Cells to Systems

LECTURE 7

THE BODY PLAN

LECTURER

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INTENDED LEARNING OUTCOMES

At the end of this lecture, you should be able to:

- Identify regions of the body by their anatomical name in domestic and novel species, necessary to communicate in a meaningful way.
- Describe the position and relationships of the major systems in relation to the major bones of the quadruped skeleton and in relation to each other, so they can be found in any animal you are presented with.
- Identify major structures of the major systems by their anatomical name and relative position, to facilitate communication about these body systems.
- Find selected structures from a written description and/or their anatomical name, a necessary skill in a veterinary career, for example to follow instructions to perform a surgery.

KEY WORDS

- Body regions: pectoral limb, pelvic limb, head, neck, thorax, abdomen, pelvis.
- Body cavities: thoracic/abdominal/pelvic
- Relationships of generalised body systems (musculoskeletal, cardiovascular, lymphatic, nervous, integument) and body systems with a restricted range (respiratory, digestive, urinary, reproductive, endocrine).
- Specific structures/organs: heart, aorta, carotid artery, jugular vein, cranial vena cava, caudal vena cava, portal vein, brain, spinal cord, spleen, trachea, lungs, diaphragm, tongue, teeth, oesophagus, liver, stomach, intestines, kidneys, bladder, male and female reproductive tract.

