INTRODUCTION TO THE ANATOMY OF LYMPHATIC & HEMATOPOITIC SYSTEM

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LECTURER ANATOMY KGMC

The Lymphatic System

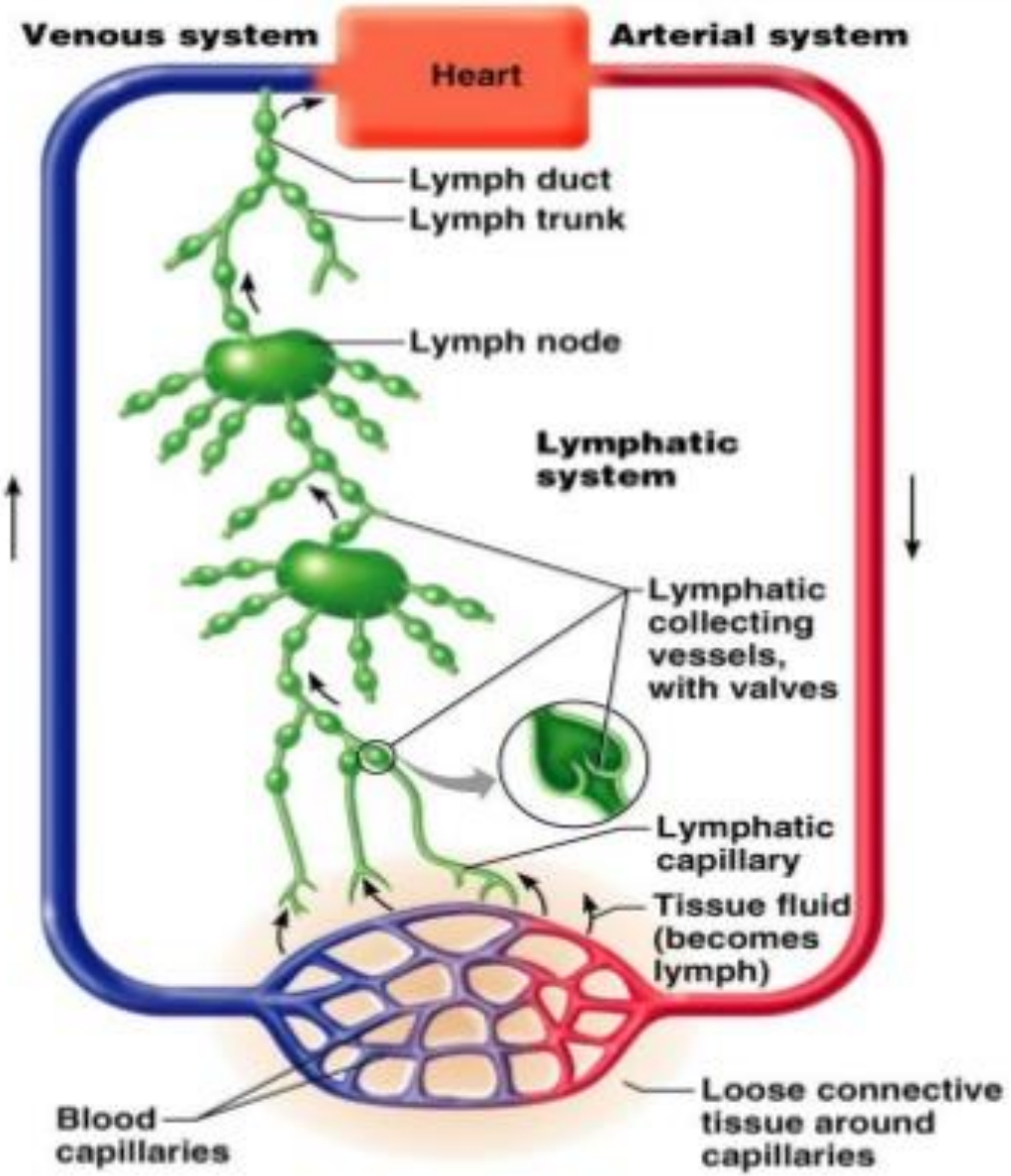
- A circulatory system for fluids
- Returns fluid to the blood
- Removes antigens from the body
- Exposes antigens to the immune system
- Main structures of the lymphatic system
  - **Lymph**
  - **Lymphatic vessels**
  - **Lymph nodes**
  - **Diffuse Lymphoid tissue, Eg: tonsils**
  - **Lymphoid organs, Eg: spleen &Thymus**
  - **Bone marrow**

Lymph

- Lymph is a clear watery fluid, similar in composition to plasma , with important exception of plasma proteins and identical in composition to interstitial fluid.
- Transports the plasma proteins that seep out of the capillary beds back to the bloodstream.
- It also carries away larger particles, Eg. Bacteria, Cell debris etc.
- Contains lymphocytes which circulates in the lymphatic system allowing them to patrol the different regions of the body.

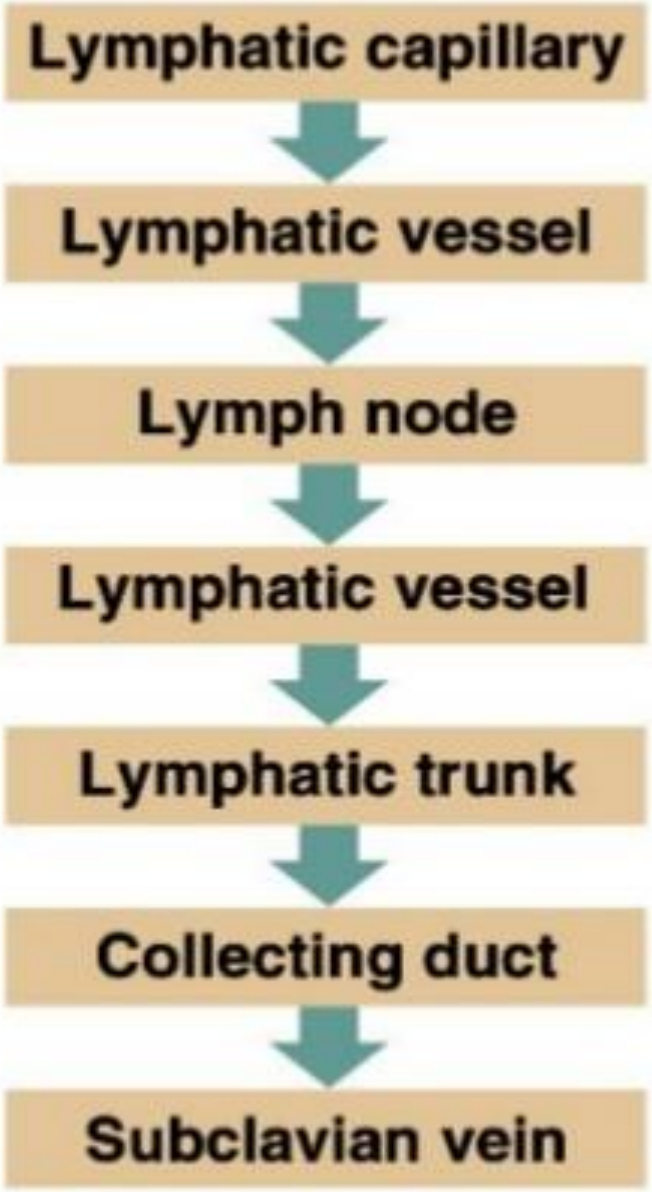
The Lymphatic System

- **Lymphatic vessels** collect tissue fluid from loose connective tissue
  - Carry fluid to great veins in the neck
  - Fluid flows only toward the heart
- Collect excess tissue fluid and blood proteins



