cells, also expressed in neuroendocrine tumors other than C-cell tumors, cytoplasmic staining
 - Other nonspecific neuroendocrine markers: Chromogranin A, Synaptophysin, Somatostatin, Neuron Specific Enolase (NSE)

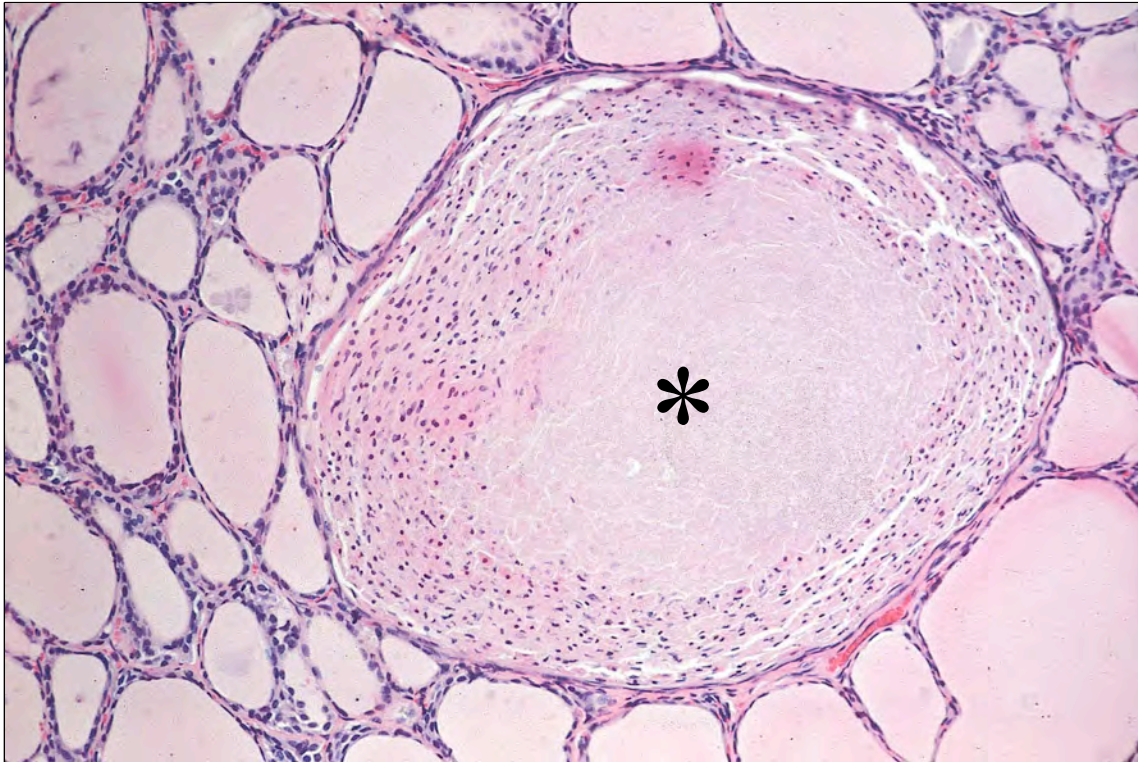
Common Congenital Lesions

- Ultimobranchial Cyst
- Persistent Thyroglossal Duct
- Thyroid Gland – Ectopic Tissue, Thymus
- Thymus – Ectopic Tissue, Thyroid Gland

Thyroid Gland: Congenital Lesions

Thyroid Gland – Ultimobranchial Cyst

- Congenital remnant of ultimobranchial duct
- Cystic structures (*) lined by flattened squamous epithelium and distended with laminated, keratinized material and debris