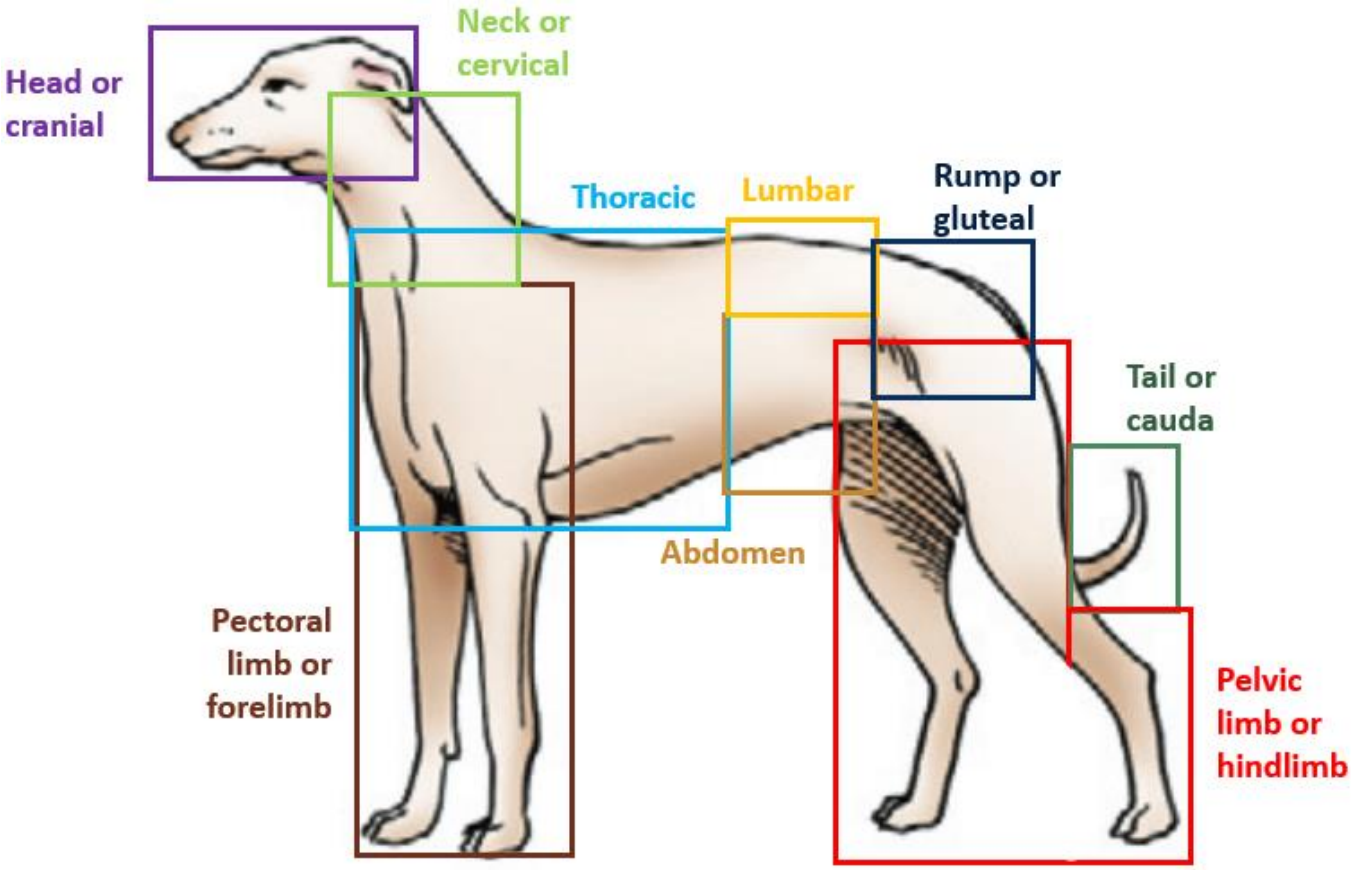
LECTURE NOTES

While the body can be studied by system to better understand function and dysfunction, systemic anatomy neglects how these systems are arranged throughout the body and as a result how they will interact with similarly located structures from other systems. As such, regional anatomy divides the body into smaller sections and examines the integrated systems that function as a whole body.

REGIONAL ANATOMY

The main **body regions** are:

- Head or cranial body region
- Neck or cervical body region
- Thorax or thoracic body region
- Pectoral limb or forelimb body region
- Lumbar body region
- Abdomen or abdominal body region
