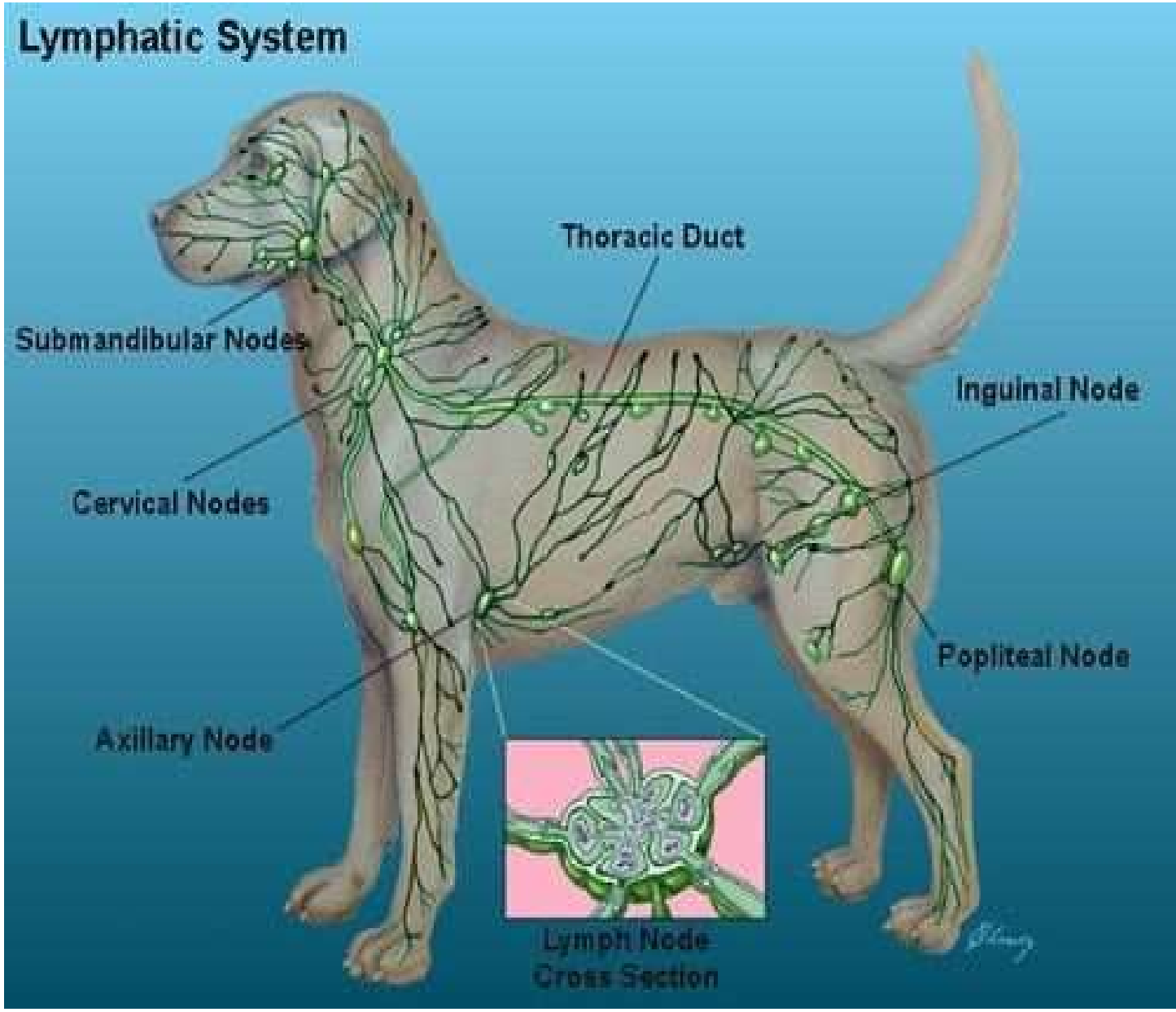
Lymphatic system

The lymphatic system, or lymphoid system, is an organ system in vertebrates that is part of the immune system and complementary to the circulatory system.

