

# Veterinary Bioscience: Digestive System



## LECTURE 15 INTESTINES OF THE DOG AND CAT

### INTENDED LEARNING OUTCOMES

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

- Describe the gross anatomy of the small and large intestines of the dog and cat, including their course and position in the body and relationships to other organs.
- Describe the gross anatomy of the anal canal and the clinical importance of the anal sacs.
- Describe the gross anatomy of the pancreas of the dog and cat.

### OVERVIEW

The **intestine** commences at the **pylorus** of the stomach and extends to the **anus**.

It is divided into the **small intestine (proximally)** and the **large intestine (distally)**.

The **boundary** between the two parts is distinguished by the presence of a blind diverticulum - the **caecum** - at the origin of the large intestine.

The **small intestine** consists of **three parts**:

- An initial **duodenum**, which is **short** and quite **closely fixed in position**.
- The **jejunum** and **ileum**, which are carried by the **great mesentery**.

The **large intestine** also comprises **three parts**:

- The proximal blind ending **caecum**.
- The **colon**, which forms the greater length of the large intestine, and
- The **rectum**, which arbitrarily begins at the pelvic inlet and runs to join the short **anal canal**.

The **length of the intestine is related to diet**. The dog (**carnivore**) has a **relatively short** gut, about 3-4 times its body length. (The intestinal length in **herbivores** varies with the gastrointestinal adaptation, but is usually **very long** - may be up to 25 times the body length in sheep; see lecture on comparative intestinal anatomy).

## SMALL INTESTINE

This is the most convoluted part of the tubular digestive tract. It extends from the **pylorus to the ileo-colic orifice** and it consists of three parts: **duodenum, jejunum** and **ileum**.

### DUODENUM

#### External Features:

- **First part** of the small intestine is very short, ~25cm in the dog (relatively short).
- Located close to the dorsal body wall.
- **U-shaped** with:
  - o **Cranial flexure** – About level with the **right 9<sup>th</sup> intercostal space**. Runs from the pylorus, passes dorsally and to the right, **against the visceral surface of the liver** before deflecting caudally.
  - o **Descending portion** – Follows the **right body wall**, where it is related:
    - dorsally to the right lobe of the **pancreas**
    - ventrally to the jejunal mass
    - medially to the ascending colon and caecum
  - o **Caudal flexure** – **Passes medially behind the root of the mesentery** about level with the **tuber coxae**. Closely anchored to the abdominal roof.
  - o **Ascending portion** – **Tightly anchored** by the **mesoduodenum**. Passes cranially close to the midline for a short distance. It is between the descending colon on the left and the root of the mesentery on the right. Then bends ventrally to **enter the great mesentery** and **continue as the jejunum**.
- **Supporting membranes** are:
  - o **Mesoduodenum** – Attaches the duodenum to the abdominal roof. The mesentery of the descending duodenum begins fairly long but shortens towards the caudal flexure.
  - o **Hepatoduodenal ligament** – Connects the duodenum to the liver. Contains the bile duct, portal vein and hepatic artery.
  - o **Duodenocolic fold** – Fold with a free caudal border that attaches the **caudal flexure** of the duodenum to the descending mesocolon.

#### Internal Features:

- The **pyloric opening** from the stomach
- The **major duodenal papilla**:
  - o Contains the **opening of the bile duct and pancreatic duct**.
  - o A few centimetres distal to the pylorus.
- The minor duodenal papilla:
  - o Contains the **accessory pancreatic duct**.
  - o Opens just distal to the major papilla.

#### Wall structure:

Neither papilla is conspicuous; the remaining internal surface has folds and numerous villi. The wall is composed of the usual four layers, and the functions are further digestion and absorption. Large (Brunner's) glands in the submucosa secrete a protective mucus (particularly in the initial parts of the duodenum).

