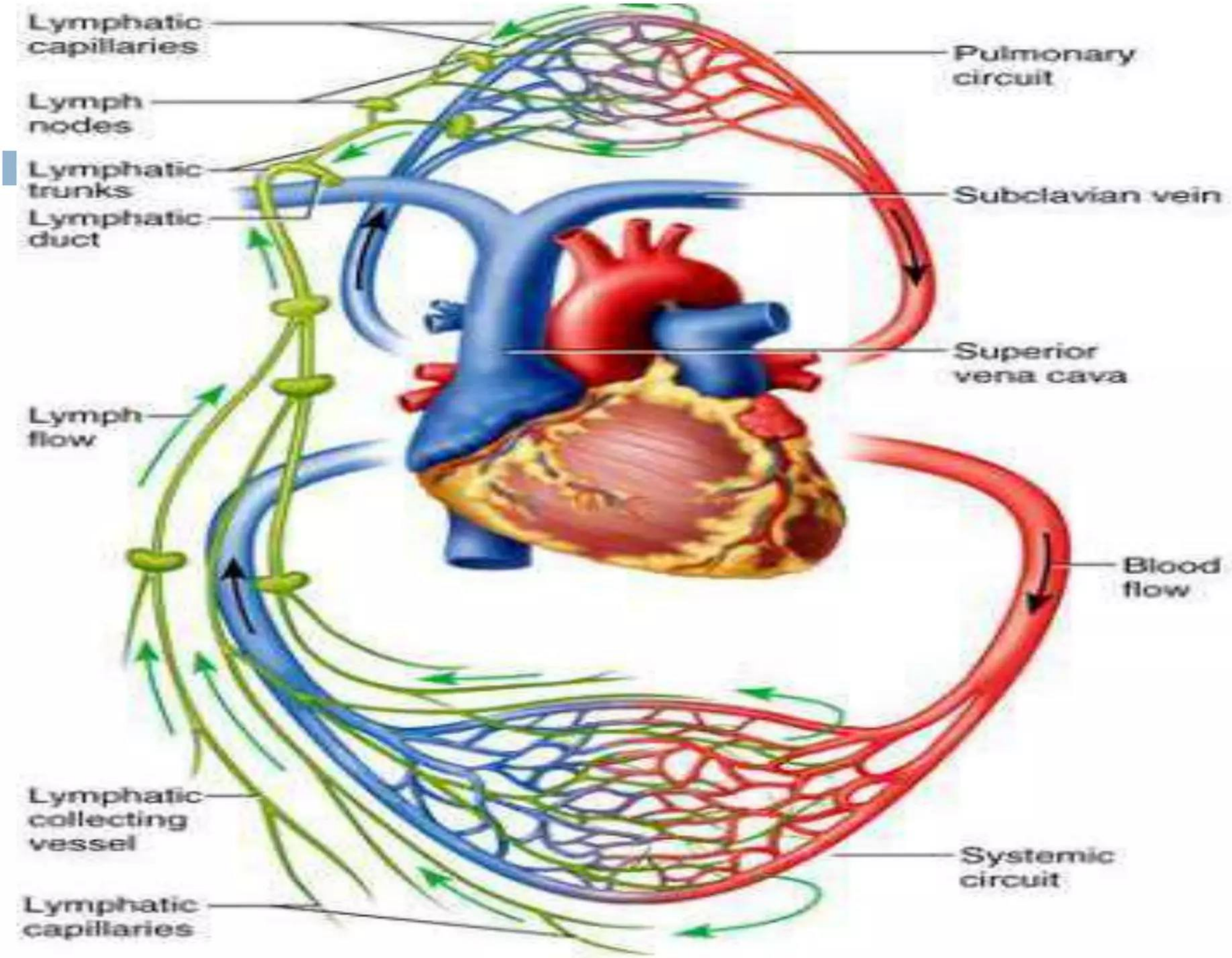
WHAT IS LYMPHATIC SYSTEM?

- The **lymphatic system is part of** the circulatory system and an important part of the immune system, comprising a network of lymphatic vessels that carry a clear fluid called lymph (fromLatin, ***lympha meaning***"water")directionally towards the heart.


Lymphatic capillaries
Lymph nodes
Lymphatic trunks
Lymphatic duct
Lymph flow
Pulmonary circuit
Subclavian vein
Superior vena cava
Blood flow
Systemic circuit
Lymphatic collecting vessel
Lymphatic capillaries

Functions of lymphatic system

- Fluid balance
  - Net fluid loss from capillaries into interstitial fluid
  - Lymph system returns excess fluid from tissues to the circulation
- Protection
  - Lymph passes through lymph nodes, containing many immune cells
  - Lymphatic system protects against pathogens and often destroys traveling cancerous cells
- Fat absorption
  - Dietary fat from the digestive system is absorbed into lymphatic capillaries

Components of Lymphatic System

1. Lymph
2. lymph capillaries
3. Lymphatic vessels
4. Lymphoid organs
   a) Lymph nodes
   b) spleen
   c) Thymus
5. Epithelio- Lymphoid system
6. Bone marrow

lymph

- The tissue fluid that enters the lymph capillaries.

Lymph composition

- The composition of lymph is **similar to** that of **plasma but the constituents have** some additional substances that are too large to pass through blood capillary walls.

