

Veterinary Bioscience: Digestive System



PRACTICAL 8 COMPARATIVE INTESTINES

TEACHING STAFF

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LOCATION

- WEBS (Building 125) Dissection Laboratory (Room B104)

INTENDED LEARNING OUTCOMES

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

- Identify the different parts of the gastrointestinal tracts of the horse, cow, sheep, pig and chicken.
- Compare and contrast the key features of each of these GI tracts.
- Relate these differences to the different diets and mechanisms of digestion utilised by the different species.

SUPPLEMENTARY AND PREPATORY MATERIAL

- **LMS:** A suite of video tutorials is available. These videos should be reviewed **prior** to attending class.
- **OBLA:** Examine the transverse and longitudinal abdominal sections of the horse and sheep in the museum paying particular attention to the location of the liver and its relationship to other viscera.

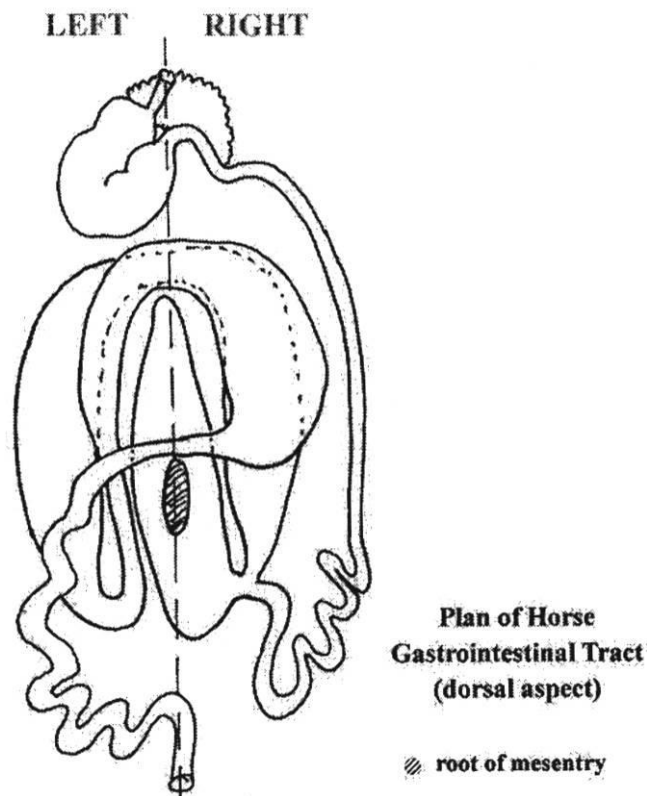
REFERENCES

- Singh. *Dyce, Sack & Wensing's Textbook of Veterinary Anatomy*. 1996. pp 675-688.
- Nickel, Schummer and Seiferle. *The Viscera of the Domestic Mammals*. 1973. pp 148-175.

NB: This practical class will be composed of 5 stations. Each group of approximately 15 students will spend 30 minutes at each station.

STATION 1 - HORSE

Label this diagram as you proceed through your examination of the equine digestive tract.



STOMACH

Small (5-15 litres) relative to size of horse but relatively large in unweaned foal – why?

Located on the left side of abdomen within the ribcage.

The margo plicatus marks the boundary between the non-glandular (continuous with oesophageal mucosa) and glandular (gastric and pyloric) regions of the gastric mucosa.

There is a well developed cardiac sphincter and the oesophagus enters the stomach obliquely – significance?

Note: shape, greater and lesser omenta, greater and lesser curvatures, saccus caecus, fundus, body, pylorus (pyloric antrum, pyloric canal, pyloric sphincter), margo plicatus, rugae.

Q. Can the stomach be assessed during a clinical examination?

SMALL INTESTINE

25 meters in length and unremarkable in appearance. Duodenum and ileum short, the latter having a thicker wall and being firm consistency. Most of the small intestine is located in the left dorsal abdomen

DUODENUM

Note: shape, flexures, major and minor duodenal papillae (openings of bile and pancreatic ducts), hepatoduodenal ligament and contained structures,

JEJUNUM AND ILEUM

The ileum empties into the left ventral aspect of the base of the caecum at the ileal papilla – externally marked by the ileocaecal fold. The ileal papilla comprises smooth muscle and contains a venous plexus.