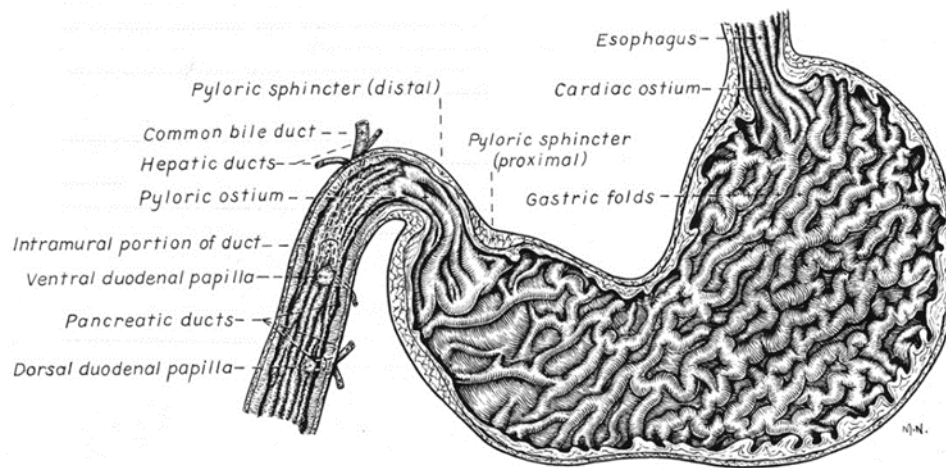


FIG. 13-15. Longitudinal section of stomach and proximal portion of duodenum.

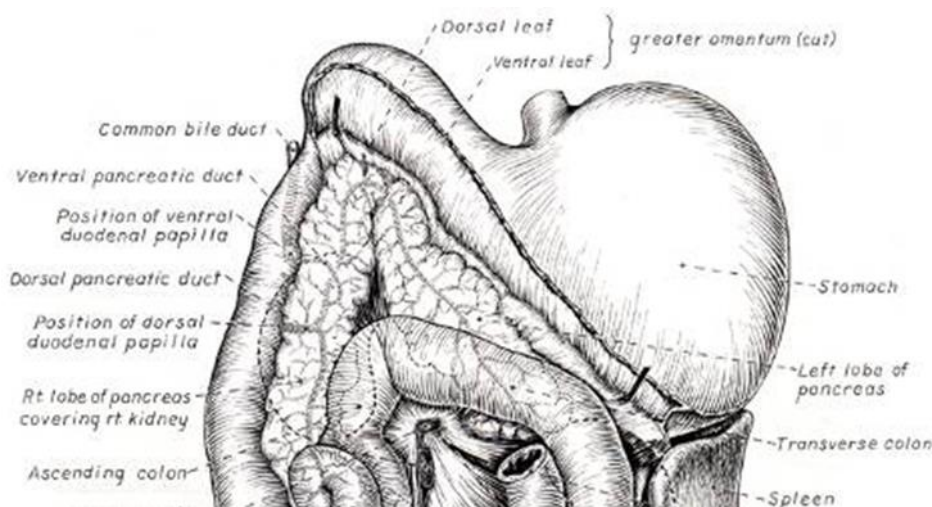
Miller: Anatomy of the Dog.

## PANCREAS

The **pancreas** is closely **related to the duodenum in the dorsal part of the abdomen**.

**External features:** usually **yellowish/pink** in colour. (Resembles a salivary gland in gross morphology, but softer). It is **coarsely lobulated and forms a nodular surface** and has irregular margins.

**Shape forms a V** which lies in very **close association to the cranial flexure of the duodenum**. It is divided into a **body**, a **long slender right lobe** and a **shorter thicker and wider left lobe**. The two lobes **unite at the pancreatic angle** which lies **caudo-medial to the pylorus**.



The **left lobe**:

- **Directed caudomedially**, crosses the median plane behind the stomach and **ends against the left kidney**.
- Enclosed within the **deep leaf of the greater omentum**, where this passes dorsal to the transverse colon.
- **Dorsal surface of the pancreas**, near the pancreatic angle, is **crossed by the portal vein**, as it heads to the porta of the liver to the right of the median plane.

The longer **right lobe**:

- **Directed caudo-dorsally** and **follows the dorsal surface of the descending duodenum** within the mesoduodenum, near or in **contact with the dorsal right flank**.
- Dorsally this lobe is related to the visceral surface of the liver and then to the ventral surface of the right kidney. It lies lateral to the ascending colon and dorsal to the small intestine.