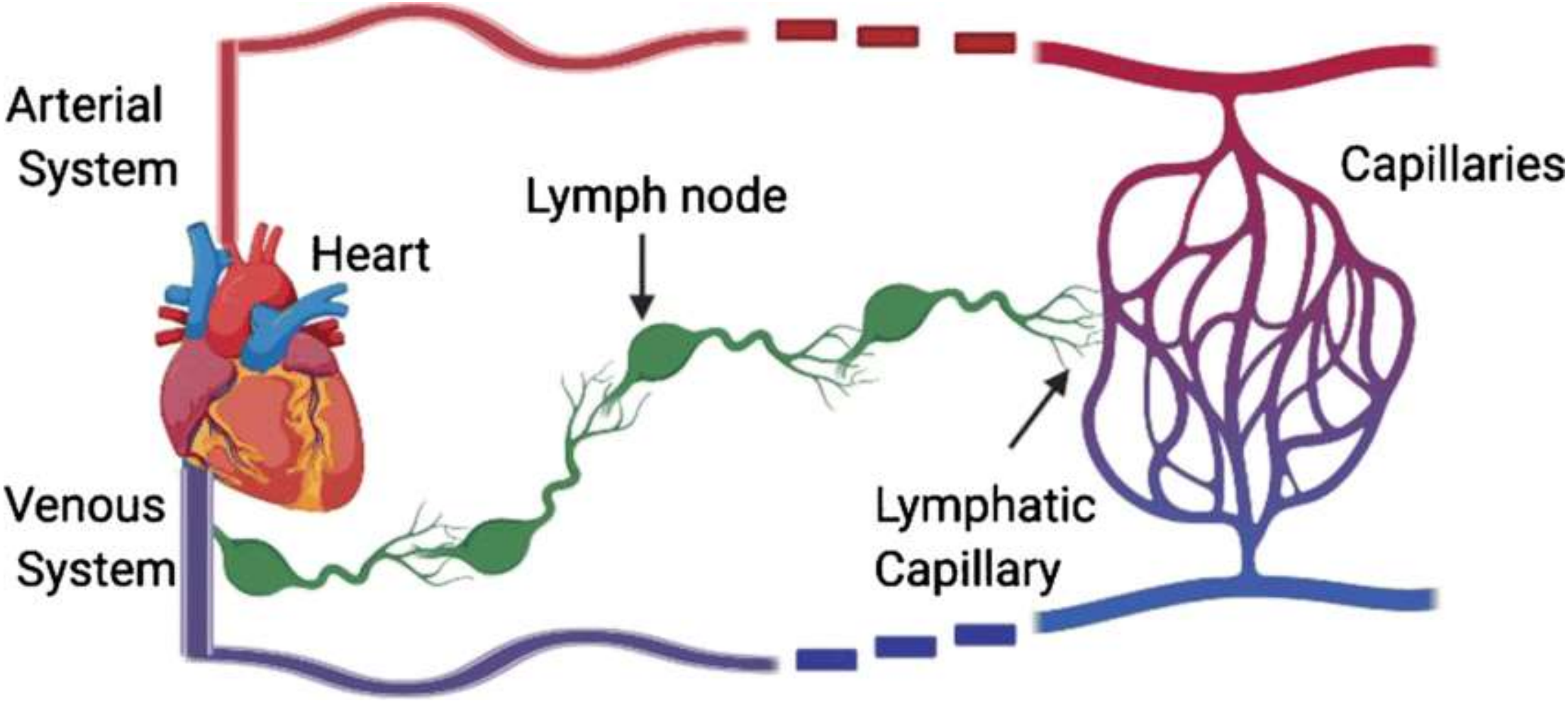


- **The body tissue washed in tissue fluid. Some fluids returned by blood vessels, however, the remain parts returned by lymphatic system(the fluid in case called Lymph).**

- **The lymphatic system is connected to the circulatory system. It consists of capillaries, vessels, ducts, and nodes. This system transports lymph one-way…back to the bloodstream.**

- **Lymphatic system and circulatory system both carry fluid from body but the difference is that the lymphatic system does not have a closed circuit and a pumping organ like heart.**

- **The lymph moves via skeletal muscle action, respiratory movement, and contraction of smooth muscle in vessel walls.**


Arterial System
Heart
Lymph node
Capillaries
Venous System
Lymphatic Capillary

The lymphatic system has primary functions:

- Transports proteins and fluids, lost by capillary seepage, back to the bloodstream.

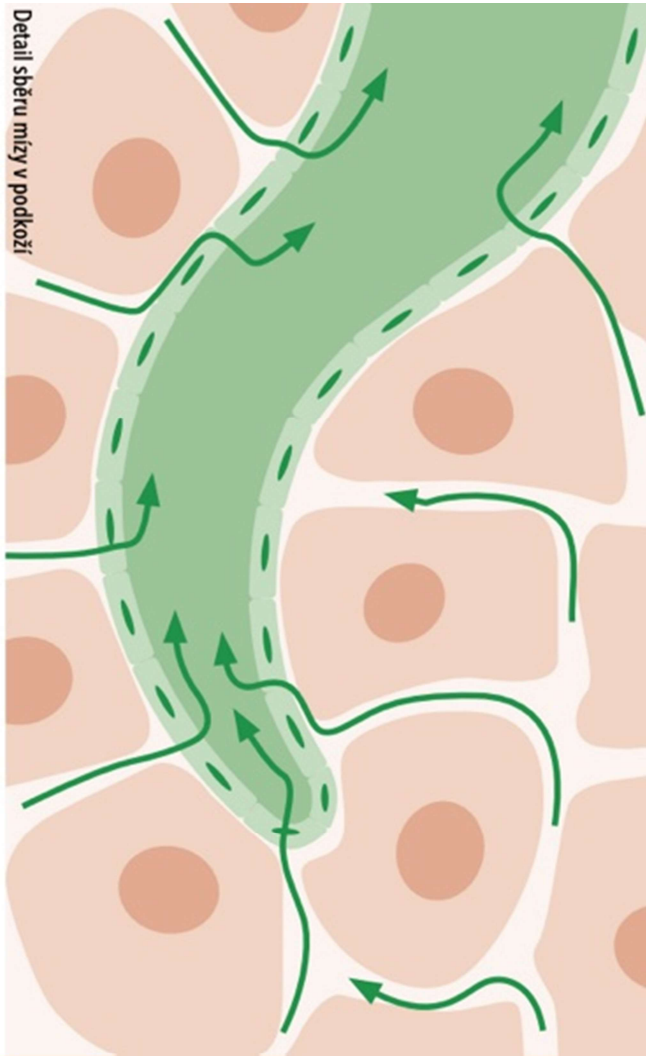
- Participates in the body's immune response and kill the microorganism.