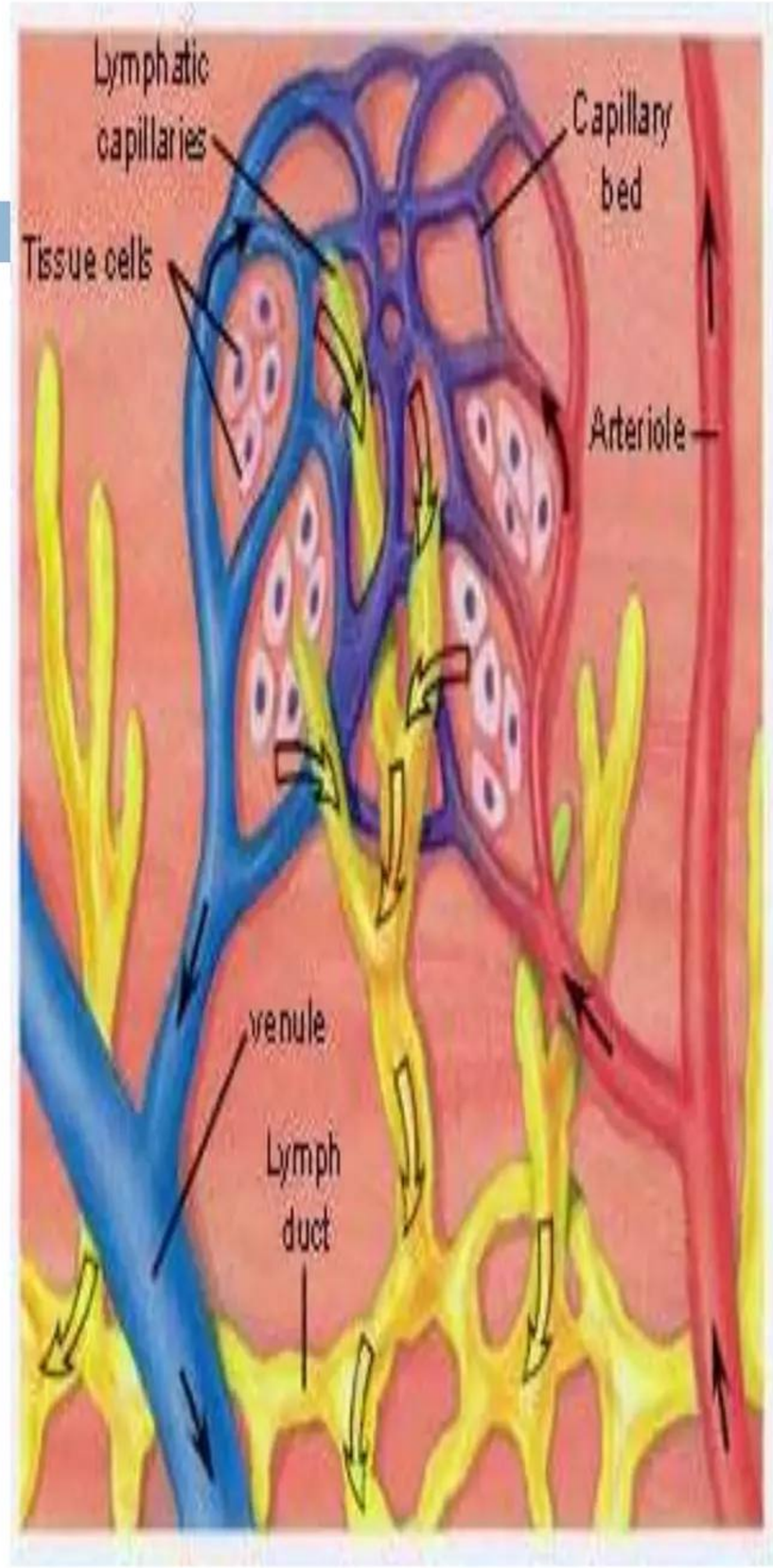
The lymph transport plasma protein that seeps out of capillary beds back to blood stream

- It also carries away larger particles eg. bacteria cell debris which is then filterd out and destroyed by lymph nodes.
- Thus the lymph contains:
- Lymphocytes
- Macromolecules of protein
- Fat droplets
- Particulate matter

Lymph Fluid

Lymph is formed when high arterial pressure forces fluid out of the capillaries and into the tissue.

***About 30lt of fluid passes from arterial end of capillaries into intercellular space every day. Out of this ,about 27lt of fluid consisting of micromolecules are absorbed back by venous end of the capillaries.the remaining 3lt of fluid consisting of macromolecules is absorbed by lymph capillaries.**