### Duct system:

- Two pancreatic ducts in the dog; one in the cat.
- The dog has a pancreatic duct and an accessory pancreatic duct:
  - o The **pancreatic duct** – In the dog, this ventral duct and the **bile duct** usually have separate openings **on the major duodenal papilla**, 3-6cm distal to the pylorus.
  - o The **accessory pancreatic duct** (usually slightly larger) opens on the opposite aspect of the gut **on the minor duodenal papilla**, 3-5cm further distal.

### Pancreatic blood supply:

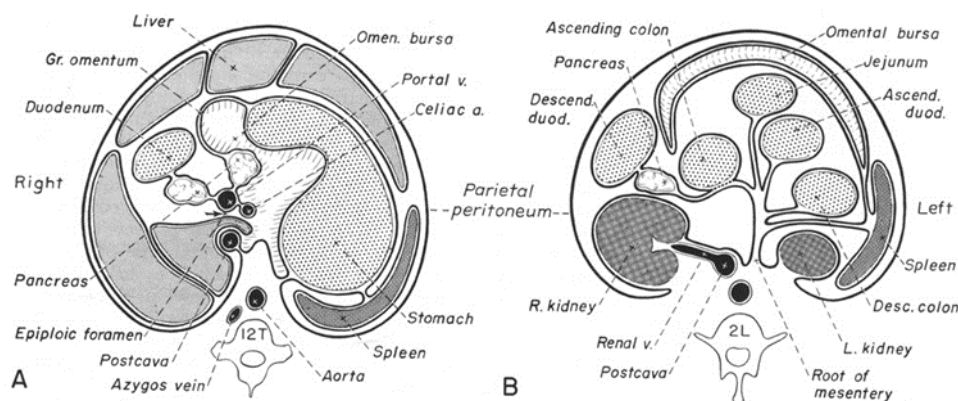
- The **cranial pancreaticoduodenal artery** – a branch of the celiac artery.
- The **caudal pancreaticoduodenal artery** – a branch of the cranial mesenteric artery.
- The veins drain to the **portal vein**.

## JEJUNUM AND ILEUM

Form the bulk of the small intestine, **occupying the ventral part of the abdomen, between the stomach and the bladder**.

### External Features:

- The **jejunum** is the **most convoluted part of the small intestine** and the longest. It begins about level with the root of the mesentery at the duodeno-jejunal flexure.
- The **main part of the ileum is straight and usually contracted**.
  - o The ileum is arbitrary distinguished from the jejunum as the part attached to the **ileocaecal fold**. It ends by opening into the ascending colon at the **ileo-caeco-colic junction** at about the level of the 1<sup>st</sup> or 2<sup>nd</sup> lumbar vertebrae.
- The jejunum and ileum are **supported by a long mesentery** (mesojejunioileum):
  - o Mesentery is gathered at its **root around the origin of the cranial mesenteric artery** from the aorta and fans out to the length of the jejunum and ileum at its distal margin.
  - o Connected with the dorsal abdominal wall by a double layer of peritoneum, between which the **vessels and nerves reach the intestine**.
  - o Allows the gut to slip freely over the abdominal floor in response to respiratory and other movements and to be easily exteriorised during surgery.
- **Ventrally and laterally** the intestinal mass is **covered by the folded greater omentum**. **Cranially** it extends to the **stomach** (separated from it by the deep leaf of the omentum).