Orders of Lymphatic Vessels

- **Lymph capillaries**
  - Smallest lymph vessels
    - First to receive lymph
- **Lymphatic collecting vessels**
  - Collect from lymph capillaries
- **Lymph nodes**
  - Scattered along collecting vessels
- **Lymph trunks**
  - Collect lymph from collecting vessels
- **Lymph ducts**
  - Empty into veins of the neck



Lymphatic Capillaries

- Located near blood capillaries
- Receive tissue fluid from CT
  - Increased volume of tissue fluid
    - Minivalve flaps open and allow fluid to enter
- Highly permeability allows entrance of
  - Tissue fluid
  - Bacteria, viruses, and cancer cells
- **Lacteals** – specialized lymphatic capillaries
  - Located in the villi of the small intestines
    - Receive digested fats
    - Fatty lymph – **chyle**

Location and Structure of Lymphatic Capillaries

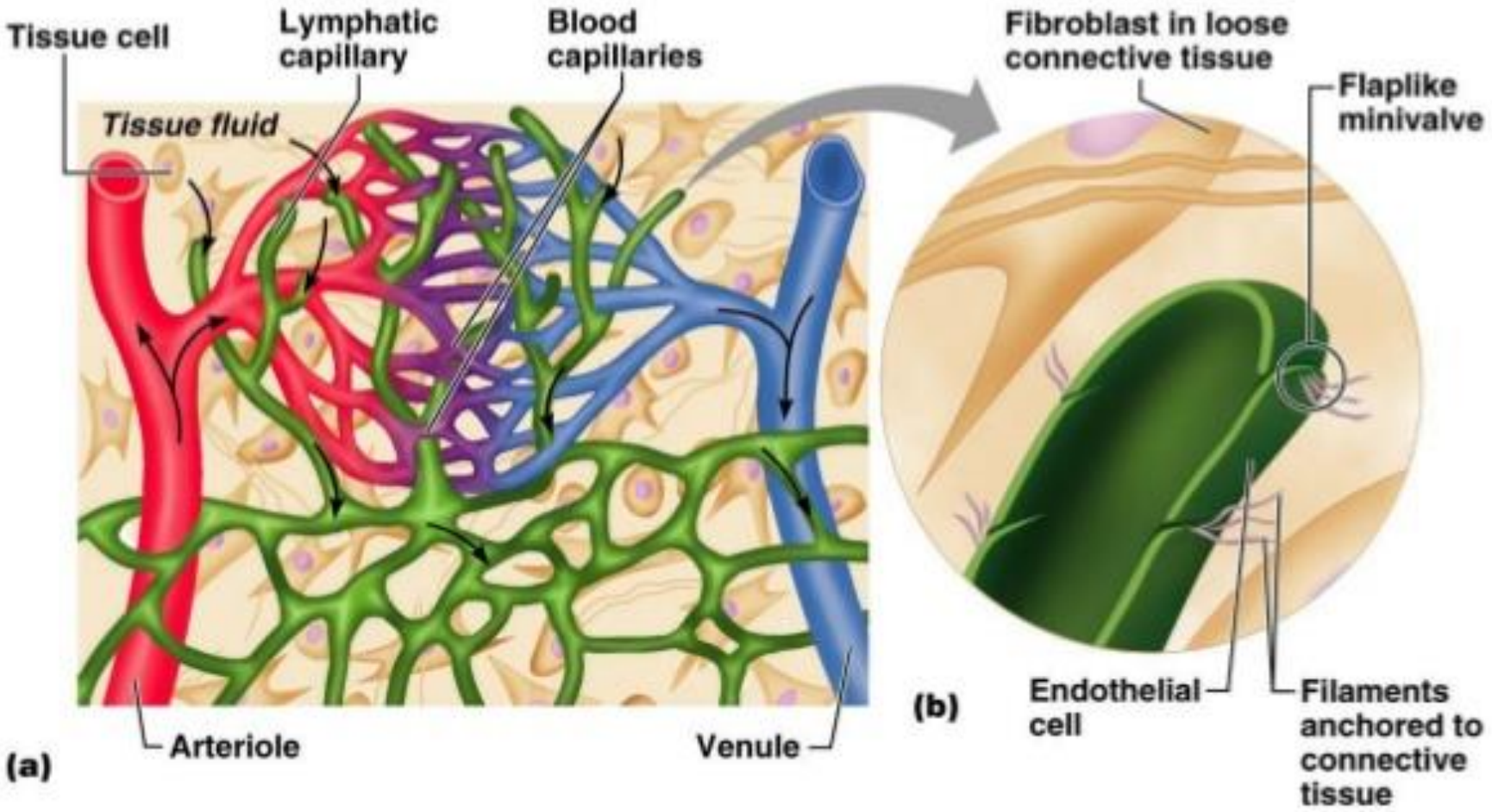


Figure 20.2a, b

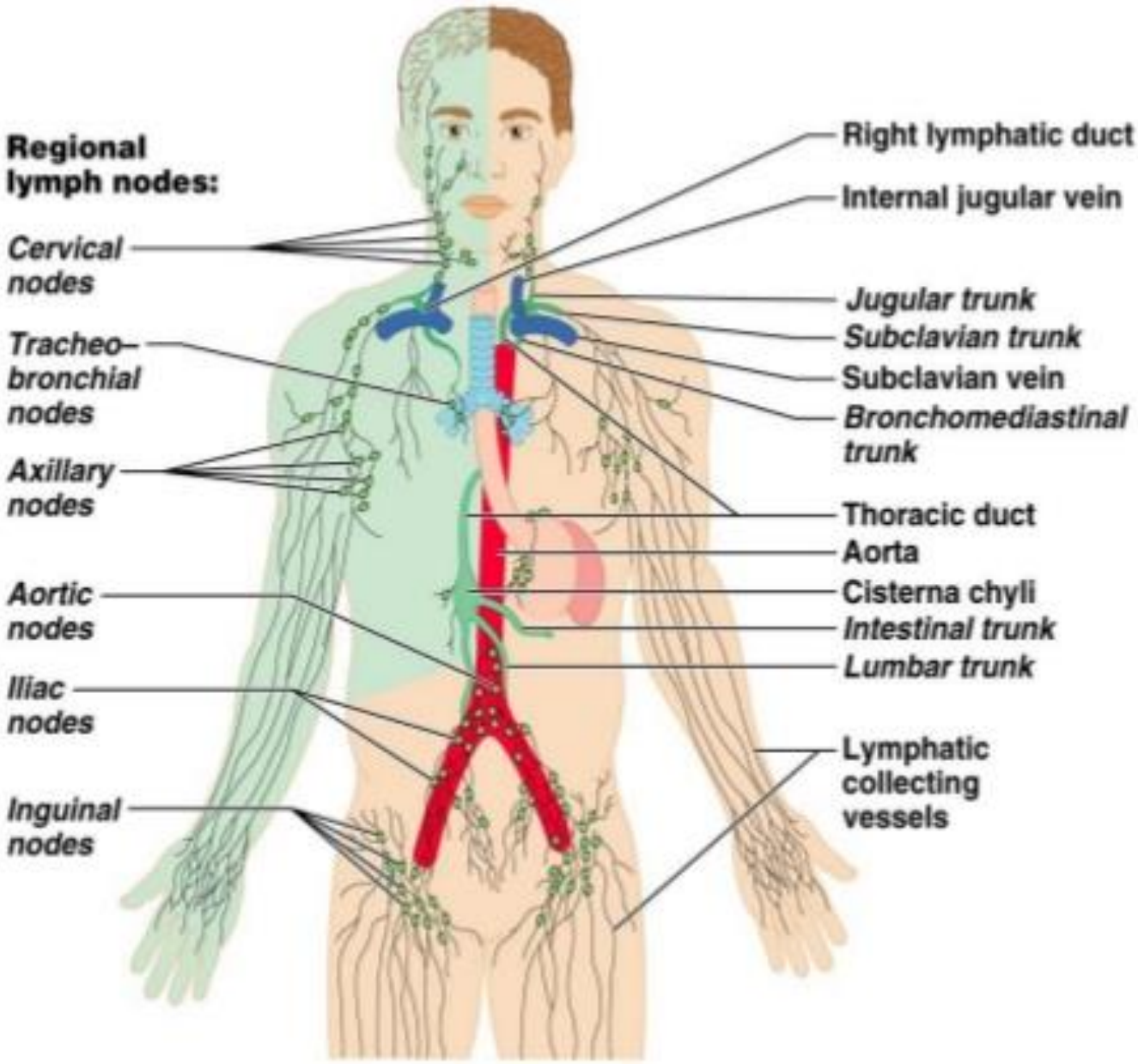
Lymphatic Collecting Vessels

- Accompany blood vessels
- Composed of the same three tunics as blood vessels
- Contain *more valves* than veins do
  - Helps direct the flow of blood
- Lymph propelled by
  - Bulging of skeletal muscles
  - Pulsing of nearby arteries
  - Tunica media of the lymph vessels