Lymph Capillaries

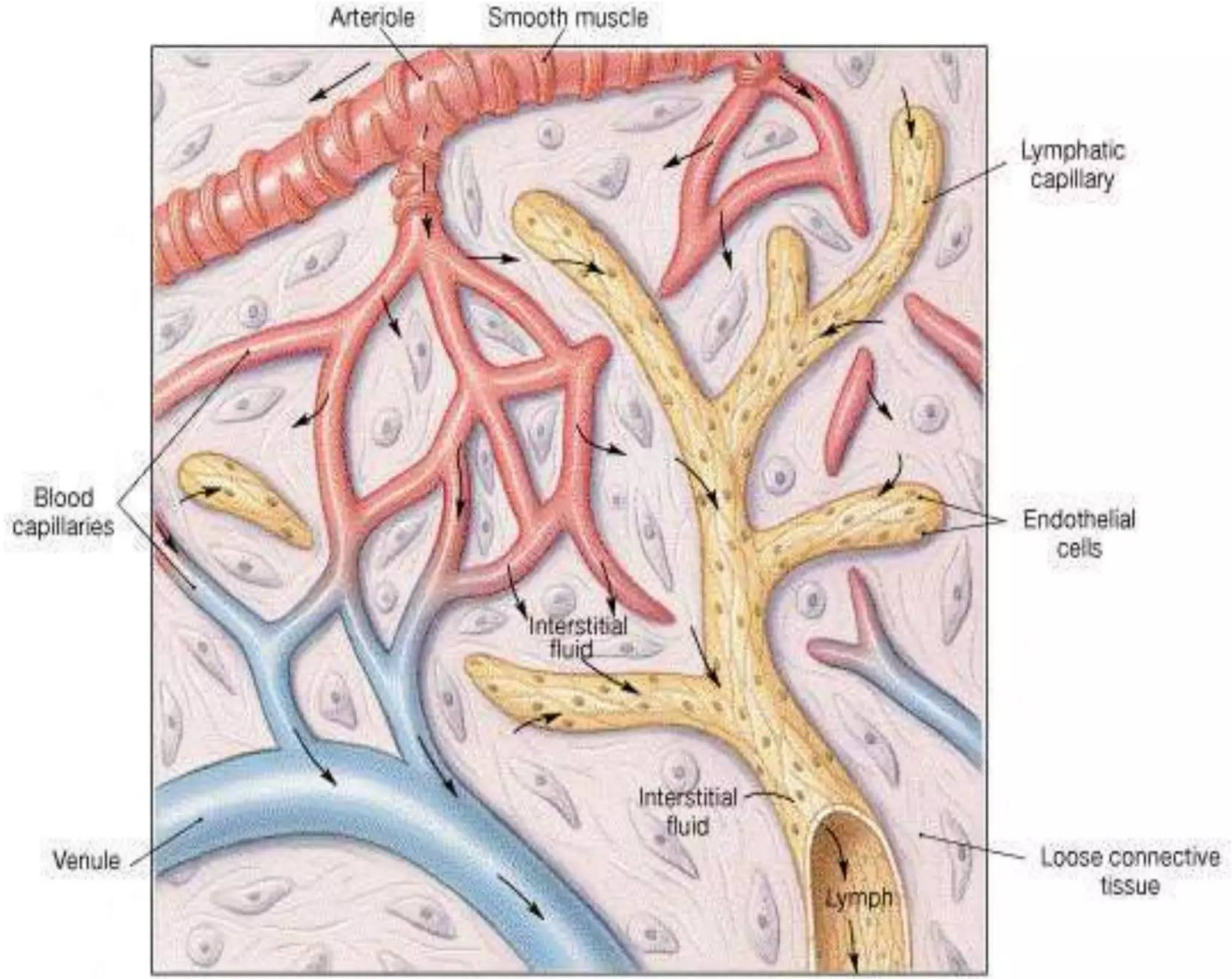
- Microscopic blind-ended lymph vessels which begin in the intercellular spaces.
- They form vast network in intercellular spaces of most of the tissues of the body.
- The wall of lymph capillaries are made of single layer of endothelial cells.

- The lymph capillaries are different from blood capillaries in following respect:

1. Begin blindly in intercellular spaces
2. Have bigger lumen which is less regular
3. Are permeable to bigger molecules .

- The sites where lymph capillaries are absent

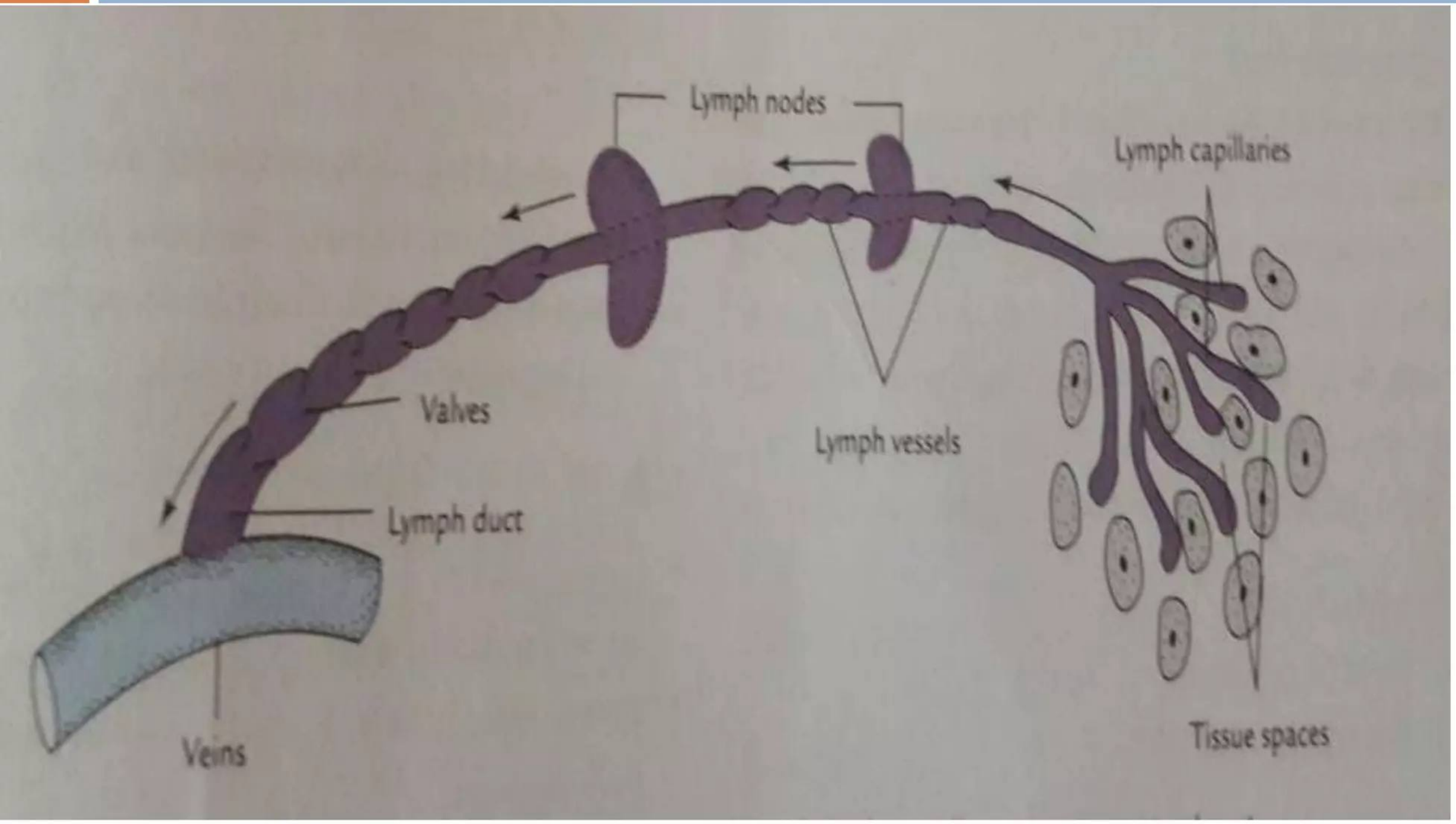
1. Epidermis
2. Hair
3. Nails
4. Cornea
5. Articular cartilage
6. Brain and spinal cord
7. splenic pulp



