THYMUS

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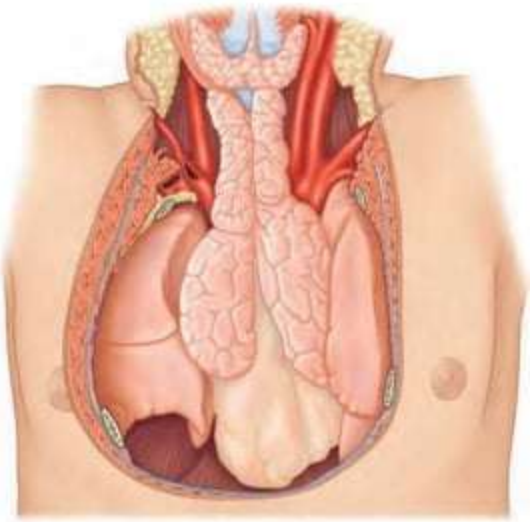
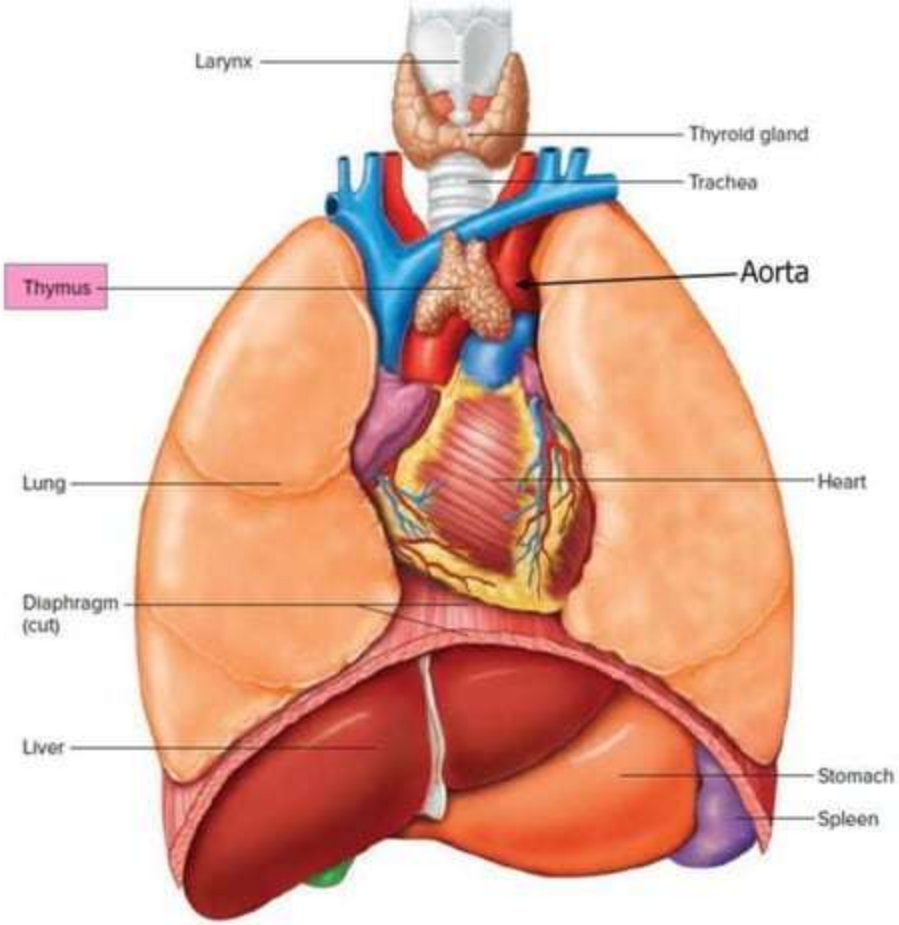
JAN 2019

INTR0DUCTION...

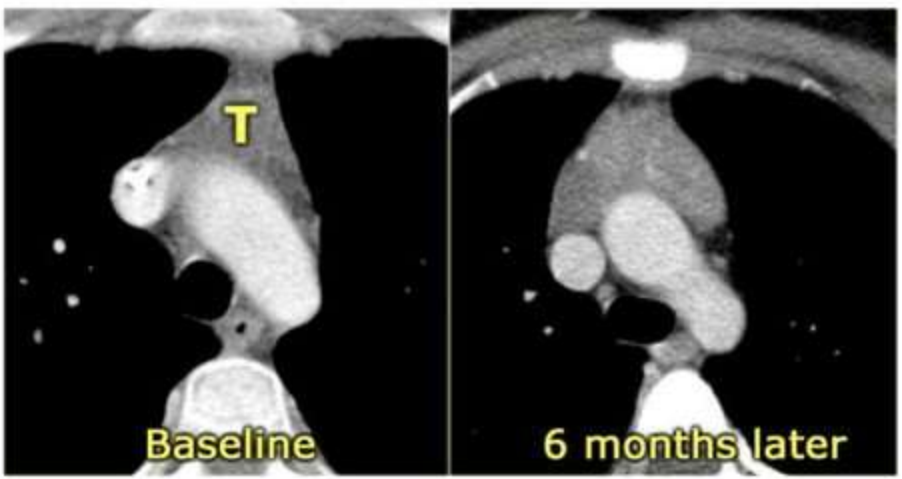
- Primary lymphoid organ.
- Encapsulated, soft & bilobed
- Site - Superior Mediastinum
- Two parts are joined in the midline by connective tissue that merges with the capsule of each lobe



