

Rum.

The Abdomen



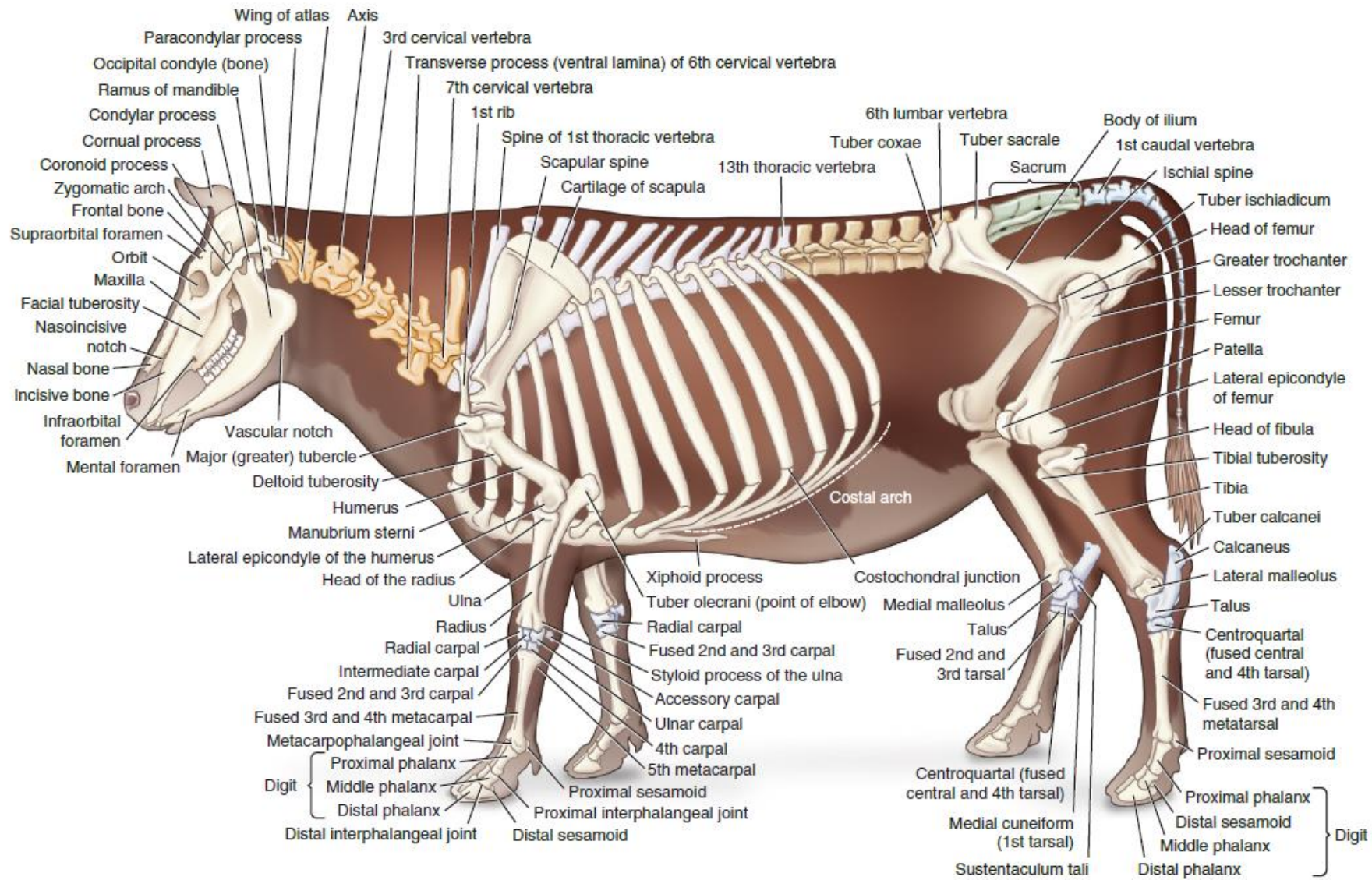


FIG. 5-9 Lateral view of the bovine skeleton. Vertebral column formula: $C_7T_{13}L_6S_5Cd_{18-20}$.

