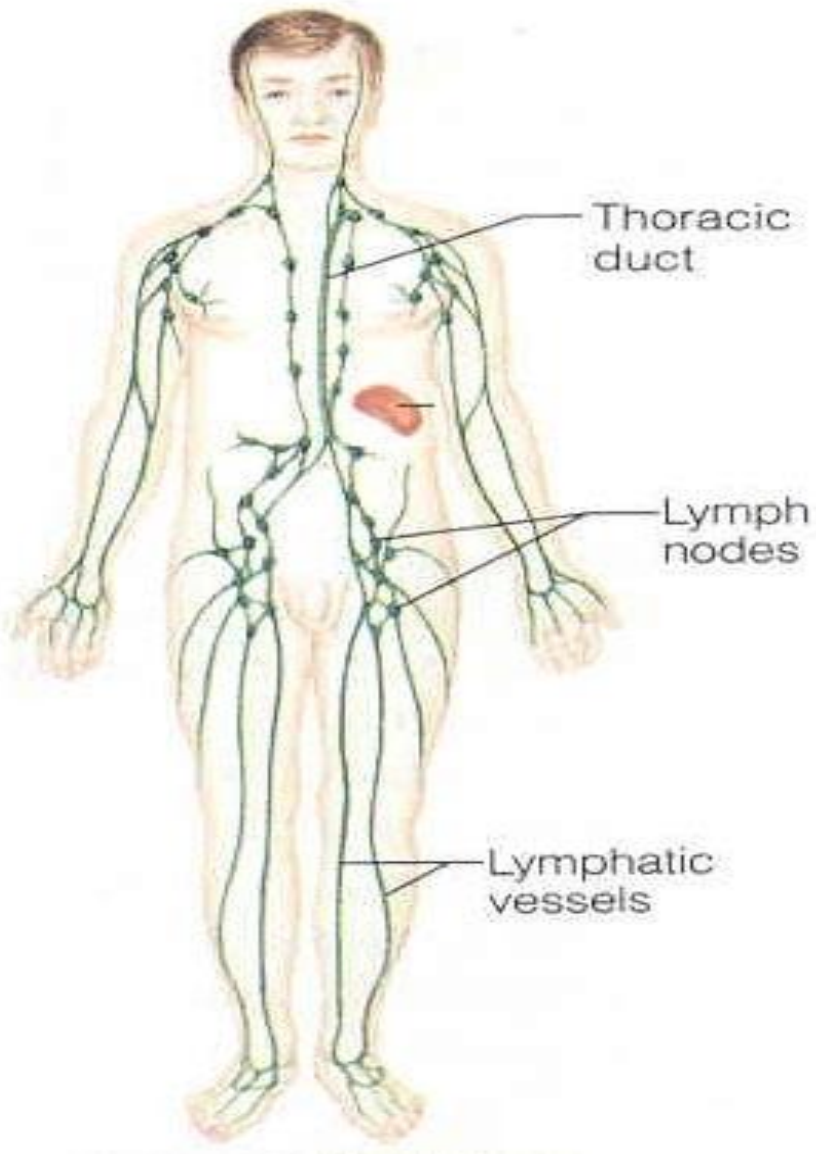
LYMPHATIC SYSTEM

INTRODUCTION

- Lymphatic system is also called as immune system.
- **This system consists of following structures→**
- ***Lymphatic vessels:--*** Thin walled vessels collect lymph and drain into vein.
- ***Specific lymphatic organ:--*** Lymphatic tissue surrounded by capsule, e.g. Lymph node, spleen and thymus.
- ***Lymphatic tissue found within tissue of other organ:--*** Not surrounded by capsule, e.g. Tonsil, peyer's patches.

Components of the Lymphatic System

- **Lymph→** Tissue fluid drained by lymphatic vessels. Consists of tissue fluid, proteins, fat & particulate matters.
- **Lymphatic Vessels**
  - Lymphatic Capillaries
  - Lymphatic Vessels
  - Lymphatic Trunks
  - Lymphatic Ducts
- **Lymphatic Organs**
  - Thymus
  - Lymph Nodes
  - Spleen
  - Tonsils
- **Lymphatic cells**



Lymphatic system

- The specific immune response is evoked by lymphocytes.
- Lymphocytes are of two types, B and T.
- They are derived from common stem cells in the bone marrow.
- B lymphocytes mature and become immunocompetent in the bone marrow.

- T lymphocytes mature and become immunocompetent in thymus and migrate to other peripheral lymphoid organ.

- The defence mechanism mediated by B lymphocytes is called *humoral immune response*.