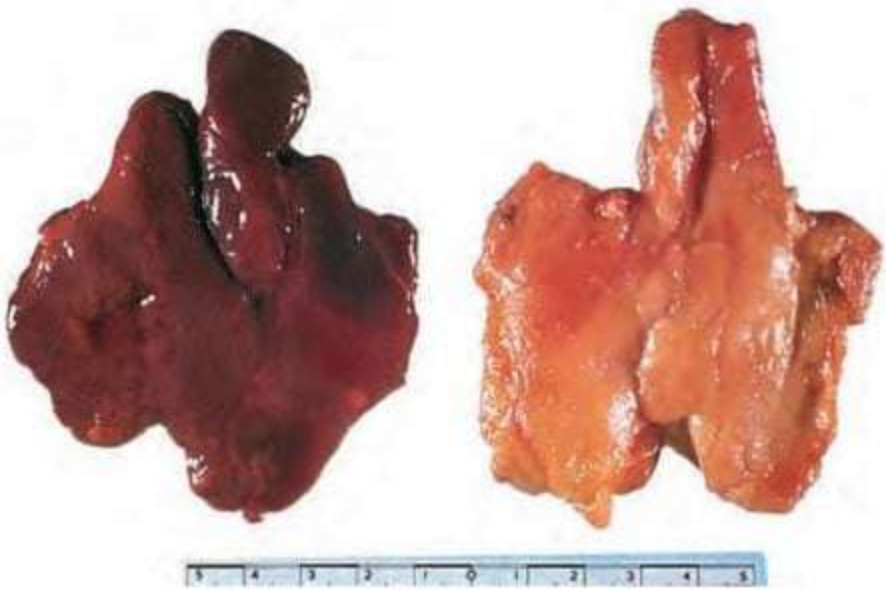

Larynx
Thyroid gland
Trachea
Thymus
Aorta
Lung
Heart
Diaphragm
(cut)
Liver
Stomach
Spleen

INTRODUCTION…

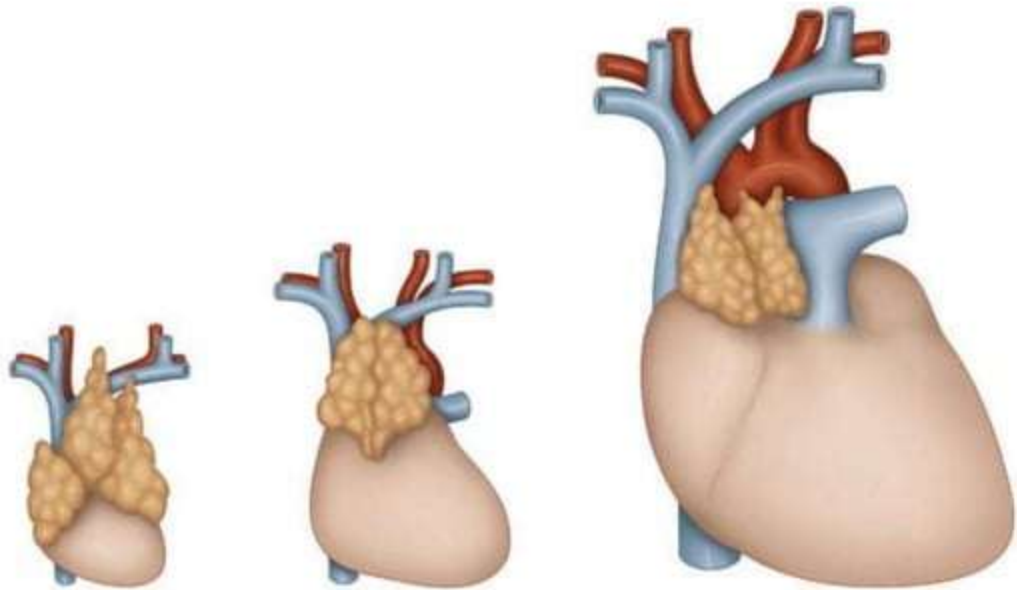
- Capsule may adhere to the fibrous pericardium, which is thinner superiorly
- **VIsible on CT** and **MRI**



MORHOLOGY…



AGE RELATED CHANGES…



Thymus in a newborn.

Thymus in a 2-year-old child.

