Anatomy

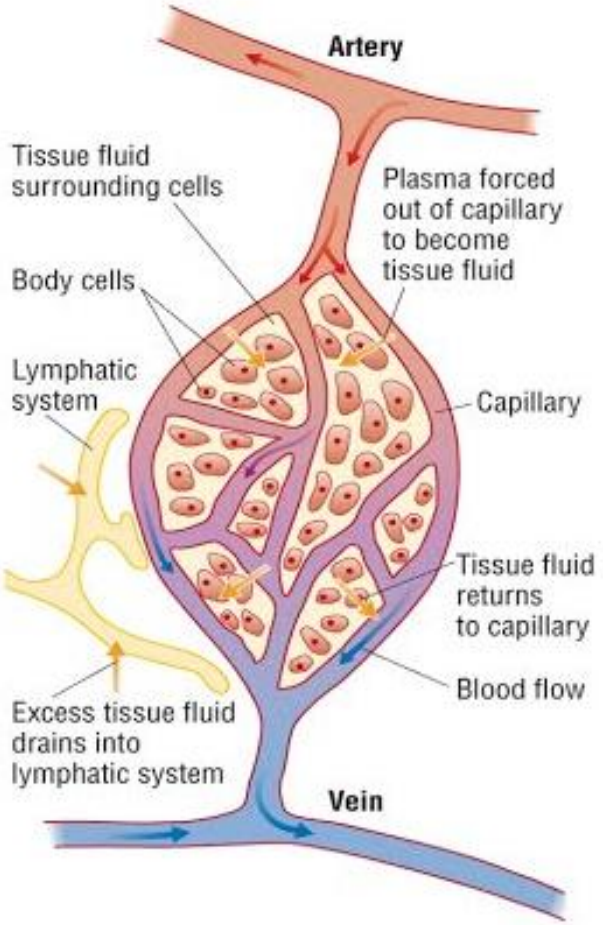
Dr. Ramzi

Lymphatic System

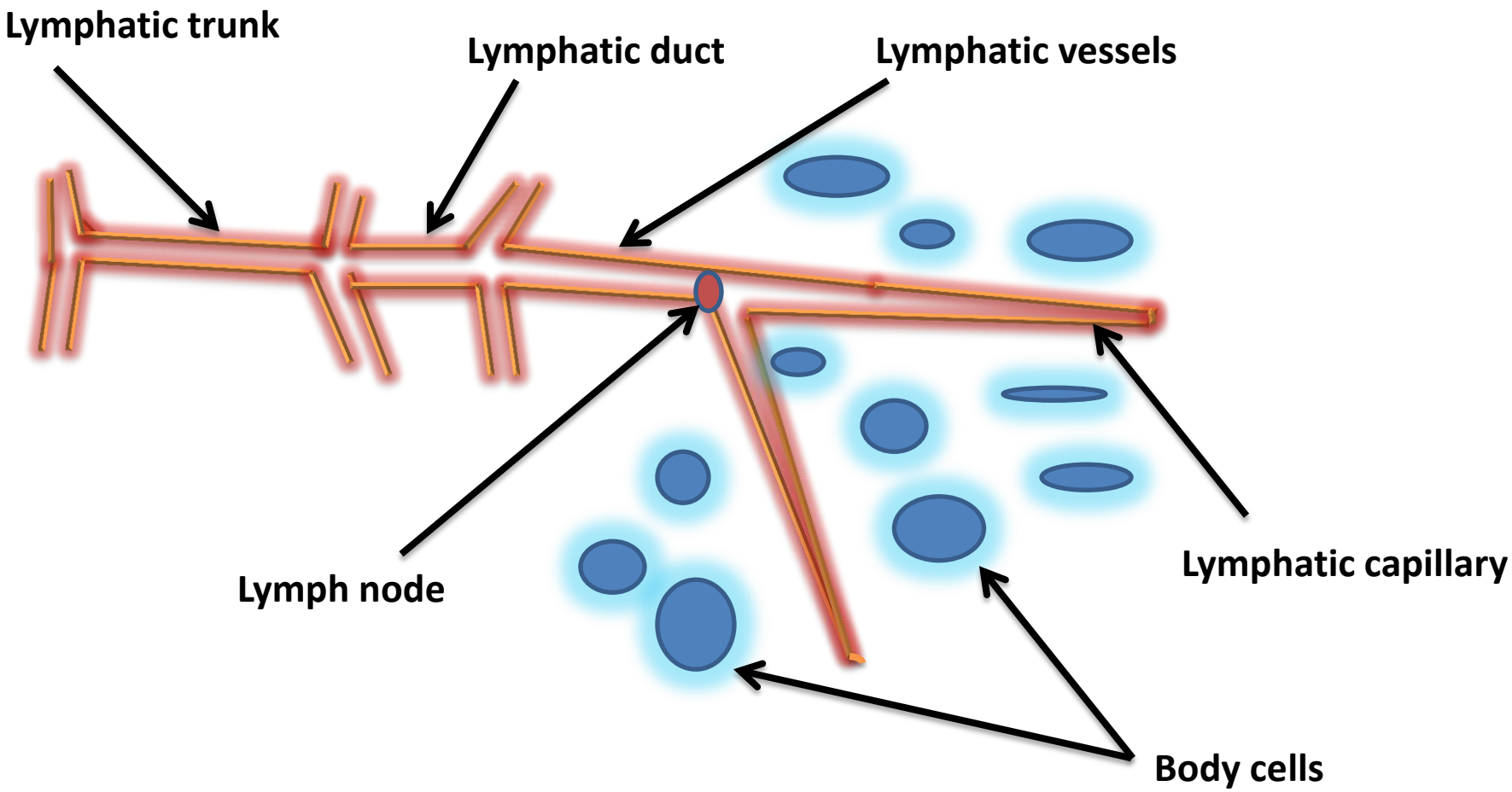
It is the second system of vessels which is begun at the tissue spaces between the capillaries of blood vascular system.

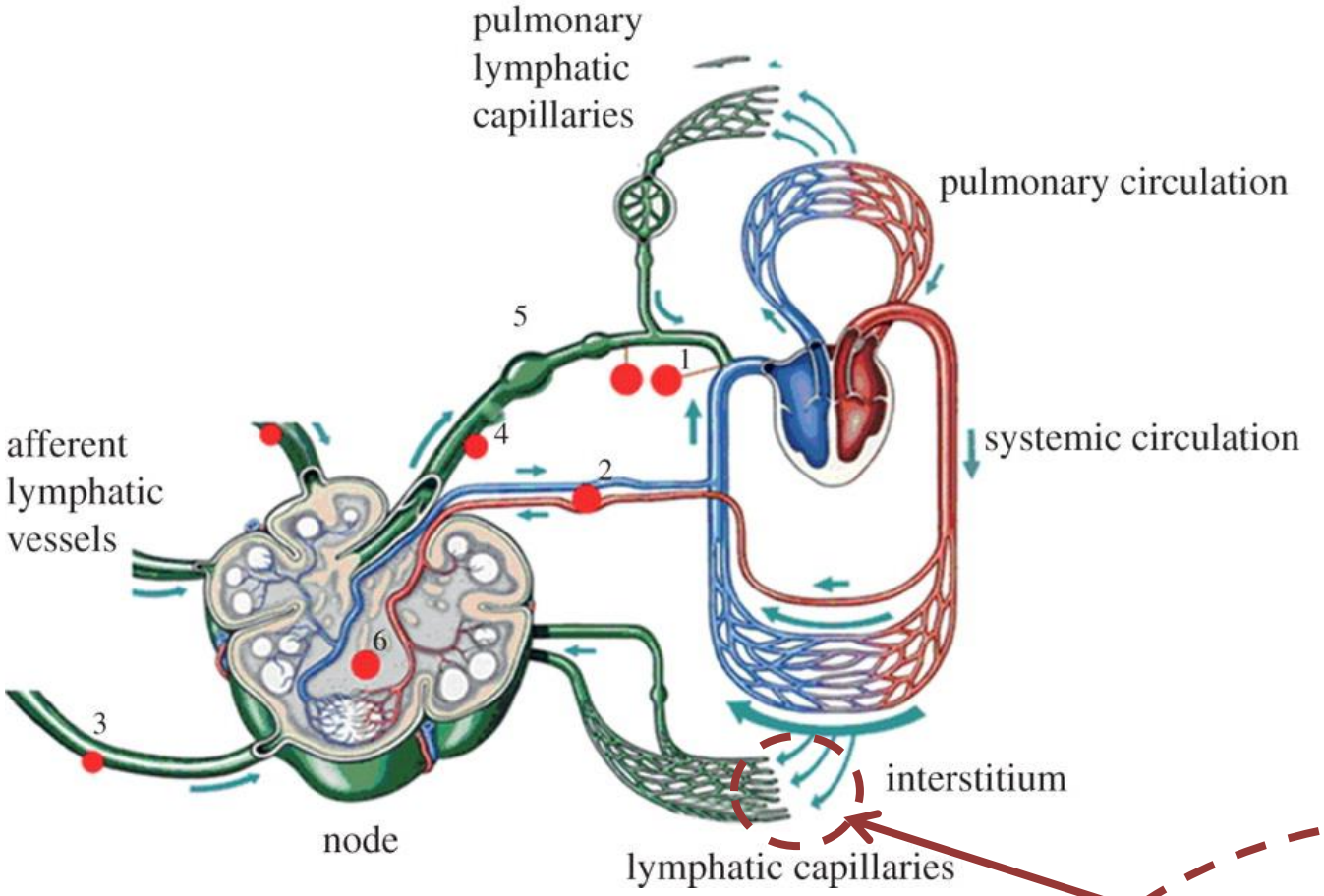
It is formed from:

1. **Lymphatic fluid**
2. **Lymphatic vascular part**
   - **a. lymphatic capillaries**
   - **b. lymphatic vessels**
   - **c. lymphatic duct**
   - **d. lymphatic trunk**
3. **Lymphatic tissue**
   - **a. solitary lymph nodule**
   - **b. lymph node and hemal lymph nodes**
   - **c. Tonsil**
   - **d. thymus**
   - **e. spleen**