Lumbar Vertebrae

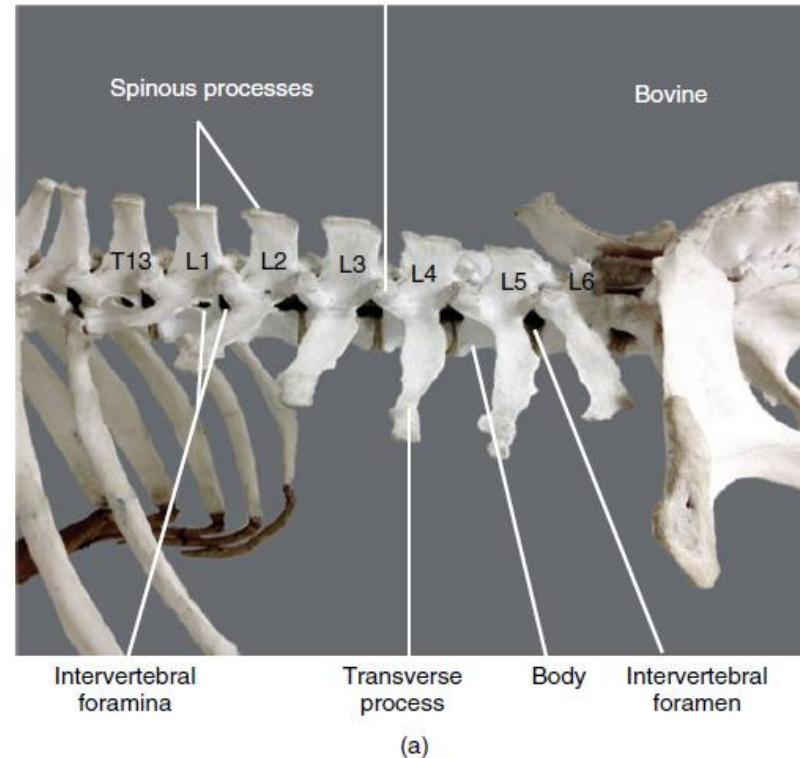
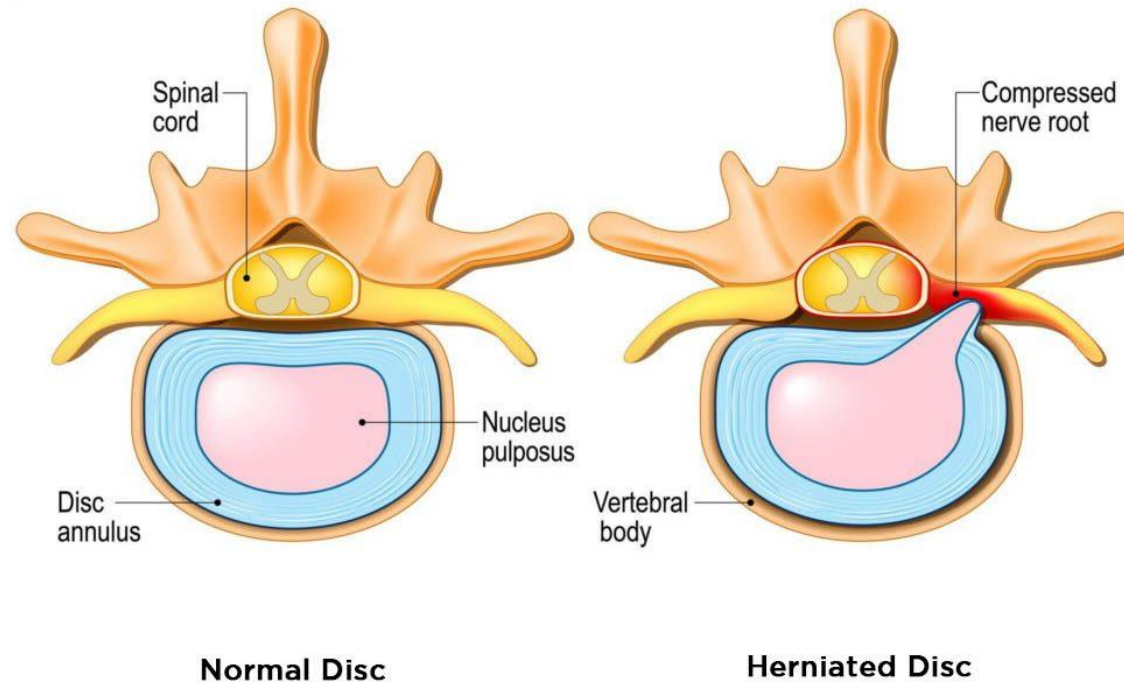