Note: vessels and mesenteries and the ileocaecal fold.

LARGE INTESTINE

CAECUM

The caecum is 1 meter in length, comma shaped with a capacity of 30 litres. The base is located in the right dorsal abdomen partly against the flank and partly under the ribs. The body runs ventrally then cranially along the abdominal wall. The apex is near the xiphoid cartilage. 4 taenia (with haustra between) run most of the length of the caecum.

Note: Position in the body, shape, base, body, apex taenia, haustra, termination of ileum (ileocaecal orifice), origin of colon (caecocolic orifice), lymph nodes, greater curvature, lesser curvature.

COLON

Large colon = ascending + transverse.

Small colon = descending.

Ascending colon: 4 parallel limbs and 3 flexures

RVC (running adjacent to caecum) (4 taeniae)

➔ sternal flexure

LVC (begins with small diameter but enlarges and remains wide until pelvic flexure) (4 taeniae)

➔ pelvic flexure (small diameter)

LDC (taeniae increase from 1 to 3 along its length_

➔ diaphragmatic flexure

RDC (shortest and widest) (3 taeniae)

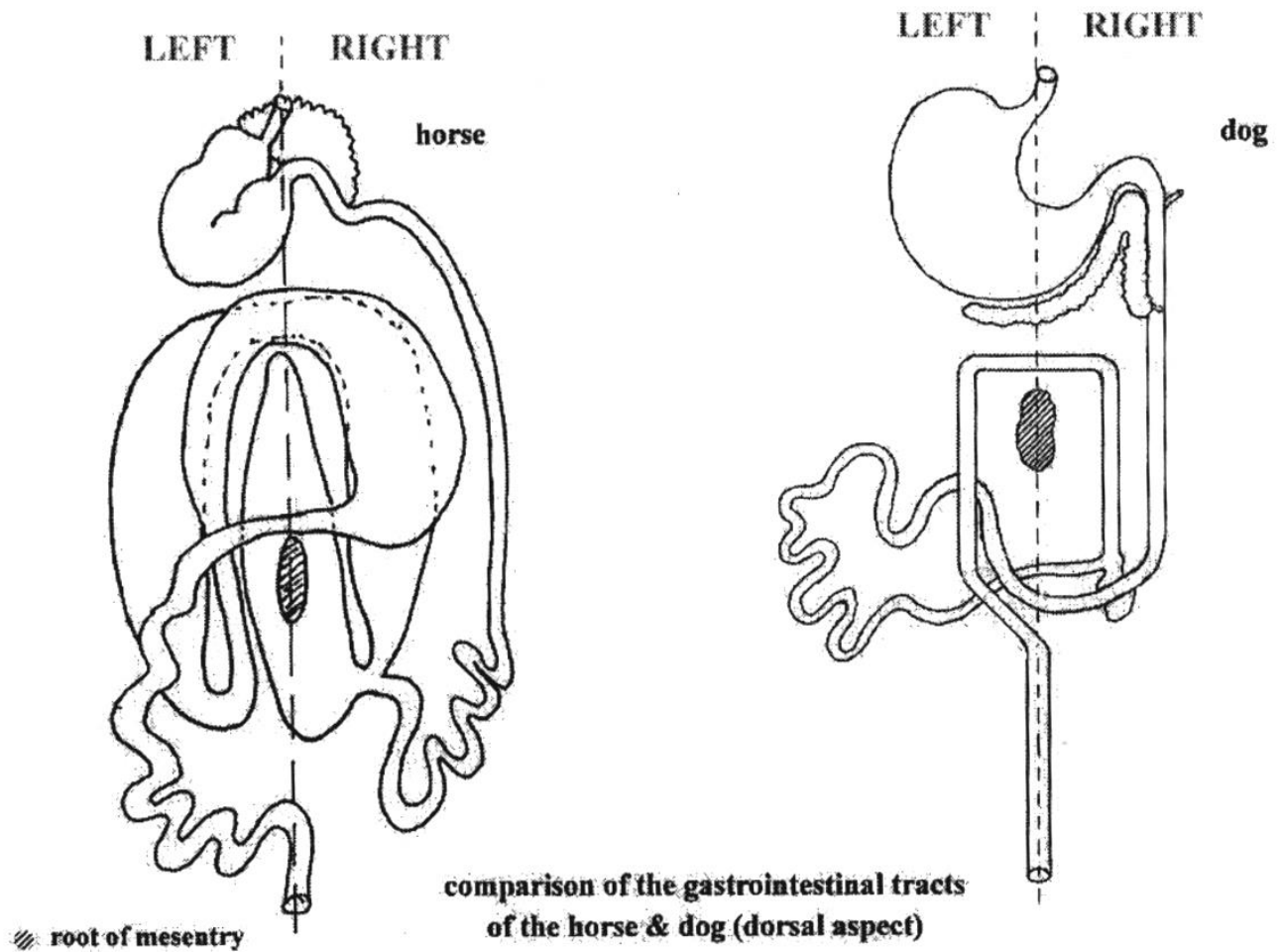
Transverse colon: short and runs from right to left in front of the root of the mesentery.