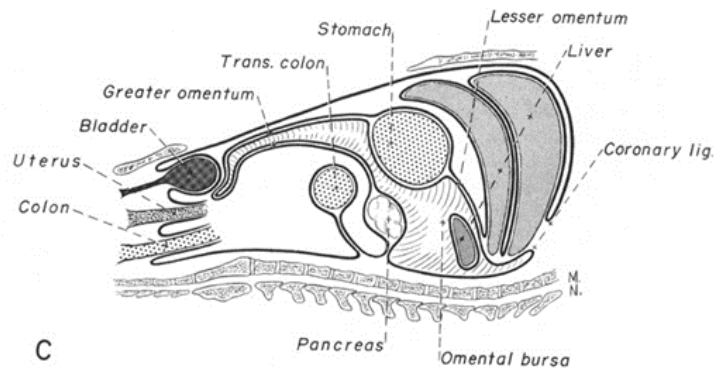


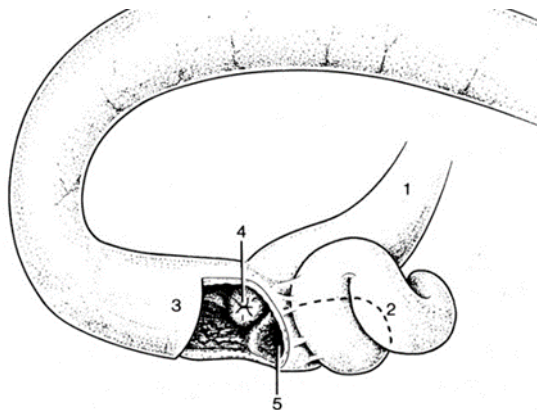
FIG. 13-13. Peritoneal schema.  
A. Transverse section through the epiploic foramen.  
B. Transverse section through the root of the mesentery.  
C. Sagittal section.

Miller: Anatomy of the Dog.

### Internal features:

The luminal surface has a velvety appearance due to the presence of densely packed **intestinal villi** and the presence of mucous secretion from the intestinal glands. Permanent longitudinal and spiral **folids** in the mucosa serve to increase the absorptive area in some species but they are not pronounced in dogs.

The **opening into the colon** – the **ileocolic orifice** – is guarded by the **ileocolic sphincter**.



**Figure 3-45.** The ileocolic junction and its relation to the cecum in the dog.

1, Ileum; 2, cecum; 3, ascending colon; 4, ileal orifice surrounded by annular fold; 5, cecocolic orifice.

Dyce et al: Textbook of Veterinary Anatomy.

Peyer's patches – the larger aggregations of lymphoid nodules in mucosa – may be visible on the luminal surface. In most species they become larger and more numerous in the ileum. (This is debatable in the dog).

**Structure of the wall** – composed of the usual four layers (see histology class for further detail of microscopic anatomy). The serous layer is complete except at the mesenteric edge, where the vessels and nerves enter. The mucosa is soft and velvety and has a greyish or yellowish red colour and is very vascular. The finger-like villi and dense subepithelial capillary plexus greatly increase the area of epithelium available for absorption.

## LARGE INTESTINE

Runs from the termination of the ileum to the anus and has a greater diameter than the small intestine. Consists of different segments: the **caecum**, **colon**, **rectum** and **anal canal**.

The ileum and colon in the dog form a continuous tube that is joined to one side by the caecum, i.e. there is no direct connection between the canine ileum and caecum (This is different to other species).

**Structure of the wall of the large intestine** – Has the same four layers as the rest of the intestine (see histology class for further detail of microscopic anatomy).

**Functions of the large intestine** – It is largely responsible for the absorption of water, some microbial action on the ingesta and the secretion of mucus.

### CAECUM

Usually located to the right of the median plane.

#### External features:

- Located in the **right dorsal quarter of the abdominal cavity**, about level with the most caudal aspect of the costal arch and close to the right kidney.
- Has a **blind ending**.
- Short (~5cm long) and twisted into a spiral (dog)/ comma-shaped (cat).
- The **ileocecal fold** is a fold of peritoneum attaching the caecum to the ileum.

#### Internal features:

- The caecum **opens into the ascending colon** via the **caecocolic orifice**, just distal to the ileocolic junction. The caecocolic orifice is guarded by a circular muscular ring, the **caecocolic sphincter**.

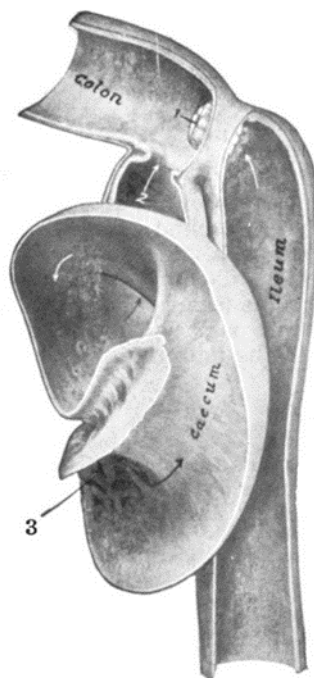


FIGURE 51-18. Sectional view of ileum, cecum, and colon of dog.

1, Ileal opening; 2, cecocolic orifice; 3, apex of cecum.