Mouse

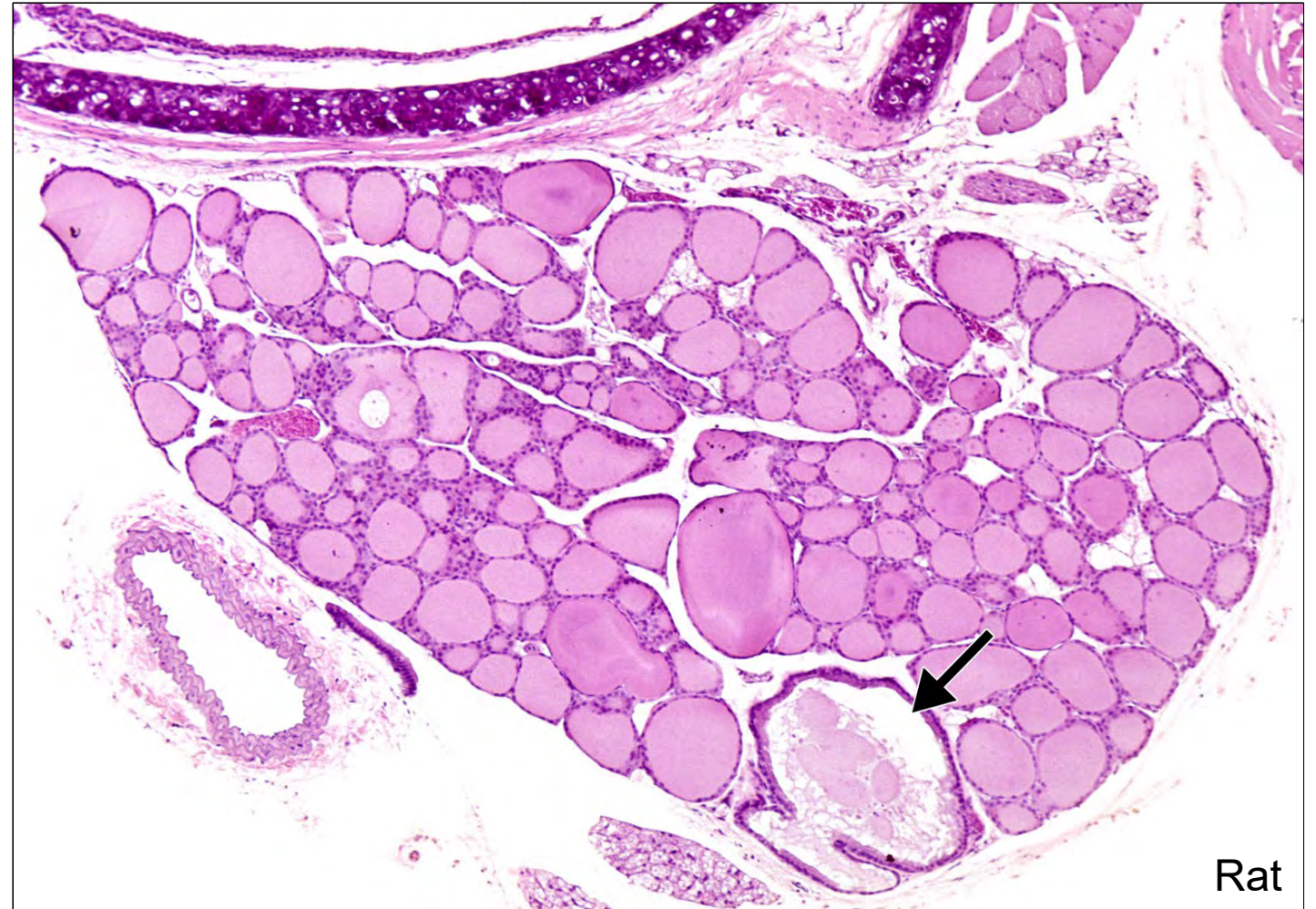


Mouse

Thyroid Gland: Congenital Lesions

Thyroid Gland – Persistent Thyroglossal Duct

- Congenital remnant of thyroglossal duct
- Cystic or duct-like structure (black arrow) lined by cuboidal to columnar epithelium
- Epithelium may be ciliated
- May contain mucinous material