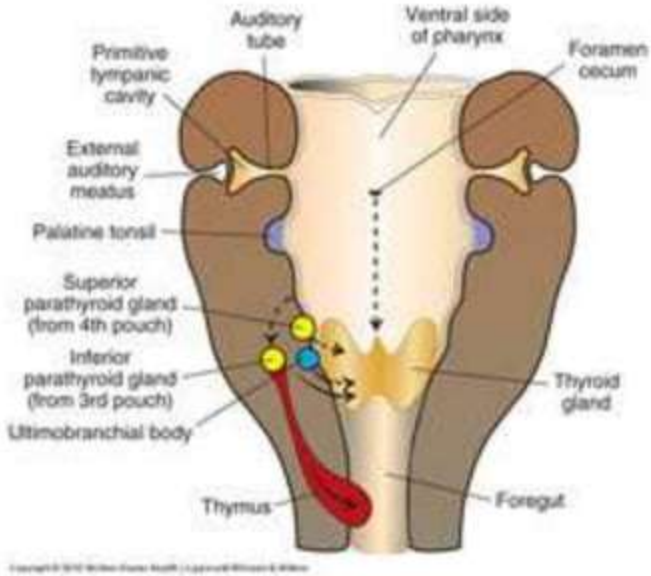
Thymus in an adult

RELATIONS

- Largest in the early part of life, particularly around puberty,
- Persists actively into old age
- As age advances **fibrofatty degeneration (**hiding the existence of persistent thymic tissue.
- Greater part of the thymus lies in the **superior** and **anterior mediastinum**;
- Inferior aspect of the thymus reaches the level of the **fourth costal cartilages**

- In some children, the thymus as encircling the **left innominate vein* .**
- Bilateral embryonic origins from the third pharyngeal pouch.
- Superiorly, extensions into the neck are common.

EMBRYOLOGY



- Superior poles join at, and extend above, the level of the **suprasternal notch**;
- Left lobe usually extends higher and is seen first behind the strap muscles

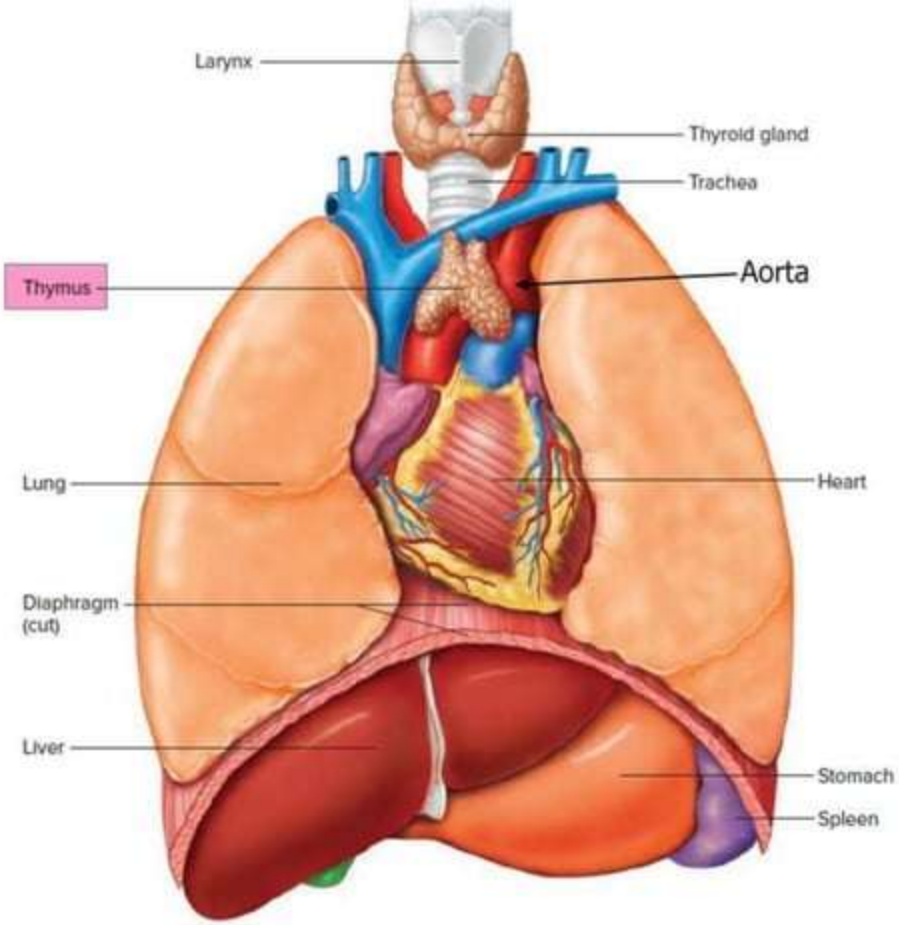
TRANSCERVICAL THYMECTOMY

A

B

RELATIONS…

- Reaches to the inferior poles of the thyroid gland or even higher
- Connected to the thyroid gland bye **thyrothymic ligament**.
- Shape is largely moulded by adjacent structures.
- Inferiorly, the right lobe commonly lies between the right side of the ascending aorta and the right lung, anterior to the superior V. cava.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(cut)
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Stomach
Spleen

ANTERIOR RELATION…

From superior to inferior…

- Sternohyoid and sternothyroid,
- Cervical fascia,
- Manubrium sterni,
- Internal thoracic vessels,
- Upper three costal cartilages,
- Pleurae lie laterally
- Phrenic nerves are anterolateral and inferior;

(Last 2 structures may be injured during thymectomy)

POSTERIOR RELATIONS…

- Lies is in contact with the vessels/Viscera of the superior mediastinum…

➢ Left brachiocephalic vein.

➢ Inferior thyroid veins .

➢ Superior part of the thoracic trachea.