- The defence mechanism mediated by T lymphocytes is called *cellular immune response*

% of lymphocytes in various lymphoid organ

	B lymphocytes	T lymphocytes
Bone marrow	90	10
Thymus	0	100
Lymph node	40	60
Spleen	55	45
Blood	30	70

LYMPH NODE

- ***GENERAL FEATURE—***
- Oval or bean shaped situated along the course of lymphatic vessels.

- They serve as filter of lymph, removing particulate matter and bacteria, thereby localising and preventing the spread of infection.

- Lymph node usually found in groups e.g. axilla, inguinal region, root of lung.

- ***COMPONENTS/STRUCTURE—***
- ***Stroma : Connective tissue framework***

  -Capsule

  -Trabeculae

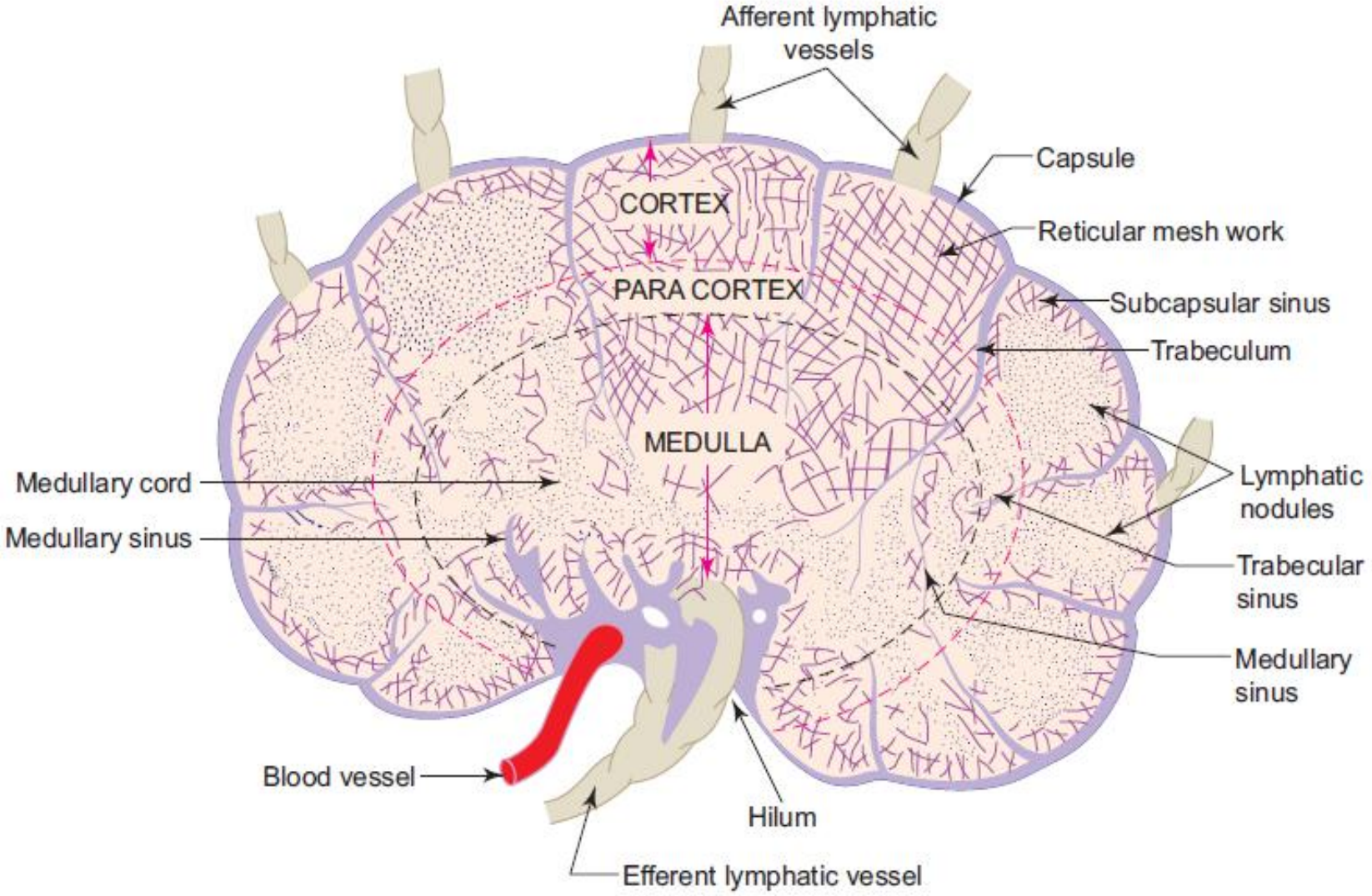
  -Reticular stroma

- ***Parenchyma : Lymphoid tissue***

  -Cortex

  -Paracortex (inner cortex)

  -medulla



- **Connective tissue framework—**
- ***Capsule and trabeculae-***

*Lymph node is surrounded by a thin connective capsule which sends trabeculae into the interior.