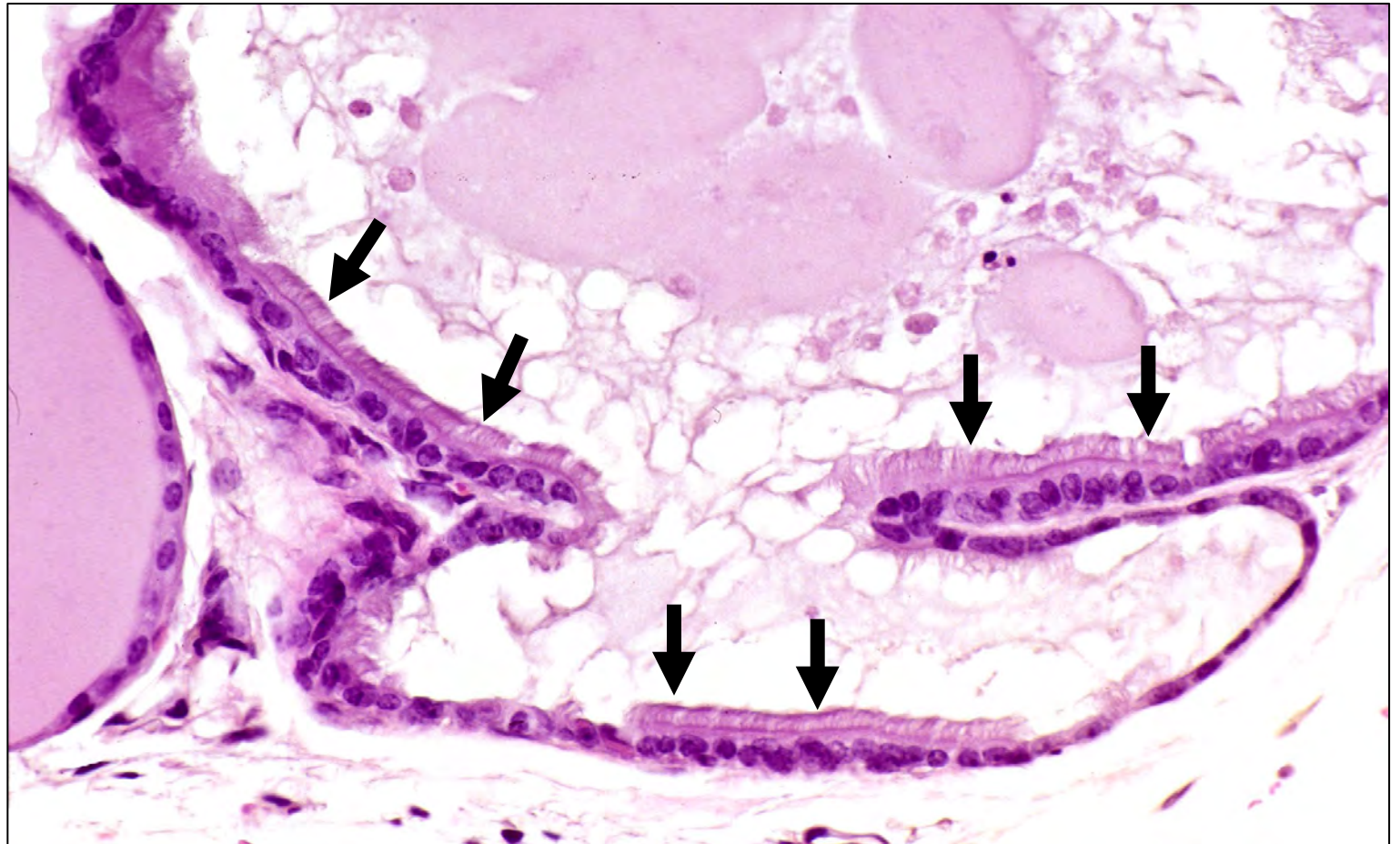


Rat

Thyroid Gland: Congenital Lesions

Persistent Thyroglossal Duct (continued)