Descending colon: Long and of many loops. Located in dorsal, caudal and left part of the abdomen. Has 2 taeniae. Rectum – part of descending colon located within the pelvis.

Note: arrangement of the various regions of the colon

- The different parts and flexures
- Taeniae and haustra (numbers on each)
- Mesentery and lymph nodes

Q: Which parts of the equine digestive tract could be examined via rectal palpation?



STATION 2 – COW (AND SHEEP)

STOMACH

Visualise its location in the abdominal cavity; size and relationship of **rumen**, **reticulum**, **omasum** and **abomasum**. The first three compartments are non-glandular and are referred to as the

The is the smallest compartment in small ruminants and the is the smallest compartment in the large ruminants.

Where would a nail or wire be lodged if swallowed?

What would happen?

Capacity – large ruminants measure about 60 litres (rumen, 80%; reticulum, 5%; omasum, 8%; abomasum, 13%); small ruminants measure about 20 litres (rumen, 75%; reticulum, 8%; omasum, 4%; abomasum, 13%).

RUMEN

External features

Parietal and **visceral surfaces**; all the **grooves** (right longitudinal, accessory, coronary, caudal and cranial ruminoreticular) and **sacs** (dorsal, ventral, caudodorsal and caudoventral blind, cranial – very small in sheep and goat).

Note that it is usually difficult to see all the grooves and other features in large animals, but this can be accomplished in a newborn.

Internal features

Pillars – they correspond with the grooves on the outside and they are

Papillae are long in the sacs and are very short or absent in the sacs.

The reason for their poor development in the dorsal region is

The functions of the papillae are

Note **ruminoreticular orifice** and **ruminoreticular fold**.