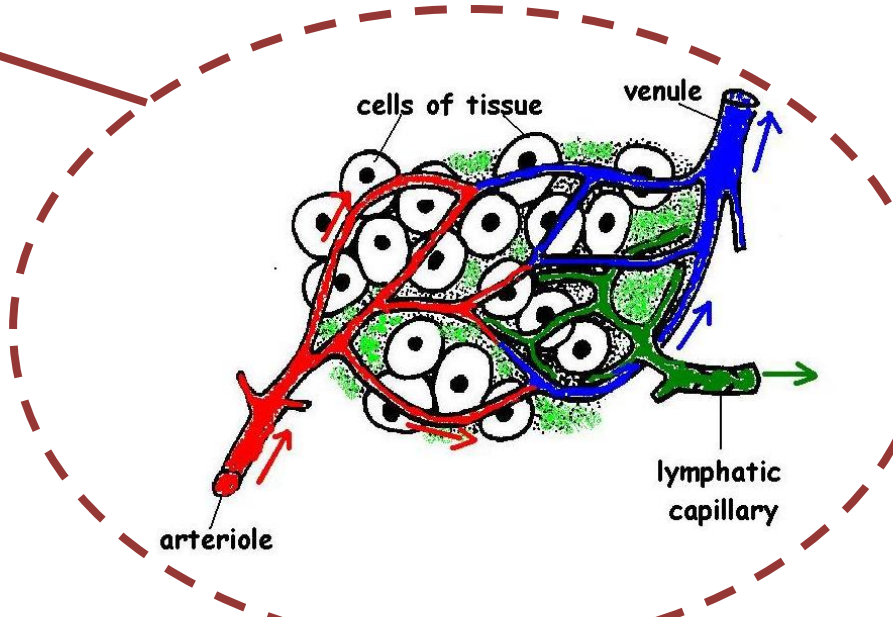


Lymphatic vascular part





1. lymphatic venous anastomosis
2. node blood supply
3. afferent lymphatic vessels
4. efferent lymphatic vessels
5. lymphangion
6. lymph node



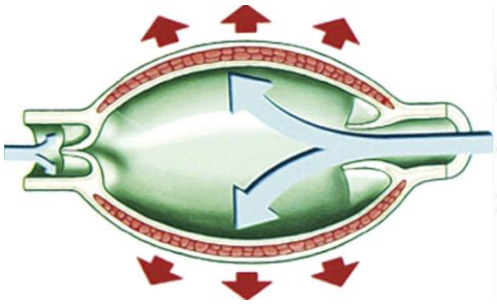
Function of lymphatic system

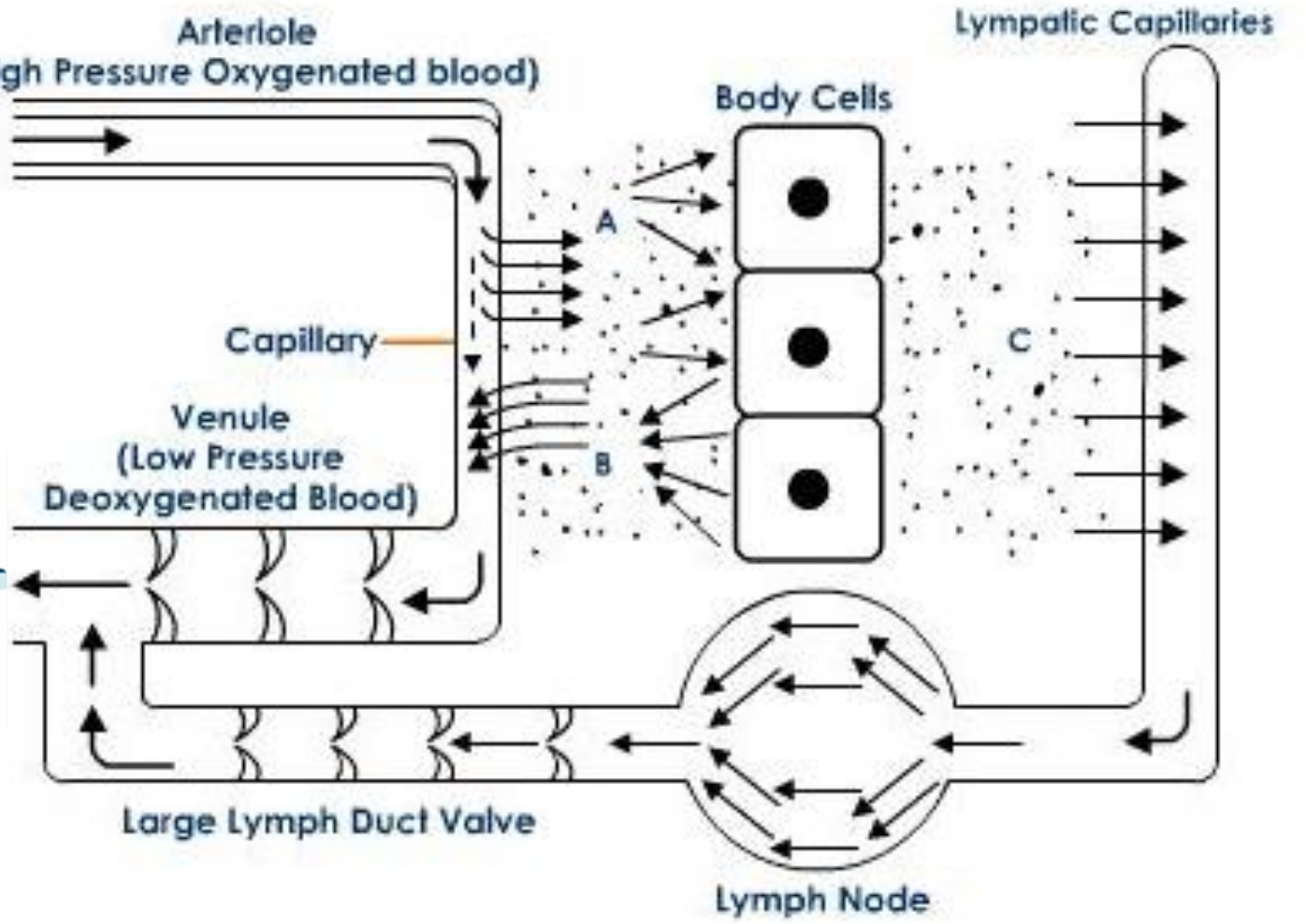
1. Return the tissue fluid to the blood stream
2. It filtrates the lymph fluid (removal the bacteria, virus and debris of dead cells)
3. Produce and carry WBCs and antibody
4. Absorbed and transport the fat from the intestine

- **Lymph**: is clear colorless fluid except in the lymphatic vessels of the intestine which is milky in color. It is present in the lymphatic capillaries, vessels, duct, trunk and lymphatic sinus of the lymph node.

Lymph Movement

The lymph flow in lymphatic vessels very slowly. Forcing out fluid from the blood capillaries set up some pressure in the tissue fluid. This pressure gradient causes the lymph to flow in the lymphatic vessel. Movements of viscera and contractions of the body muscles help by squeezing the lymph along. The valves prevent the backward flow.





Movement of the lymph in vessels is affected by external forces such as:

1. The tissue pressure is greater than the pressure inside the lymphatic capillaries.
2. Muscular contraction of all body.
3. Respiratory movement.
4. Intestinal movement.
5. Present smooth muscle fiber within the wall of lymphatic vessels helps the lymph during contraction.
6. Present of bicuspid valves in the lymphatic vessels prevent lymph to retain.

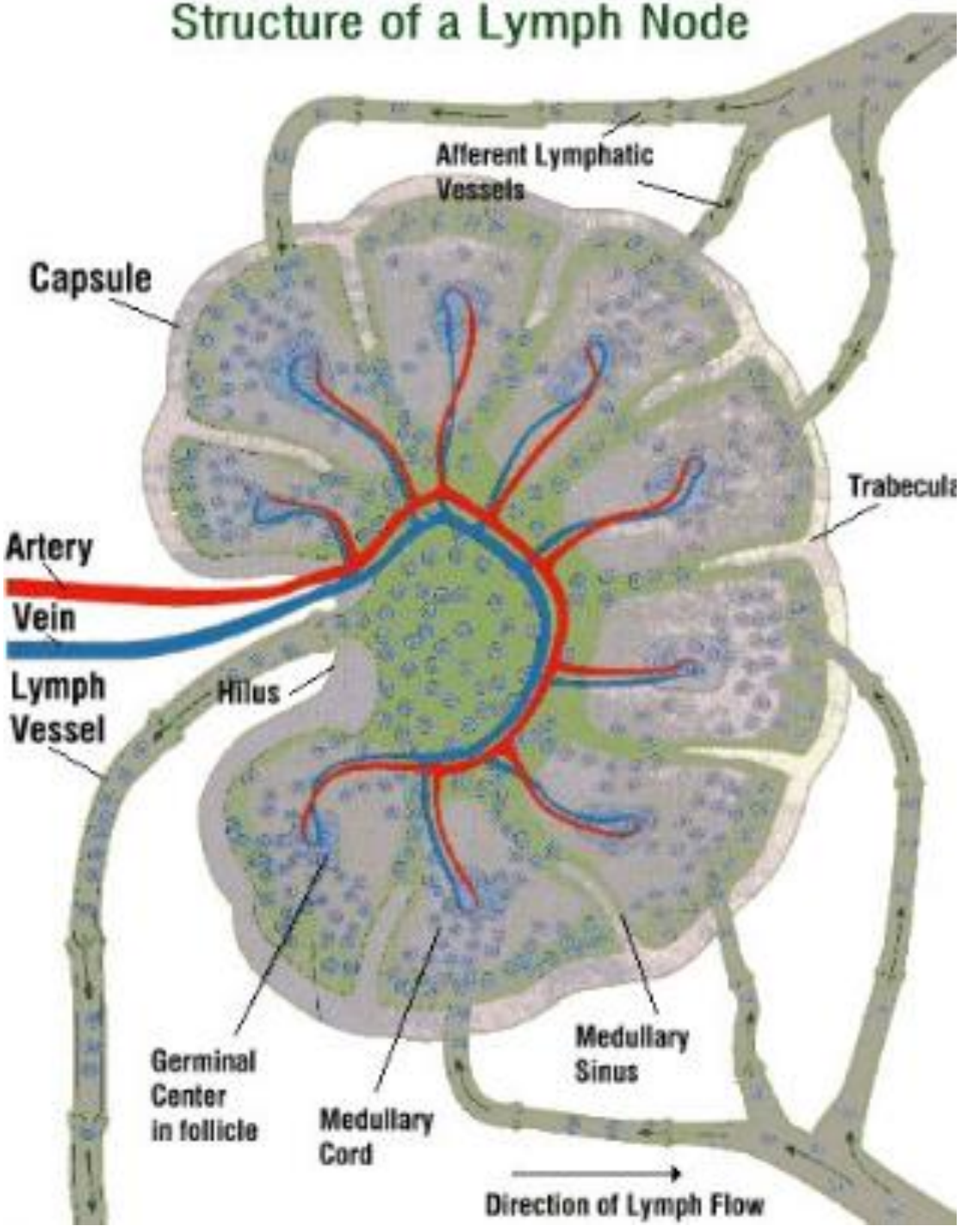
- **Lymphatic capillary**: is a thin walled blind ended vessel having large pores.
- **Lymphatic vessels**: is a thin walled vessel which carry L. to the L.N. is known as afferent v. while the vessels which are carry the L. away from the L.N. known as Efferent v.
- **Lymphatic duct**: is a large lymphatic vessel which receives lymph from several centers.
- **Lymphatic trunk**: is a large lymphatic vessel which collects lymph from large area of the body.
- **Lymphatic nodules**: is very small lymphatic tissues which may be unite to form aggregation of lymphoid tissue within the wall of the intestine and called peyer's patches or found within the tonsil or thymus.