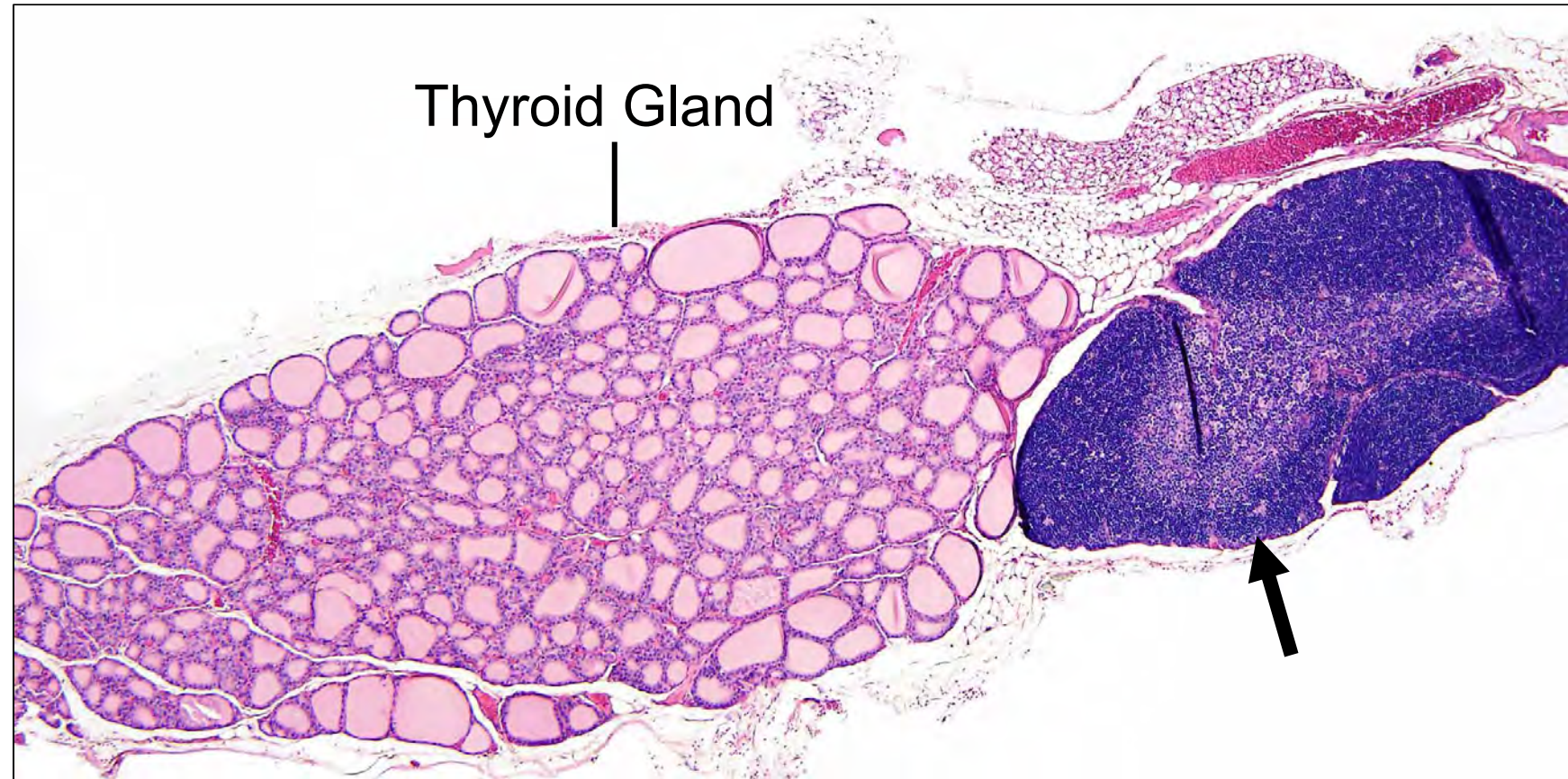
Higher magnification image showing the ciliated epithelial lining (black arrows) of a persistent thyroglossal duct from a rat



Thyroid Gland: Congenital Lesions

Thyroid Gland – Ectopic Tissue, Thymus

Common congenital lesion that occurs because of the close association of the thymus and thyroid during development