- Is the pathway for the absorption of fats from the small intestine into the bloodstream.
- Removed debris from cells of the body.

Lymphatic system terminology

Lymph: **is the clear, nearly colorless, alkaline fluid (95% water) that occupies the space between all cells of the body, and it is similar to blood plasma (Lymph is mostly fluid from blood plasma). Lymph seeps through lymphatic capillaries.**

lymphatic capillaries are tiny, thin-walled micro-vessels located in the spaces between cells (except in the central nervous system) which serve to drain and process extracellular fluid. Upon entering the lumen of a lymphatic capillary, the collected fluid is known as lymph. Each lymphatic capillary carries lymph into a lymphatic vessel.

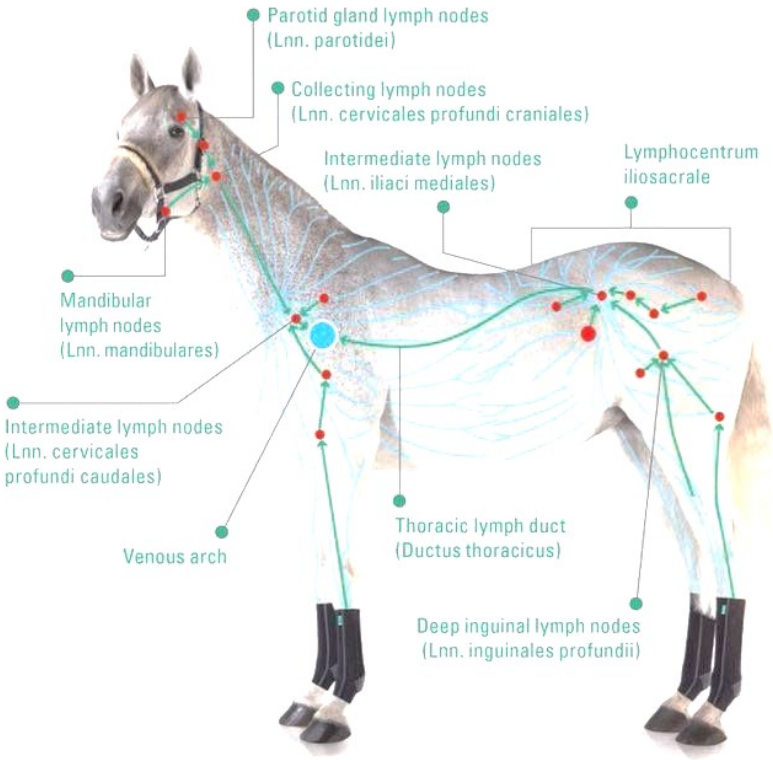


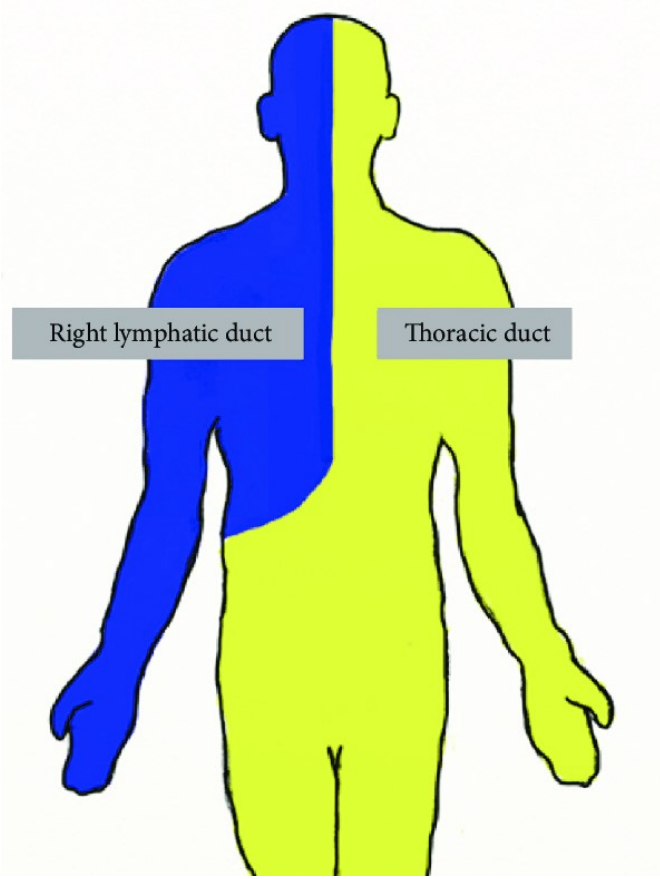
lymphatic vessels: are thin-walled vessels (tubes) structured, like blood vessels, that carry lymph. Lymph vessels have a thin layer of smooth muscles assisting in carrying lymph.

Lymph vessels that carry lymph to a lymph node are called afferent lymph vessels, and those that carry it from a lymph node are called efferent lymph vessels, from where the lymph may travel to another lymph node, may be returned to a vein, or may travel to a larger lymph duct.

A lymph duct is a great lymphatic vessel that empties lymph into one of the subclavian veins. There are two lymph ducts in the body—the right lymphatic duct (right thoracic duct) and the thoracic duct (left thoracic duct).