Lymph Nodes

- Lymph nodes are bean shaped organs along with lymphatic collecting vessels
- Up to 1 inch in size
- Cleanse the lymph of pathogens
- Human body contains around 500
- Lymph nodes are organized in clusters
- These nodes are considerably in size: some are as small as a pin head & the largest are about the size of an almond

Lymph Nodes


Regional lymph nodes:
Cervical nodes
Tracheo-bronchial nodes
Axillary nodes
Aortic nodes
Iliac nodes
Inguinal nodes
Right lymphatic duct
Internal jugular vein
Jugular trunk
Subclavian trunk
Subclavian vein
Bronchomediastinal trunk
Thoracic duct
Aorta
Cisterna chyli
Intestinal trunk
Lumbar trunk
Lymphatic collecting vessels

Microscopic Anatomy of a Lymph Node

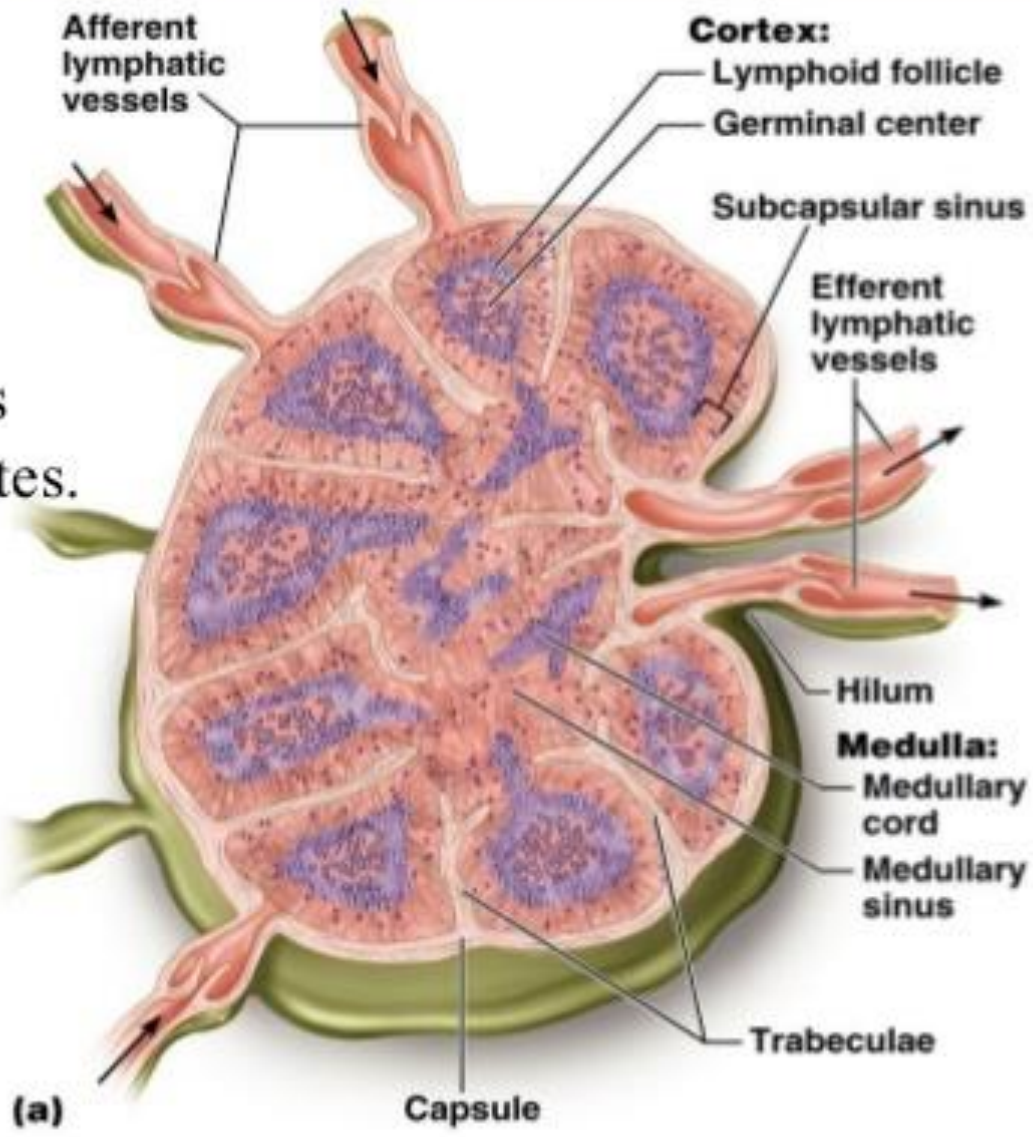
- Outer ***Fibrous capsule*** – surrounds lymph nodes
- Trabeculae – connective tissue strands
- The main substance of the node consists of ***reticular and lymphatic tissue*** containing many lymphocytes and macrophages.
- Each node has a concave surface called hilum, where an artery enters & a vein and efferent vessel leaves.
- Lymph vessels
  - Afferent lymphatic vessels
  - Efferent lymphatic vessels

Microscopic Anatomy of a Lymph Node

Functions:

1.Filtering and phagocytosis

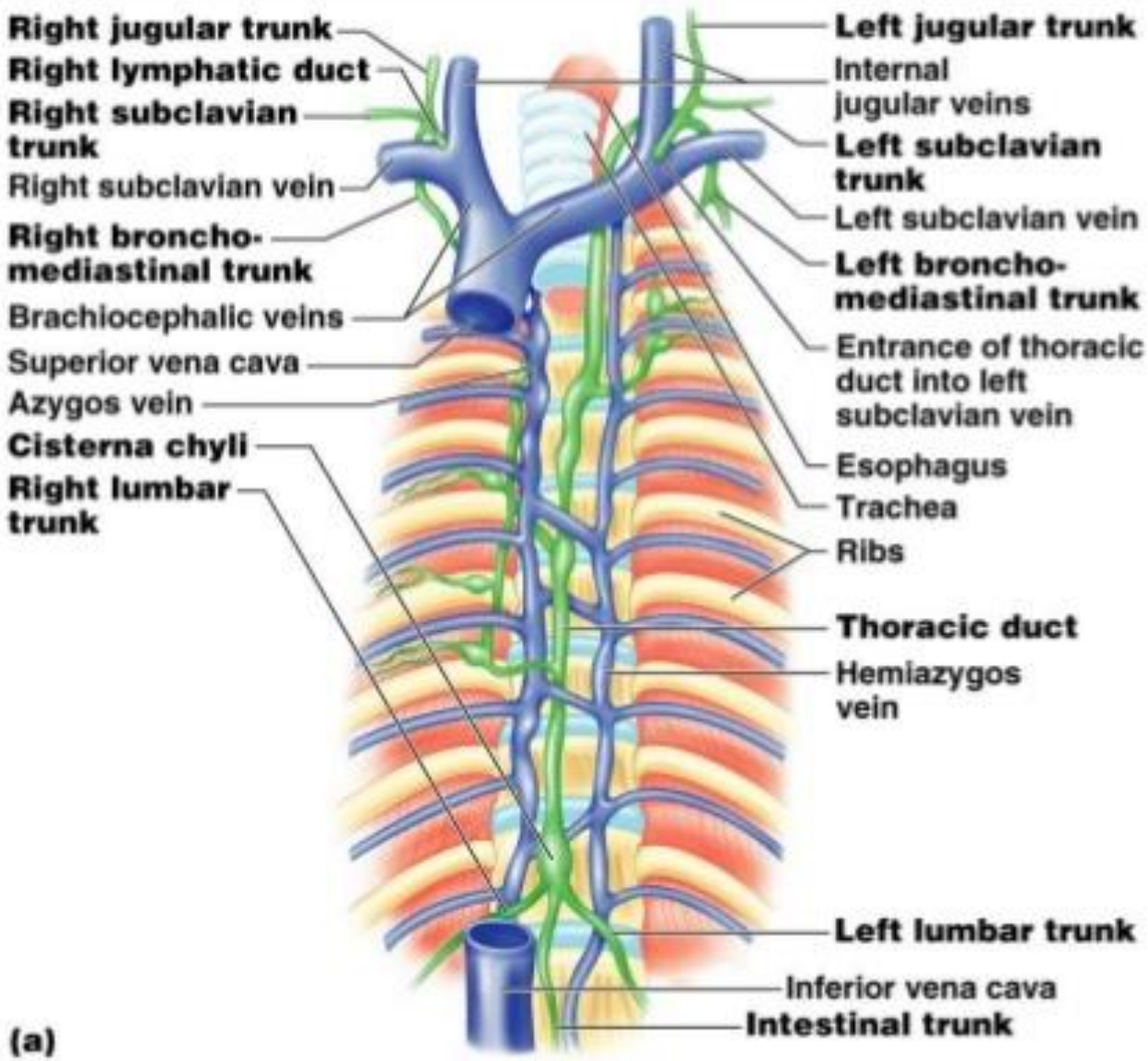
2.Proliferation of lymphocytes.



Lymph Trunks

- Lymphatic collecting vessels converge
- Five major lymph trunks
  - **Lumbar trunks**
    - Receives lymph from lower limbs
  - **Intestinal trunk**
    - Receives chyle from digestive organs
  - **Bronchomediastinal trunks**
    - Collects lymph from thoracic viscera
  - **Subclavian trunks**
    - Receive lymph from upper limbs and thoracic wall
  - **Jugular trunks**
    - Drain lymph from the head and neck

The Lymphatic Trunks

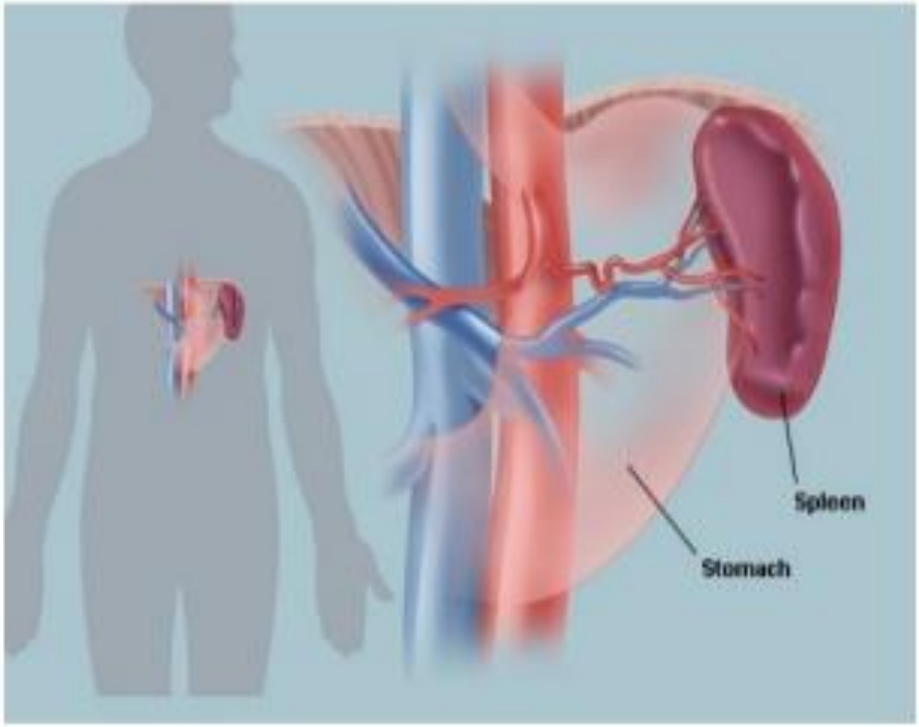


Lymph Ducts

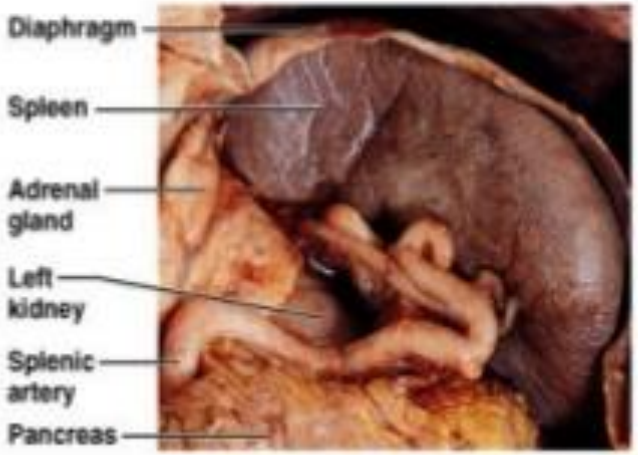
- **Cisterna chyli**
  - Located at the union of lumbar and intestinal trunks
- **Thoracic duct**
  - Ascends along vertebral bodies
  - Empties into venous circulation
    - Junction of left internal jugular and left subclavian veins
  - Drains three quarters of the body
- **Right lymphatic duct**
  - Empties into right internal jugular and subclavian veins

