



- **Lymphoid organs:**

• **Primary lymphoid organs (where lymphocytes are produced and mature):**

- ✓ Bone marrow (B-lymphocytes).
- ✓ Thymus gland (immature T-lymphocytes migrate to it for proliferation and maturation): which is present in children (in the superior mediastinum behind the sternum → consisting of right and left lobes). The thymus shrinks in adults and is converted to fatty tissue.

• **Secondary lymphoid organs (where naïve lymphocytes get exposed to antigens):**

- ✓ Spleen.
- ✓ Lymph nodes.
- ✓ Mucosal-associated lymphoid tissue (MALT).
- ✓ Tonsils.

- **What is Waldeyer's ring?**

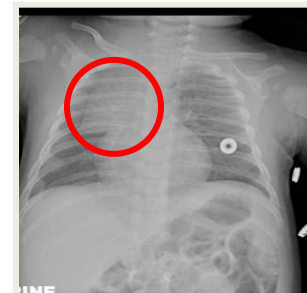
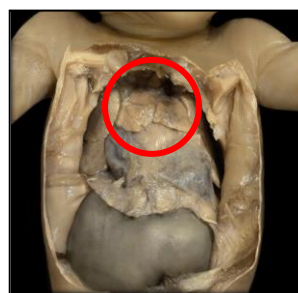
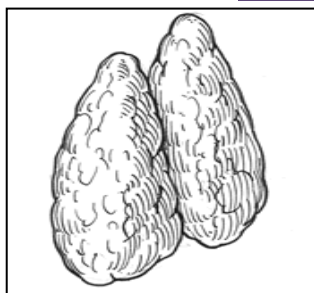
- It is an interrupted circle (دائرة غير مكتملة) of protective lymphoid tissue in the upper ends of the respiratory and alimentary tracts consisting of:

- ✓ **Pharyngeal tonsils:** which are located in the nasopharynx and also known as adenoids.
- ✓ **Tubal tonsils:** around the openings of the auditory tube.
- ✓ **Palatine tonsils:** located on either side of oropharynx → they lie in the tonsillar sinus which is formed between the palatoglossal and the palatopharyngeal arches.
- ✓ **Lingual tonsil:** located under the mucosa of the posterior third of the tongue.

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THYMUS

- **How does it look?**



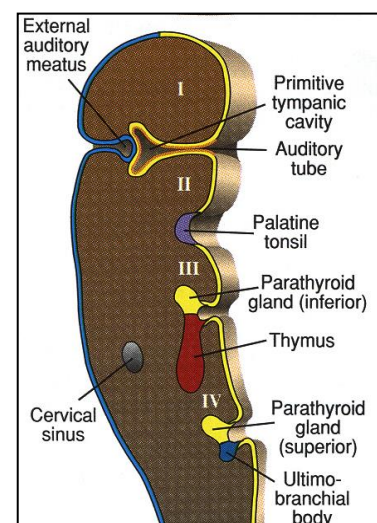
Note: there is an active growth of the gland during childhood but it starts involution (shrinkage) at puberty due to the production of steroid hormones (ACTH, adrenal and sex hormones). During adulthood, there will be atrophy and it is replaced by fat.

- **Where does it develop from (figure):**

- It develops from the 3rd pharyngeal pouch (where the inferior parathyroid glands also develop). In some books, the 4th pharyngeal pouch is also mentioned as an origin of development for the thymus gland in addition to the 3rd pharyngeal pouch.

- **Function of the thymus gland:**

- It is the site where immature T-lymphocytes proliferate and differentiate to mature T-lymphocytes:
 - ✓ **Helper T-cells (CD4+).**
 - ✓ **Cytotoxic T-cells (CD8+).**
- It also aids in the development of self-tolerance: which means that mature T-cells will not attack the own antigens of the body (no autoimmunity).
- **It secretes thymic factors:** thymocin, thymulin and thymopoietin



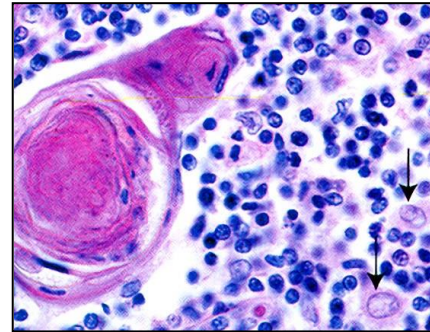
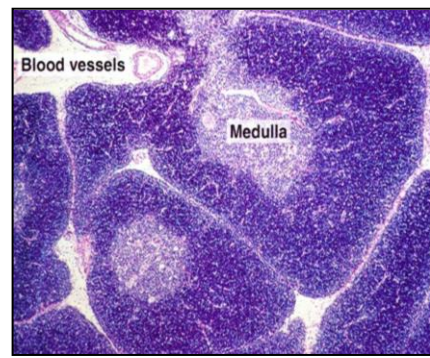
- **Blood supply:** from inferior thyroid & internal thoracic arteries (branching from capsular & septal arteries to arterioles & venules).