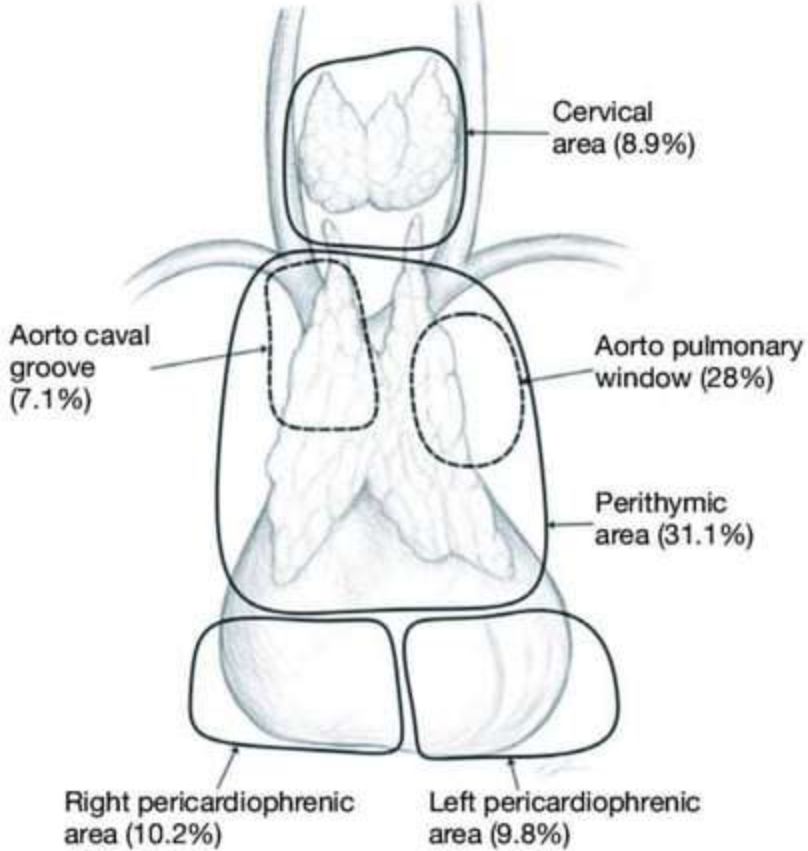
➢ Anterior cardiac surface (right atrium and ventricle).

ECTOPIC THYMUS…

Often found…

- Scattered around the gland
- In unusual mediastinal locations.

- Accessory nodules may occur in the neck
- Representing separated portions, detached during embryological descent.
- Sometimes reaching more superiorly than the **thyroid cartilage**.
- **Ectopic intrathyroidal thymi** have been reported in children.


Cervical
area (8.9%)
Aorto caval
groove
(7.1%)
Aorto pulmonary
window (28%)
Perithymic
area (31.1%)
Right pericardiophrenic
area (10.2%)
Left pericardiophrenic
area (9.8%)

VASCULAR SUPPLY…

- **Thymic branches** originating from…
  - ***Internal thoracic,***
  - ***Inferior and***
  - ***Superior thyroid arteries***.
- As no definite hilum exists
- Arterial branches either travel along the interlobar septa before entering the thymus at the junction of the cortex and medulla
- Reach the thymic tissue directly through the capsule.

VENOUS DRAINAGE…

Thymic veins drain to …

- ***Left brachiocephalic v.,***
- ***Internal thoracic v.and***
- ***Inferior thyroid veins***, and occasionally directly into the ***superior vena cava***.

- One or more veins often emerge medially from each lobe of the thymus to form a common trunk opening into the ***left brachiocephalic v****.

LYMPHATIC DRAINAGE…

- *No afferent lymphatics.*
- **Efferent lymphatics** arise from the medulla and corticomedullary junction,
- Drainage through the extravascular spaces, accompany the supplying arteries and veins, d
- Drained in…

➢ *Brachiocephalic,*

➢ *Tracheobronchial*

➢ *Parasternal nodes.*

INNERVATION…

Sympathetic -

- Cervicothoracic (stellate) ganglia or ansa subclavia
- Branches from the **phrenic** and descending cervical nerves (inferior roots of the ansa cervicalis) are distributed mainly to the capsule.

Parasympathetic - Vagi.

- Two lobes are innervated separately through their dorsal, lateral and medial aspects.

INNERVATION…

- During development and before its descent into the thorax , by the **vagi** in the neck.
- After its descent, receives a sympathetic innervation via fibres travel along the vessels;
- **Postganglionic sympathetic terminations -** branch radially and form a plexus with the vagal fibres at the cortico-medullary junction.

FUNCTION…

Organ is important for…

- Development of immunocompetent T-cells,
- Proliferation of clones of of mature T-cells,
- Developing immunological self-tolerance,
- Secretion of hormones for T-cell development. (thymosin, thymulin and thymopoietin)
- Hormones are produced by reticular epithelial cells in the cortex.