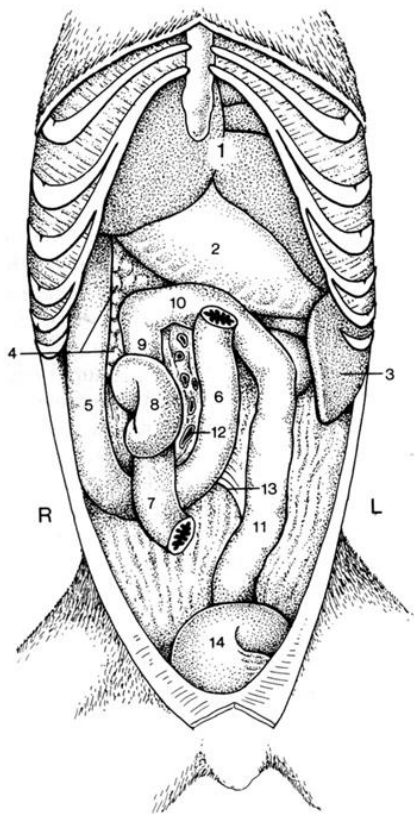
## COLON

### External features:

- Shaped like a question-mark (?) when viewed from ventrally and has three parts:
- **Ascending colon** (5 cm)
  - o Short and tightly fixed, it lies to the right between the descending duodenum and the root of the mesentery.
  - o **Generally makes contact with the pyloric part of the stomach.**
- **Transverse colon** (7 cm)
  - o Passes from **right to left cranial to the root of the mesentery.**
  - o **Ventral to the left lobe of the pancreas.**
  - o It is more loosely attached by its **mesocolon** and dips into the abdomen.
- **Descending colon** (12 cm)
  - o **Longest segment.**
  - o Follows a **nearly straight descent in the left flank.**
  - o Enters the **pelvic inlet dorsal to the bladder** (and uterus).
  - o **Is continued as the rectum.**
  - o Only segment of the large intestine of the dog easily palpated.
- **Supporting membranes** are:
  - o The **mesocolon** and the **duodenocolic fold.**

### Internal features:

- **Ileocolic orifice** is bound by a circular muscular sphincter.



**Figure 14-11.** The canine duodenum, cecum, and colon in situ; ventral view.

1, Liver; 2, stomach; 3, spleen; 4, pancreas; 5, descending duodenum; 6, ascending duodenum; 7, ileum; 8, cecum; 9, 10, 11, ascending, transverse, and descending colon; 12, vessels in root of mesentery; 13, duodenocolic fold; 14, bladder.



## RECTUM

Begins at the **pelvic inlet** and ends at the **anal canal**.

### External features:

- 5 cm long
- **Most dorsal of the pelvic viscera**, suspended by the short **mesorectum**.
- **Terminal end is retroperitoneal**.
- It is bounded:
  - o **dorsally** by the left and right **ventral sacrocaudal (sacroccygeal) muscles**.
  - o **laterally** by the **levator ani muscle**.
  - o **ventrally** by the **vagina in the female** and the **urethra in the male**.

### Internal features:

- Mucosal surface is smooth and there are no villi or permanent folds present.
- There are numerous **solitary lymph nodules** that form **rectal pits** on the mucosa.

## ANAL CANAL

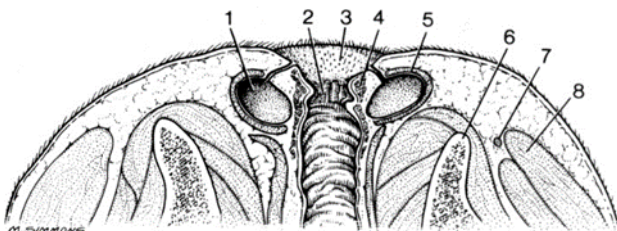
Connects the rectum to the exterior environment.

### External features:

- **Very short** (~1cm) in length.
- **External surface** is covered by **skin** which is thin, hairless and provided with numerous sebaceous and sweat glands – the **circumanal glands**.

### Internal features:

- Lumen is constricted at the **rectoanal junction**.
- The **mucosa is thrown into longitudinal folds**, normally pressed together to occlude the orifice.
- The lumen is kept closed, except during defaecation.
- **Two sphincters are responsible for anal continence**:
  - o **Internal anal sphincter** is a thickening of the inner circular **smooth muscle** layer of the rectum.
  - o **External anal sphincter** is composed of **striated muscle** and is under **voluntary control**.