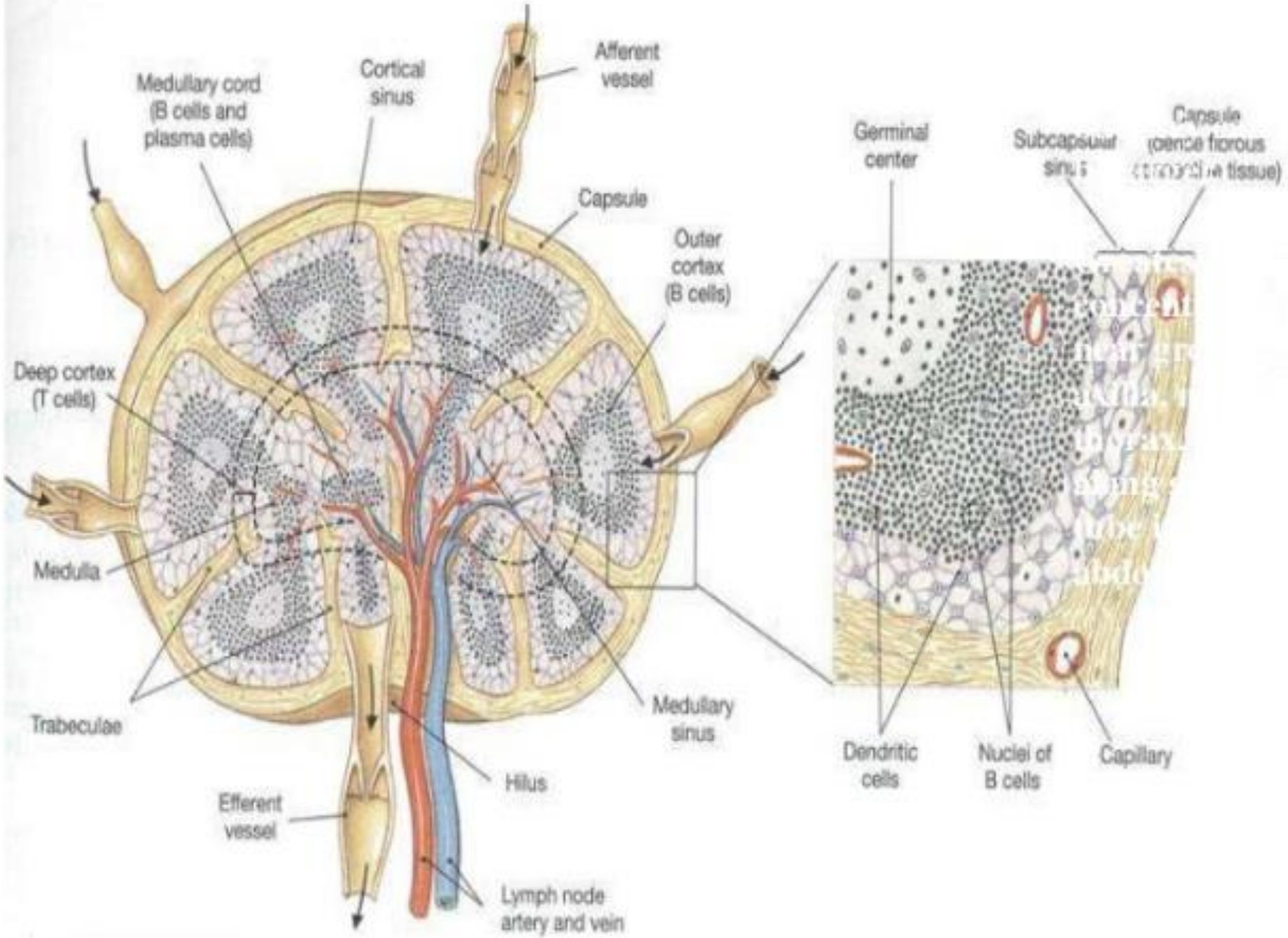
***Lymph node*: is compact mass with pink gray color of C.T. occurring at many sites in the animal body.**

- **Function of lymph node:**
- **1. It filtrates lymph fluid.**
- **2. The macrophage takes up residence in the lymph node and ingests the foreign body.**

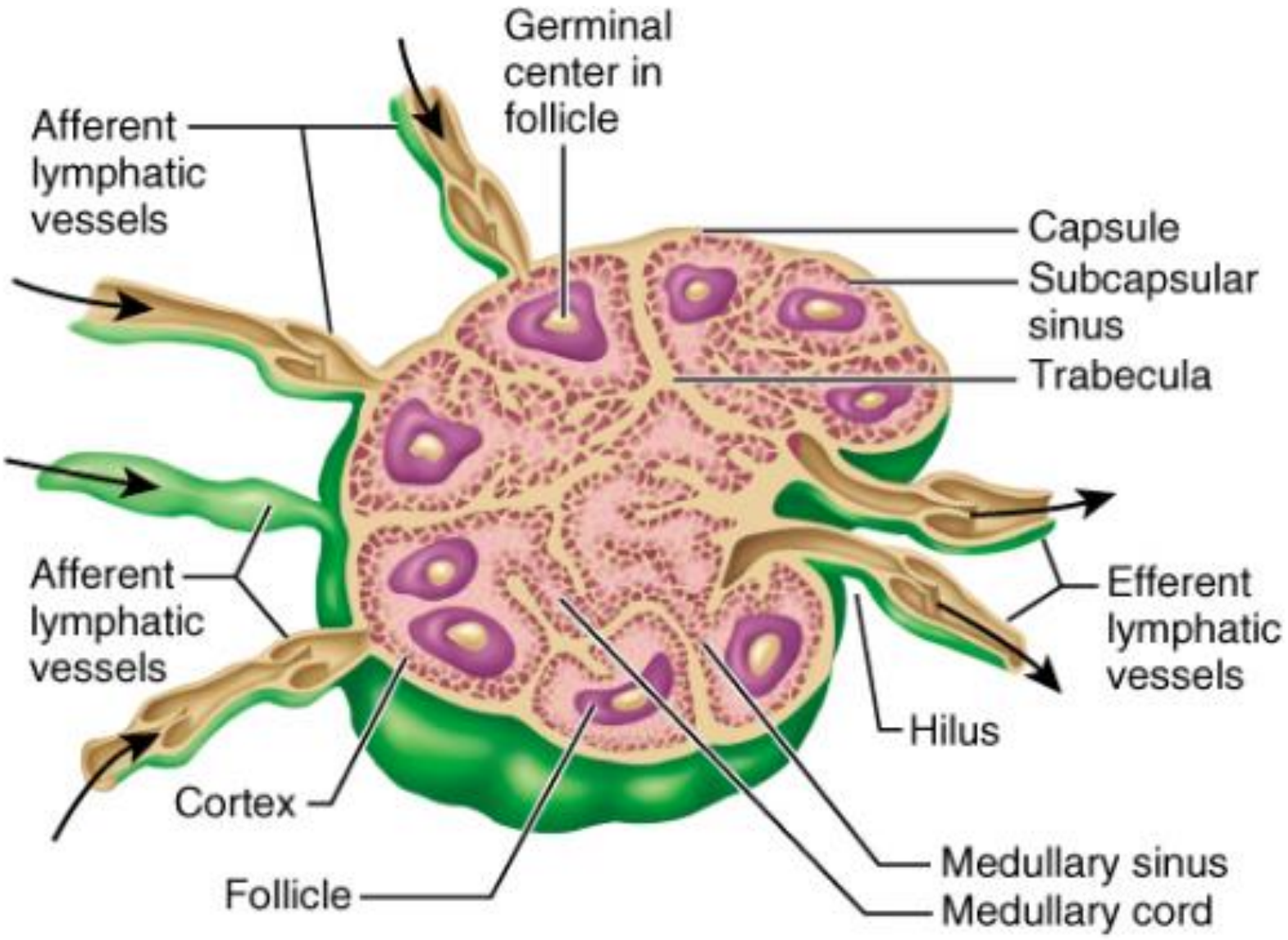
- **Hemal node: its red small node present only in the ruminants (ox, sheep and goat) and, it is characterized by absent of the afferent and efferent vessels and has only small blood vessels which filtrate the blood.**
- **a. it is present along the length of aorta.**
- **b. accompanying with the ruminal and jejunal L.N.**
- **c. near the superficial L.N.and under the skin and tripizus m.**
- **d. the total number in all animal body is about (127-259) nodes.**
- **e. spleen is consider as the largest hemal node.**

Structure of a Lymph Node




Afferent vessel
Cortical sinus
Medullary cord (B cells and plasma cells)
Capsule
Outer cortex (B cells)
Deep cortex (T cells)
Medulla
Trabeculae
Medullary sinus
Hilus
Efferent vessel
Lymph node artery and vein
Germinal center
Subcapsular sinus
Capsule (dense fibrous connective tissue)
Dendritic cells
Nuclei of B cells
Capillary