Q. What are the functions of the rumen?

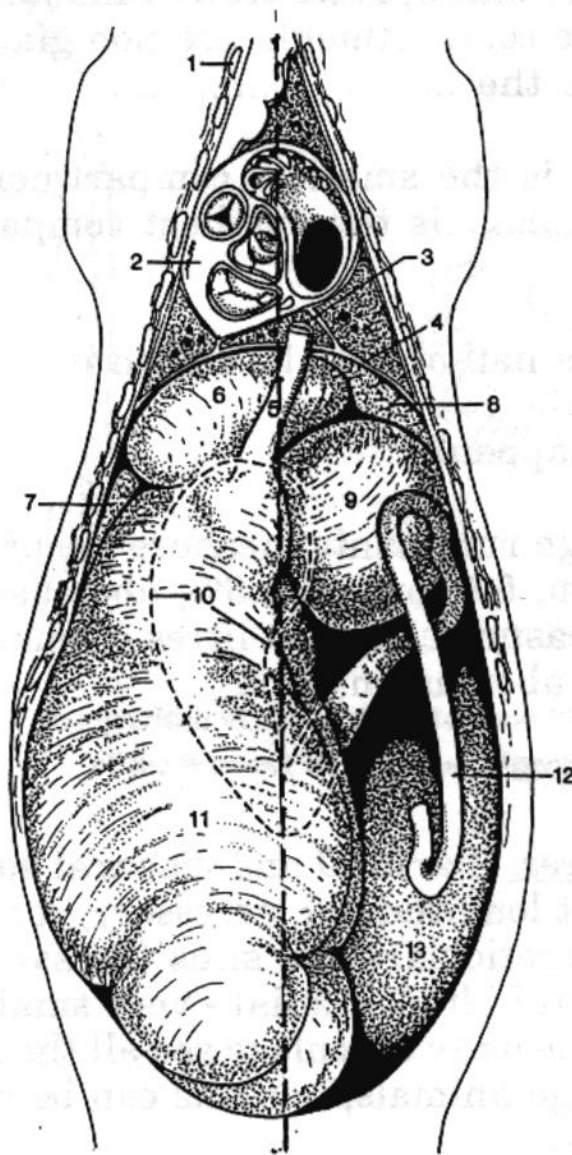


FIGURE 28-12. Dorsal section of the thorax, and dorsal view of the stomach and intestinal mass to illustrate the topography of the thoracic and abdominal organs.

1, First rib; 2, heart sectioned at the level of the valves; 3, accessory lobe of right lung; 4, diaphragm; 5, esophagus; 6, reticulum; 7, spleen; 8, liver; 9, omasum; 10, outline of abomasum; 11, dorsal sac of rumen; 12, descending duodenum; 13, intestinal mass.

Topography of Gastrointestinal Tract of Ruminants

(From Textbook of Veterinary Anatomy; Dyce, Sack, Wensing)

RETICULUM

External features

Is this the smallest compartment in small or large ruminants?

The **cardia** is the opening from the

Internal Features

The **reticular groove** is formed by and it extends from theto the **reticulo-omasal orifice**.

When a newborn drinks milk, in response to in the milk, the reticular groove will

The interior of the reticulum consists of numerous honeycomb-like structures known as and these **cells** are formed by **primary folds** or **ridges**.

Within each cell are **secondary folds** and on the surface of the primary and secondary folds and on the floor of the cells are

The **papillae** serve to increase the surface area for

Q. What are the functions of the reticulum?

OMASUM

External features

Is this the smallest compartment in small or large ruminants?

Internal features

The **omasal groove** is not as prominent as the reticular groove and it extends between the orifice and the.....orifice.

The interior of the omasum is seen with numerous **omasal laminae** which are..... of 4 different sizes and they are arranged in a definite pattern:

The surface of the **omasal laminae** is studded with rough which give them the look of very coarse sandpaper and may be designed to

Q. What is the function of the omasum?

ABOMASUM

External features

This compartment is equivalent to the simple stomach of
and it is glandular.

Internal features

The interior is seen with about a dozen **spiral folds** and the opening into the duodenum is the
.....and closure of this opening is assisted by a knob-like structure
known as.....

Q. What is the function of abomasum?

Q. What is the structure and function of the oesophageal groove?

SMALL INTESTINES

Visualise its location and relationship with other organs.

DUODENUM, JEJUNUM AND ILEUM

External features

Note that the duodenum has a **sigmoid flexure**.

Internal features

The internal surface consists of numerous fine projections, **villi**, which serves to
.....

Major duodenal papilla – What duct(s) open here in the sheep and the ox?
.....

Minor duodenal papilla – What duct(s) open here in the sheep and the ox?
.....

LARGE INTESTINES

CAECUM AND COLON

Note the arrangement of each segment, especially the ascending colon.

Q. Are **Taenia** and **haustra** present?

Q. What are the functions of the large intestine?

.....
.....

Now examine the sheep GI tract.