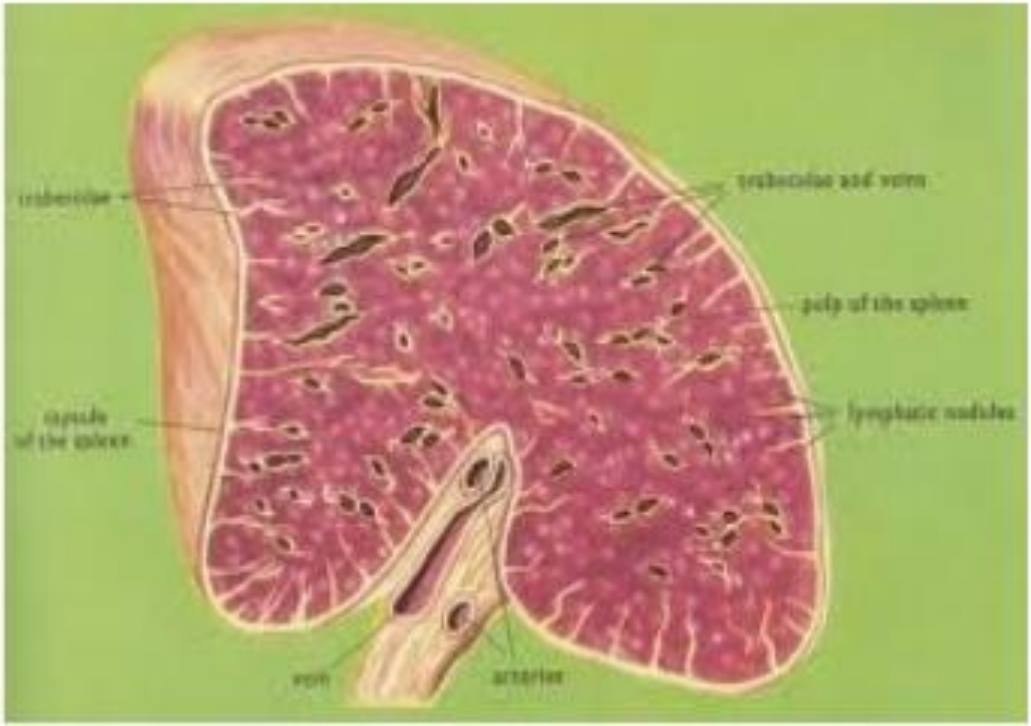
Spleen

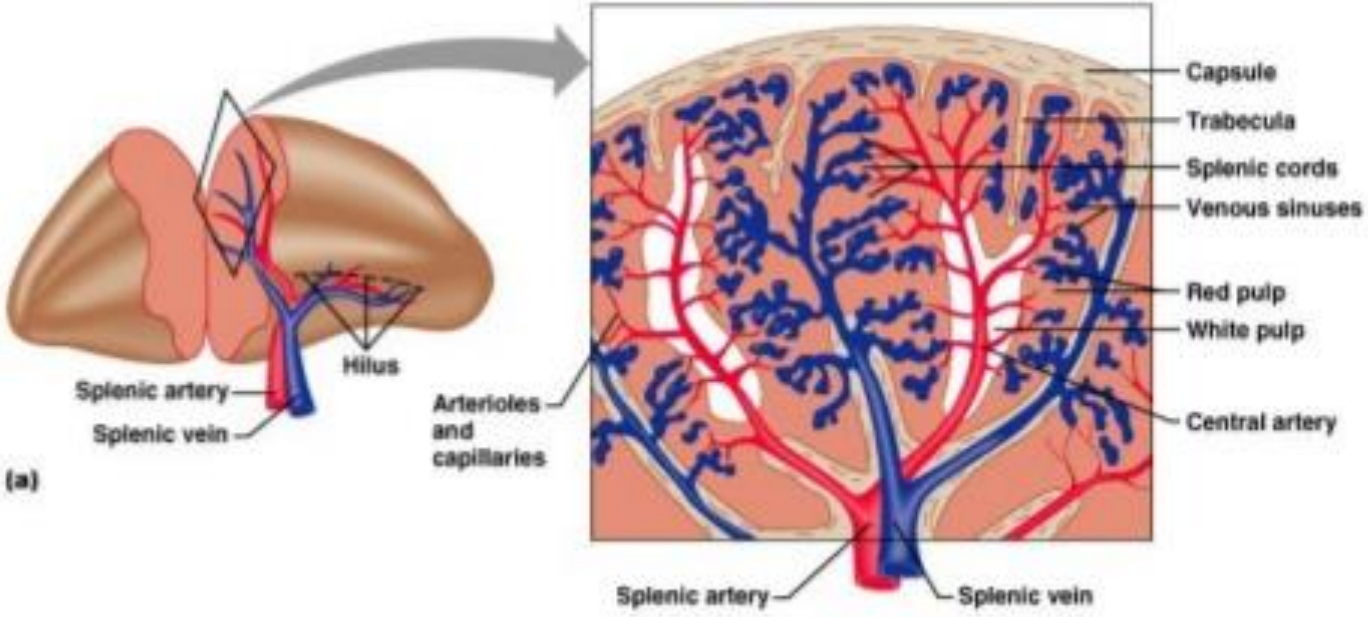
- Largest lymphoid tissue; is in left hypochondriac region in between the fundus of stomach and the diaphragm.
- Purple in color, 12 cm long, 7cm wide and 2.5 cm thick and weighs about 200 g.
- Functions
  - Removal of blood-borne antigens: "white pulp"
  - Removal & destruction of aged or defective blood cells: "red pulp"
  - Stores platelets
  - In fetus: site of hematopoiesis



Spleen

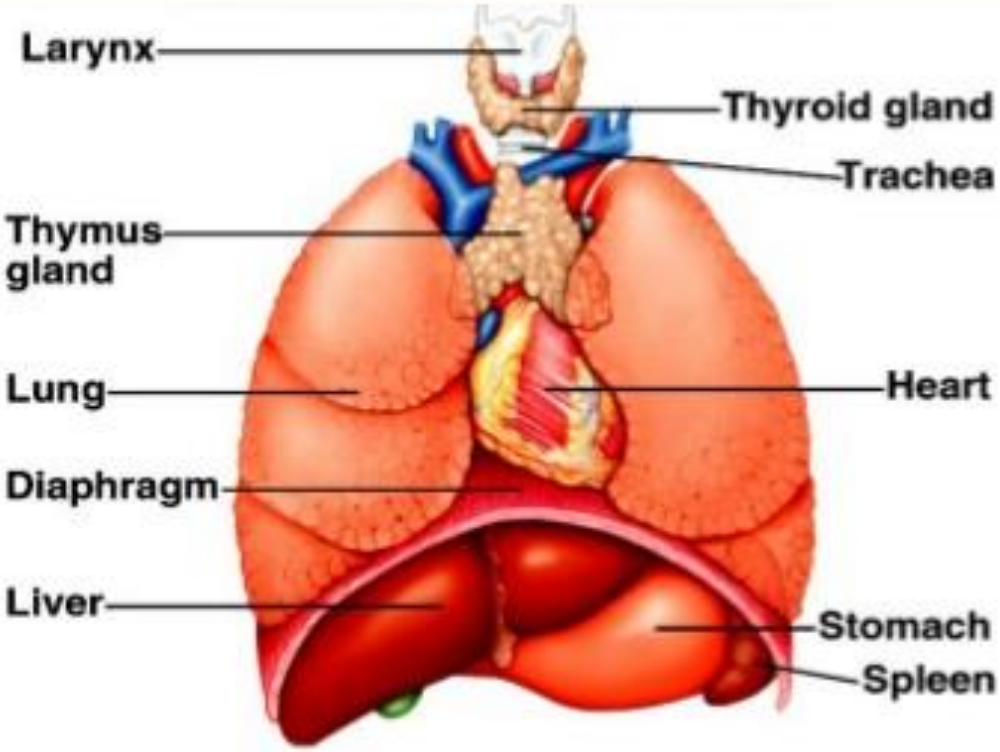

Diaphragm
Spleen
Adrenal gland
Left kidney
Splenic artery
Pancreas

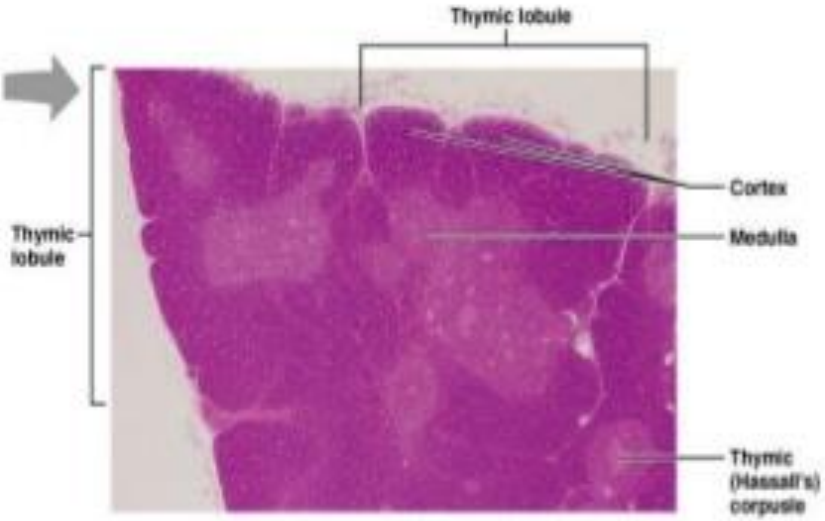

trabeculae and veins
pulp of the spleen
lymphatic nodules
vein
arteries


Hilus
Splenic artery
Splenic vein
(a)
Capsule
Trabecula
Splenic cords
Venous sinuses
Red pulp
White pulp
Central artery
Arterioles and capillaries
Splenic artery
Splenic vein