**Figure 3-46.** Dorsal (horizontal) section through the canine anal canal.

1, Anal sac; 2, columnar zone of the anal canal; 3, cutaneous zone; 4, internal anal sphincter; 5, external anal sphincter; 6, ischium; 7, sacrotuberous ligament; 8, gluteus superficialis.



## ANAL SACS

Two hazelnut-sized sacs on **each side of the anal canal in dogs (and cats)**.

### External features:

- Each sac is **sandwiched between the internal and external anal sphincters**.
- Positioned **ventrolateral to the anus**.
- Are approximately 1 cm diameter.
- Serve as a **reservoir** for a foul-smelling watery to pasty secretion.
- A **single duct from each sac** opens near the **anocutaneous junction**.

### Internal features:

- The **glands of the anal sac** lie in the wall of the sac and open into it.

### Functions:

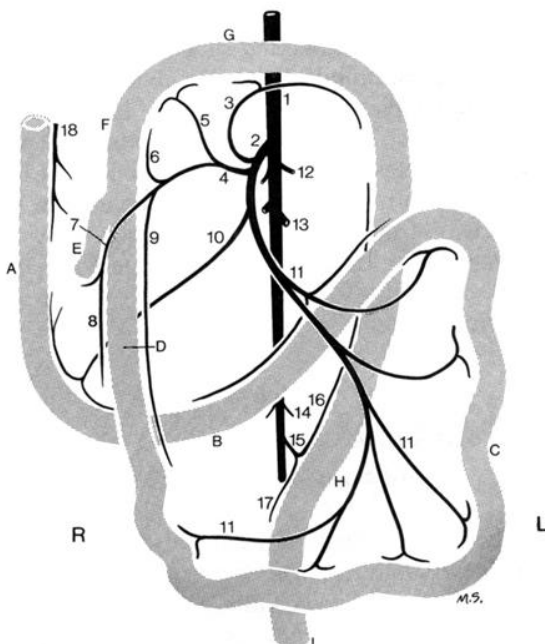
- The sac is compressed at defaecation and the secretion is expelled; It serves as a territorial marker in most carnivores (most notoriously the skunk).
- **Sacs are of clinical importance** – Frequently become enlarged with accumulated secretion and may become abscessed and painful, causing "scooting", constipation. May rupture to the skin surface - 'anal fistulas'.

## BLOOD SUPPLY TO THE INTESTINE

### Arteries:

- The initial part of the **duodenum** is supplied by the hepatic branch of the **celiac artery**.
- The **cranial mesenteric artery** supplies:
  - o The majority of the **small intestine**.
  - o The **ileocecocolic junction** region.
  - o The **mid part of the colon**.
- The smaller **caudal mesenteric artery** supplies the **descending colon** and the **cranial part of the rectum**.
- Branches of the **internal pudendal artery** supply the **caudal part of the rectum and anus**.

Many **anastomoses** ensure that intestines can normally survive the complete obstruction of a major supplying vessel.