Q. How do the relative sizes of the different forestomachs differ from the cow?

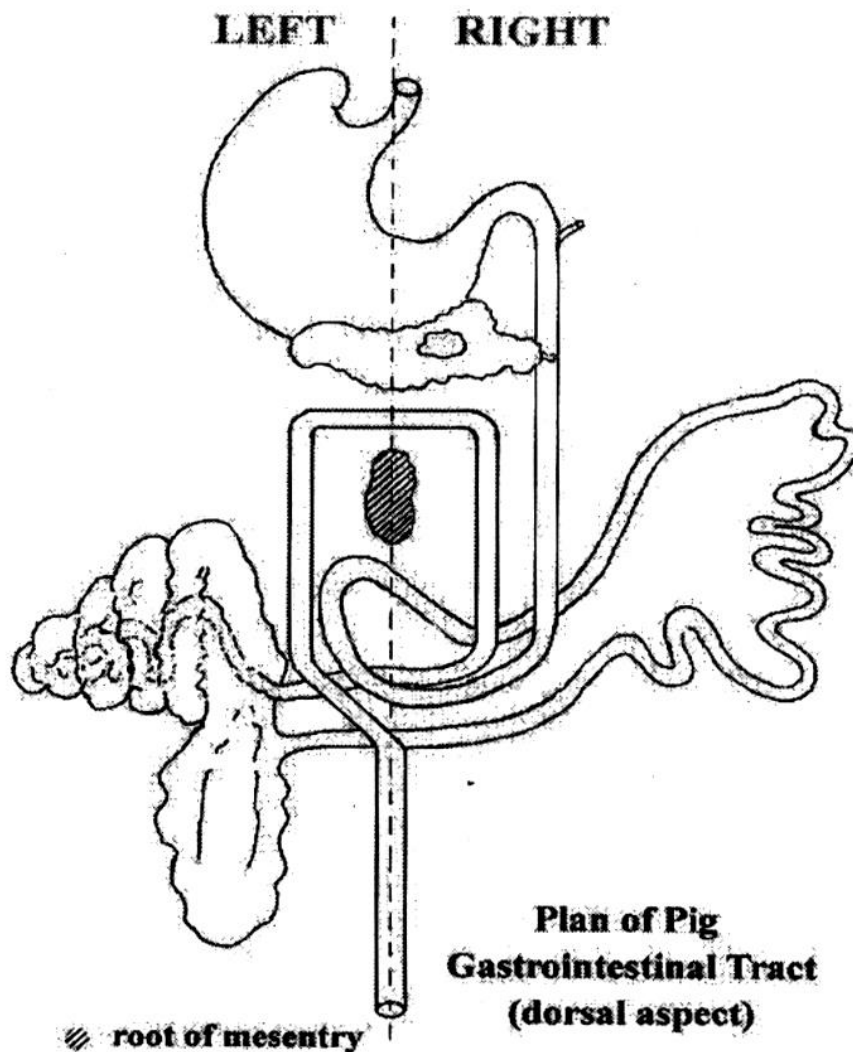
STATION 3 – PIG

The pig is a monogastric omnivore. The porcine gastrointestinal tract is similar in shape and position to that of the dog except for the caecum and ascending colon. The porcine caecum is larger; the ascending colon longer and in the form of a cone comprising two spirals.

Identify the following organs of the porcine gastrointestinal tract and label the diagram below:

Stomach, duodenum, jejunum, ileum, caecum, ascending colon and descending colon.

Also identify the **pancreas**, the **portal vein** and the **major abdominal arteries** if possible.



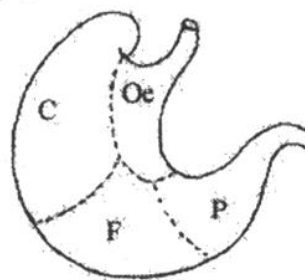
Visualise the organs as if they were in the live animal – elevating the tract by grasping the root of the mesentery and lifting it slightly off the table may assist in this –also refer to the models, diagrams and foetal specimens provided.

Identify the following features of the porcine gastrointestinal organs:

STOMACH

Shape, **greater and lesser curvatures**, **greater and lesser omenta**, **diverticulum ventriculi** (a small pouch protruding caudoventral from the dorsal region of the fundus), **body**, **fundus** and **pylorus** (including the **pyloric sphincter** and **torus pyloricus** (a mound of smooth muscle and adipose tissue protruding into the pyloric lumen)). Note on the internal surface the **non-glandular oesophageal region** around the opening of the oesophagus and the **cardiac**, **fundic** and **pyloric gland regions**. Can you distinguish these different regions in this specimen?

Regions of the gastric mucosa in the pig



Oe oesophageal - very irregular surface

C cardiac gland region - thin, smooth, light red/grey

F fundic gland region - thick, prominent folds, red/brown

P pyloric gland region - less numerous folds, pale pink/yellow

SMALL INTESTINES

DUODENUM

Initially passes caudally to the right of the root of the mesentery, length = 60cm.