Thymus

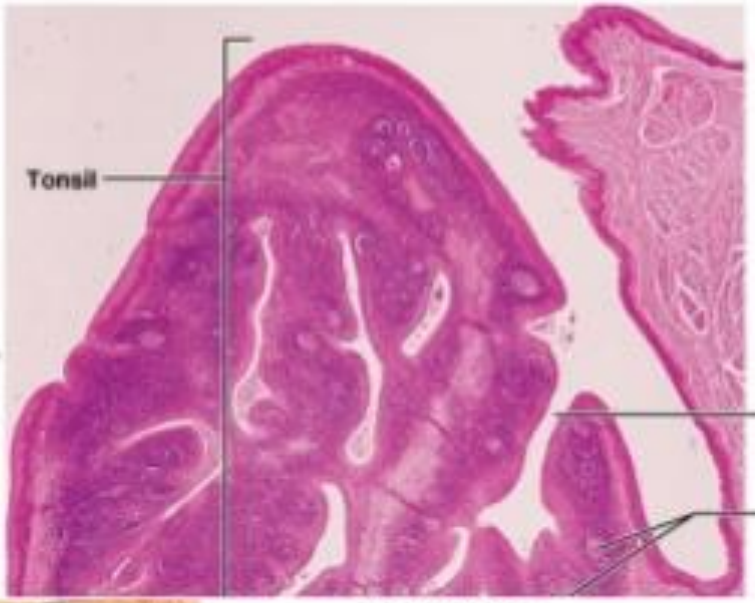
- Lies in the upper part of the medistinum behind the sternum & extends upwards into the root of the neck.
- Weighs about 10-15 g at birth and grows until the individual reaches puberty. 30-40g by middle age .
- Prominent in newborns, almost disappears by old age
- Function: T lymphocyte maturation (immunocompetence)
- Has no follicles because no B cells
- Structure:
  - Consists of two lobes joined by areolar tissue.
  - Lobes are enclosed by a fibrous capsule which dips into their substances, dividing them into lobules that consist of an irregular branching framework of epithelial cells and lymphocytes.


Larynx
Thyroid gland
Trachea
Thymus gland
Lung
Heart
Diaphragm
Liver
Stomach
Spleen

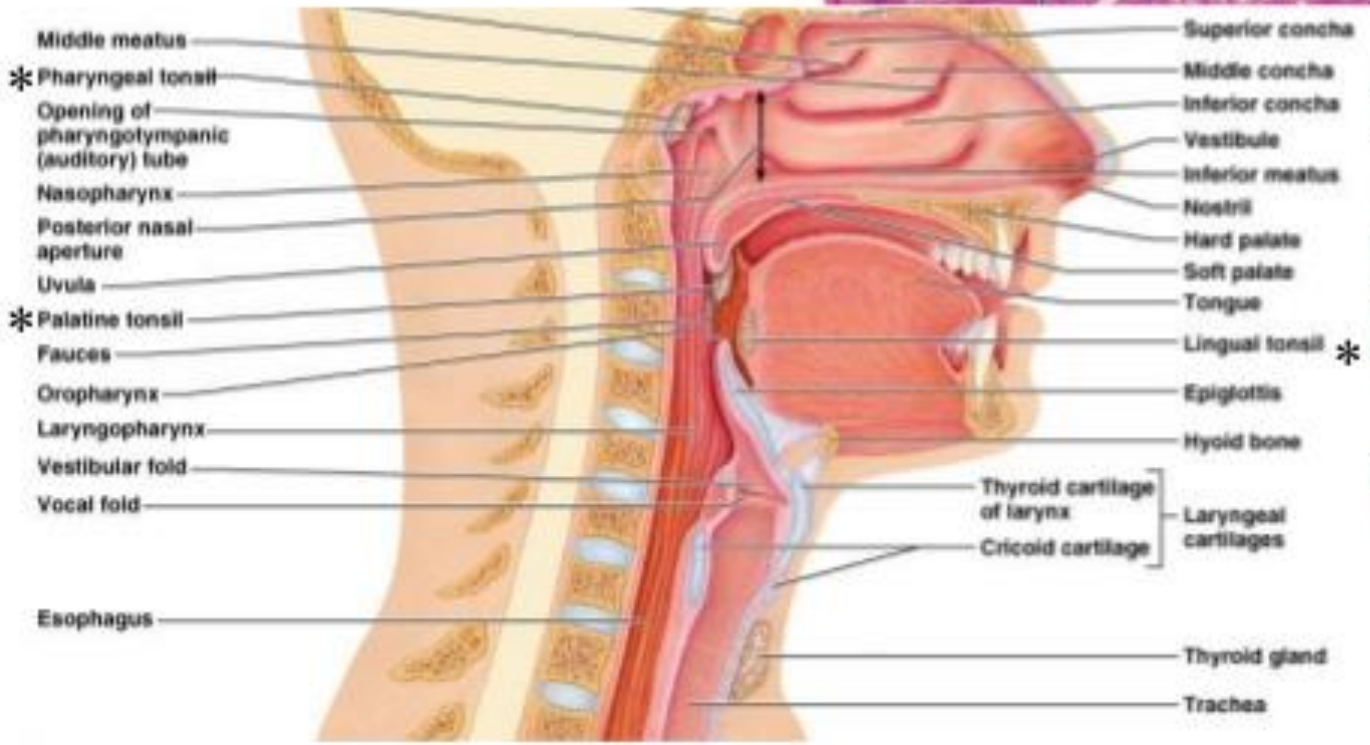

Thymic lobule
Cortex
Medulla
Thymic lobule
Thymic (Hassall's) corpuscle

Tonsils

Simplest lymphoid tissue: swellings of mucosa, form a circle



Crypts get infected in childhood



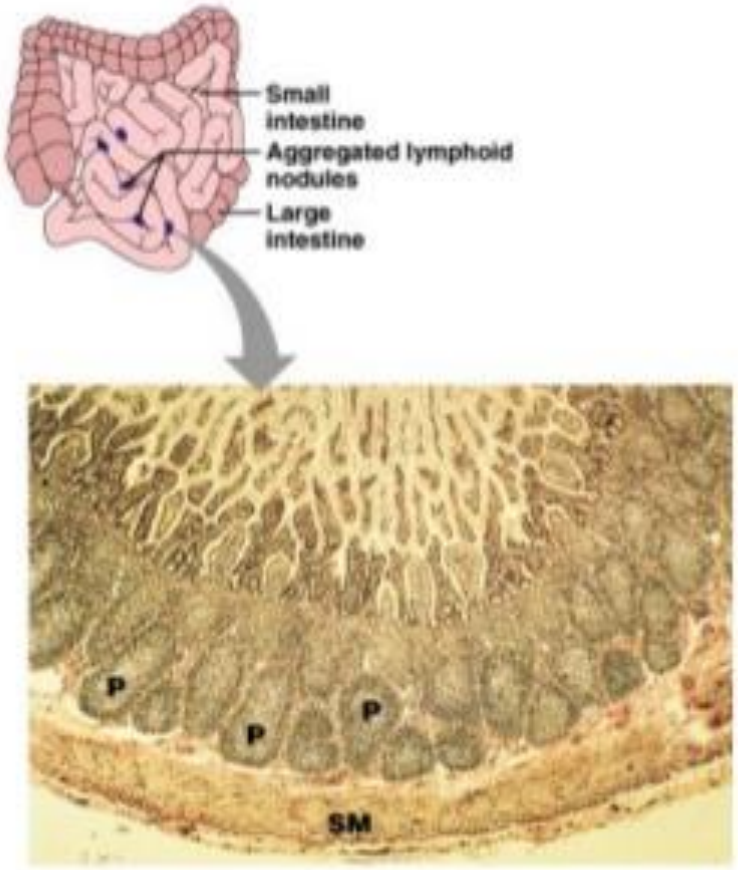
Palatine (usual tonsillitis)