- **Thymus has no afferent lymphatics (while lymph nodes have afferent lymphatic vessels).**

- **Histology:**

- **The thymus consists of lobules which are separated by connective tissue. Each lobule has:**

- ✓ **A cortex:** which is having densely packed small (immature) lymphocytes and it is the site for proliferation and terminal differentiation of T-cells. The differentiating T-cells in the cortex are protected by the blood-thymus barrier which is consisting of
 - * Epithelial Reticular Cell (ECR) layer: stellate cells with pale oval nuclei.
 - * Perivascular connective tissue
 - * Capillary wall.
- ✓ **A medulla:** lymphocytes in the medulla are large mature T-cells. Macrophages, fibroblasts and mast cells can also be seen in the medulla. The unique feature which is characterizing the thymus is the presence of thymic (Hassall's) corpuscles which are concentric, flat, degenerated type VI-ERCs (figure). These corpuscles produce IL-4 and IL-7 which function in thymic differentiation & education of T-lymphocytes. Note that the medulla has no blood-thymus barrier.

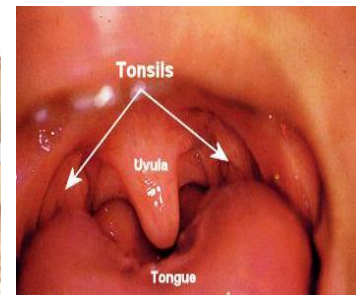
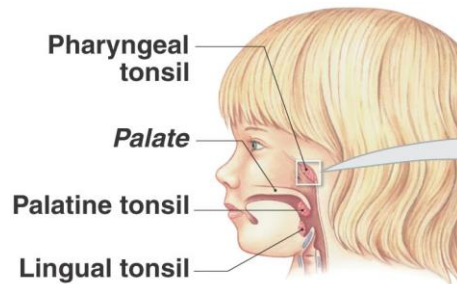


- **Clinical:**

- There might be developmental dysplasia or aplasia (Di George Syndrome) of the 3rd & 4th pharyngeal pouches. This will lead to immunodeficiency syndromes ± parathyroid abnormalities.
- Ectopic thymus ± parathyroid.
- Neonatal thymectomy: there will be no T-lymphocytes in the circulation.
- Auto-immune disorders: when T-lymphocytes are reactive with self-antigens (there is no development of self-tolerance).

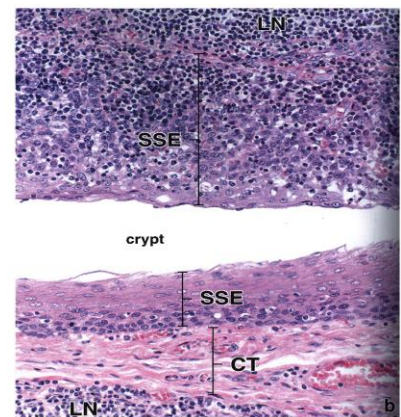
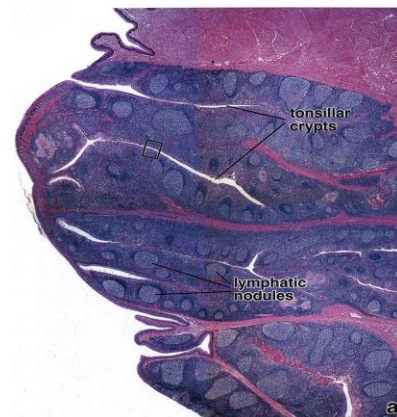
TONSILS

- Palatine tonsils (showed in the picture) develop from the 2nd pharyngeal pouch and they are located in the tonsillar sinuses on each side of the oropharynx.
- Tonsils are lymphoid swellings of the mucosa forming an interrupted circle (not complete) known as Waldeyer's ring (mentioned previously).



- **Histology of palatine tonsils:**

- They are a component of mucosal-associated lymphoid tissue (MALT).
- **Epithelium:** stratified squamous non-keratinized epithelium → which dips into the underlying connective tissue to form 12-15 tonsillar crypts. The walls of the crypts contain numerous lymphoid follicles many of them with germinal centers.



- **MALT:**

- They include tonsils, appendix (GIT), Peyer's patches (40 follicles, 1cm wide, in the ileum) and lymphoid nodules in the walls of the bronchi (respiratory tract).
- So it functions in protecting the GIT and respiratory system from foreign matters.



LYMPH NODES

- They are bean/kidney shaped secondary lymphoid organs which are surrounded by capsules and filter the lymph (the lymph enters via the afferent lymphatic vessels: remember that these vessels are not present in the thymus).
- Under the capsule is a subcapsular lymphatic sinus which is continuous with trabecular sinuses and medullary sinuses (figure).
- **Hilum**: is a concave (مُقَعَّر) surface and the site of entry of blood vessels and exit of efferent lymphatics.
- **The cortex**: it is made up of lymphoid follicles which contain B-lymphocytes. While T-lymphocytes are present in the paracortical area (deep cortex).
- **The medulla**: it shows:
 - **Medullary cords**: containing plasma cells, their precursors and macrophages.
 - **Medullary sinuses**: which empty their lymph into efferent lymphatics.
- Most lymphocytes enter the lymph nodes through High Endothelial Venules (HEV) located in the deep cortex and about 10 % enter through the afferent lymphatics.
- Antigens from tissues enter the lymph node through afferent lymphatics and circulate around the sinuses.
- **In the figure**:
 - **A**: cervical lymph nodes.
 - **B**: axillary lymph nodes.
 - **C**: superficial inguinal lymph nodes.
- **Thoracic duct**:
 - It begins as a loosely dilated sac in the abdomen called cisterna chyli.
 - This duct drains both legs and the left side of the body (left arm and left side of the head and neck).
 - Dumps into the venous circulation into the left brachiocephalic vein.
- **Right lymphatic duct**:
 - Draining the upper right quadrant (right arm and right side of the head and neck) of the body into the right brachiocephalic vein.