The left thoracic lymph duct: Collects the lymph from left side of the body and region of the right side of the body below the thorax, while the right thoracic lymph duct collects the lymph from the upper right side of the body (right arm, right region of thorax, head, and neck)





Lymph trunk is a collection of lymph vessels that carries lymph, and is formed by confluence of many efferent lymph vessels.

There are ***four pairs*** and an ***unpaired*** lymph trunks:

1. *Jugular lymph trunks*
2. *Subclavian lymph trunks*
3. *Bronchomediastinal lymph trunks*
4. *Lumbar lymph trunks*
5. *Intestinal lymph trunk—unpaired.*

lymphocyte is one of the subtypes of white blood cell in a vertebrate's immune system. Lymphocytes include natural killer cells , T cells , and B cells . They are the main type of cell found in lymph, which prompted the name "lymphocyte".

Distribution of Lymphatic Nodes

1- Head region

A- Mandibular LN Drains intermandibular space, lips & salivary glands

B- Parotid LN Drains dorsal structures of the head

C- Retropharyngeal LN (Lateral, medial) Drain deep head structures

D- Hyoid LN (Rostral, Caudal)

2- Neck region

A/ Superficial cervical lymph nodes Drains the superficial structure of neck and proximal forelimb

B/ Deep cervical lymph nodes Along the trachea, drains the deeper neck structures

C/- Middle cervical LN.

D- Sub rhomboid LN.

3- Thoracic Lymph nodes

A/ Dorsal center Drains the back and the deeper structures of the dorsal thoracic wall, drain to the thoracic duct

B/ Ventral center Cranial sternal center, drain deeper structures of the ventral body wall

C- Thoracic aortic LN

D- Intercostal LN

E- xiphoid LN

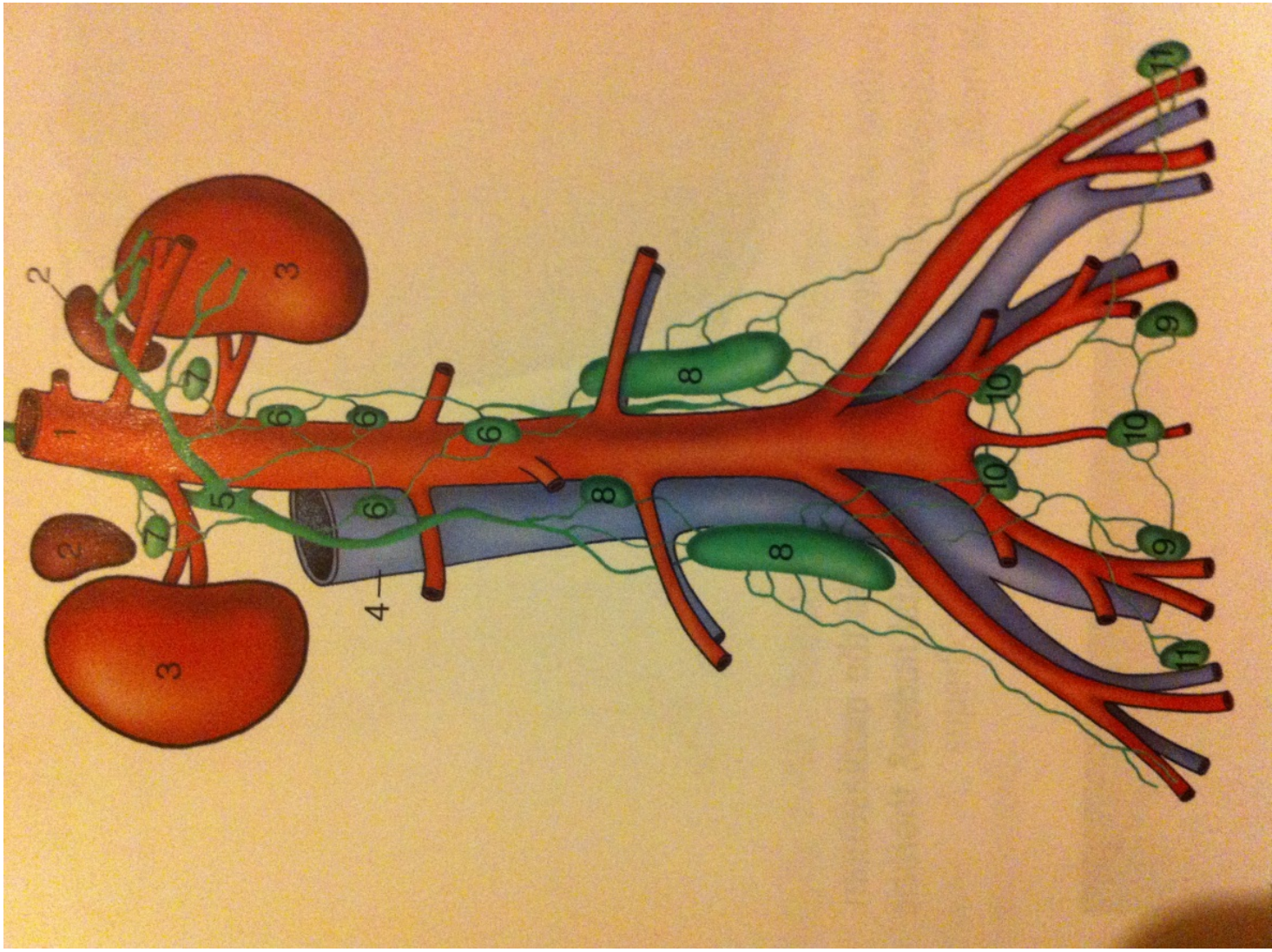
F- Mediastinal LN (cranial, middle, caudal)