*Beneath the capsule is the subcapsular sinus.

*The subcapsular sinus receives afferent lymphatic vessels and is continuous with trabecular sinus.

*Trabecular sinus becomes continuous with the medullary sinus.

- ***Reticular stroma-***

*Made of reticular fibre and phagocytic reticular cells.

*Gives structural supports to lymphoid cells.

- **Parenchyma-**
- ***Cortex*** **–** Peripheral part of the lymph node situated deep to the capsule.
- It contains→

1.Subcapsular sinus

2.Lymphatic nodules- with or without germinal centres formed mainly of B lymphocytes.

a)Primary nodule-lymphatic nodule *without* germinal centre.

b)Secondary nodule-nodule *with* germinal centre.

- The germinal centre contains large lymphoblast with more cytoplasm and lighter nuclei as compared to periphery of nodule.

- ***Paracortex-***
- It is the inner cortical zone, does not have precise boundary with outer cortex.

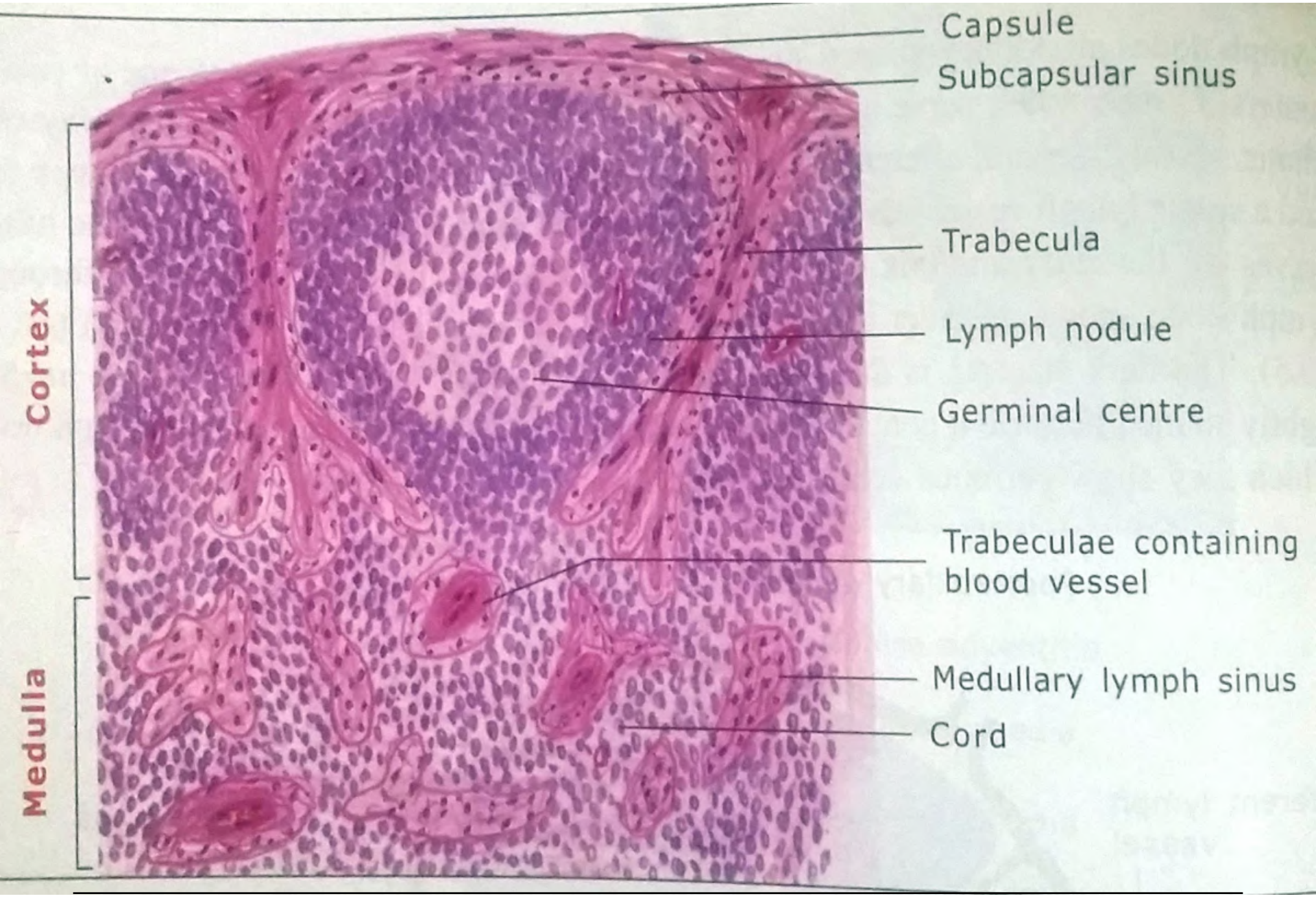
- Contains mainly T lymphocytes and called thymus-dependent zone.