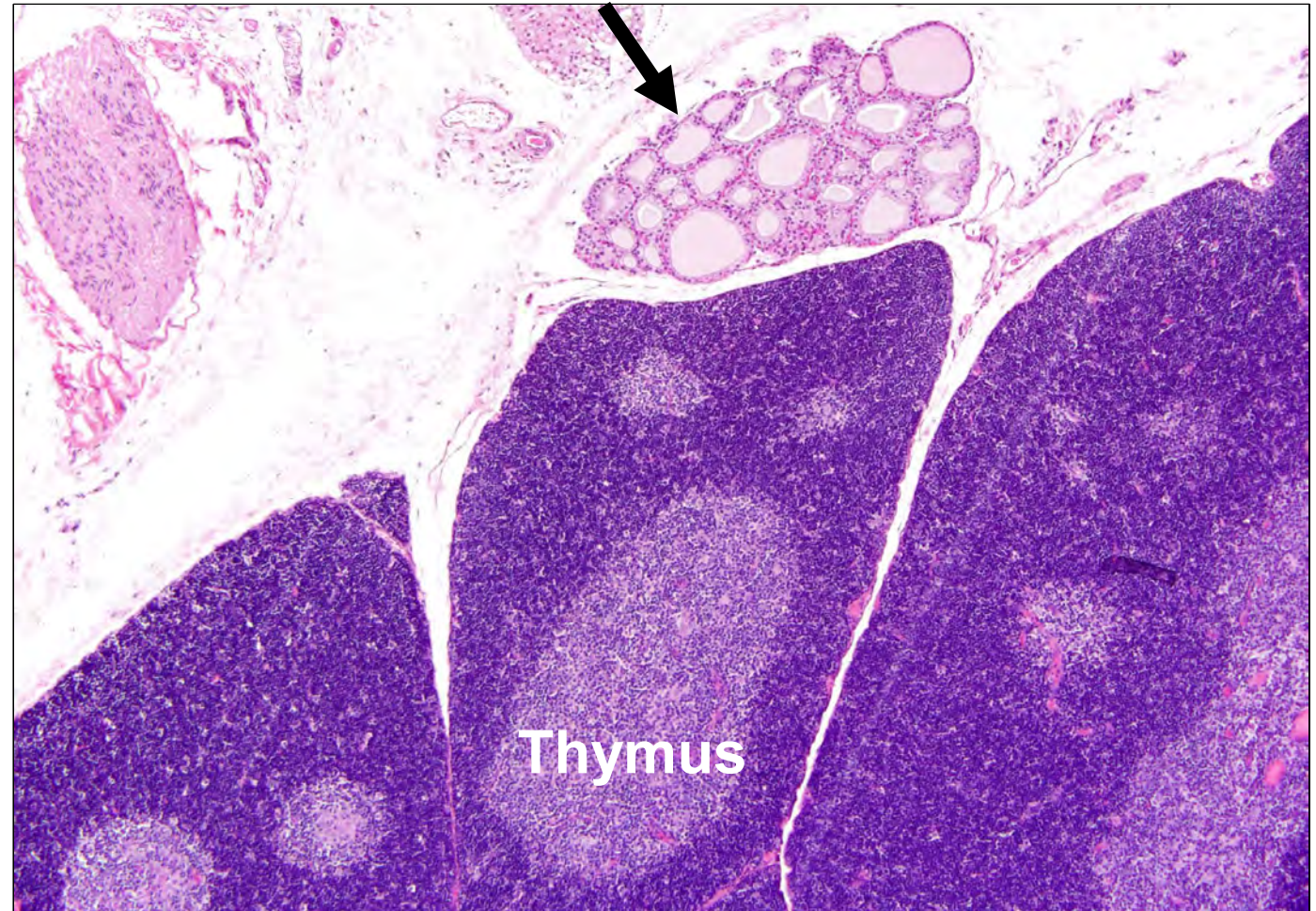


Well-differentiated thymic tissue (black arrow) adjacent to the thyroid gland of a rat

Thyroid Gland: Congenital Lesions

Thymus – Ectopic Tissue, Thyroid

Ectopic thyroid tissue may occur in the thymus (or anywhere in the neck or mediastinum along the midline) because of the close association of the thymus and thyroid during embryological development



Well-differentiated ectopic thyroid tissue (black arrow) is adjacent to the thymus of a rat

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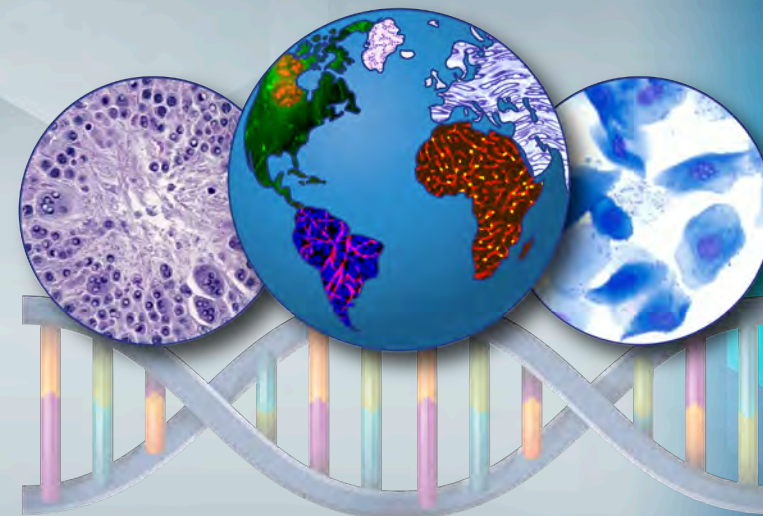
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