(a) Association of blood capillaries, tissue, and lymphatic capillaries

LYMPH VESSELS

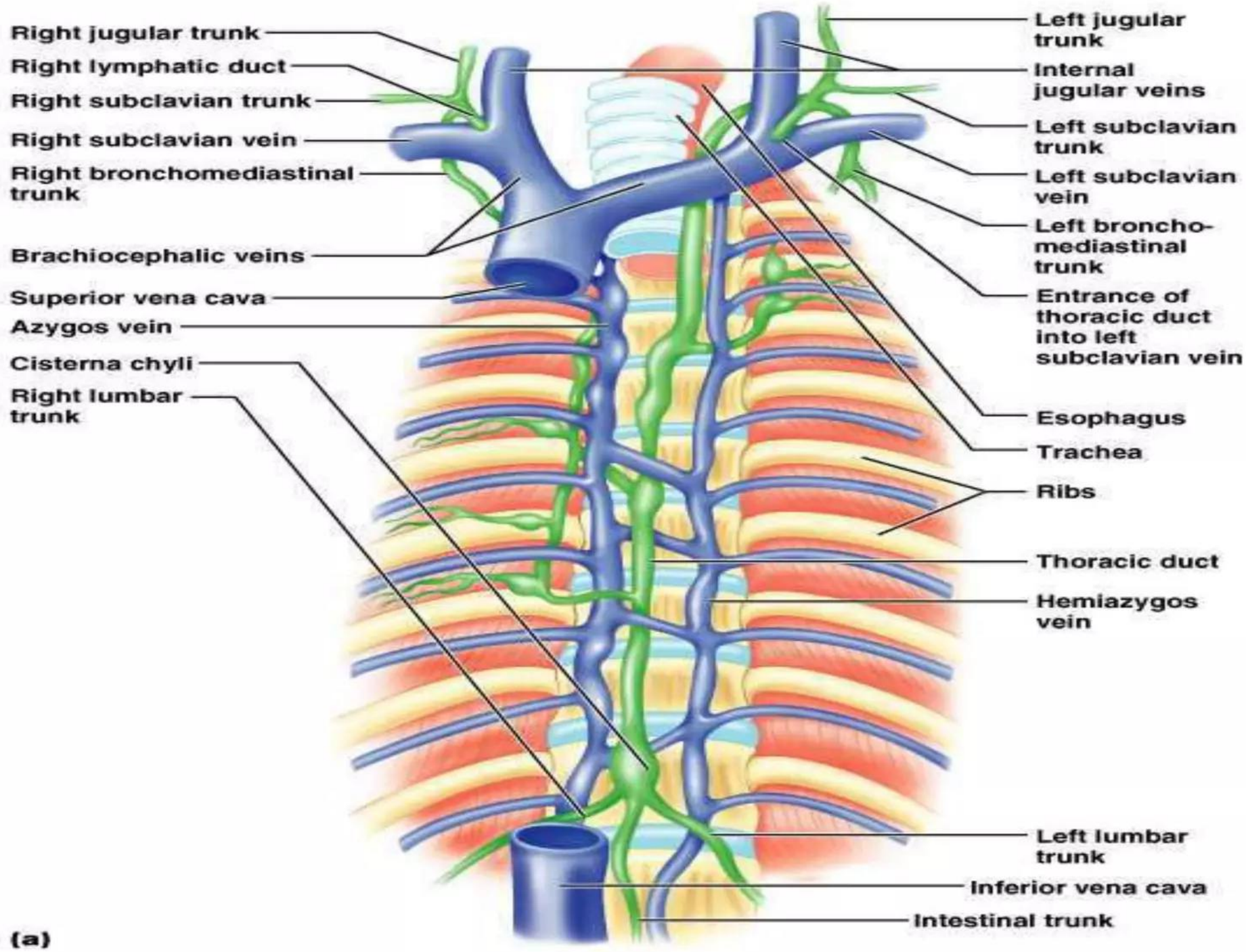
- Lymph capillaries unite to form lymphatic vessels.
- Thin walled vessels.
- Beaded appearance.
- Flow of lymph in lymphatic vessel is unidirectional.
- The lymphatic vessels pass through a series of l.node before lymph is drained into venous system.