G- Bronchial LN (left, right)

H- Pulmonary LN

4- Abdominal & pelvic regions

A- Lumbar LN
B- Renal LN
C- Ovarian LN
D- Iliosacral LN
E- Inguino femoral LN
F- Coxal LN
G- Ischiatic LN
H- Gluteal LN
I- Tuberal LN
J- Anorectal LN

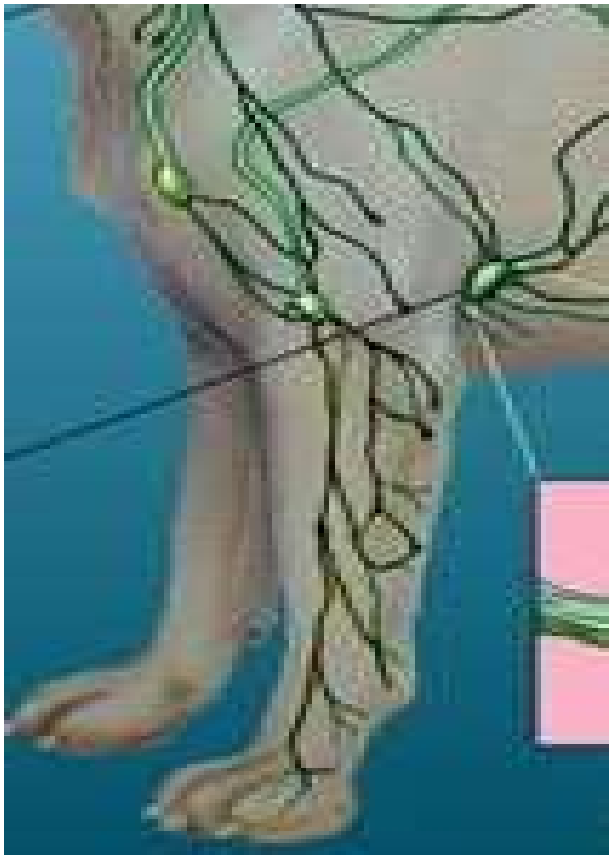


5- Thoracic Limb

A- Axillary LN

B- Accessory axillary LN

C- Infraspinous LN

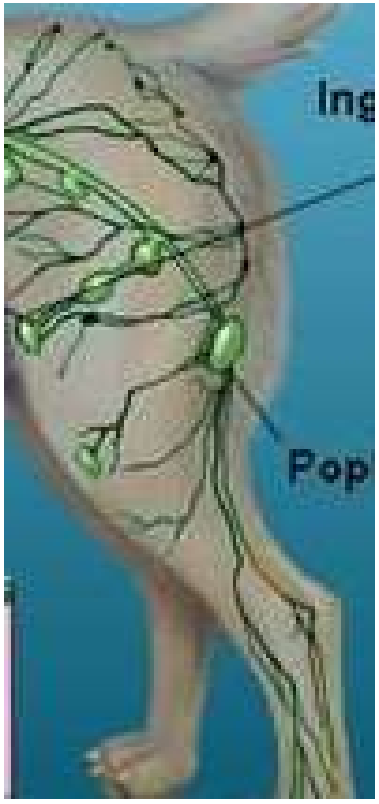


6- Pelvic Limb

A- Iliofemoral LN

B- Epigastric LN

C- Popliteal LN



Lymphatic tissue:

Lymph node:

Small, bean-shaped masses of lymphoid tissue enclosed by a capsule of connective tissue.

Lymph nodes serve as filters for the fluid.

Each lymph node is divided into two general regions, the cortex and the medulla.