Identify, on the mucosal surface, the **major duodenal papilla** a few cm distal to the pylorus. The **minor duodenal papilla** is located a further 9 or 10 cm on but is not always obvious being but a small slit-like opening on the mucosal surface. Its approximate position can be estimated by reference to the pancreatic duct as it leaves the extremity of the right lobe of the pancreas to enter the duodenal wall.

Which ducts open at the respective papillae in the pig?

PANCREAS

Note the colour of this organ and identify the right and left lobes and body with the **annulus pancreaticus**. Which major abdominal blood vessel passes through this opening?

JEJUNUM

Similar to that of the dog. Length = 14 – 19 cm. Observe the position of the **mesenteric lymph nodes**. How do they compare with those of the dog and sheep?

ILEUM

Short terminal section of small intestine. Is the demarcation between jejunum and ileum macroscopically distinct? If not, can you identify the boundary between the jejunum and the ileum by other means? Observe from the mucosal side the entry of the ileum into the large intestine at the caecocolic junction. Note the **ileal papilla** with the **ileal orifice**, **ileal sphincter** and **frenula** either side of the papilla.

LARGE INTESTINES

CAECUM

Note the unremarkable transition from caecum to colon at this site. Observe the **taeniae** (thin muscular bands running longitudinally in the wall) and the **haustra** (rows of sacculations) between them. How many of each is present in this organ?