Lymph nodes
Lymph capillaries
Valves
Lymph vessels
Lymph duct
Veins
Tissue spaces

Clinical correlation

- Lymphangitis
- Elephantiasis

Lymphatic ducts



Thoracic duct

- **What is duct?**

A **duct is a circumscribed channel leading from** an organ.

- **Length-45cm**
- Ascends through the diaphragm and passes upwards in the thoracic cavity.

It drains Lymph from

- Lower extremites
- abdomen
- Left Thoracic region
- Left side ofHead & Neck
- Left upper Limbs.

THE RIGHT LYMPHATIC DUCT

- IT LIES IN THE ROOT OF THE NECK AND OPEN

INTO RIGHT SUBCLAVIAN VEIN.

- **IT DRAINS LYMPH FROM**

1. RIGHT THORACIC REGION
2. RIGHT SIDE OF HEAD AND NECK
3. RIGHT UPPER LIMB

Structure of lymphatic duct

- Like wall of veins , the wall of lymphatic ducts have same three layers, ie tunica adventitia, tunica media and tunica intima.
- Lumen of LD.contains valves which are numerous and closely packed than veins.
- The lumen of vessel proximal to the valve is expanded into a sinus.
- The valves are so closely paced that l.vessels when filled with lymph has a beaded appearance.

Superficial and deep lymph vessels

- According to location lymph vessels are divided into two types:-

1. Superficial lymph vessels
2. Deep lymph vessels

Drainage of lymph

- Contraction of smooth m/s in the wall of the lymph vessel
- Pulsation of arteries near the lymph vessels.
- Massaging action from contraction of surrounding muscles.
- Respiratory movements
- Negative pressure in brachiocephalic vein
- Valves within lumen of lymph vessels.

Lymphoid Organs

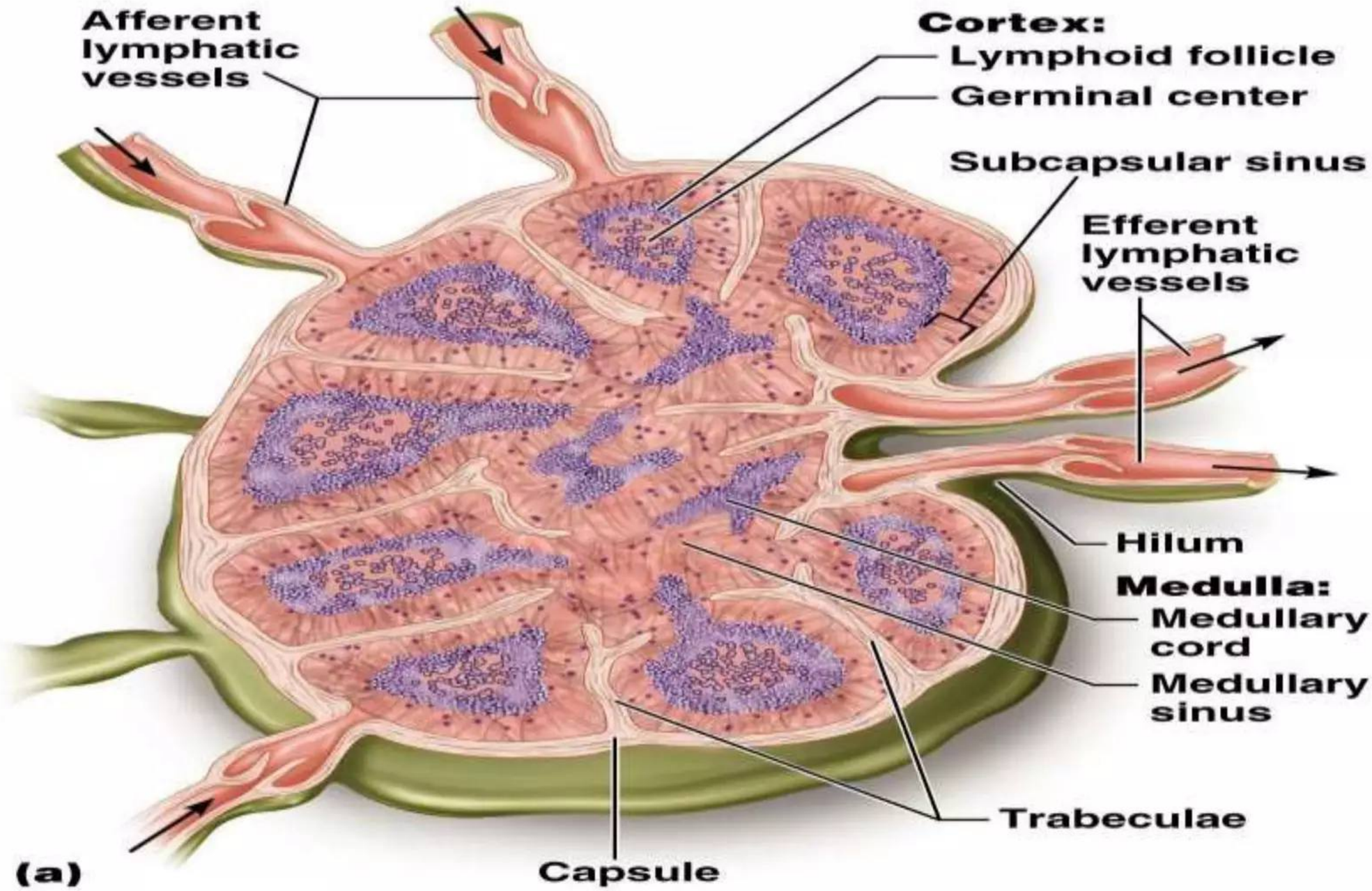
- Lymphoid organs are made up of lymphatic tissues.
- The lymphatic tissue is a specialized connective tissue and consist of:

1. Framework of reticular fibers and reticular cells
2. Lymphocytes and related plasma cells and macrophages .

- The lymphoid organs are classified into following two types:
- Primary L.O.- which are involved in the production of lymphocytes.
- secondaryL.O.-which are involved in activation of lymphocytes and initiation of an immune response.

LYMPH NODES

- Lymph nodes are bean shaped organs along with course of lymph vessels
- Up to 1 inch in size
- Lymph passes through a number of lymph nodes before reaching the large lymphatic duct.
- These nodes are considerably in size: some are as small as a pin head & the largest are about the size of an almond.
- They are pink in living body and brownish in cadaver.



Lymph node contd..

- **Structure**

l.Node are oval in shape

They present a slight depression on side k/a **HILUM**.

Each lymph node consists of fibrous capsule and gland substance

- Below the capsule is sub capsular substance.
- The gland sustance is divided into

1. The **outer portion is called cortex.**
2. The **inner portion is called medulla.**

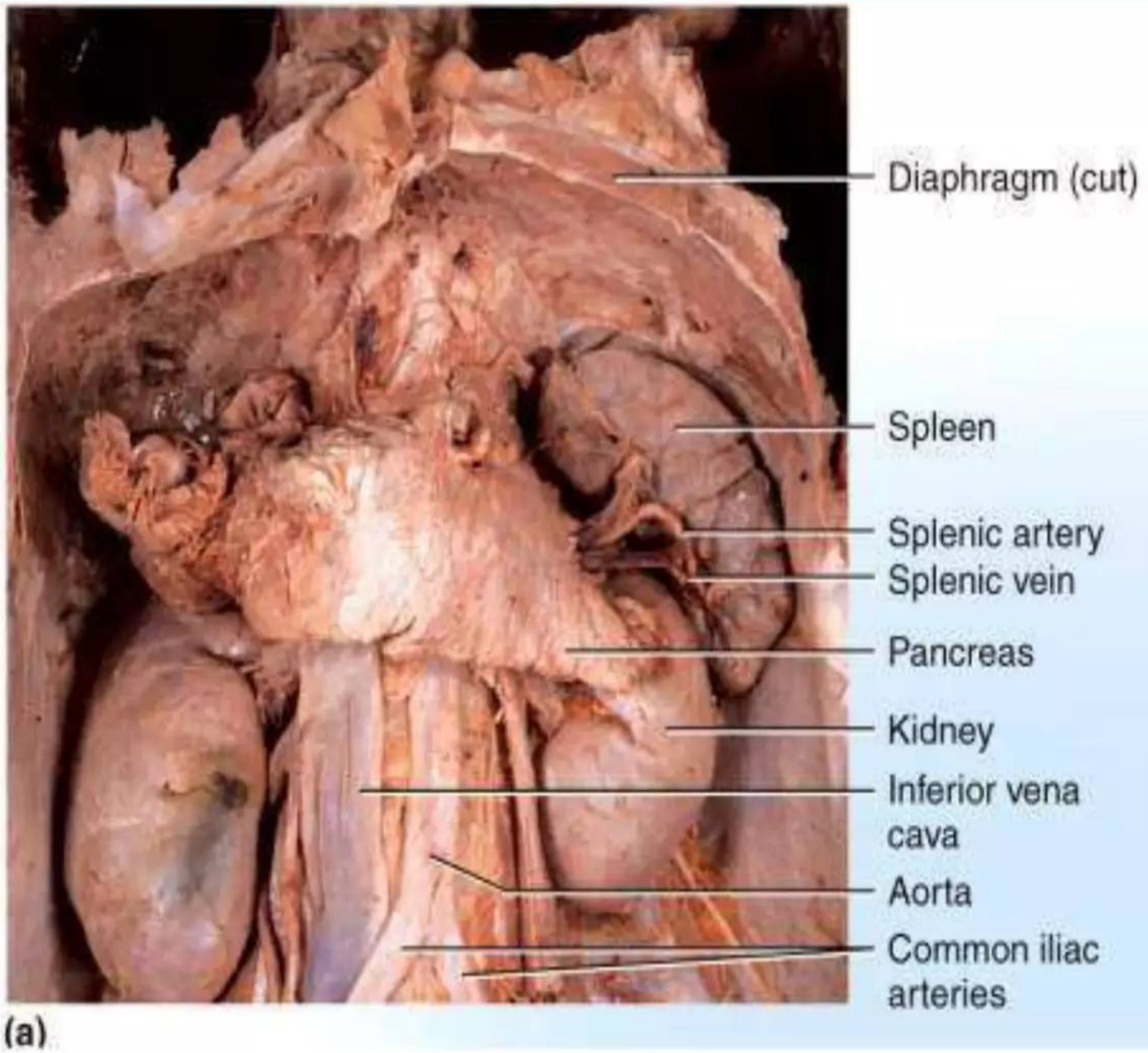
Lymph node contd..