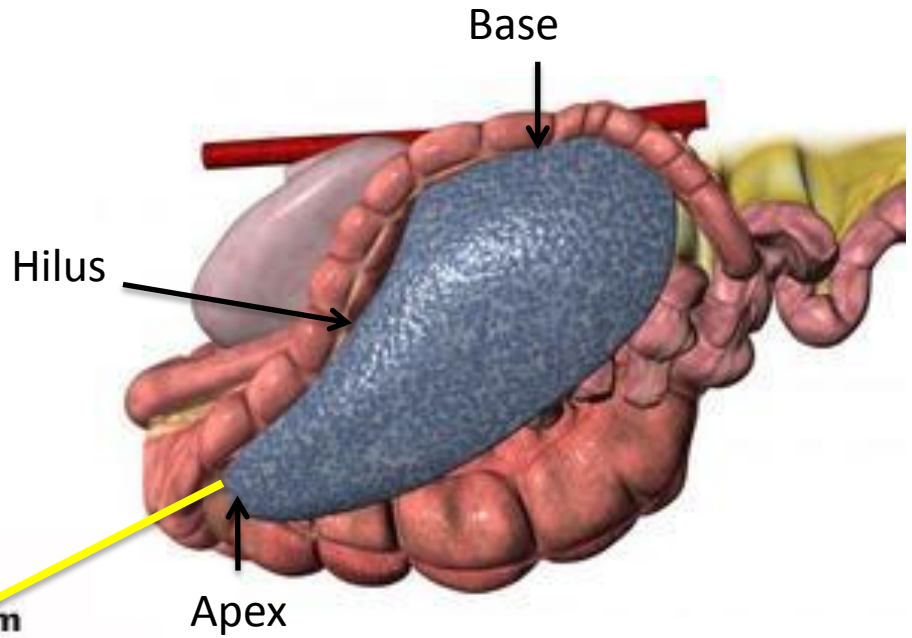
Cross section of Lymph node

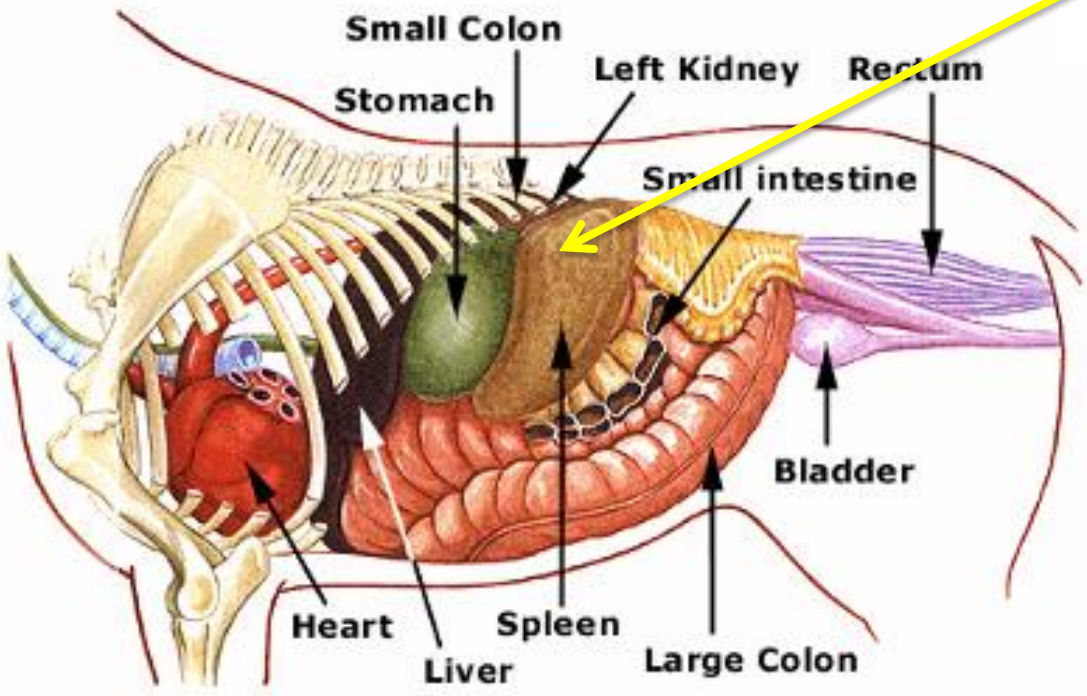


- **Tonsils**: is aggregation of lymphoid tissue in the root of tongue and soft plate which have different size and shape and have efferent vessels.
- **Thymus**: is a lymphoid tissue which developed and active in the late prenatal and early postnatal and when the animal become mature the glands degenerated and become small. It is located in the thoracic inlet.
- **Spleen**: is a soft highly vascular red to dark purple in color and it is not essential for life.
- **Function of spleen:**
- 1. In the embryonic life, it produces RBCs.
- 2. Store the blood.
- 3. Destroyed the aged RBCs.
- 4. Re-cycle iron from hemoglobin.
- 5. It has large number of lymphocyte and macrophage.

Spleen of the horse

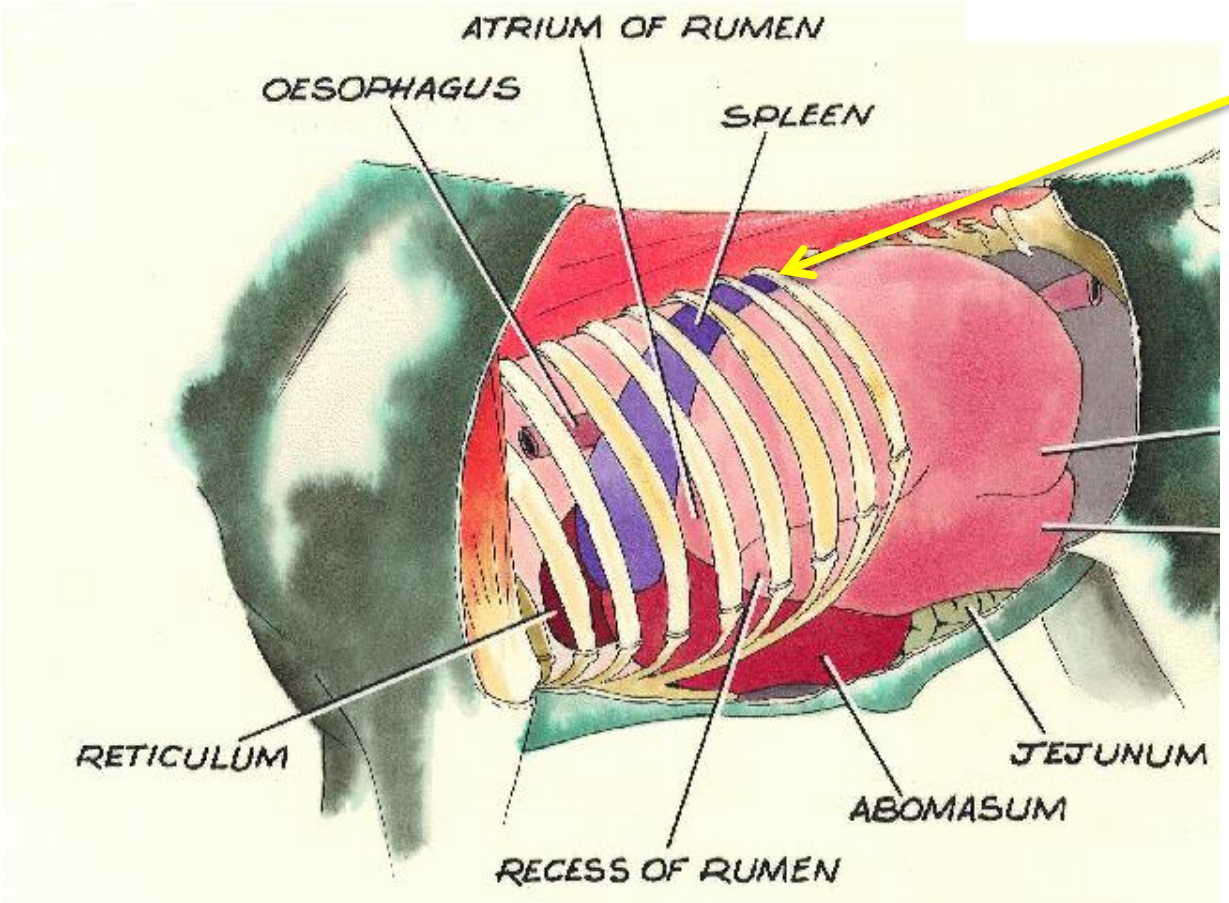
1. Shape: triangular
2. Color: bluish-red
3. Length: 50 cm
4. Weight: 1 kg





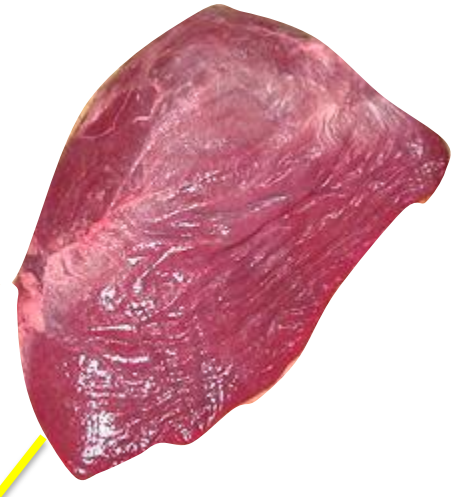
Spleen of the ox

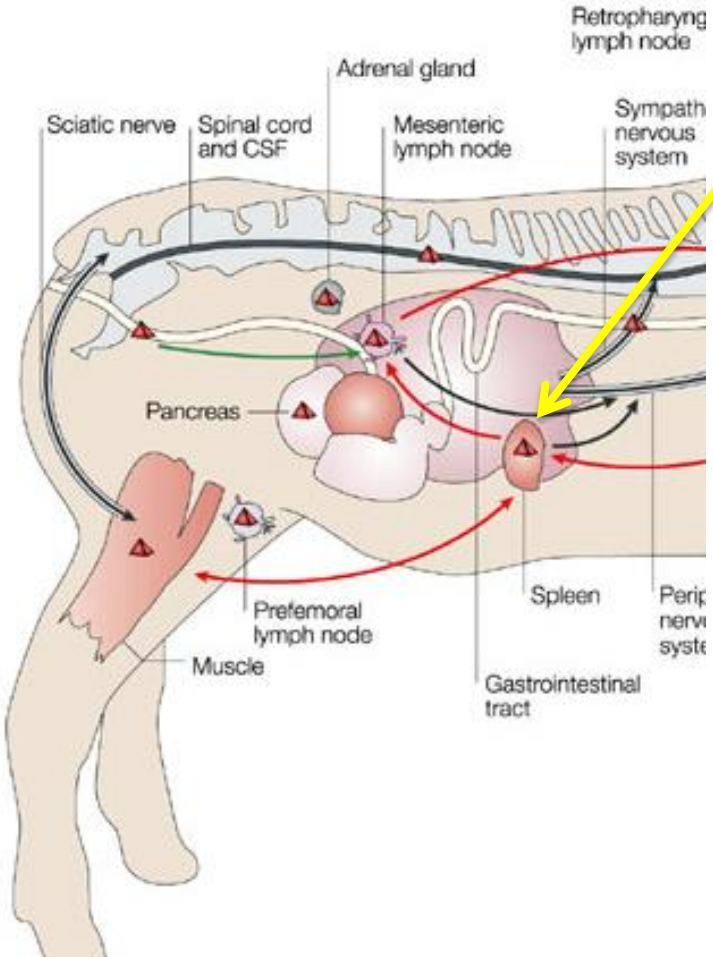
1. Shape: elongated oval
2. Color: red- brown
3. Length: 50 cm
4. Weight: 900 gm