Figure 3.1 (a) Bovine skeleton showing articulated caudal thoracic and L1–L6 lumbar vertebrae. Note the long transverse processes of the lumbar vertebrae compared, for example, to T12–T13 thoracic vertebrae. Note that the intervertebral foramen between L1 and L2 is divided by a small bone into two foramina. Two intervertebral foramina may be present in some parts of the lumbar region. (b) Typical bovine lumbar vertebra: lateral, cranial, and caudal views. The cranial articular processes are deep and face dorsomedially. The caudal articular processes are cylindrical in shape and fit into the groove (articular surfaces) of the cranial articular processes of the caudally located vertebra. On the lateral view, note the formation of a complete intervertebral foramen on this lumbar vertebra. * Body of vertebra.

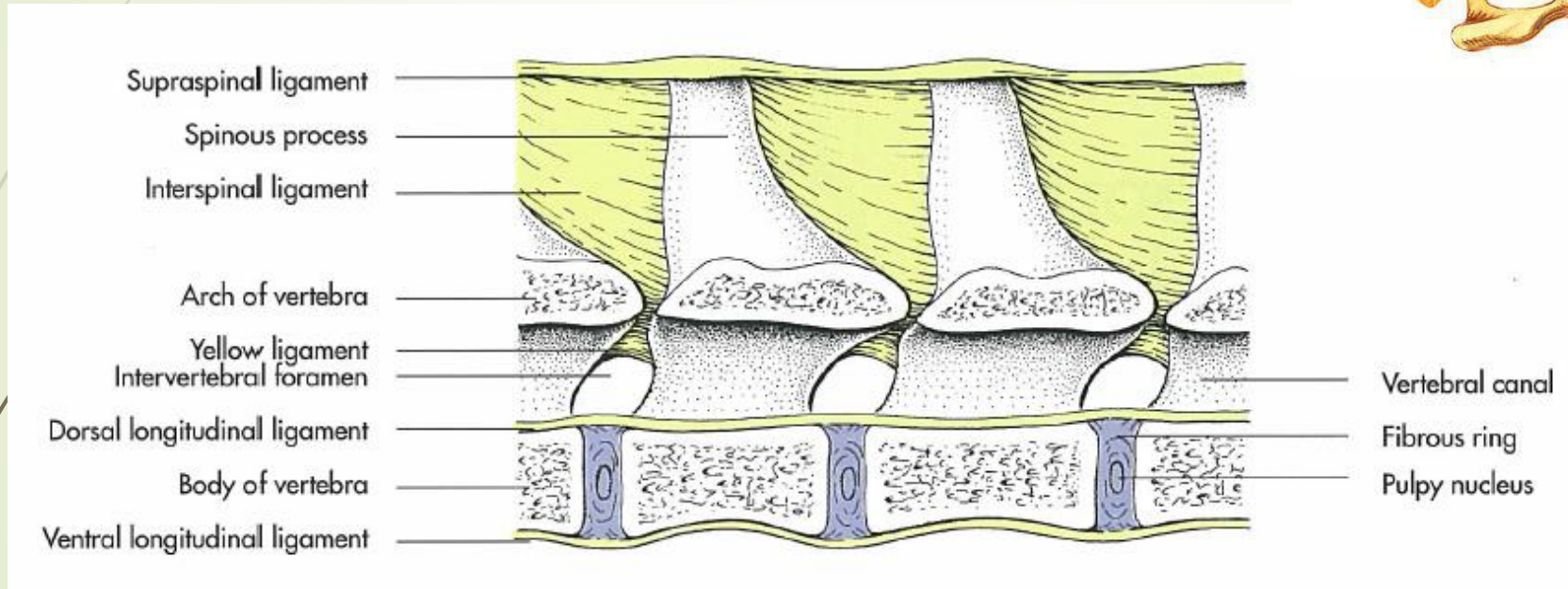
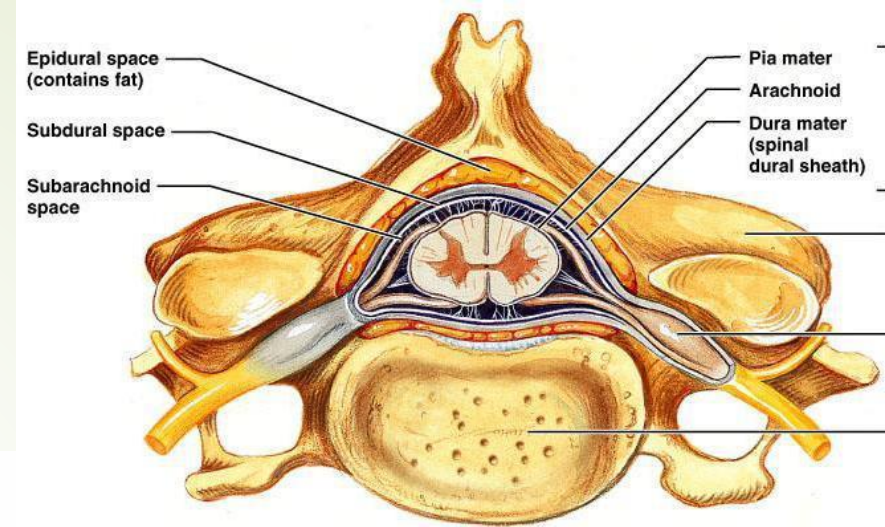
- **The number of lumbar vertebrae varies in small ruminants between five and seven (L1–L5–7). Goats typically have six or seven lumbar vertebrae, four pelvic (sacral), and between four and eight caudal (coccygeal) vertebrae. Cattle have six lumbar vertebrae, five sacral, and a variable number of caudal (tail)vertebrae (~18–20 vertebrae).**