Lingual (tongue)

Pharyngeal ("adenoids")

Tubal

Parts of the intestine are so densely packed with MALT (mucosa-associated lymphoid tissue) that they are considered lymphoid organs



- Aggregated lymphoid nodules ("Peyer's Patches")
  - About 40 follicles, 1 cm wide
  - Distal small intestine (ileum)
- Appendix

Hematopoiesis: overview

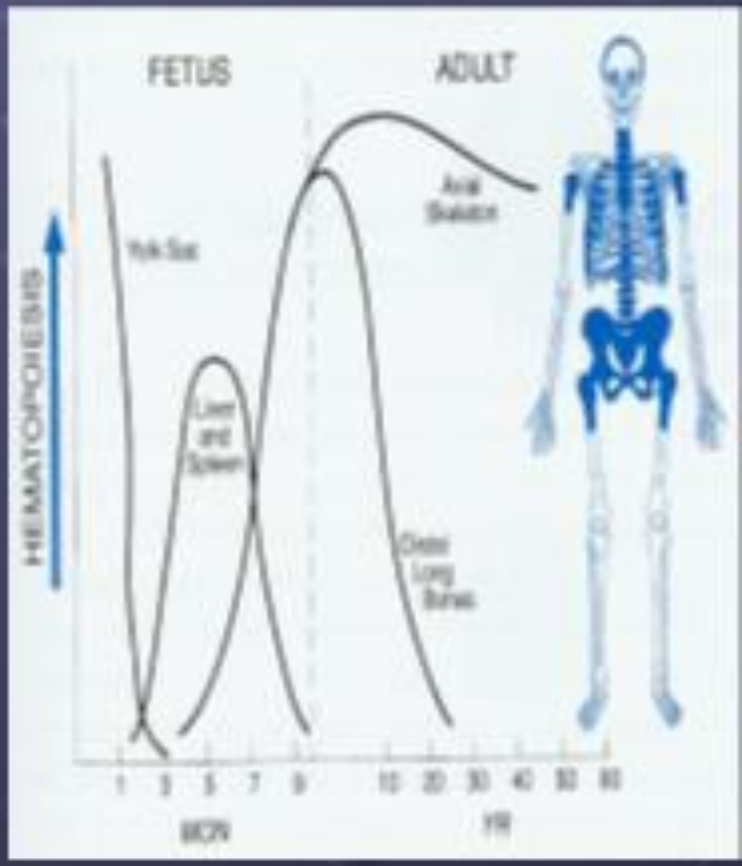
- Medullary
  - Origin of blood cells and sequential sites of normal blood production within the bone marrow
- Extramedullary
  - Blood cell production in hematopoietic tissue other than bone marrow
    - Liver
    - Spleen
  - Compensatory mechanism to provide blood cells in times of need

Hematopoiesis

- Primary sites of Production
  - Fetus
    - Yolk sac
    - Liver and spleen
    - Bone marrow (all bones)
  - Adult
    - Child up to teen years - all bones
    - 18 years and up - flat bones (sternum, ribs, pelvis, vertebra, skull)
    - Adults- bone marrow

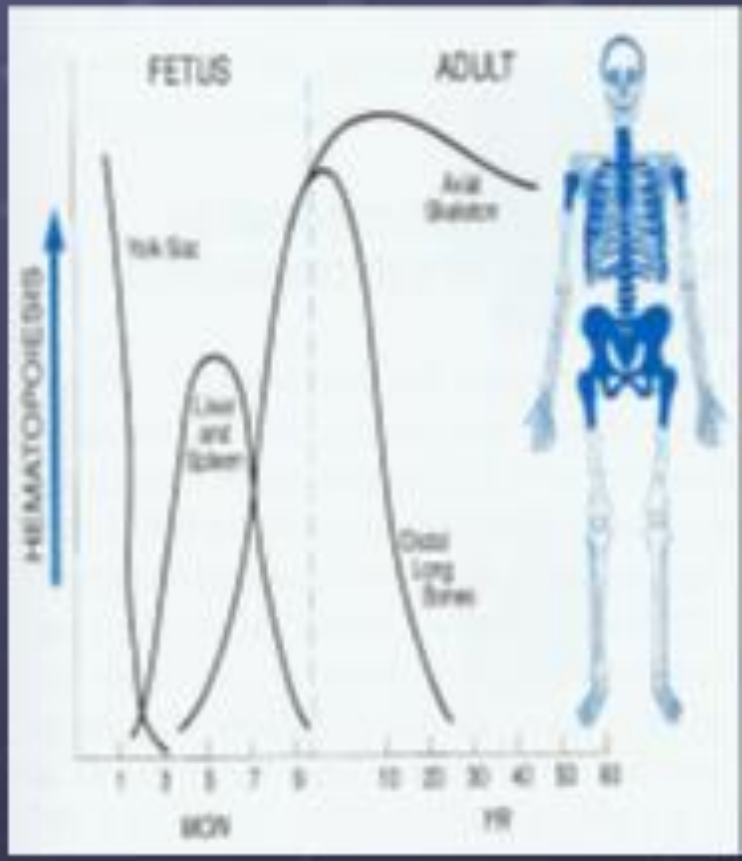
Ontogeny (origin) of Hematopoiesis

- Begins in mesoderm of **yolk sac forming erythroid cells.** Production continues until 2.5 fetal months
- Hemoglobin found in these embryonic cells consist of Gower 1, Gower 2 and Portland.
- **Fetal liver** now assumes responsibility for hematopoiesis during second month.