Spleen of the sheep

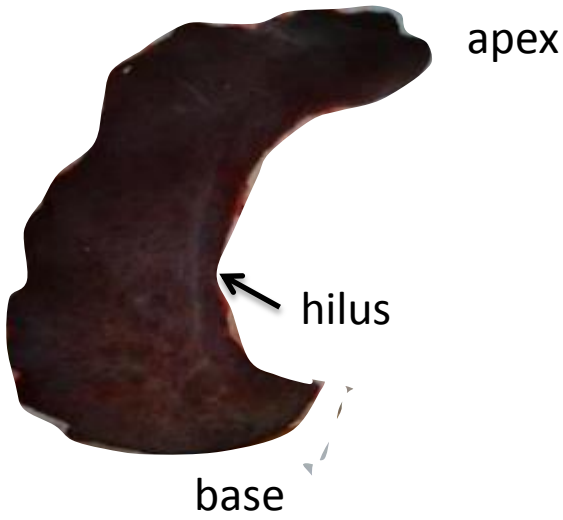
1. Shape: triangular
2. Color: red-brown
3. Length: 8-10 cm
4. Weight: 100 gm





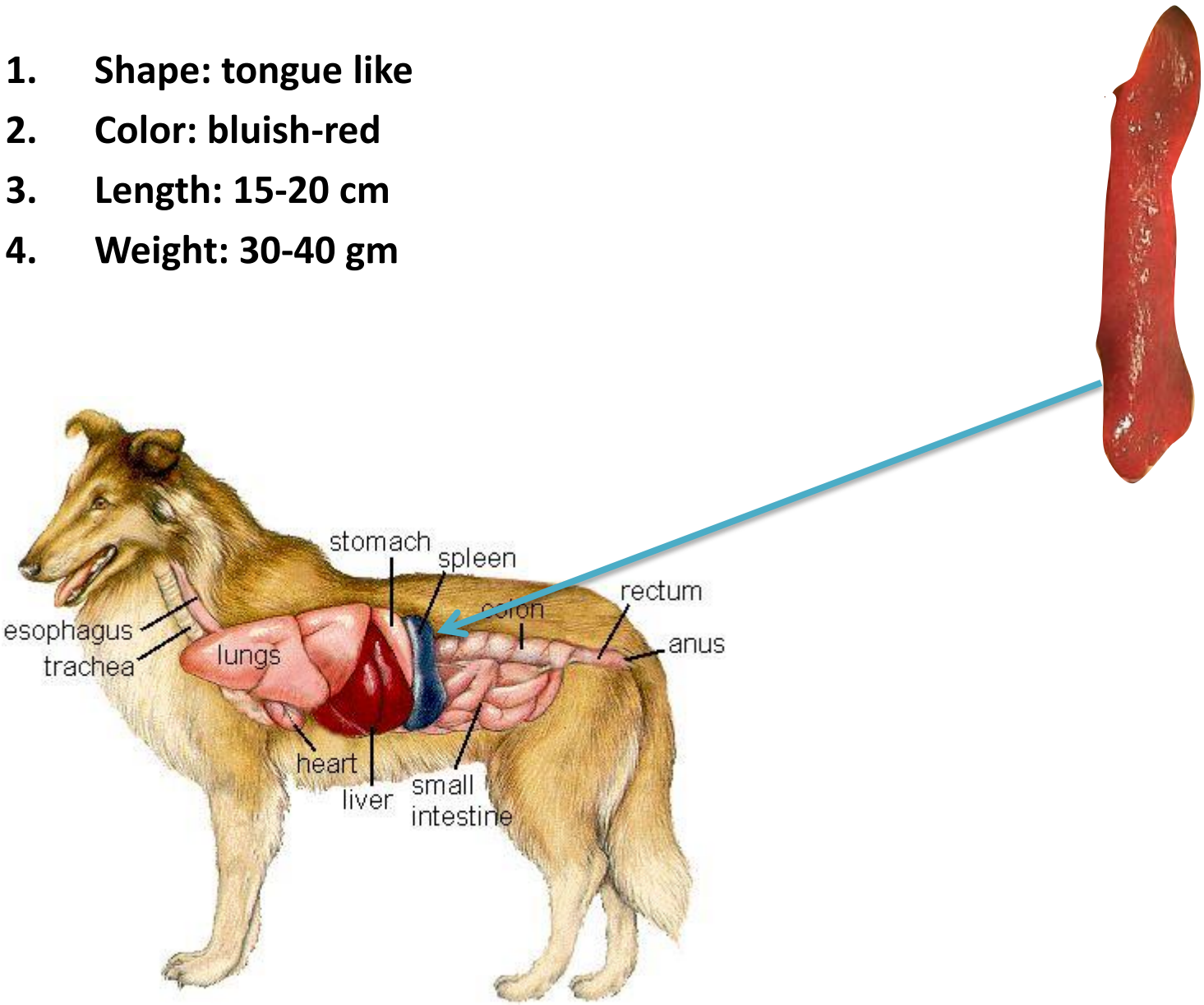
Spleen of the camal

1. **Shape: crescent**
2. **Color: red-brown**
3. **Length: 30-40 cm**
4. **Weight: 1-1.5 kg**