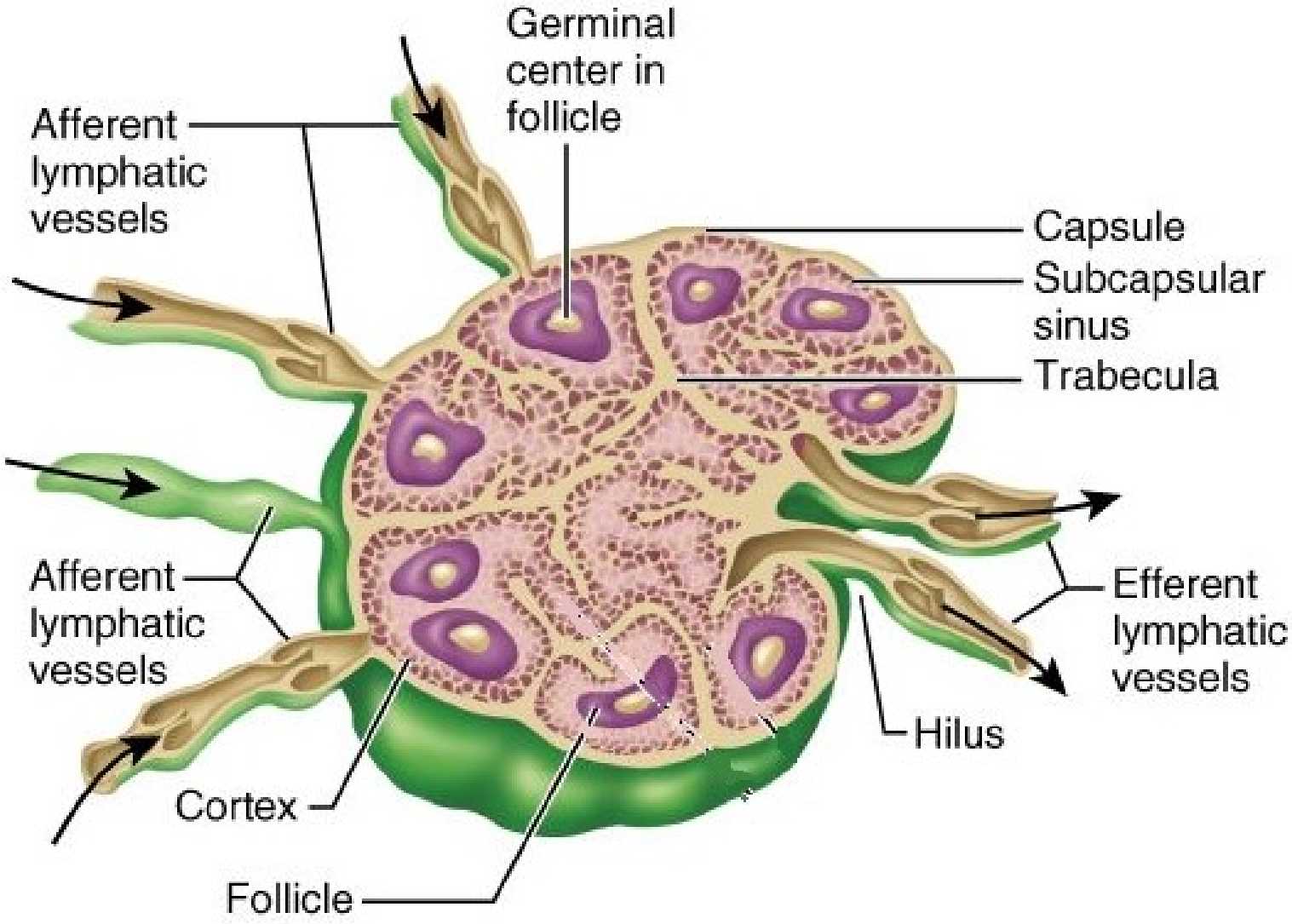
The capsule is a connective tissue surrounded the cortex.

The cortex, a region containing mostly inactivated B and T lymphocytes.

The cortex is further divided into two functional areas: the outer cortex and inner cortex, or paracortex.

The medulla is located in the middle and has sinuses and cord.

Lymphatic nodes in horse are 8000 small lymph nodes, while in dogs are 60 large L.N.


Germinal center in follicle
Afferent lymphatic vessels
Capsule
Subcapsular sinus
Trabecula
Afferent lymphatic vessels
Efferent lymphatic vessels
Hilus
Cortex
Follicle

Lymph nodule:

- small structures, function is to defending local area because its localized collection of lymphoid tissue.
- Lymph nodules form in regions of frequent exposure to microorganisms or foreign materials and contribute to the defense against them.
- Lymph nodules located in the loose connective tissue beneath epithelial membranes as in the digestive system, respiratory system, and urinary bladder.

The nodule differs from a lymph node in that

1- It is much smaller.

2- Does not have a well-defined connective-tissue capsule as a boundary.

3- It also does not function as a filter, because it is not located along a lymphatic vessel.

The solitary lymphatic nodules

Found scattered throughout the mucous membrane of the small intestine especially the ileum.

In small intestine, they called Peyer's patches and they are roughly egg-shaped lymphatic tissue nodules

They form an important part of the immune system by monitoring intestinal bacteria populations and preventing the growth of pathogenic bacteria in the intestines.

Hemal Lymphatic Nodes Type of Lymphatic tissue. Its different from LN by absence of afferent and efferent vessels and does not be divided to cortex and medulla.

The spleen

- is a major lymphoid and blood filtration organ.
- Located in the left cranial abdomen.
- It is responsible for storing and removing erythrocytes from the blood as well as antigen surveillance of the blood and antibody production.
- The spleen lies vertically on the left side of the cranial abdomen. It is attached to the greater curvature of the stomach by the gastrosplenic ligament.
- The spleen is enclosed in a capsule of fibrous and elastic tissue.
- Spleen divided in to the red and the white pulp, which are separated by the marginal sinus.