- Rump or gluteal body region
- Pelvic limb or hindlimb body region
- Tail or cauda body region



The **pectoral limb** or **forelimb** can be further subdivided into:

- Shoulder or scapular region – containing the scapula
- Brachium or brachial region – containing the humerus
- Antebrachium or antebrachial region – containing the ulna and radius
- Carpus or carpal region – containing the carpal bones
- Metacarpus or metacarpal region – containing the metacarpal bones
- Digits or digital region – containing the phalanges
- Manus – the carpus, metacarpus, and digits.

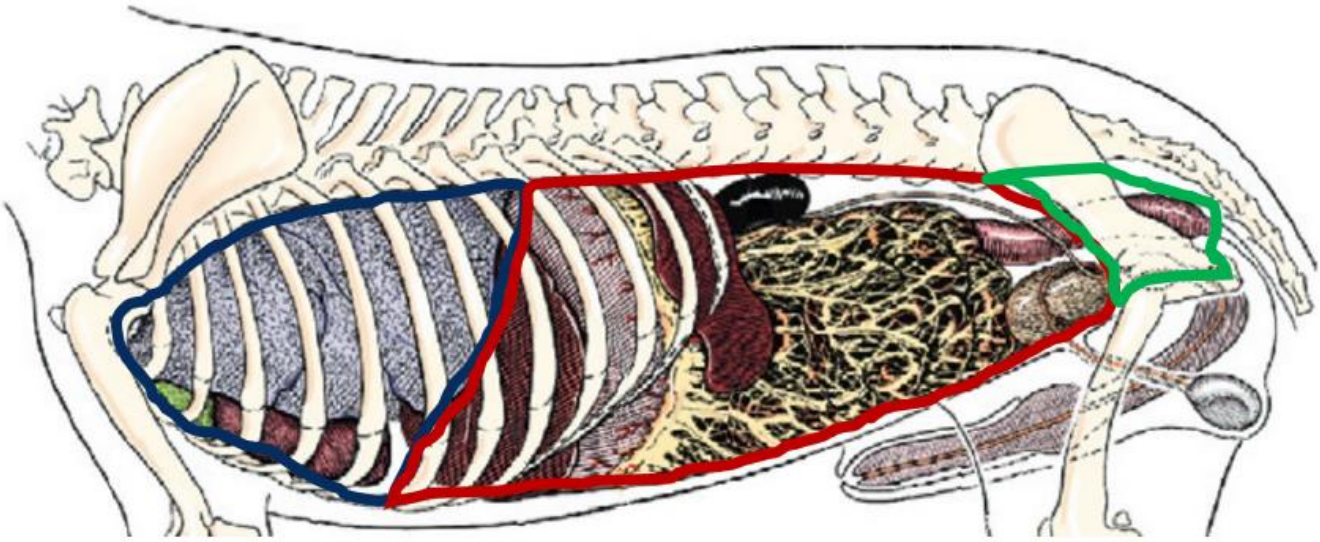
The **pelvic limb** or **hindlimb** can be further subdivided into:

- Rump or gluteal region – containing the pelvis and gluteal muscles
- Thigh or femoral region – containing the femur
- Crus or crural region – containing the tibia and fibula
- Tarsus or tarsal region – containing the tarsal bones
- Metatarsus or metatarsal region – containing the metatarsal bones
- Digits or digital region – containing the phalanges
- Pes – the tarsus, metatarsus, and digits.

Body cavities

The space inside the body can also be divided based on landmarks.

- **Thoracic cavity** – cranial to the diaphragm
- **Abdominal cavity** – caudal to the diaphragm and cranial to the pelvic inlet
    - The pelvic inlet is the space between the most cranial bony landmarks of the pelvic bone
- **Pelvic cavity** – caudal to the pelvic inlet

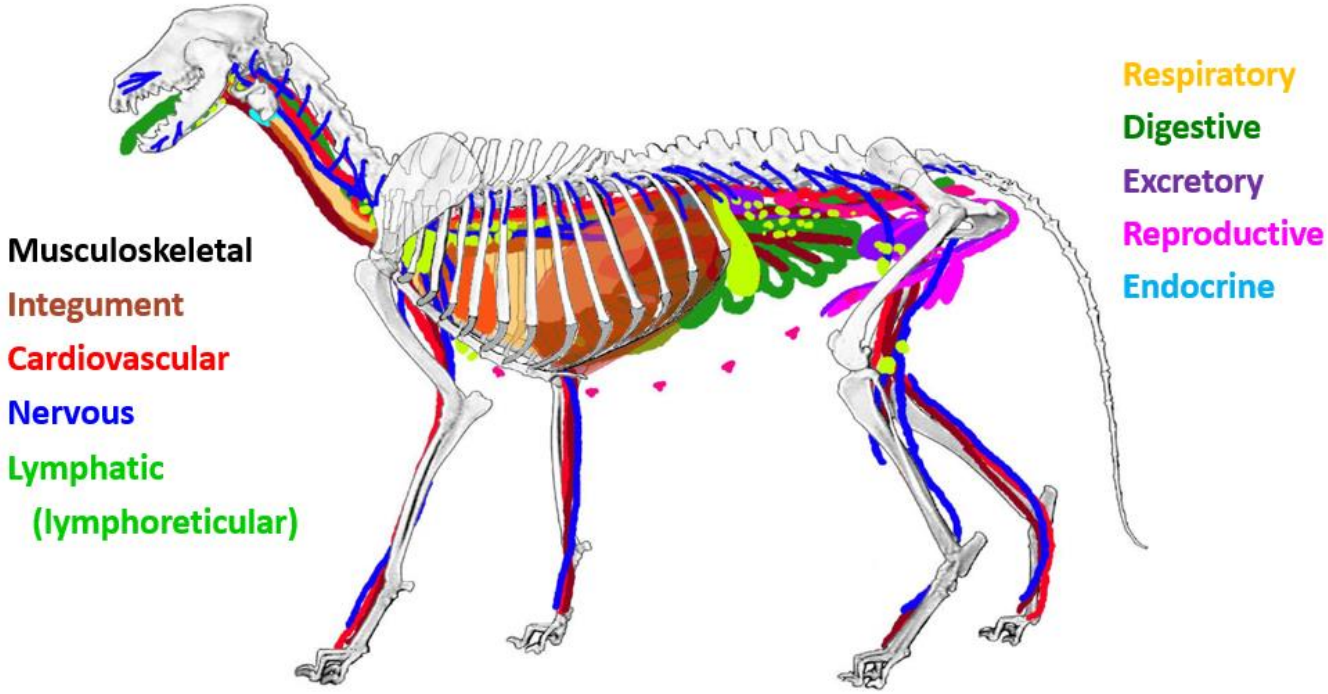


Applying anatomical language

Some tips when using, applying, or reading the anatomical language given in the last three lectures:

1. Work from the known to the unknown
2. Terms based on Latin and Greek roots (see lecture 4 and the lists on Canvas)
    - Dissect words to determine their meaning
    - English also based on these roots, so some word parts will already be familiar
3. Names mostly describe appearance, form, relative position, tissue and/or function
4. Practice is required

SYSTEMIC ANATOMY



Ten systems – 5 general – 5 regional specific

Generalised body systems

There are 5 generalised body systems, which means they are found in all regions of the body.

Musculoskeletal

The musculoskeletal system contains the bones, joints, muscles, tendons, ligaments, and fascia. The skeletal part of the musculoskeletal system was looked at in some detail in lecture 5 of Cells to Systems. This skeleton provides the scaffold to which the muscles and connective tissue structures attach. The muscles layer over this boney scaffold and fill out the integument to provide most of what we recognise as the body shape. Tendons are dense, strong connective tissue structures which connect muscles to bones, while ligaments are composed of similar material but typically connect bones to bones. Fascia are sheets or bands of connective tissue found beneath the skin and around the muscles that attach the muscles to each other and to nearby structures.

Integument

The haired skin covers all of the body and is continuous with the internal mucosal lining at the body openings. The digital pads are highly modified skin structures, evolved to allow animals to run on rough ground without damaging their more delicate haired skin. Other modified skin structures are the claws, and their further modification to hooves, on the most distal ends of each digit, and the nasal plate on the most rostral end of the head surrounding the external nasal opening (external nares).

Cardiovascular

The smallest tubes in the cardiovascular system, the capillaries, permeate every tissue in the body ensuring every cell is supplied with oxygen and nutrients while removing their waste products.

Larger cardiovascular structures of importance are:

- Heart – located in the midline of the cranioventral thorax, generally medial to the 3rd, 4th and 5th ribs
- Aorta – the largest artery, running caudal from the heart in the dorsal thorax and abdomen
- Carotid artery – the artery which runs cranially from the aorta in the ventrolateral neck to supply the brain with oxygenated blood
- Jugular vein – a large vein returning deoxygenated blood from the brain and head. It is also located in the ventrolateral neck, but more ventral and more lateral than the carotid artery
- Cranial vena cava – the jugular vein and the veins returning from the forelimbs combine to form the cranial vena cava, entering the heart from a dorsocranial direction
- Caudal vena cava – the largest vein in the body, returning blood from all caudal structures in the body (except for the digestive tract) and traversing the abdomen and thorax in a dorsal position. It enters the heart from a dorsocaudal direction.
- The portal vein - blood from the digestive tract needs to be processed before entering the general circulation to remove excess nutrients and toxins. The portal vein collects all the digestive tract blood and carries it directly to the liver. 'Portal' comes from the Latin for gateway, so you may think of the portal vein as the gateway of nutrients acquired from digestion into the body.

Nervous system

The nervous system can be divided by location into the **central nervous system (CNS)** and the **peripheral nervous system (PNS)**. The CNS is the brain and the spinal cord, located within the skull and vertebrae of the axial skeleton respectively, and runs the long central axis of the body. The PNS runs out from the CNS throughout the entire body. To do this, the PNS contains many long peripheral nerves. There are also groups of nerve cell bodies found within the PNS, which are called ganglia.
The special senses of taste, smell, sight, and hearing are also important parts of the nervous system.