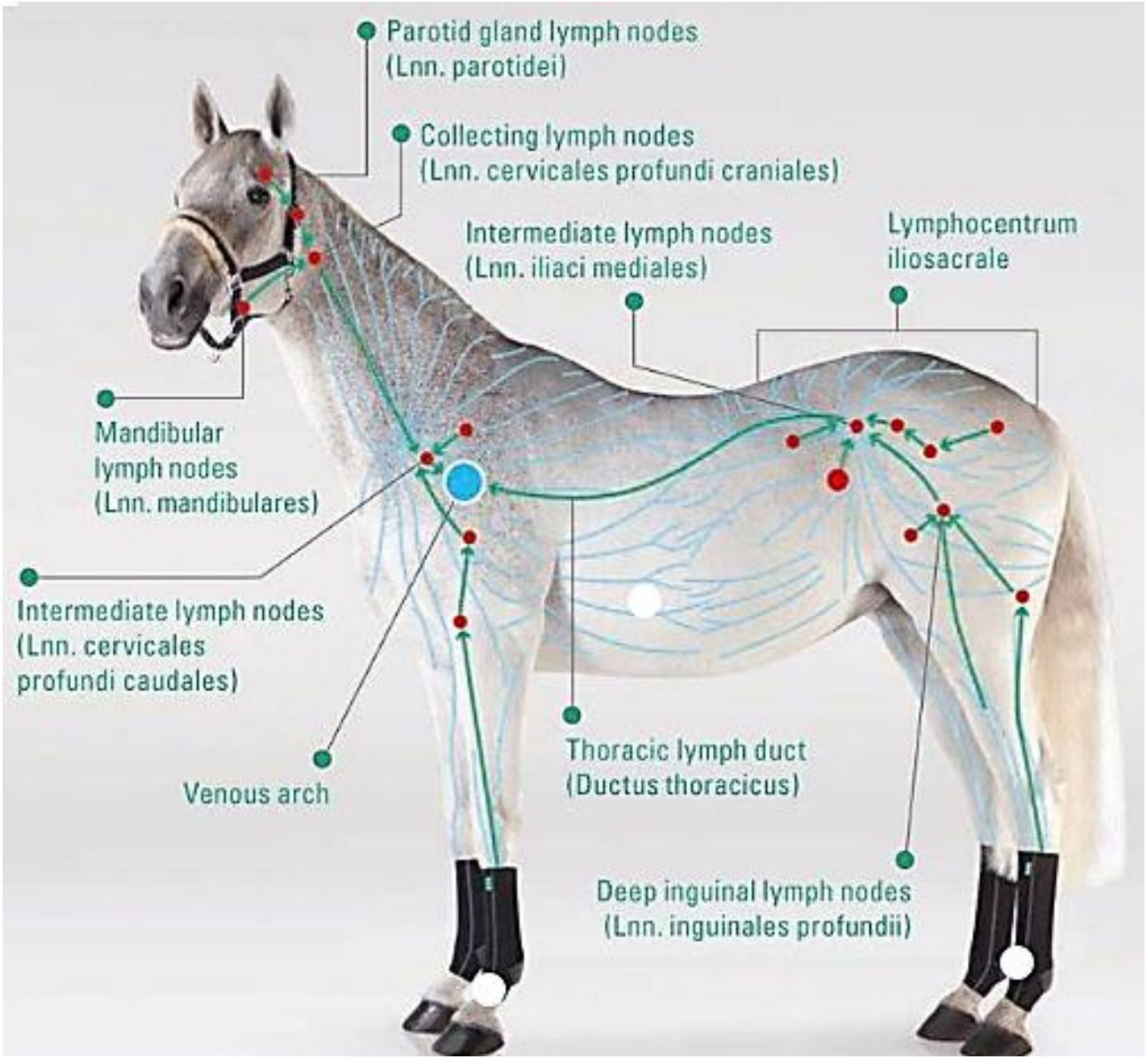
Spleen of the dog

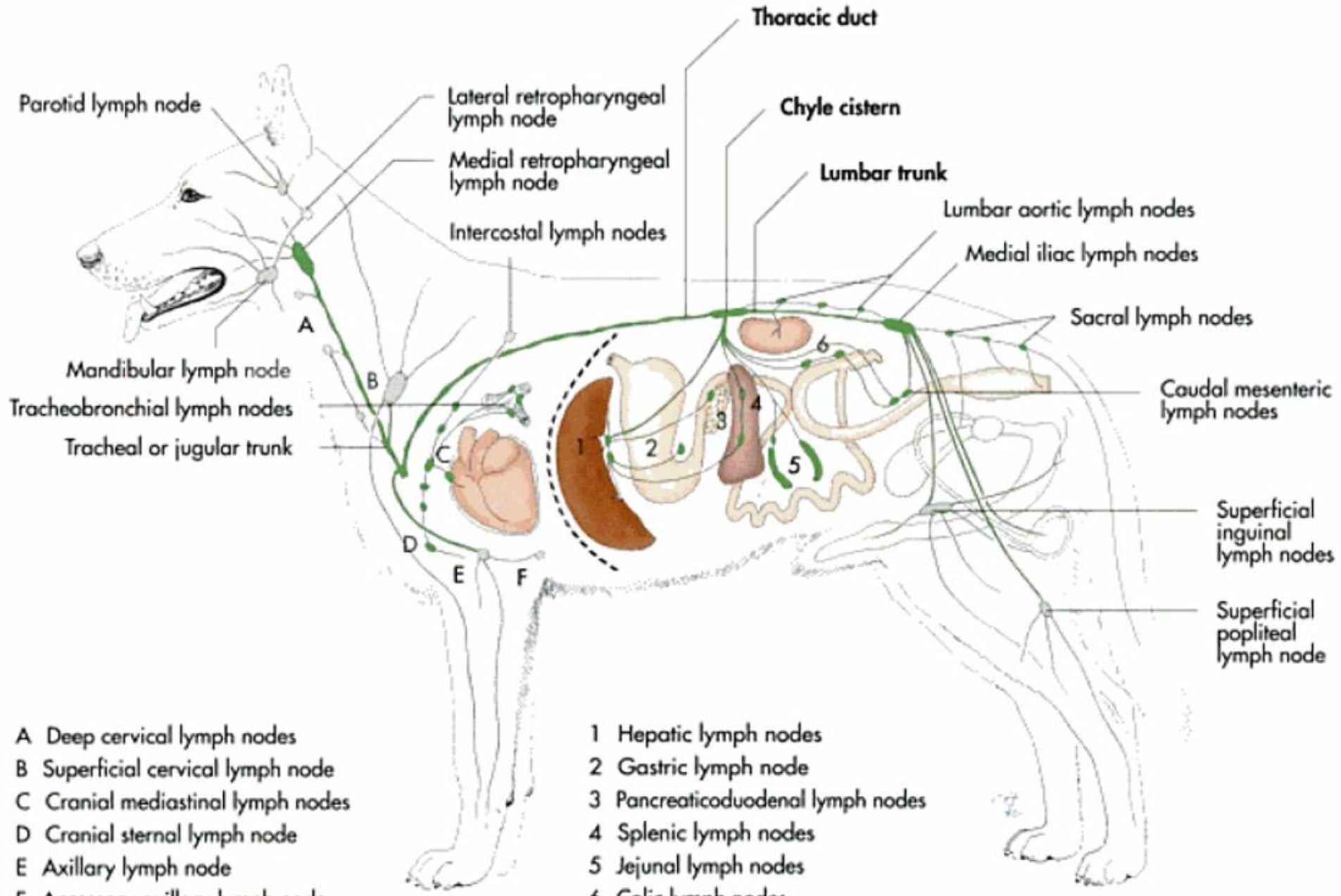
1. **Shape: tongue like**
2. **Color: bluish-red**
3. **Length: 15-20 cm**
4. **Weight: 30-40 gm**



Lymphocenter

It is aggregation of lymph nodes which collecting lymph from certain area.




Thoracic duct
Parotid lymph node
Lateral retropharyngeal lymph node
Chyle cistern
Medial retropharyngeal lymph node
Lumbar trunk
Lumbar aortic lymph nodes
Intercostal lymph nodes
Medial iliac lymph nodes
Sacral lymph nodes
A
Mandibular lymph node
B
Caudal mesenteric lymph nodes
Tracheobronchial lymph nodes
Tracheal or jugular trunk
C
1
2
3
4
5
6
Superficial inguinal lymph nodes
D
E
F
Superficial popliteal lymph node
A Deep cervical lymph nodes
B Superficial cervical lymph node
C Cranial mediastinal lymph nodes
D Cranial sternal lymph node
E Axillary lymph node
F Accessory axillary lymph node
1 Hepatic lymph nodes
2 Gastric lymph node
3 Pancreaticoduodenal lymph nodes
4 Splenic lymph nodes
5 Jejunal lymph nodes
6 Colic lymph nodes

Lymphocenters of the head

1. Mandibular L.C.

   A. Mandibular Lnn.: it is about 70-150 Lnn. formed mass of 10-16 cm length.

Location: on the caudal part of the intermandibular space.

Shape: it is V shape in the horse and they are two group Ln. oval in shape in ruminant.

Afferent: from the parts of the face, nasal cavity and tongue.

Efferent: go to cranial deep cervical Ln.

B. Pterygoid Lnn.:

Location: present only in ruminant on the pterygoid medialis muscle.

Shape: small group.

Afferent: from the hard palate.

Efferent: go to mandibular Ln.

2. Parotid L.C.

Location: at the caudal border of the rams of mandible, embedded or cover by the parotid salivary gland.

Shape: small group of 6-10 Lnn. and about 0.7-1 cm.

Afferent: skin of maseter, frontal sinus and parotid regions, muscles of eye lacrimal gland and parotid gland.

Efferent: to the lateral and medial retropharyngeal Lnn.

3. Retropharyngeal L.C.

A. Lateral retropharyngeal Lnn.

Location: ventral to the wing of atlas and cover by parotid gland and lateral to the pharynx.

Shape: it is group of 8-15 Ln. of 1.5 cm

Afferent: from the pharynx, muscle of the neck and trachea.

Efferent: go to cranial deep cervical Lnn.

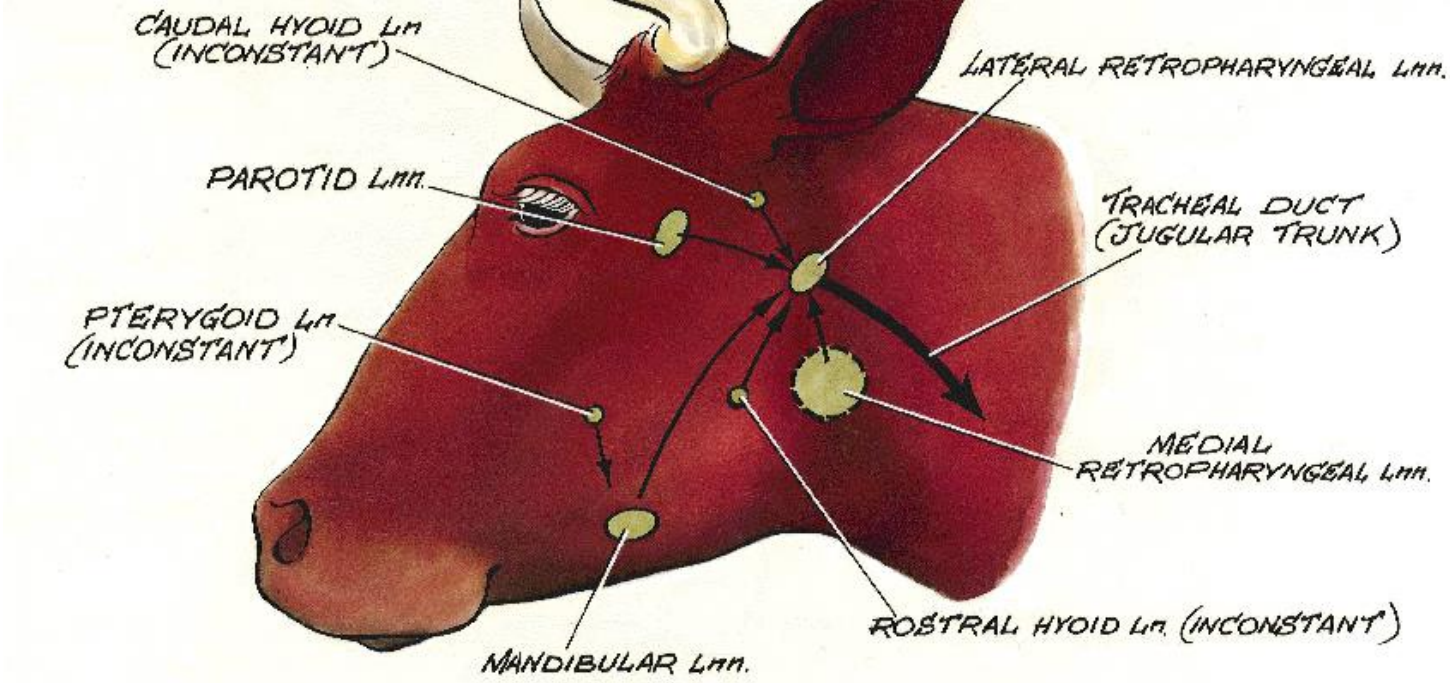
B. Medial retropharyngeal Lnn.

Location: on the dorsolateral surface of pharynx.

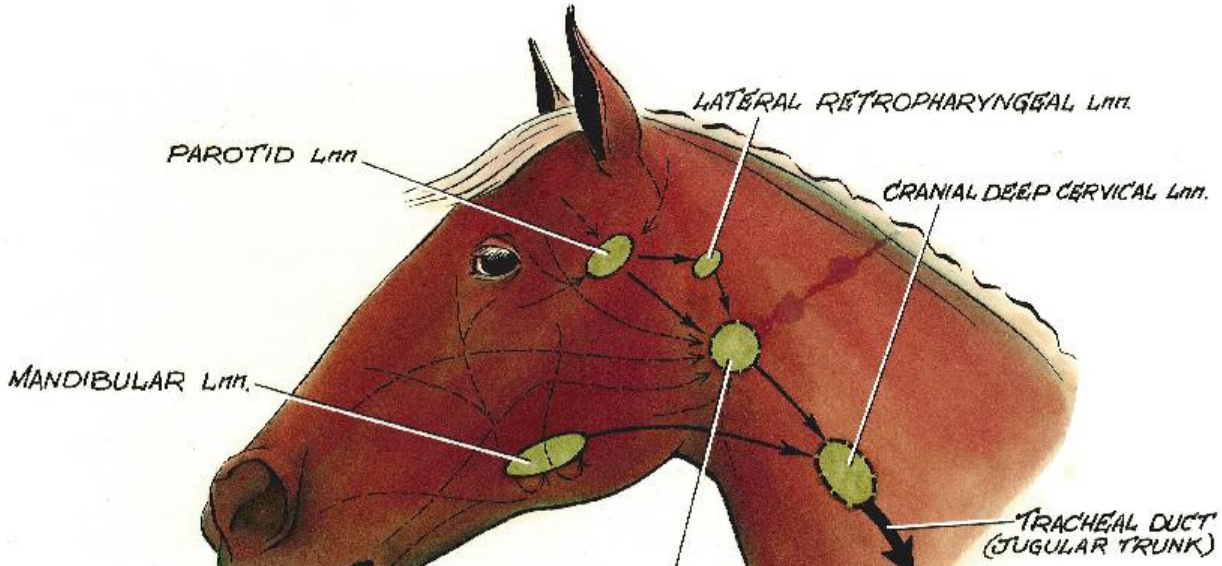
Shape: small aggregation of Ln.

Afferent: from the pharynx, muscle of the neck, trachea, nasal cavity and larynx.

Efferent: go to cranial deep cervical Lnn



LYMPH NODES OF PAROTID, MANDIBULAR AND RETROPHARYNGEAL LYMPHOCENTRES OF COW'S HEAD.



Lymphocenter of the Neck

1. Superficial cervical L.C. (Prescapular L.C.)

   it includes superficial cervical Lnn.

Location: cranial to the shoulder joint and cover by brachiocephalic muscle.

Shape: group of Lnn about 5 cm.