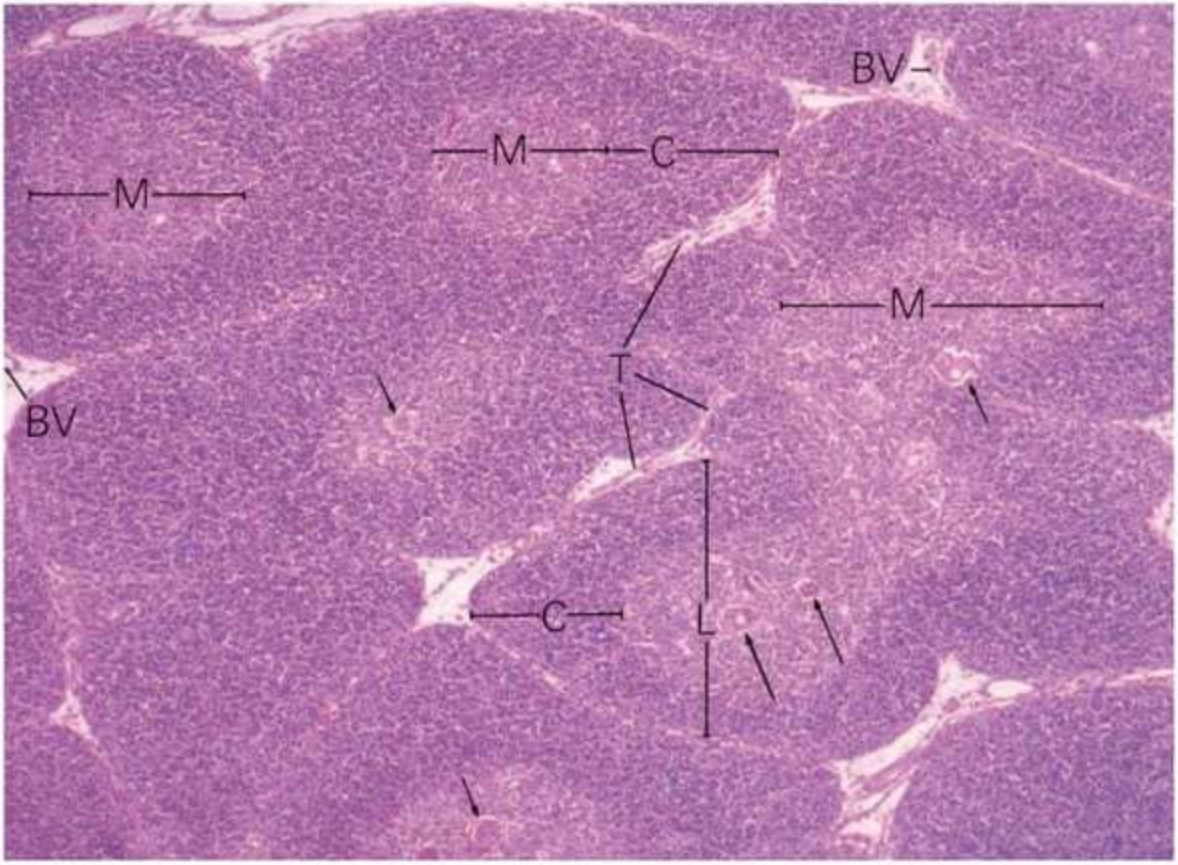
HISTOLOGY…

- Two lobes divided up into many incomplete lobules.
- **CORTEX** - outer, more darkly staining region is the cortex, and this is **highly cellular**.
- **MEDULLA** - inner lighter staining region,less cellular.
- An outer connective tissue capsule and septa divides organ into incomplete lobules.

CAPSULE AND TRABECULAE

Contain …

- Blood vessels…
- Efferent (but not afferent) lymphatic vessels
- Nerves.
- Collagen fibers and fibroblasts,
- Variable numbers of plasma cells, granulocytes, lymphocytes, mast cells, adipose cells,and macrophages.


BV
M
C
M
M
BV
T
C
L

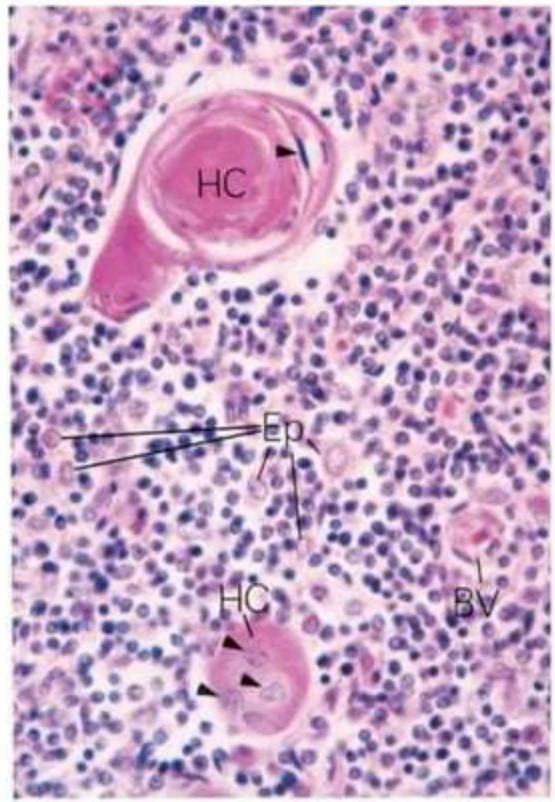
CORTEX…

- Outer portion of the parenchyma,
- Markedly **basophilic** in (H&E) preparations because of the **closely packed developing T lymphocytes** with their intensely staining nuclei.

Thymic parenchyma contains developing T cells in an Extensive meshwork formed by epithelioreticular cells.