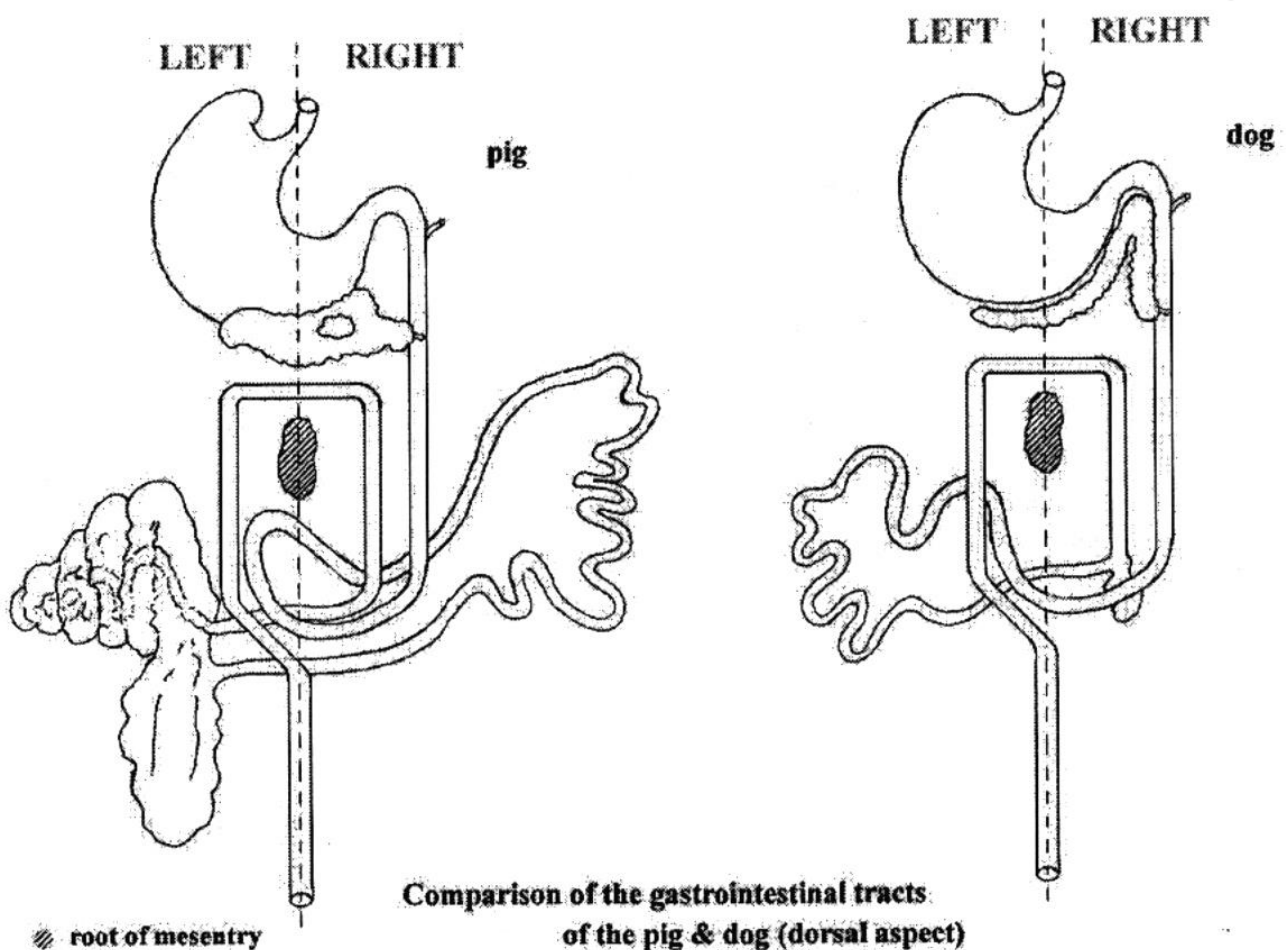
COLON

The ascending colon is formed into a cone; the base is anchored dorsally to the roof of the abdomen while the apex points ventrally and is freely movable within the abdominal cavity.

The initial portion of the **ascending colon** spirals inwards from the base of the cone in a clockwise direction, this part has 2 taeniae and haustra. The distal portion, which has no taeniae and haustra, spirals outwards from the apex in an anti-clockwise direction and back up to the right caudal region of the base of the cone. From here it passes cranially to the right of the root of the mesentery to enter the transverse colon followed by the descending colon.

Can you distinguish the 2 portions of the ascending colon within the spiral?

The **descending colon** is similar to that of the dog in appearance and position.



STATION 4 – FOWL

The following describes the digestive tract (distal to the oropharynx) of the chicken. Note that there is some variation in the anatomy of the digestive tract between avian species, chiefly as a result of adaptation to different diets. These variations are mainly of the form, size or development of the crop, stomach or caeca.

OESOPHAGUS

The **oesophagus** is divided from the oropharynx by a row of papillae caudal to the laryngeal mound. It initially lies dorsal to the trachea but then runs down the neck on the right side of it.

Cranial to the sternum the oesophagus expands to form the **crop**.

Q. What is the function of the crop?

The oesophagus continues into the body cavity where it passes dorsal to the tracheal bifurcation and heart to enter the stomach dorsal to the liver.

STOMACH

The stomach has two parts:

The spindle shaped **proventriculus** is the glandular stomach that secretes HCl, mucus and pepsinogen. It opens into the gizzard via a constriction called the **isthmus**.

The **gizzard** (ventriculus) has a thick muscular wall with a thick lining of a protein-carbohydrate complex called **koilin**. Note the presence of grit within the lumen.

Q. What is the function of the gizzard?

Note the gall bladder lying on the right side dorsal to the liver – this structure is absent in some avian species. Note also the spleen cranial to the gizzard and to the right of the proventriculus.

INTESTINES

The **duodenum** arises from the right side of the gizzard just distal to the isthmus. It makes a long u-shaped loop caudally and follows the caudal curvature of the gizzard. The **pancreas** lies between its descending and ascending limbs. The cystic duct from the gall bladder, the hepatic duct from the liver and the pancreatic ducts empty into the distal end of the ascending duodenum.

The coiled **jejunum** begins distal to the duct openings.

The **ileum** is considered to begin opposite the apices of the caeca and is connected to both caeca along its length by the ileocaecal folds.

The paired **caeca** arise at the ileocolic junction and run cranially, parallel to the ileum.

Q. What is the function of the caeca?

The large intestine/colon and rectum is relatively short and functions to reabsorb water and electrolytes.

The **cloaca** is a chamber that has three divisions separated by annular folds:

- 1) the coprodeum, into which the rectum opens
- 2) the urodeum, into which the oviduct/s (most avians retain only the left ovary and oviduct) or deferent ducts, as well as the ureters, open, and
- 3) the proctodeum, which opens to the exterior at the vent. The bursa of Fabricius, an important lymphoid organ, is located in the dorsal wall of the proctodeum. This is large in young birds but small or absent in adults.