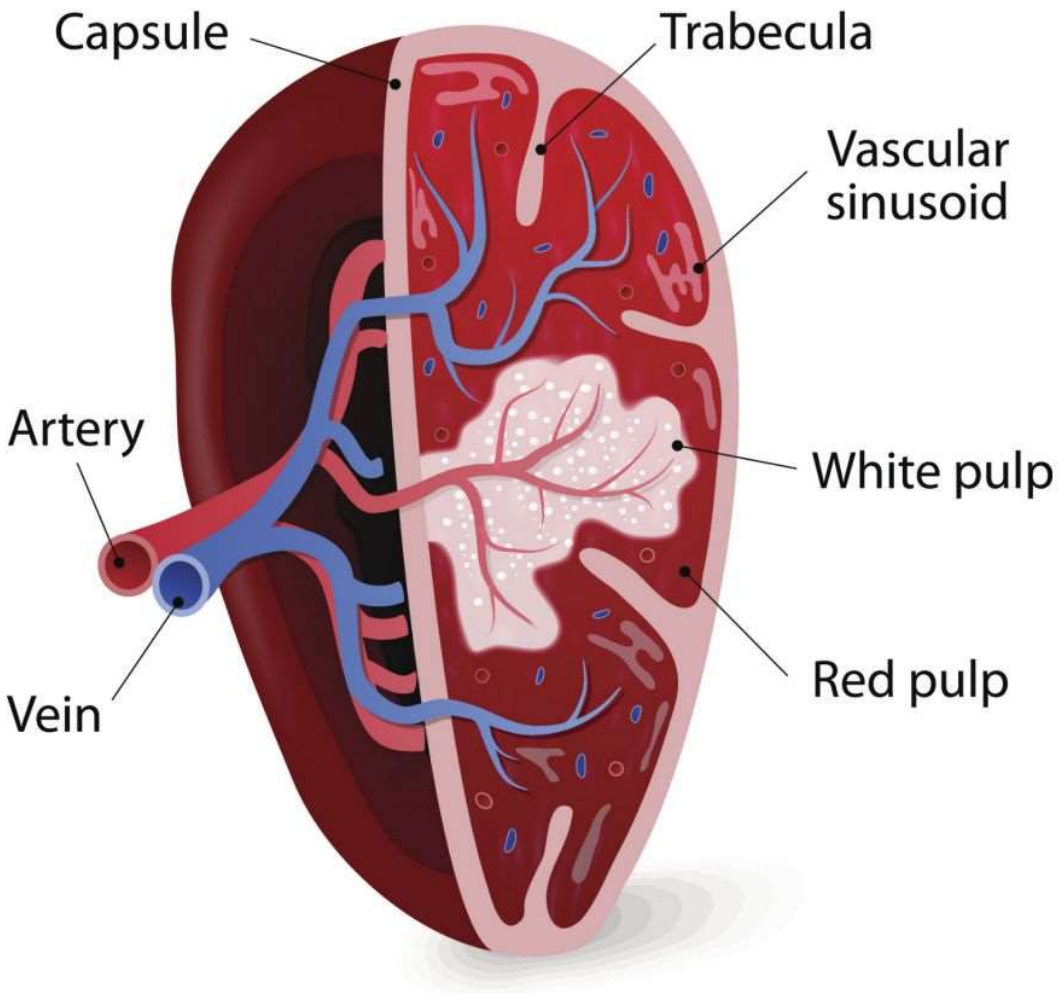
Red Pulp

- The red pulp makes up the majority of the spleen.
- It is composed of a network of splenic cords (lymphatic cords) and venous sinuses (lymphatic sinuses).
- The splenic cords contain macrophages, plasma cells, lymphocytes and other mature blood cells e.g. granulocytes and erythrocytes.
- The lymphatic sinuses are wide vascular channels.
- The blood pass from lymphatic cords to the sinuses which then to blood veins and lymphatic vessels.

White Pulp

- White pulp is organised in relation to the splenic arterioles.
- Consists of lymphoid tissue surrounding a central arteriole.
- There is a sheath of T cells directly around the arteriole called the periarteriolar lymphoid sheath (PALS).
- White pulp contains follicles (lymphoid follicles or B follicles) which contains B cells.

SPLEEN ANATOMY



Spleen in different spp.

Carnivores: Is elongated and dumb-bell shaped (larger ventrally)

Ruminants: Is flat and rectangle shaped

Horses: Lies under the last three ribs. The color is bluish-red, funnel-shaped. Dorsally it is broad but narrows as it extends cranially and ventrally

Birds: Lies alongside, to the right, of the proventriculus and is found caudodorsally to the liver with spherical in chickens, triangular in ducks & oval in pigeon.


HORSE
cranial
caudal
lateral view
medial view


COW
lateral
medial

The tonsils

are non-encapsulated lymphoid tissue. They have crypts lined with stratified squamous epithelium which are infiltrated with lymphocytes. they can stop germs entering the body through the mouth or the nose. The tonsils also contain a lot of white blood cells, which are responsible for killing germs.

Sheep: Six tonsils can be observed in the sheep, that is, the lingual tonsil , the palatine tonsil, the para-epiglottic tonsil, the pharyngeal tonsil, the tubal tonsil , and the tonsil of the soft palate.

Cow: Five tonsils are present in the ox;the lingual tonsil, the palatine tonsil, the pharyngeal tonsil, the tubal tonsil, and the tonsil of the soft palate. The para-epiglottic tonsil lacks.