- The dense lymphoid tissue in the paracortex becomes continuous with medullary cords.

- ***Medulla-***
- Has two components, medullary cords and medullary sinuses.

- Medullary cords- are branching and anastomosing cords of lymphoid tissue contains mainly B lymphocytes, few plasma cells and macrophages.

- Medullary sinuses- drain into the efferent lymphatic vessels found at the hilum.



Flow of lymph through lymph node

Afferent lymphatic vessels

Subcapsular sinus

Trabecular sinus

Medullary sinus

Efferent lymphatic vessels

SPLEEN

- ***GENERAL FEATURES—***
- Spleen is the largest lymphoid organ.
- Present in the left hypochondrium.
- **COMPONENTS/STRUCTURE—**
- **A)Connective tissue framework**
- Capsule
- Trabeculae
- Reticular stroma
- **B)parenchyma**
- White pulp
- Red pulp

- **Connective tissue framework—**
- ***Capsule-***
- Covers the spleen completely.
- Lies deep to the peritoneum.
- Formed by dense collagenous connective tissue and few smooth muscle fibres.

- ***Trabeculae-***
- Given off from the capsule into the substance of spleen.

- ***Reticular stroma-***
- Made of reticular fibres and associated phagocytic reticular cells.

- ***Parenchyma—***
- The interior of spleen shows rounded white/grey areas surrounded by red matrix.
- These grey area are called *white pulp* and the dark red matrix called *red pulp*.

- ***White pulp—***is the lymphatic tissue sheath that surrounds the central artery (eccentric position)
- It contains lymphocytes and macrophages in a reticular connective tissue meshwork.

- This peri-arterial lymphatic sheath also contain lymphatic nodules with germinal centre.
- These nodules are called *splenic nodules or malpighian corpuscles.*
- Lymphocytes in white pulp is T while in nodule B lymphocytes.

- ***Red pulp***— consist of network of inter-anastomosing splenic cords.

- Splenic cords-- made up of reticular cells and reticular fibres containing B and T lymphocytes, macrophages, plasma cells, RBC, and granulocytes.

- These splenic cords are also called as "cords of Billroth".

Splenic Circulation

- Blood enters via splenic artery at hilus
- Splenic artery → trabecular arteries (within trabeculae).
- Trabecular arteries → central arteries(covered by a *peri-arterial lymphatic sheath*) **[PALS].**
- Central artery terminate into straight vessels called penicilli.
- Penicilli shows localiszed thickening (ellipsoid)

Penicilli continue as arterial capillary.

- The mode of blood flow between arterial capillaries and splenic sinuses is not clear.
- Two different theories open and closed circulation have been proposed.

- According to *"closed circulation theory"* arterial capillaries open directly into splenic sinuses that drain into tributaries of splenic vein.

- According to *"open circulation theory"* the arterial capillaries open and pour their blood into splenic cord of red pulp.
- Pulp veins drain into trabecular veins.
- Trabecular veins drain into splenic vein at the hilus.

Splenic Cords and Splenic Sinusoids

Open and Closed Circulation in Spleen

Spleen

Functions of the spleen

- Filtration of blood.
- Storage of blood.
- Formation of blood cells during fetal life.
- Aged and abnormal RBCs are destroyed in the spleen.
- Immune response.

THYMUS

- Covered by a capsule which extends to form Trabeculae.
- Trabeculae extends inwards to forms numerous incomplete lobules *(lobulated appearance)*.
- Each lobule consists of dark staining outer cortex and a light staining inner medulla.

- Cortex contains densely packed lymphocytes *(No lymphatic nodules)*.

- Medulla contains fewer lymphocytes but more epithelial reticular cells.

- **Medulla also contains Thymic (Hassall's) Corpuscles.**
- Thymic (Hassall's) Corpuscles are oval structures consisting of round whorls of flattened epithelial cells.