Functions

1. Filtration of lymph
2. Evoke immunological response(the plasma cells of lymph node produce anti bodies in response to action)
3. Produce lymphocytes(the germinal center of lymphatic nodules within the node are site of lymphocyte production)
4. provide portal of entry of lymphocytes into lymphatic channels.

SPLEEN

This is the largest lymphoid organ,posterior to the stomach



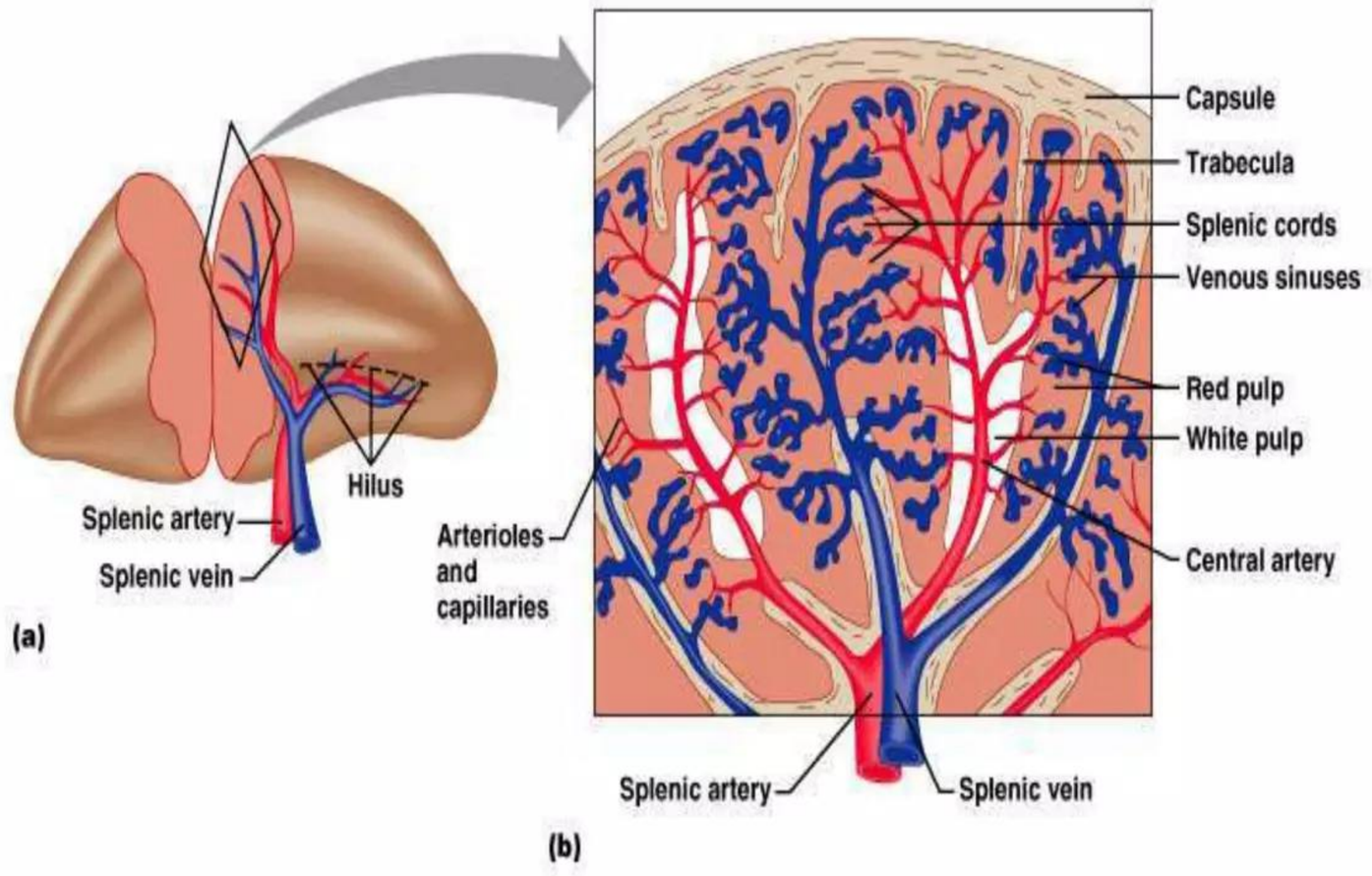
(a)

SPLEEN STRUCTURE

- (spleen is about the size of a fist).
- a. Capsule
- b. Trabeculae
- c. Red pulp
- d. White pulp

WHITE PULP:
(made of masses of lymphocytes)

RED PULP:
(made of sinuosoid capillaries)