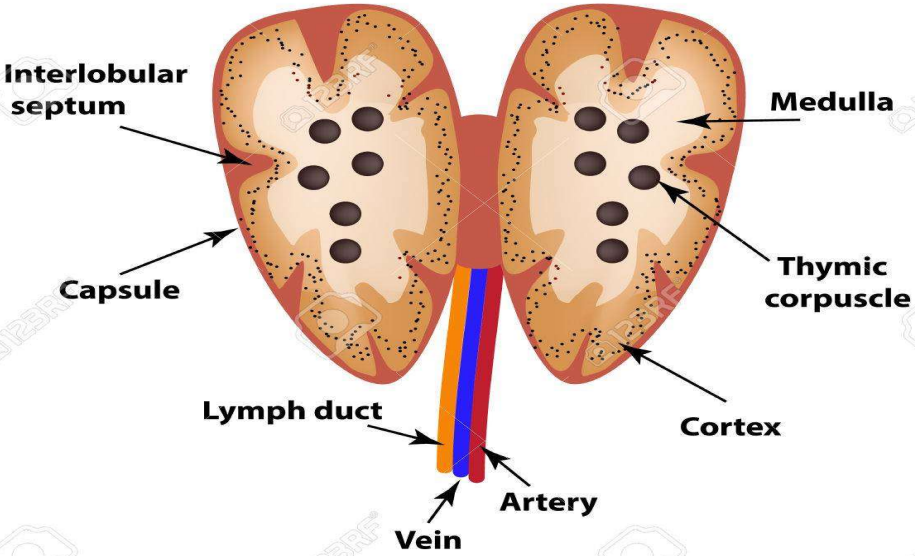
Horse: Five tonsils are present in the horse, that is, the lingual tonsil, the palatine tonsil, the pharyngeal tonsil, the tubal tonsil, and the tonsil of the soft palate. The para-epiglottic tonsil is not present in the horse.

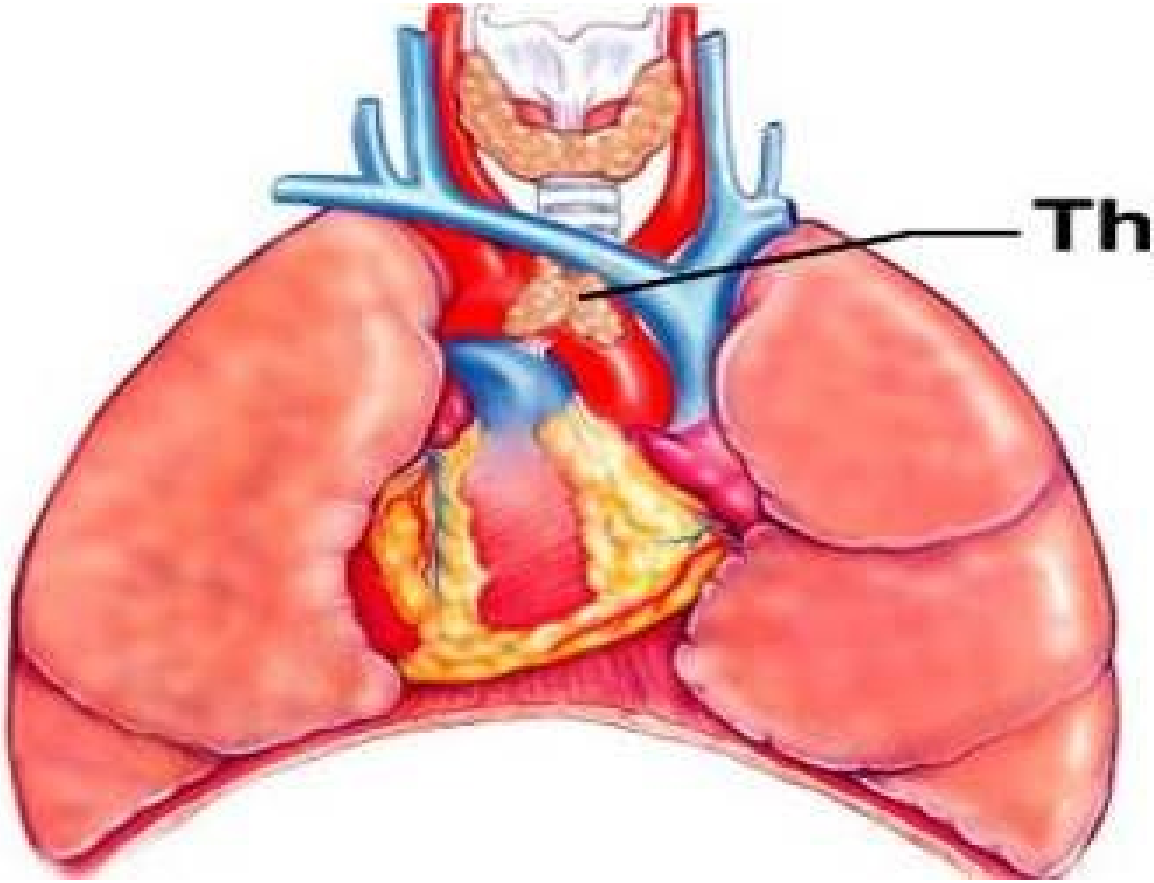
Dogs: Three tonsils are present in the dog, that is, the lingual tonsil, the palatine tonsil, and the pharyngeal tonsil.

The thymus

- Is found cranial to the heart and has a 'lobular' structure. Within the lobules the tissue consists of an outer cortex and an inner medulla.
- The thymus is surrounded by a capsule made of thin connective tissue.
- The connective tissues house blood vessels and efferent lymphatic vessels along with nerves.
- The cortex is dense consisting of rapidly dividing thymocytes (developing T lymphocytes).
- The medulla has non-dividing, more mature T cells.

STRUCTURE OF THE THYMUS





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