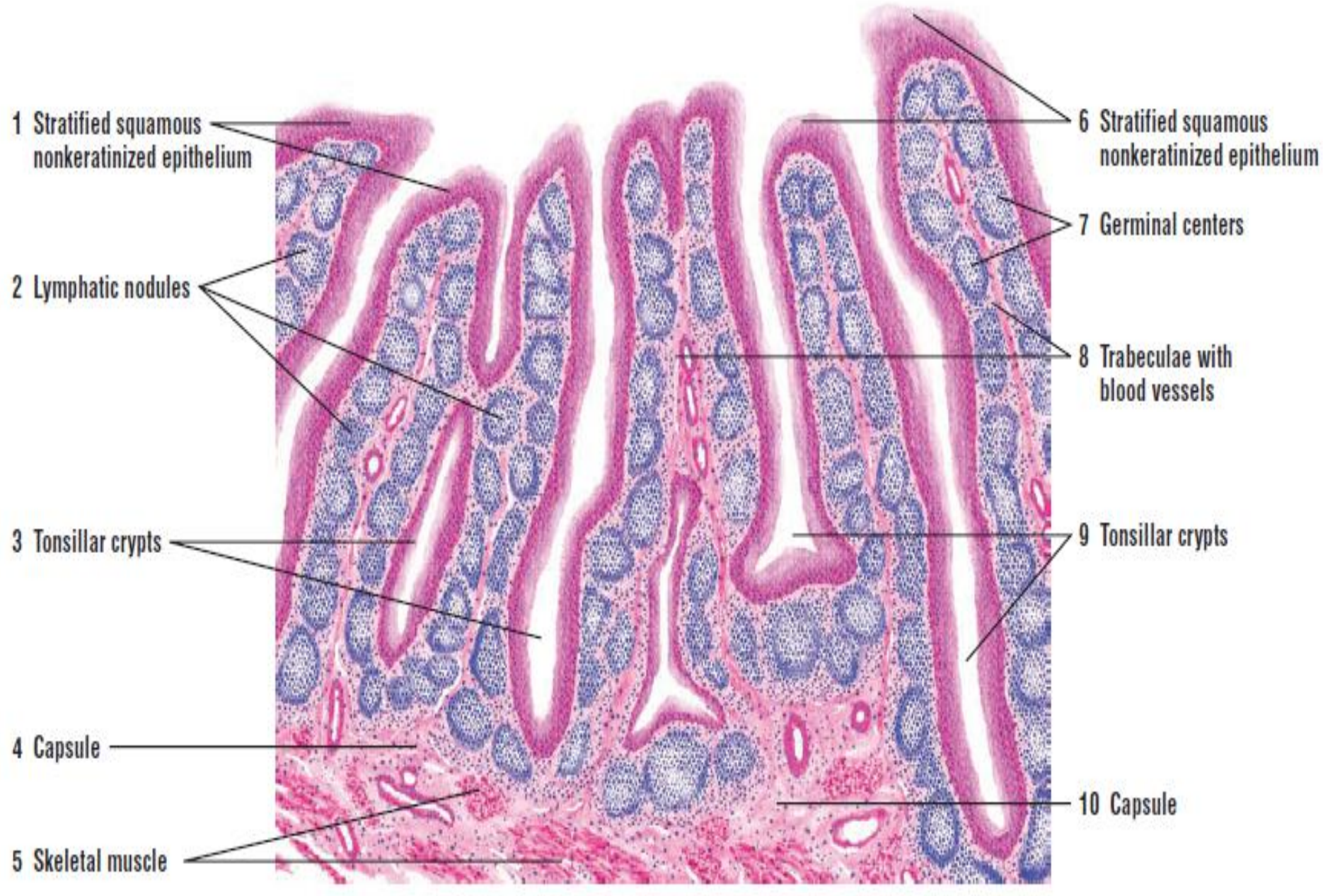
Thymus

Function of thymus

- Maturation of T lymphocytes.
- Mature T lymphocytes then carried from thymus to the lymph node, spleen, and other lymphatic tissues.
- Thymopoietin induces T cell production and maturation.
- Thymosin supports T cell activities.
- Thymus gets atrophied after puberty.

PALATINE TONSIL

- Collection of lymphoid tissue in mucosa of oropharyngeal isthmus.
- Consist of lymphatic nodules within diffused lymphoid tissue .
- Lateral surface is covered by *capsule.*
- Medial surface is pitted by 10-20 tonsillar crypts, lined by *stratified squamous non-keratinised epithelium.*



- It has *only efferent vessels.*
- Infection of tonsil is called *tonsillitis.*

- Function→
- Production of lymphocytes.
- Immunological responses.