What is a Herniated Disc?



Think of the intervertebral disc as a “jelly donut” where the soft jelly material at the center of the donut represents the nucleus pulposus and the outer dough represents the anulus fibrosus. The nucleus pulposus is the material that oozes out in disc herniation (rupture).

Ligaments of Lumbar Vertebrae



The yellow ligament is pierced or punctured in caudal epidural anesthesia. This procedure involves the injection of local anesthetic into the epidural space through the yellow ligament in the cranial lumbar region between L1 and L2 (flank anesthesia), at the lumbosacral region between L6 and S1 vertebrae (lumbosacral block), or at the tail region between Cd1 and Cd2 vertebrae (tail block). The epidural space is a fat-filled potential space above the dura mater and below the periosteum lining the vertebral canal. Epidural anesthesia is especially performed under clinical conditions associated with dystocia or injuries related to the udder or female and male external genitalia.

Abdominal Muscles

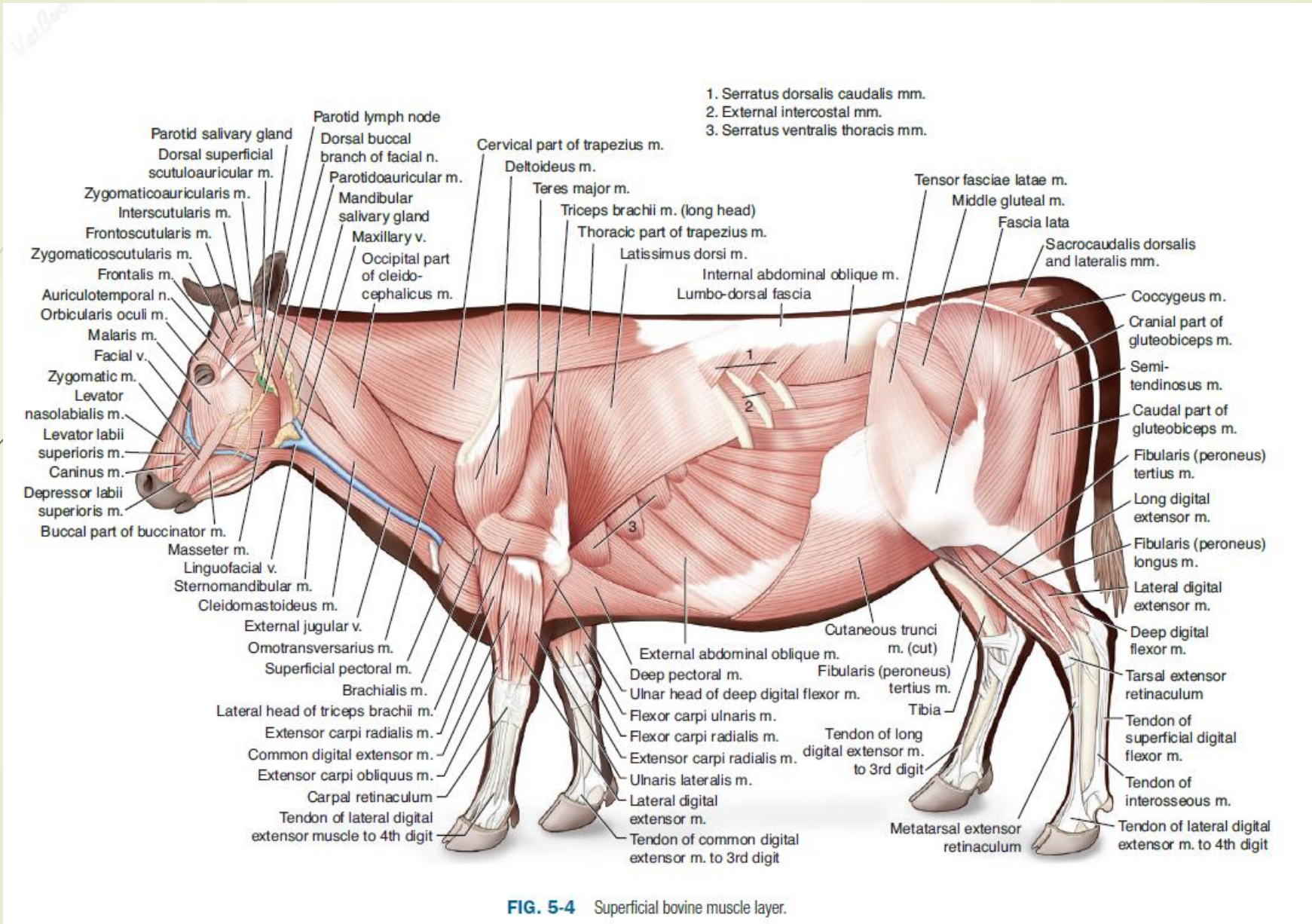
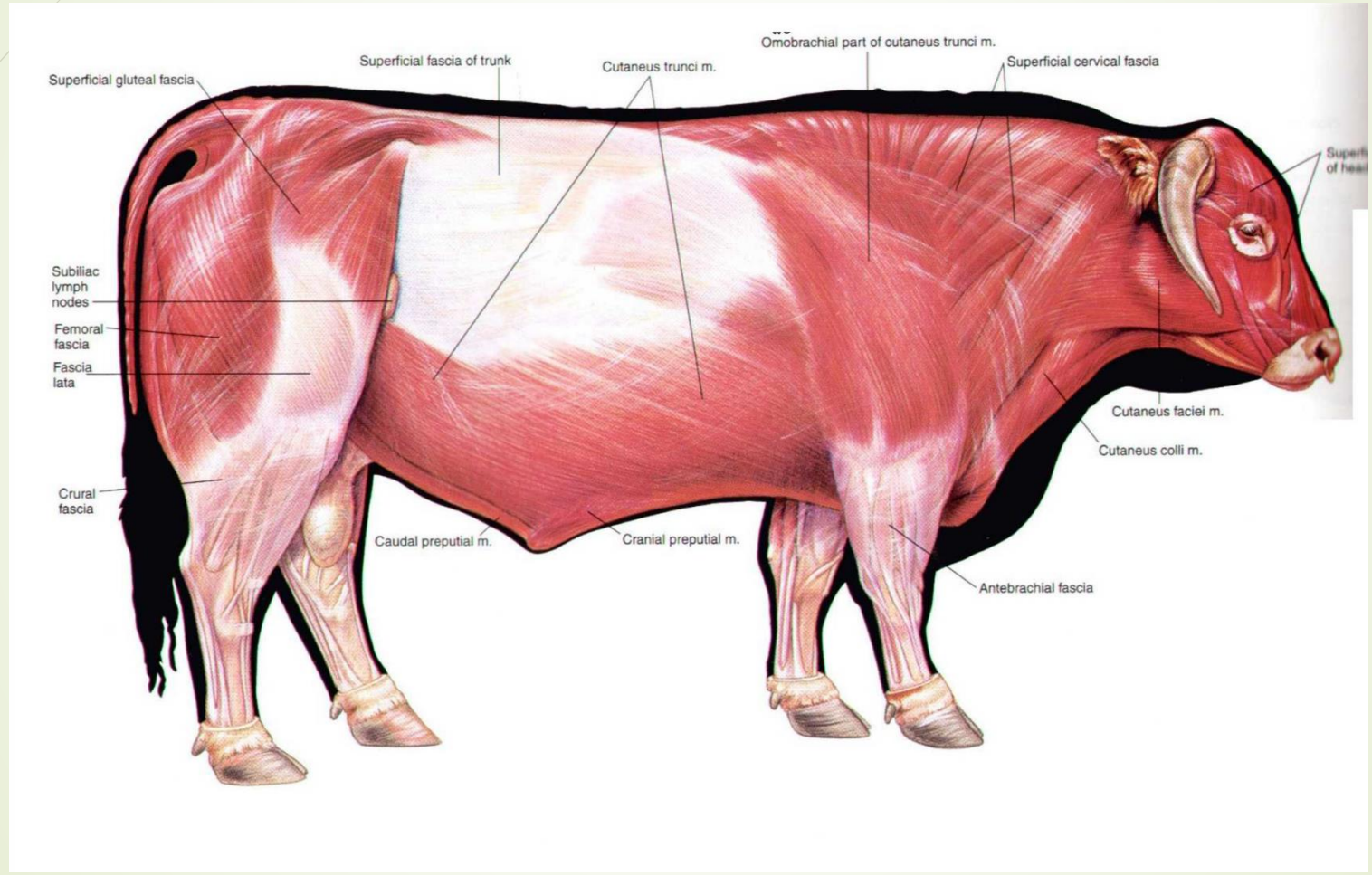
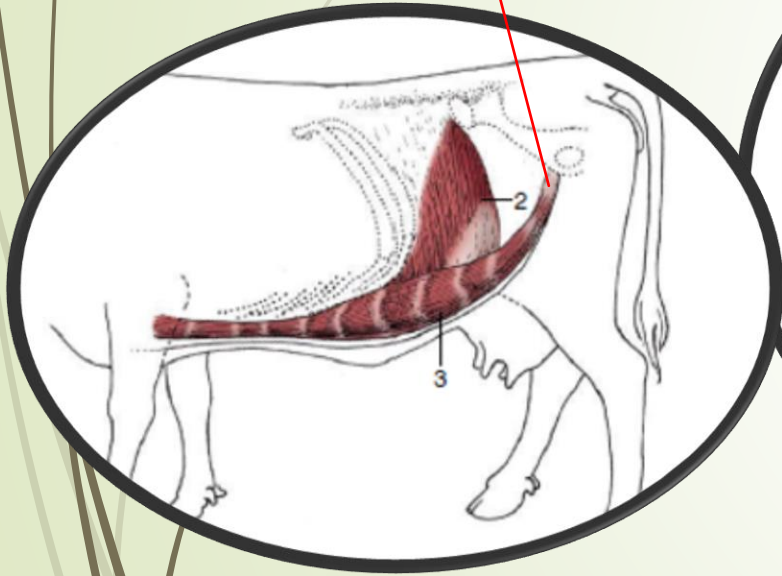