Lymphatic system (lymphoreticular)

Like capillaries, there are lymphatic ducts draining fluid from every tissue in the body. The largest organ in the lymphatic system is the spleen, usually located in the cranioventral abdomen just caudal to the stomach. Lymph nodes are the other major lymphatic structure. These are localisations of immune cells that monitor what has entered the body through the various body openings or through the skin. Thus there are many lymph nodes in the caudoventral head and at the base of the lungs. The digestive tract also has numerous lymph nodes throughout its length and lymph nodes in the caudoventral body wall monitor the caudal body organs and body openings.

Localised body systems

There are 5 **localised** or regional specific body systems, found in only some regions of the body.

Respiratory System

The respiratory system is only found in the cranial half of the body – in the head, neck, and thorax. The system begins in the nasal passages, passing internally through the maxilla of the skull. The pharynx and larynx connect the nasal passages to the trachea, the long tube lined with cartilage rings that passes through the neck ventral to the vertebral column, close to the ventral midline. In the thorax, the lungs surround the heart on the cranial, dorsal, and lateral sides. The diaphragm, the muscle which divides the thoracic cavity from the abdominal cavity, is fundamental to breathing.

Digestive system

The digestive system is present in many body regions, however, the bulk of the organs are located in the abdominal cavity. The tongue and teeth are located within the mouth in the head. The oesophagus traverses the neck, once again ventral to the vertebral column, close to the ventral midline, in close association with the trachea. The oesophagus continues through the dorsal thorax, before entering the stomach in the cranial abdomen. The liver is located cranial to the stomach, immediately caudal to the diaphragm. The liver processes the blood from the digestive tract, as well as performing many critical metabolic functions. The intestines fill most of the abdominal cavity and the digestive system subject will provide additional details about where each part of the intestines can be located. The final, caudal part of the digestive system travels through the pelvic cavity.

Reproductive system

In anatomy studies, we divide the reproductive organs into two systems historically termed male and female based on the which organs were most often present. It is a simplification to aid general understanding of the systems and their functions but it does not adequately represent all individuals.

Both the anatomically female and male reproductive system is predominantly located in the dorsal abdomen and the pelvic canal, with smaller portions located on the body surface. The female has mammary glands located on both the thoracic and abdominal ventral surface, while the penis in the male extends on the caudal and the caudoventral body wall.

Excretory system

The excretory system, which removes waste from the circulating blood, is far more restricted in location being only found in the abdominal and pelvic cavities. The kidneys are located dorsocranially in the abdomen, just ventral to the lumbar vertebrae. The bladder, the urine storage organ, is in the ventrocaudally abdomen. In anatomically female animal, a broad tube runs from the bladder through the pelvic cavity to take urine from the body. In the anatomically male animal, this tube is much longer and runs through the penis in the position described above.

Endocrine system

The endocrine system contains 5 distinct organs that produce hormones which subsequently circulate through the body. 4 of the endocrine organs are located in the skull or cranial neck (pineal, pituitary, thyroid, parathyroid), while the adrenal gland is located in the dorsocranial abdomen, in close association with the kidneys.

FURTHER READING

Hermanson, de Lahunta & Evans. *Miller and Evans' Anatomy of the Dog* (any edition). Available as an e-book through the University library here.

Evans & de Lahunta. Guide to the Dissection of the Dog (any edition). Link to its' University library page here.

Goody. Dog Anatomy, A pictorial approach to canine structure (2nd edition). Link to its' University library page here.

Singh. *Dyce, Sack & Wensing's Textbook of Veterinary Anatomy* (any edition). Link to its' University library page here.

König & Liebich. *Veterinary Anatomy of Domestic Mammals* (any edition). Link to its' University library page here.

vet-Anatomy, the interactive atlas of veterinary anatomy by IMAIOS. Available through the University library here.