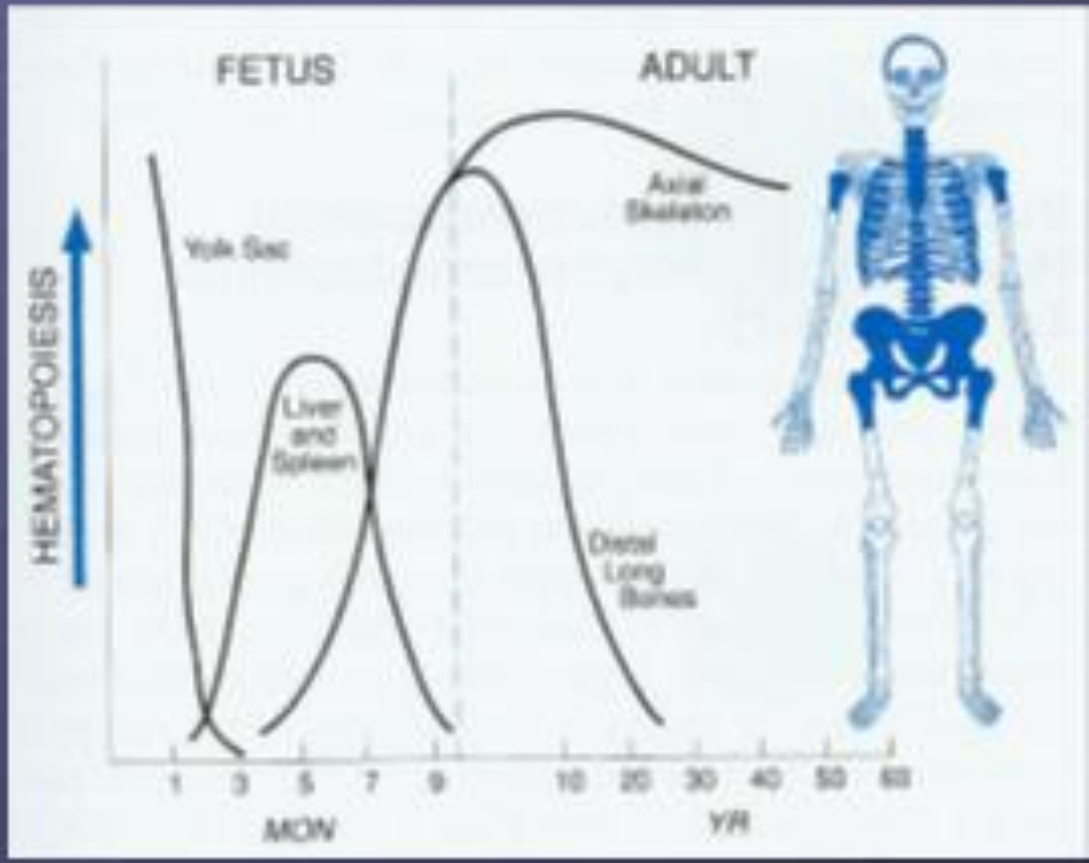
Ontogeny (origin) of Hematopoiesis

- From third to sixth month, hematopoiesis occurs in kidney, thymus, spleen and lymph nodes



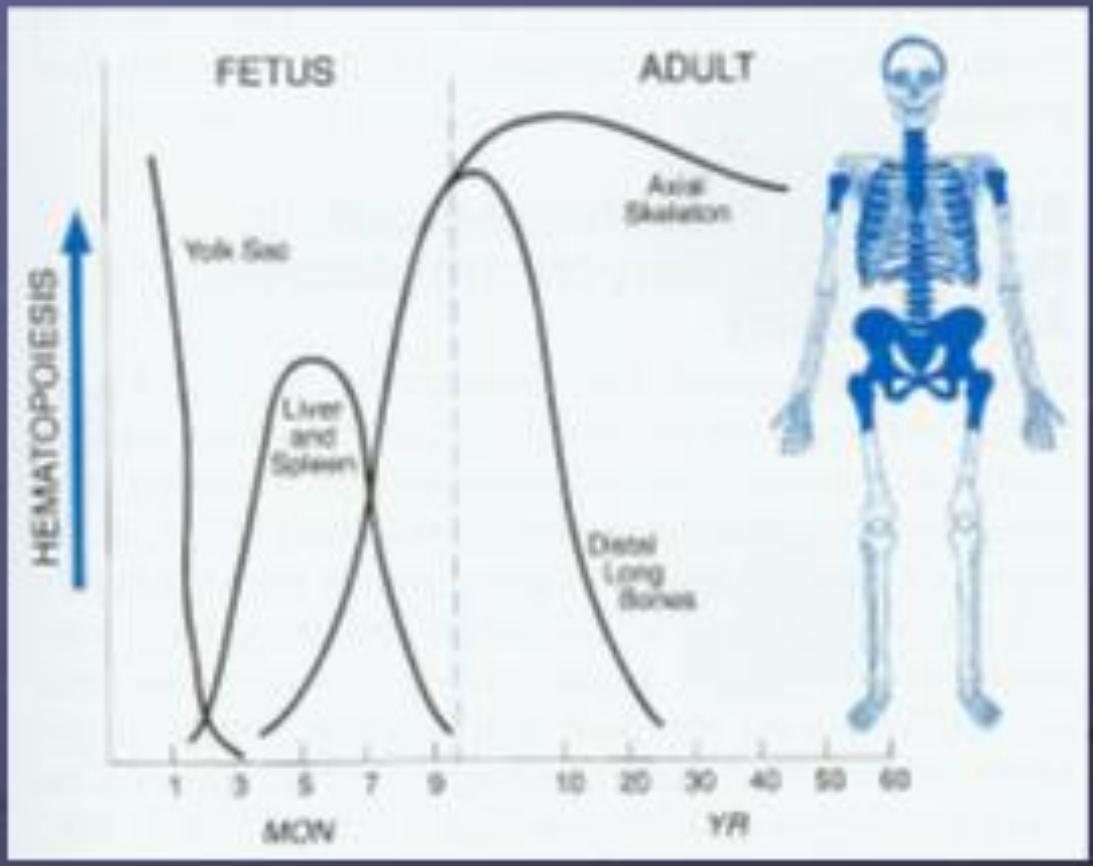
Ontogeny (origin) of Hematopoiesis

- Around fifth month of fetal life, hematopoiesis shifts to **bone marrow**
- Fetal marrow fills with RBCs



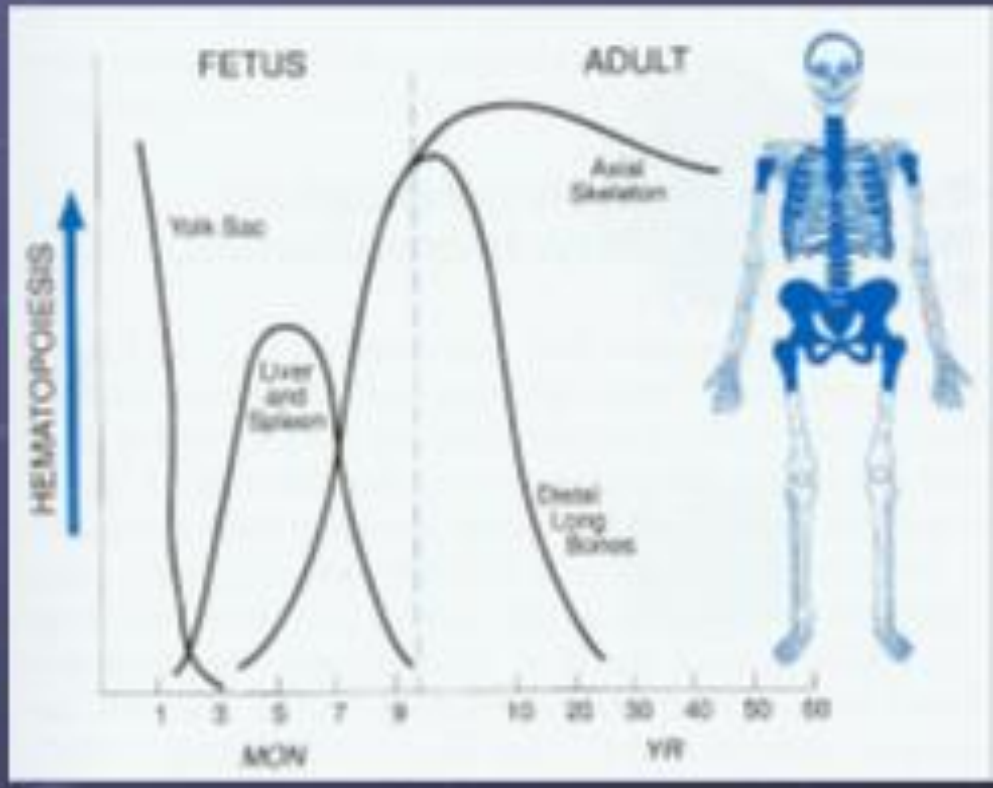
Ontogeny (origin) of Hematopoiesis

- At birth, liver and spleen stop hematopoietic activity.
- Bone marrow now becomes active site of hematopoiesis



Ontogeny (origin) of Hematopoiesis

- Children up to teen years, has hematopoiesis in all bones
- Hematopoiesis gradually decreases in shafts of long bones.
- Around age 18-20 hematopoiesis shifts to production in sternum, ribs, pelvis, vertebrae, and skull.
- After age 40, less area in these sites available for hematopoiesis.




Thanks