HISTOLOGY

- **2 cellular elements**,-
- **Lymphocytes -** small, round, dark-staining nuclei, and
- ➢ **Epithelioreticular cells-** supporting cells, with large pale-staining nuclei .



EPITHELIAO-RETICULAR CELLS
OR
RETICULAR STROMA

- Arises from **Endodermal epithelium** and produces a **cellular reticulum**.
- **No reticular fibers** associated with these cells;
- Cells, designated **epithelio-reticular cells,** serve as the stroma**.**
- Lymphocytes come to lie in the interstices of the cellular reticulum

EPITHELIORETICULAR CELLS

- Have features of both epithelial and reticular cells.
- Provide a framework for the developing T cells;
- Correspond to the reticular cells and their associated reticular fibers in other lymphatic tissues and organs.
- Reticular connective tissue cells and their fibers, however, are not present in the thymic parenchyma.
- Cells exhibit characteristic of epithelium such as intercellular junctions and intermediate filaments.

LYMPHOCYTES

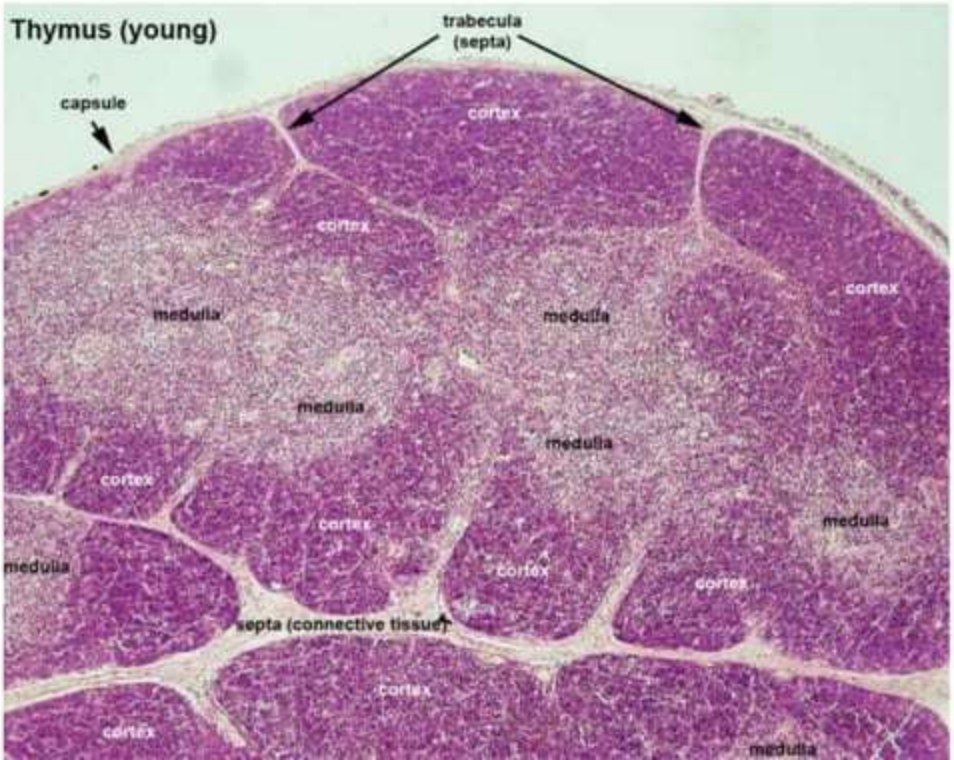
Multipotential lymphoid stem cells:

- Migrate into the endodermal rudiment in the embryo
- Derived from the yolk sac and red bone marrow.
- Proliferate and become immunologically competent.
- Differentiating into the **thymus-dependent lymphocytes (i.e.T lymphocytes)**

FATE OF LYMPHOCYTES

- Migrate to **lymph nodes** and **spleen.** to populate the **thymus-dependent** portions .
- Reside in the loose connective tissue.
- Many die or are destroyed in the thymus.
- Programmed against “self” antigens - Random process by which they acquire the ability to recognize and react to antigens
- Numerous macrophages are present to phagocytize these destroyed lymphocytes.

LOW MAGNIFICATION

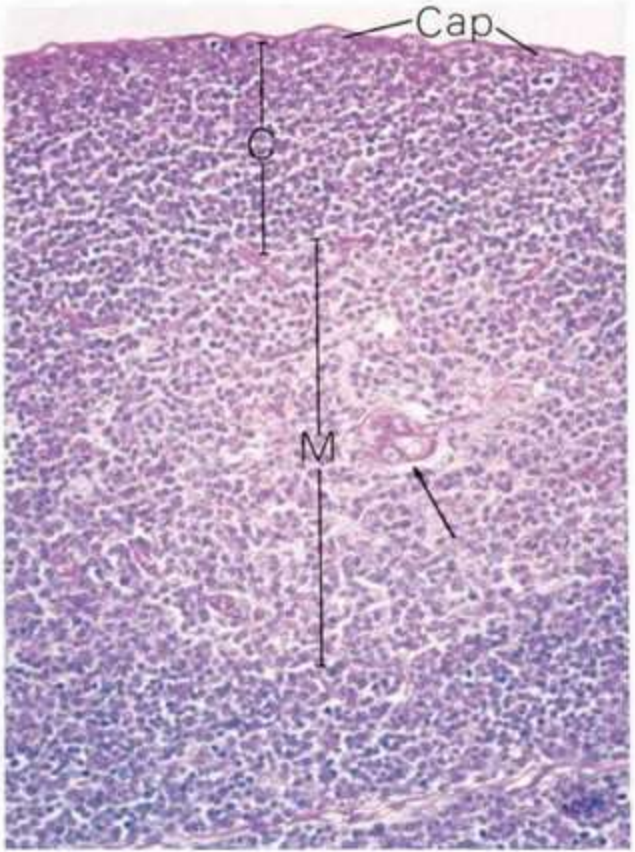


CORTEX..