Afferent: skin of caudal part of head, neck, shoulder and thoracic limb.

Efferent: go to caudal deep cervical Lnn.

2. Deep cervical L.C.

A. Cranial deep cervical Lnn.

Location: cranial, dorsal and ventral to the thyroid gland.

Shape: usually chain of 30-40 Lnn of 2.5 cm

Afferent: muscles of the head, neck, trachea, esophagus and thyroid gland.

Efferent: the efferent formed tracheal trunk (duct).

B. Middle deep cervical Lnn.

Location: along middle part of trachea.

Shape: they make chain of Lnn of 3 cm.

Afferent: from trachea, esophagus, thyroid gland, thymus and cranial deep cervical Lnn.

Efferent: go to the tracheal duct (trunk).

C. Caudal deep cervical Lnn.

Location: cranial to the first rib at the ventral surface of the trachea.

Shape: group of 20-30 Lnn of 4.5 cm

Afferent: from sternum, superficial and deep cervical Lnn, trachea and muscles of shoulder.

Efferent: they may be go to sternal Lnn or thoracic duct or terminate directly to jugular vein or caudal vena cava.

Lymphocenters of the thoracic cavity

1. Dorsal thoracic lymphocenter

A. Intercostals Lnn

Location: are located on the intercostal spaces near the head of the ribs.

Shape: usually only one small Ln. less than 1 cm {the first and second intercostal consider as cranial mediastinal Ln.}.

Afferent: mediastinum, diaphragm, muscles of the thoracic wall and trachea.

Efferent: may be thoracic duct, the last few nodes goes through aortic hiatus to celiac Lnn.

B. Thoracic aortic Lnn.

Location: are located on the dorsolateral surface of the aorta along its course

Shape: is vary in shape and size.

Afferent: from intercostal Lnn, caudal mediastinal Ln. , pleura and muscles of the thoracic wall.

Efferent: go to cranial and middle mediastinal Lnn or may be to thoracic duct.

2. Ventral thoracic lymphocenter

A. Cranial sternal Lnn.

location: on the manubrium of sternum.

Shape: group of vary shape.

Afferent: from pleura, diaphragm, trachea, esophagus, heart and thymus.

Efferent: may go to thoracic duct or cranial mediastinal Lnn.

B. Caudal sternal Lnn.
not always present

C. Phrenic Lnn.

Location: on the ventral border of caudal vena cava at the caudal vena cava foramen.

Shape: one Ln.

Afferent: from the diaphragm and liver

Efferent: to the cranial and caudal sternal Lnn.

3. Mediastinal lymphocenter

A. Cranial mediastinal Lnn.

Location: are located in the pre-cardial mediastinal associated with brachio-cephalic trunk usually they are first and second intercostal Lnn.

Shape: vary in shape and size

Afferent: mediastinum, pleura, heart, trachea esophagus and muscles of shoulder region

Efferent: left side go to thoracic duct and the right side go to jugular vein.

B. Middle mediastinal Lnn.

Location: dorsal to the heart on the aortic arch.

Shape: small group 1-5 Lnn of 1cm

Afferent: from heart, aorta, lung, trachea, esophagus and intercostal Lnn.

Efferent: go to cranial mediastinal Lnn.

C. Caudal mediastinal Lnn.

Location: caudal to the aortic arch.

Shape: few Lnn. Of 10 cm

Afferent: from lung, esophagus, pleura and phrenic Lnn

Efferent: to the middle and cranial mediastinal Ln.

4. Broncholymphocenter

A. Left trachiobronchus Lnn.

Location: on the origin of the apical bronchus

Shape: small group of 8-10 Lnn. of 3-5 cm

Afferent: lung, trachea, heart and plura

Efferent: go to cranial mediastinal Ln.

B. Right trachiobronchus Lnn.

Location: on the origin of right apical bronchus

Shape: small group of Ln 4-6 Ln.

Afferent: lung, trachea, heart and pleura

Efferent: go to middle and cranial mediastinal Lnn.

C. Middle trachiobronchus Lnn.

Location: dorsal to the angle of biforcation of the trachea.

Shape: 9-20 Ln. form mass of 2-4 cm

Afferent: trachea, heart and pleura

Efferent: middle and cranial mediastinal Lnn.

D. Pulmonary Lnn.

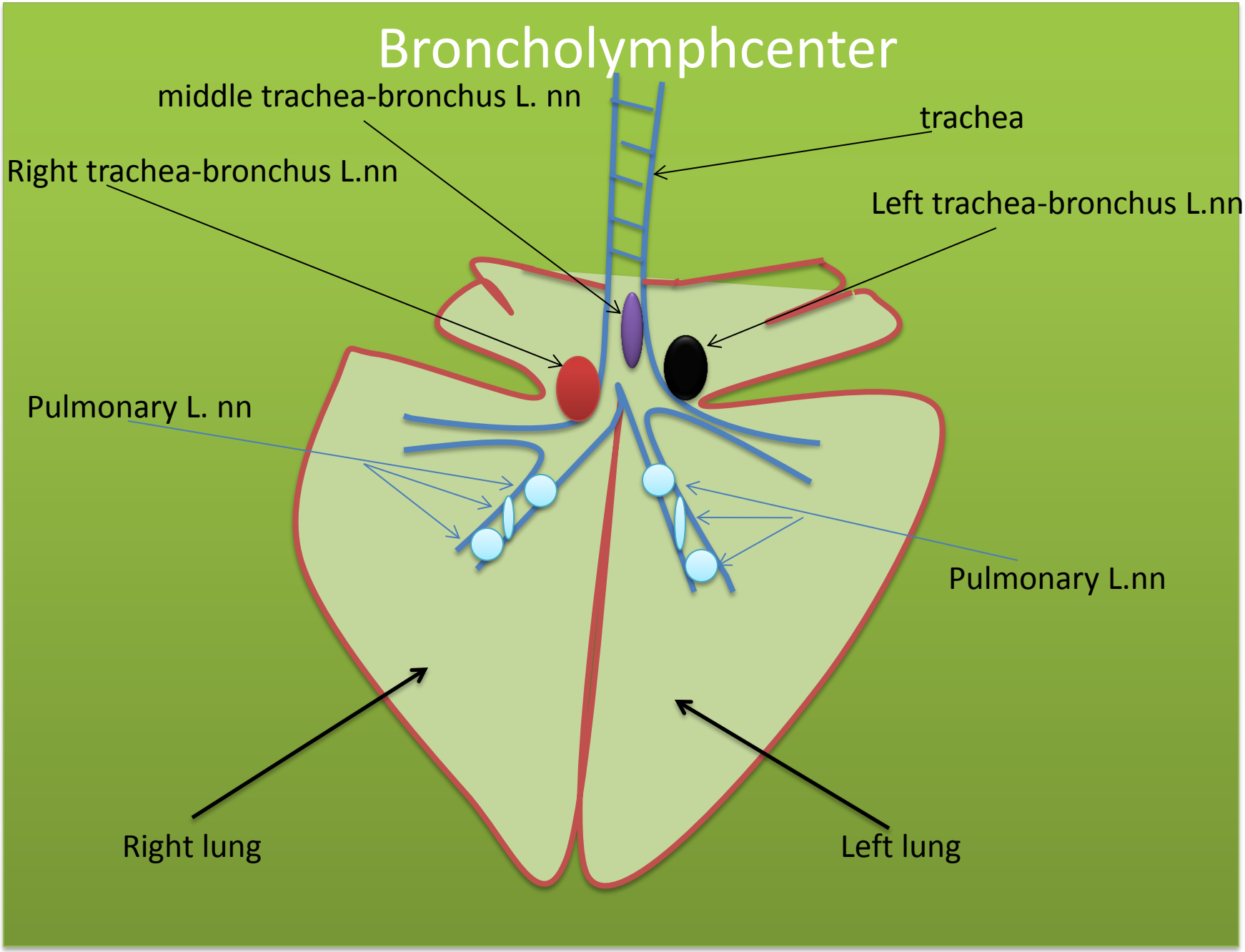
Location: carouse on the bronchus

Shape: small nodules

Afferent: from the lung

Efferent: trachiobronchus Lnn.

Broncholymphcenter



Lymphocenters of the abdominal and pelvic wall

1. Lumber lymphocenters

A. Lumber aorta Lnn.

Location: along the Crouse of the abdominal aorta from the kidney to cranial deep cercumflex artery.

Shape: small nodules

Afferent: from the peritoneum

Efferent: go to lumber aortic Ln.

B. Renal lymph nodes.

Location: are associated with the renal vessels and same of them are found at the renal hilus embedded in fatty C.T.

Shape: small lymph node (10-18)

Afferent: from kidney, ureter, adrenal glands.

Efferent: go to lumber aortic Lnn.

C. Ovarian L. nn

Location: on the ovary

Shape: small nodules

Afferent: from the ovary

Efferent: lumber aorta L.nn

2. Ilio sacral lymphocenter

A. Medial iliac L. nn

Location: on the origin of the cranial deep circumflex iliac artery

Shape: 30-35 L. nn about 3-5 cm

Afferent: from the musles of the lumber region

Efferent: to the lateral iliac L. nn.

B. Lateral iliac L. nn.

Location: at the cranial and ventral branch of the cranial deep circumflex artery.

Shape: 4-20 L. nn

Afferent: peritoneum

Efferent: medial iliac L. nn.