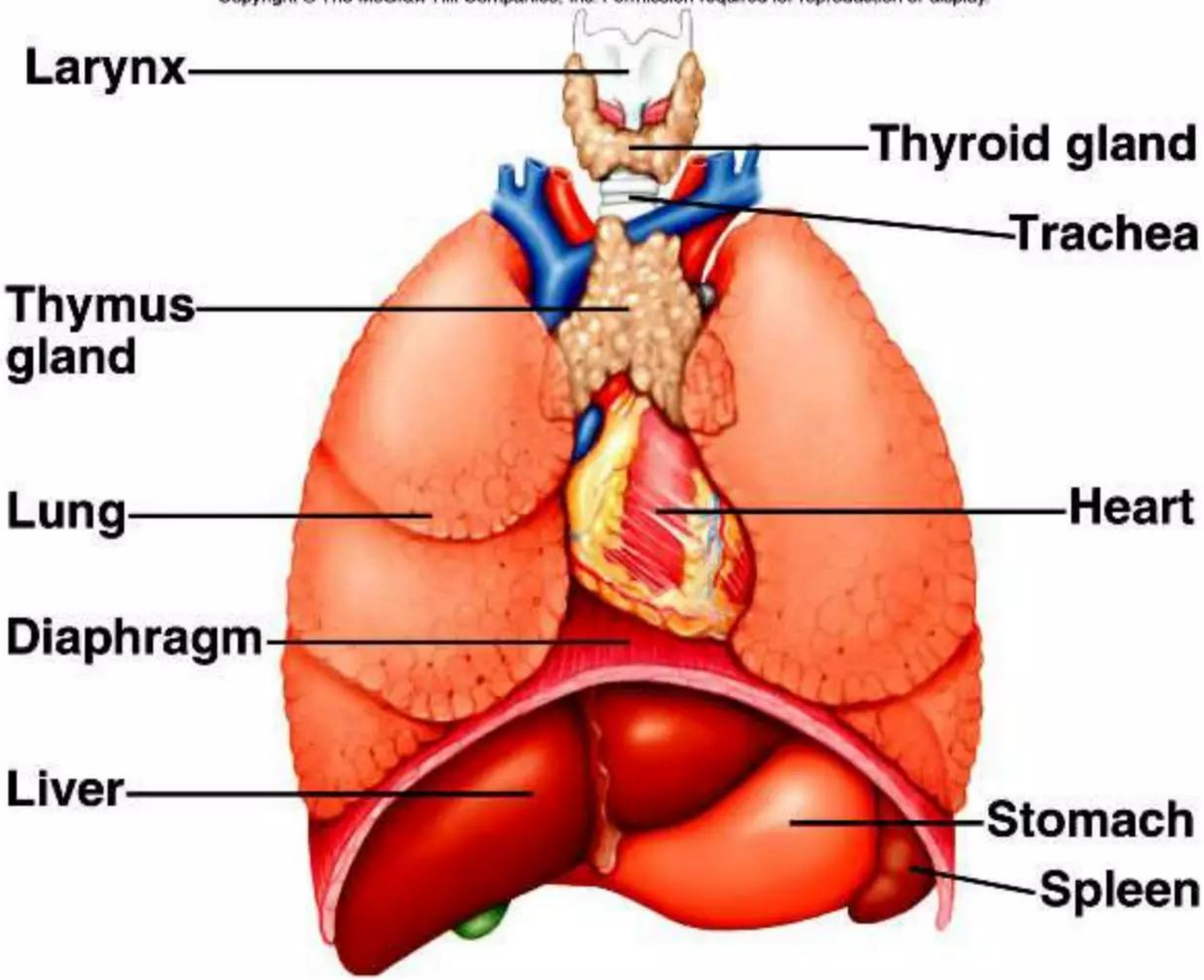


functions

- Filters the blood from antigens and microorganism
- Evokes immunological response against the antigens circulating in blood
- Produces B and T lymphocytes.
- Remove old and abnormal rbc’s
- Removes bacteria by phagocytosis
- Stores blood
- Forms blood cell during fetal life

Thymus

- Lies in the upper part of the mediastinum behind the sternum &extends upwards into the root of the neck.
- The thymus is devoid of lymph capillaries and lymphoid nodules.
- Weighs about 10-15 g at birth and 20- 30 gms at puberty. Then it regress and converted into fibro fatty tissue.



Function

- The thymus is the site of production of t lymphocytes
- It recieves immunologically incompetent stem cells from bone marrow.
- In the thymus these cells divide and mature into T-lymphocytes.
- T lymphocyes are important for both cellular and humoral immunological responses.
- Thymus secrete hormone k/a thymosin which support the activity of T-lymphocytes throughout the body

Epithelio-lymphoid system

- Epithelio- lymphoid system comprises mucosa associated lymphoid tissue(MALT)
- The large amount of unencapsulated lymphatic tissue exist in walls of alimentary, respiratory and genitourinary tracts. It is collectively termed as mucosa associated lymphoid tissue(MALT)

- The MALT tissue is generally subdivided into the following two types:

1. bronchus associated lymphoid tissue(BALT) in respiratory system.
2. Gut assosiated lymphoid tissue(GALT)

- The collections or aggregations of mucosa – associated lymphoid tissue are as follows:

1. Pharyngeal tonsil
2. Tubal tonsil
3. Palatine tonsil
4. Lingual tonsil
5. Peyer’s patches
6. Abdominal tonsil

BONE MARROW

- The **Red Bone Marrow is a key element of** the lymphatic system
- Being one of the primary lymphoid organs that generate lymphocytes from immature hematopoietic progenitor cells
- The bone marrow and Thymus constitute the primary lymphoid tissues involved in the production and early selection of lymphocytes

Clinical anatomy

- Lymphadenoma
- Lymphangitis
- Elephentasis
- Spread of cancer
- Lymphadenitis(acute infection of lymph nodes)
- splenomegaly