- Stains more darkly (**basophilic**) as it contains more lymphocytes than the medulla.
- Epithelial cell network is **more finely branched** than in the medulla - and this gives this network the name '**reticular**'.
- Epithelial cells are connected to each other by

➢ **Desmosomes**,

➢ **Intermediate filament protein keratin** is present in their cytoplasm.



CORTEX VS MEDULLA

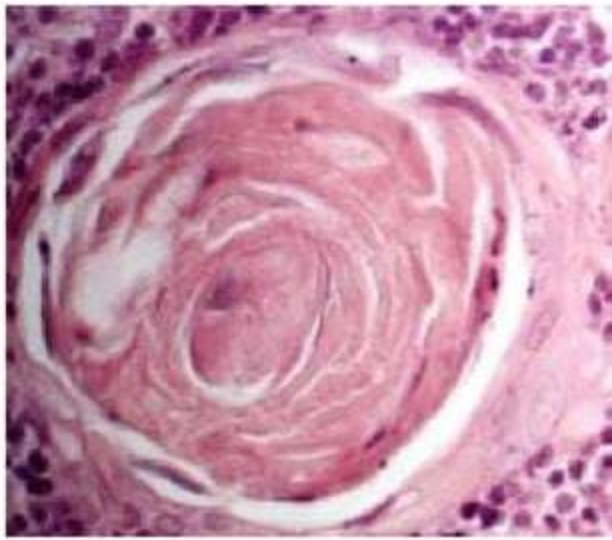
- Lymphocytic Population
- Staining Properties Of Nuclei

Medulla -

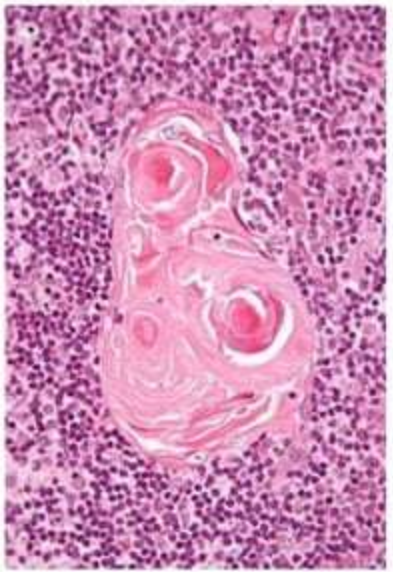
- Less cellular,
- Eosinophilic
- Presence of **Hassal's corpuscles**

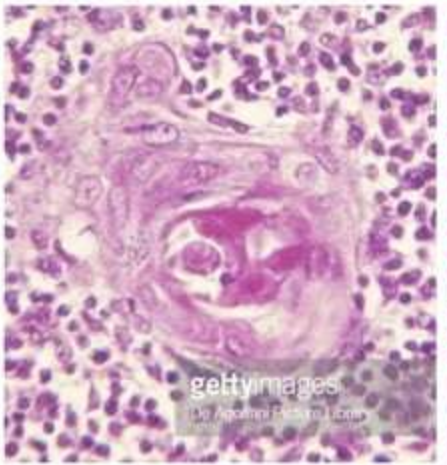
MEDULLA- HASSAL'S CORPUSCLES

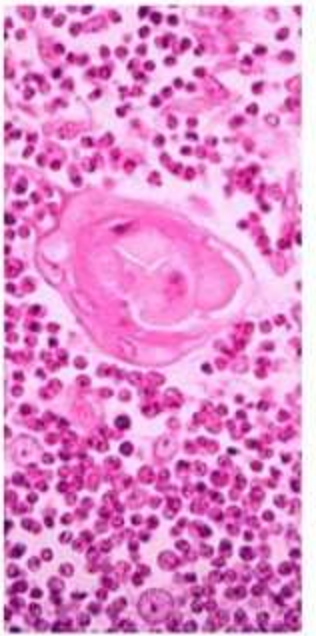
- Present in the medulla.
- Made up of **flat non-secreting epithelial cells (type 6 reticuloepithelial cells)**arranged in a concentric layers that have keratinised.
- Only found in the thymus.