THE FOWL OROPHARYNX

The oropharynx is the cavity that extends from the beak to the oesophagus.

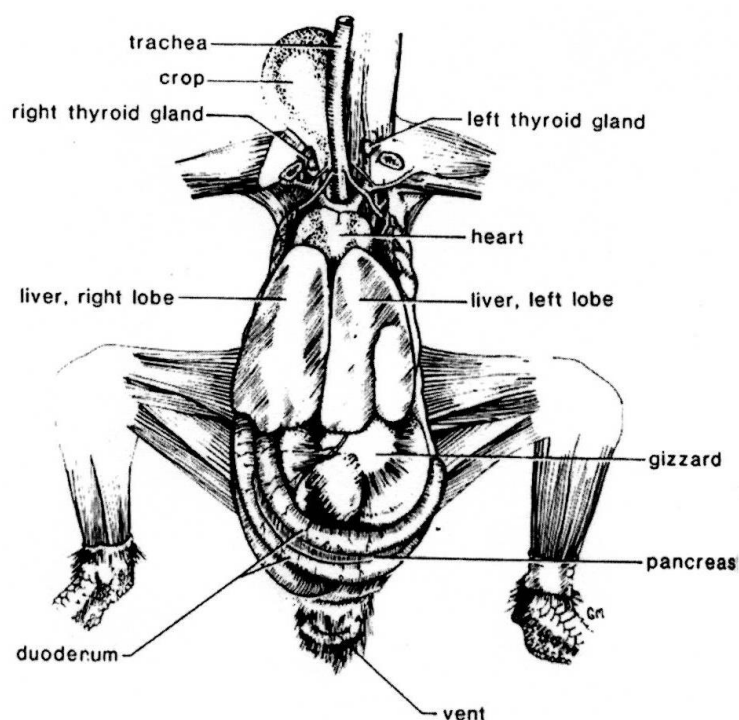
The roof of the oropharynx is formed by the palate. This has a long median cleft (the choana) that connects the oropharynx to the nasal cavity. This closes during swallowing. A shorter more caudal slit in the palate (the infundibular cleft) is the common opening of the auditory tubes.

There are numerous caudally directed papillae on the walls of the oropharynx, along the caudal border of the tongue and demarcating the entrance to the oesophagus.

The tongue lies on the floor of the cavity and is supported by a hyoid apparatus.

Several sets of salivary glands discharge saliva through numerous openings in the walls.

The laryngeal mound caudal to the base of the tongue has a median slit, the glottis, that is the entrance to the larynx. The glottis also closes during swallowing.



Ventral aspect: viscera of domestic fowl (superficial).
From King and McLelland.

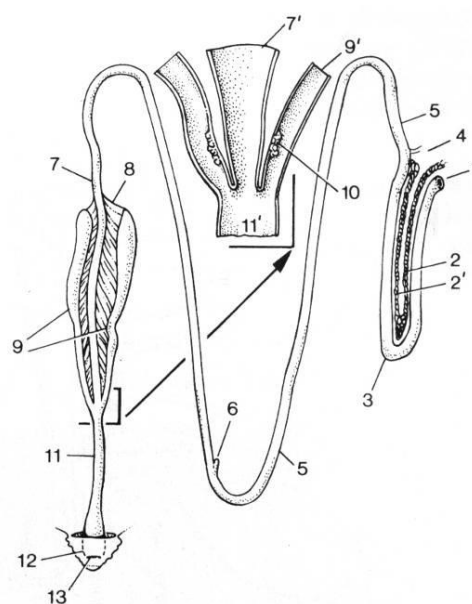


Figure 39-13. Isolated intestinal tract with detail of ileocolic junction.

1, Pylorus; 2, 2', dorsal and ventral lobes of pancreas; 3, duodenal loop; 4, bile and pancreatic ducts entering duodenum; 5, jejunum; 6, vitelline diverticulum; 7, ileum; 7', ileum opened; 8, ileocecal fold; 9, ceca; 9', cecum opened; 10, cecal tonsil; 11, colon; 11', colon opened; 12, cloaca; 13, vent.