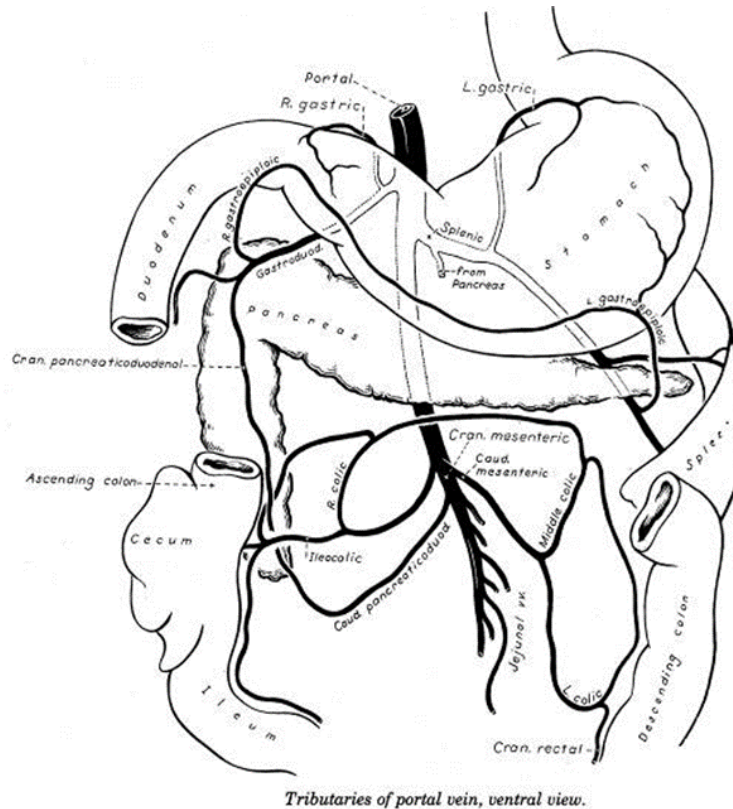


**Figure 14–16.** The blood supply of the intestinal tract, ventral view; schematic. A, Descending duodenum; B, ascending duodenum; C, jejunum; D, ileum; E, cecum; F, ascending colon; G, transverse colon; H, descending colon; I, rectum.

1, Abdominal aorta; 2, cranial mesenteric a.; 3, middle colic a.; 4, ileocolic a.; 5, right colic a.; 6, colic branch of ileocolic a.; 7, cecal a.; 8, antimesenteric ileal branch; 9, mesenteric ileal branch; 10, caudal pancreaticoduodenal a.; 11, jejunal aa.; 12, phrenicoabdominal aa.; 13, renal aa.; 14, testicular (ovarian) aa.; 15, caudal mesenteric a.; 16, left colic a.; 17, cranial rectal a.; 18, cranial pancreaticoduodenal a.

## Veins:

- The veins are generally satellite veins of the companion arteries and join to form the cranial and caudal mesenteric veins, eventually **draining** into the portal system.
- The **portal vein** carries nutrients to the liver where they are metabolised.
- The caudal part of the rectum and anus drain into the internal pudendal veins, eventually draining into the caudal vena cava.



## LYMPHATIC DRAINAGE OF THE INTESTINE

- **Lacteals** – intestinal lymphatic vessels in the mesentery.
- **Lymphatic drainage of the small intestine is especially abundant** – some of the products of digestion are absorbed through the lymphatics. Following a "fatty" meal the lymph is especially milky, making the intestinal lymphatic vessels in the mesentery especially prominent.
- Flow is directed toward the mesenteric lymph nodes, through which the lymph percolates before joining the cisterna chyli – the dilated origin of the thoracic duct. **In the dog the mesenteric lymph nodes are clustered around the root of the mesentery** while in other species they may be more scattered throughout the mesentery.

## NERVE SUPPLY TO THE INTESTINE

- Receive both **sympathetic and parasympathetic nerves**.
- Sympathetic pathways lead through the celiac, cranial mesenteric and caudal mesenteric ganglia. Sympathetic stimulation reduces peristalsis.
- The parasympathetic pathways involve both vagal and pelvic nerves. The vagal nerves supply the intestine to the junction of the transverse and descending parts of the colon. The pelvic nerves supply the descending colon and rectum. The parasympathetic nerves augment peristalsis.
- The nerves supplying the caudal rectum and anal canal come from the pudendal and caudal rectal nerves.

## POINTS TO THINK ABOUT

- The component parts of the small intestine and their position in the abdomen of the dog.
- The position in the canine duodenum of the major and minor duodenal papillae and what structures open on these papillae.
- The gross anatomy of the junction of the terminal ileum with the large intestine of the dog.
- The general position and course of the colon in the abdomen of the dog.
- The external and internal features of the anal canal in the dog.
- The gross anatomy of the anal sacs in the dog and their function and clinical importance.

## FURTHER READING

Singh: *Dyce, Sack & Wensing's Textbook of Veterinary Anatomy*, 5th Ed. Elsevier, 2018.

Boyd: *Color Atlas of Clinical Anatomy of the Dog and Cat*, 2nd Ed. Mosby, 2001.

Getty: *Sisson and Grossman's The Anatomy of the Domestic Animals*, 5<sup>th</sup> Ed. 1975.

Hermanson: *Miller and Evans' Anatomy of the Dog*, 5th Ed. Elsevier 1964.

Smallwood: *A Guided Tour of Veterinary Anatomy*, Saunders, 1992.