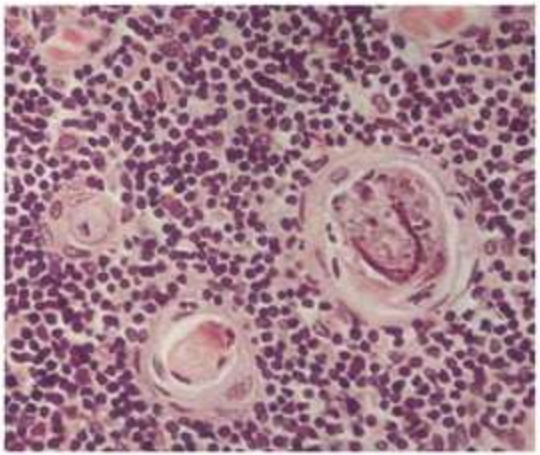
HASSAL'S CORPUSCLES







HIGHER MAGNIFICATION

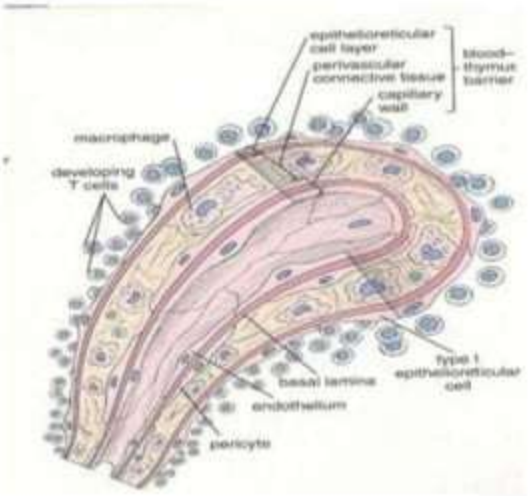


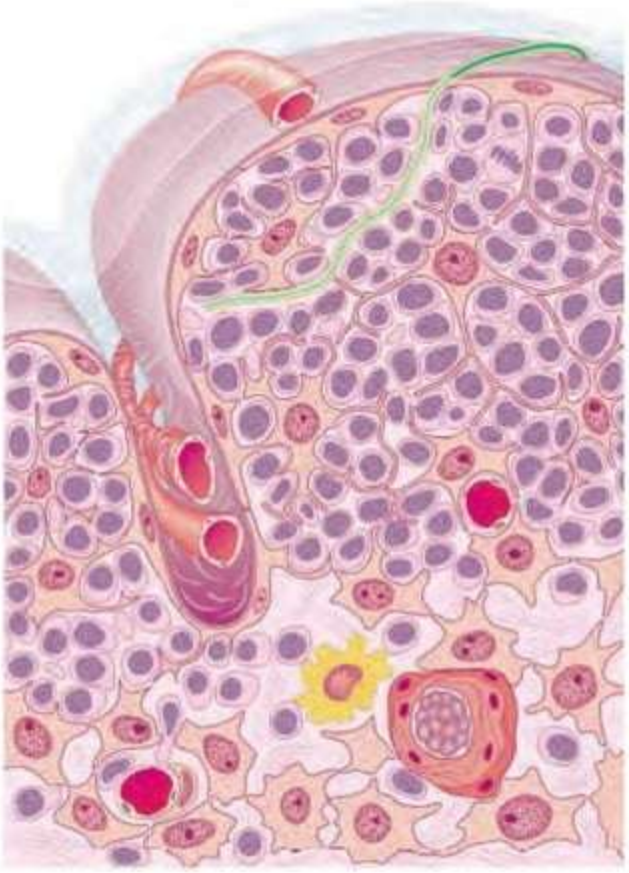
- **Hassal's corpuscles** OR **thymic corpuscles** are thought to be degenerate epithelial cells stains readily with **eosin**
- Made up of concentric layers of flattened reticular epithelial cells filled with **keratohyalin granules and keratin.**

BLOOD THYMUS BARRIER.

- Blood from the inferior thyroid, and internal thoracic arteries enters the thymus.
- **Epithelial cells form a sheath** around the capillaries, to form a barrier to the entry of antigenic material into the spaces between the epithelial cells in the reticular network..
- Efferent lymphatics transport lymph and lymphocytes away from this organ.

BLOOD THYMUS BARRIER





EM-Reticular epithelial cell and surrounding lymphocytes

- Vast number of lymphocytes present make it difficult to see the epithelial cells that both support them and may play a role in their maturation
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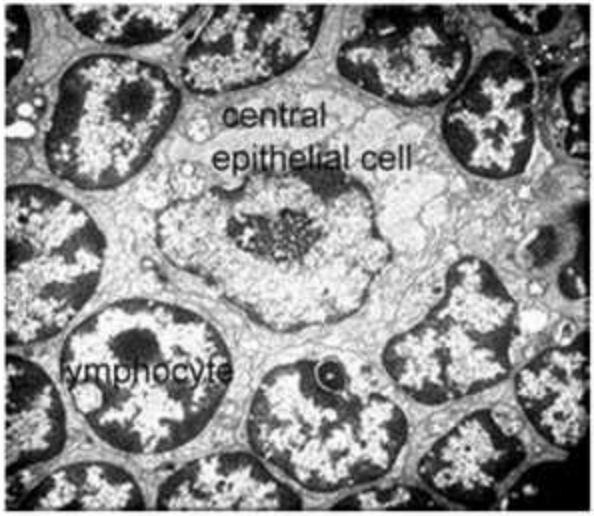

CROSSTALK

- Epithelioreticular cells of the thymic cortex play an important role in the development of immunocompetent T cells,
- Recent evidence shows that T cells at the different stages of differentiation control the microarchitecture of the thymic epithelioreticular cells,

Developing lymphocytes and epithelioreticular cells thus influence each other during T-cell development.


Thank You