C. Sacral Lnn.

Location: on the angle formed by the internal iliac artery

Shape: mass of 5-10 cm

Afferent: from the sex accessory glands

Efferent: go to medial iliac L.n

D. Uterine L.nn

Location: are located on broad ligament of uterus

Shape: small nodules

Afferent: from uterus

Efferent: medial iliac L.nn

D. Obturator L.nn

Location along the crouse of oburator artery

Shape: chain of small nodules

Afferent: from the hip joint and muscles of the thigh

Efferent: go to medial iliac L.nn

F. Anorectal Lnn

this group is divided into:

1. Cranial group (rectal L.nn)

Location: are located on the dorsal surface of the rectum

Shape: chain of small nodules

Afferent: from the rectum and muscles of the pelvic

Efferent: go to caudal mesentery L.nn

2. Caudal group (anal Lnn)

Location: from the dorsal surface of the anus

Shape: group of 3-4 L.nn

Afferent: from anus and rectum

Efferent: go to the medial iliac L.nn

3. Inguinal femoral lymphocenter (superficial inguinal lymphocenter)

A. Superficial inguinal L.nn

In the female they are called mammary L.nn

Location: they are located between the abdominal wall and the udder

Shape: mass of 10-14 cm L.nn

Afferent: from the udder

Efferent: in both sex go to deep inguinal L.nn

In the male called scrotal L.nn

Location: between the abdominal wall and the scrotum

Shape: two group of cranial and caudal to the spermatic cord

Afferent: scrotum, testes, spermatic cord and penis

Efferent: go to deep inguinal L.nn

B. Accessory mammary L.nn

Location: caudal to the mammary gland

Shape: small group

Afferent: udder

Efferent: go to deep inguinal L.nn

C. Sub iliac L.nn (prefemoral L.nn)

Location: cranial to the tenser fascia lata muscle

Shape: mass of 15-20 L.nn

Afferent: muscle of the thigh and abdominal muscle

Efferent: to the medial and lateral iliac Lnn

D. Coxal L.nn

Location: on the medial surface of the hip joint

Shape: small nodule

Afferent: from the hip joint and muscles of the thigh

Efferent: go to lateral; and medial iliac L.nn

Lymphocenter of the abdominal viscera

1. Celiac lymphocenter

A. Celiac L.nn

Location: are located at the origin of the celiac artery

Shape: small group of L. nn

Afferent: stomach, spleen, liver and pancreas

Efferent: celiac trunk

B. Gastric L.nn

Location: along the cross of left gastric artery

Shape: small nodes

Afferent: stomach, omentum and pancreas

Efferent: celiac L.nn

C. spleenic L.nn

Location: along the crouse of spleenic artery

Shape: chain of L.nn

Afferent: spleen, stomach, gastro-spleenic ligament

Efferent: celiac L.nn

D. Hepatic L.nn

Location: along the crouse of hepatic and caudal vena cava

Shape: chain of small nodes

Afferent: liver, pancreas and stomach

Efferent: celiac L.nn

E. Pancreatico-duodenal L.nn

Location: along to the crouse of pancreatico-duodenal artery

Shape: chain of small nodes

Afferent: pancreas and duodenum

Efferent: celiac L.nn

F. Omental L.nn

Location: on the omentum and gastrospleenic ligament

Shape: small node

Afferent: stomach and omentum

Efferent: celiac L.nn

2. Cranial mesenteric lymphocenter

A. Cranial mesentric L.nn

Location: at the origin of the cranial mesentric artery

Shape: small L.nn

Afferent: duodenum, jejunum, ileum, cecum and colon

Efferent: the efferent form the intestinal trunk

B. Jejunal L.nn

Location: are associated with jejunal vessels

Shape: small L.nn

Afferent: from jejunum and ileum

Efferent: go to cranial mesenteric L.nn

C. Cecal L.nn

Location: on the lateral, dorsal and medial band of the cecum

Shape: 500-700 small L.nn

Afferent: cecum and ileum

Efferent: go to cranial mesenteric L.nn

D. Colic L.nn

Location: in the fold between the dorsal and the ventral parts of colon

Shape: 3000-6000 small L.nn

Afferent: great colon (ascending colon) and ileum

Efferent: go to cranial mesenteric L.nn

3. Caudal mesentric lymphocenter

A. Caudal mesenteric L.nn

Location: are associated with the caudal mesenteric artery

Shape: group of L.nn

Afferent: small colon , transverse colon, rectum and peritoneum

Efferent: go to medial iliac or lumber trunk

B. Vesical L.nn

Location: on the lateral ligament of urinary bladder

Shape: group of small L.nn

Afferent: urinary bladder and prostate glands

Efferent: medial iliac L.nn

Lymphocenter of the pelvic limb

A. Iliofemoral (deep inguinal L.C.)

Location: are located at the proximal part of inguinal canal

Shape: elongated group of 8-12 cm

Afferent: skin, muscles of the thigh, pelvic superficial inguinal L.nn

Efferent: go to medial iliac L.nn

B. Popliteal lymphocenter

Location: are located behind the origin of gastrocnemius muscle

Shape: 3-12 L.nn about 3-5 cm

Afferent: skin, muscle of leg and hock, pastern and coffin joints

Efferent: go to deep inguinal L.nn

Lymphocenter of the thoracic limb
* Axillary lymphocenter

A. Proper L.nn

Location: are located caudal to the shoulder joint

Shape: group of 12-20 L.nn formed mass of 3-4 cm

Afferent: from the skin, muscles of the shoulder joint, cubital or elbow joint and skin of the lateral thoracic wall

Efferent: go to axillary L.nn of the first rib and the caudal deep cervical L.nn

B. Axillary L.nn of first rib (in all animals except dog and horse)

Location: are located at the lateral side of the first rib

Shape: mass of 0.5-3 cm

Afferent: from the muscle of thoracic wall and proper axillary L.nn

Efferent: go to the caudal deep cervical L.nn

B. Cubital L.nn

Location: on the medial side of the elbow joint

Afferent: from skin and muscle of distal to L.nn

Efferent: go to proper axillary L.nn

Large lymphatic trunk and ducts

1. Tracheal trunk:

They are large lymphatic vessels located along the lateral surface of the trachea and they are formed by the efferent vessels of the cranial deep cervical L.nn. Also they are receive from the middle deep cervical L.nn. and terminated in the caudal deep cervical L.nn. Then they may be go to the sternal Lnn or thoracic duct or terminate directly to the jugular vein or caudal vena cava.

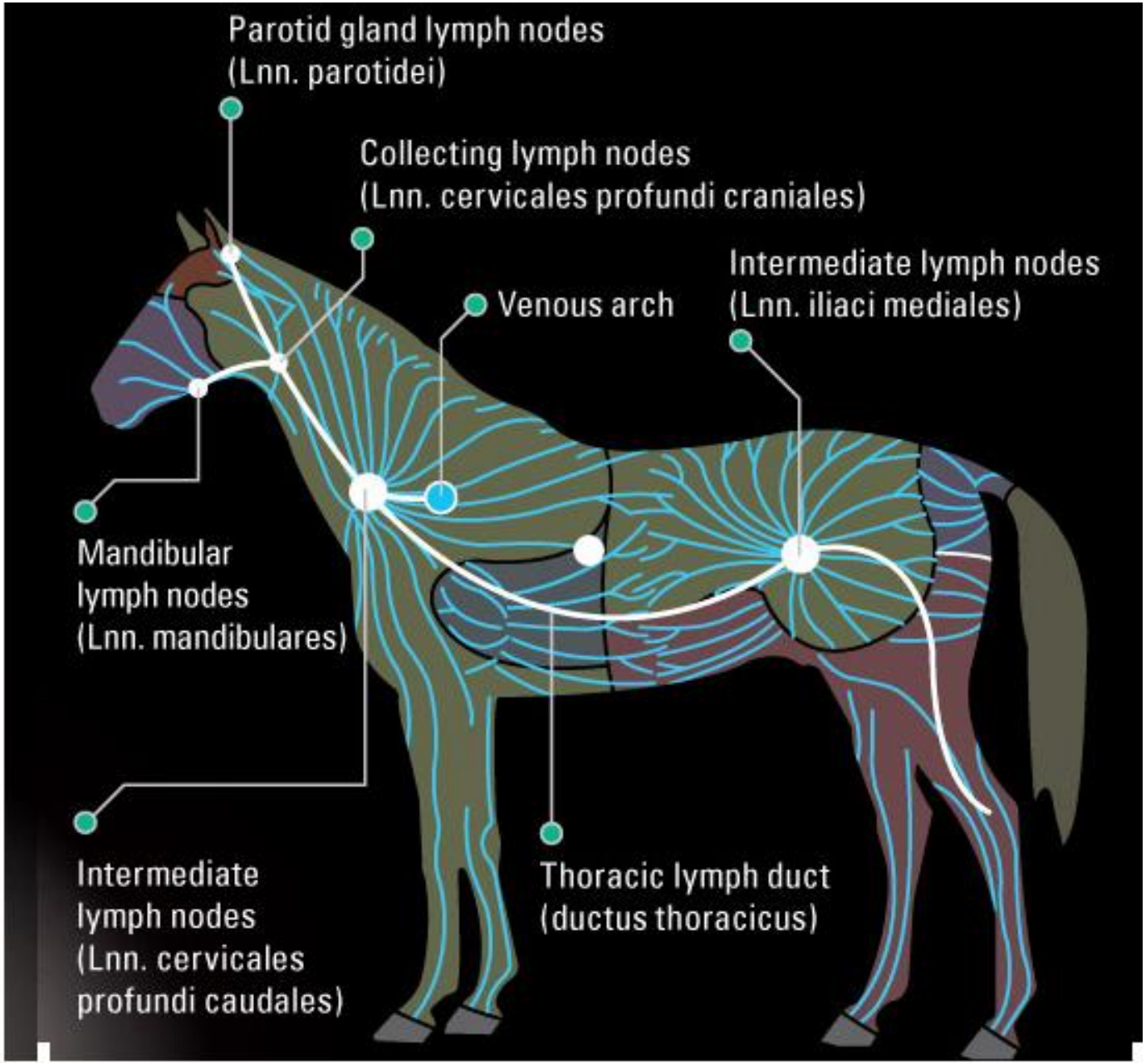
2. Lumber trunk:

They are formed by the efferent vessels of the medial iliac L.nn. , caudal mesentric L.nn. and lumber aortic L.nn. They are unite to form one large trunk of 1cm in width which are located on the ventral surface of the abdominal aorta and terminated in the Cisterna Chyli

3. Cisterna chyli: It is an elongated irregular sac like dilatation of large lymphatic trunk located between the aorta and right crura of diaphragm extend from 2nd to 3rd lumber vertebra to the last thoracic vertebra. It is about 10-18 cm in length and 1.5- 2 cm in width which contain of 2-5 simple or paired valves. It is receive from the lumber trunk, intestinal trunk and celiac trunk.

4. Thoracic duct (trunk)

It is extension of the Cisterna chyli in the thoracic cavity through the aortic hiatus(aorta and thoracic duct pass through the hiatus). The thoracic duct pass cranially and ventrally to opens on the dorsal part of the cranial vena cava.


Parotid gland lymph nodes
(Lnn. parotidei)
Collecting lymph nodes
(Lnn. cervicales profundi craniales)
Venous arch
Intermediate lymph nodes
(Lnn. iliaci mediales)
Mandibular
lymph nodes
(Lnn. mandibulares)
Intermediate
lymph nodes
(Lnn. cervicales
profundi caudales)
Thoracic lymph duct
(ductus thoracicus)

The superficial lymph nodes in animals

1. Parotid L.nn.
2. Mandibular L.nn.
3. Superficial cervical L.nn. (pre scapular L.nn.)
4. Proper axillary L.nn.
5. Axillary of the first rib
6. Cubital L.nn.
7. Superficial inguinal L.nn
   A. scrotal L.nn. (male)
   B. mammary L.nn. (female)
8. Iliofemoral (prefomeral) L.nn.
9. Popliteal L.nn.