FIG. 5-4 Superficial bovine muscle layer.

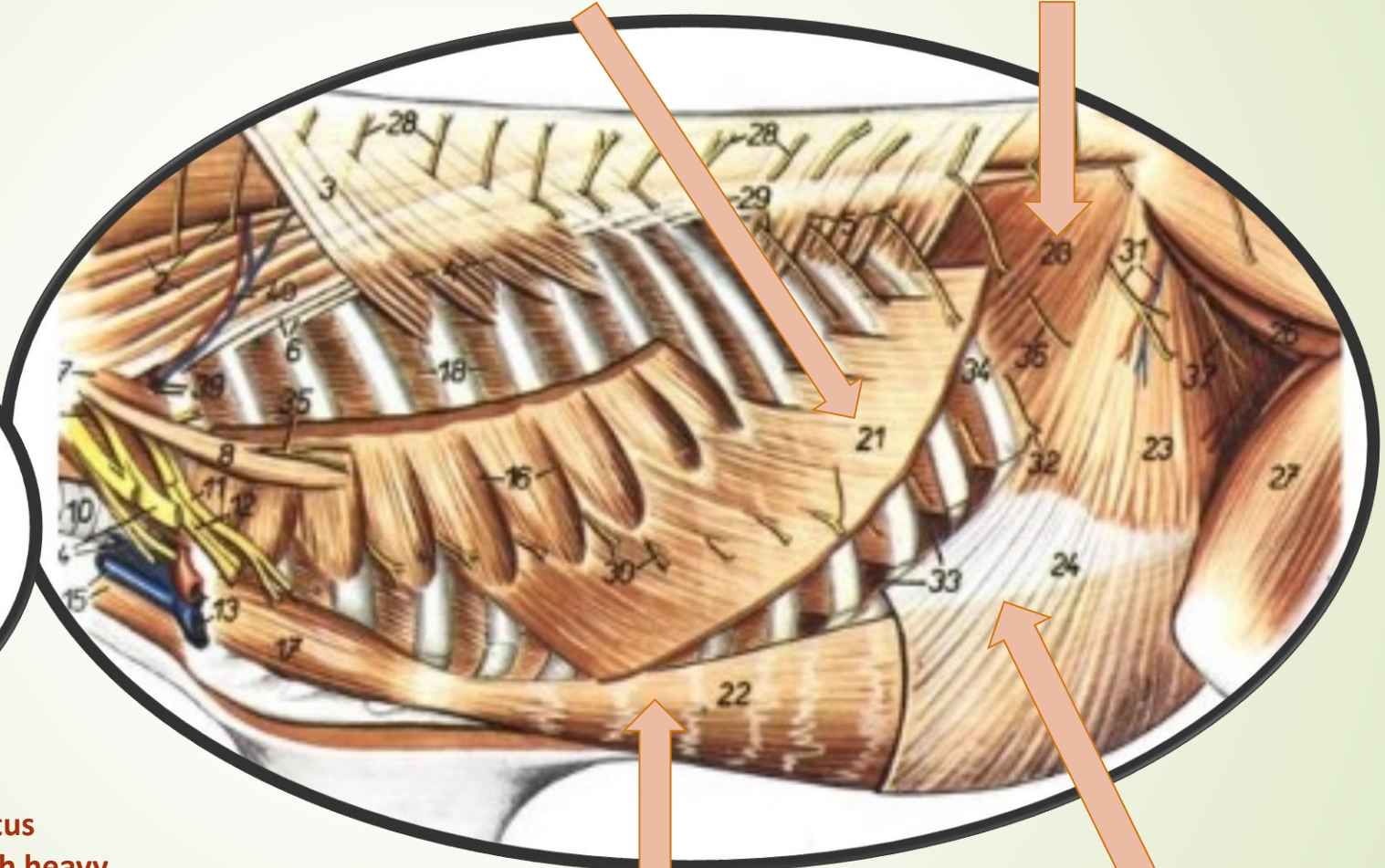


External abdominal oblique M. Transverse abdominal M.

prepubic tendon

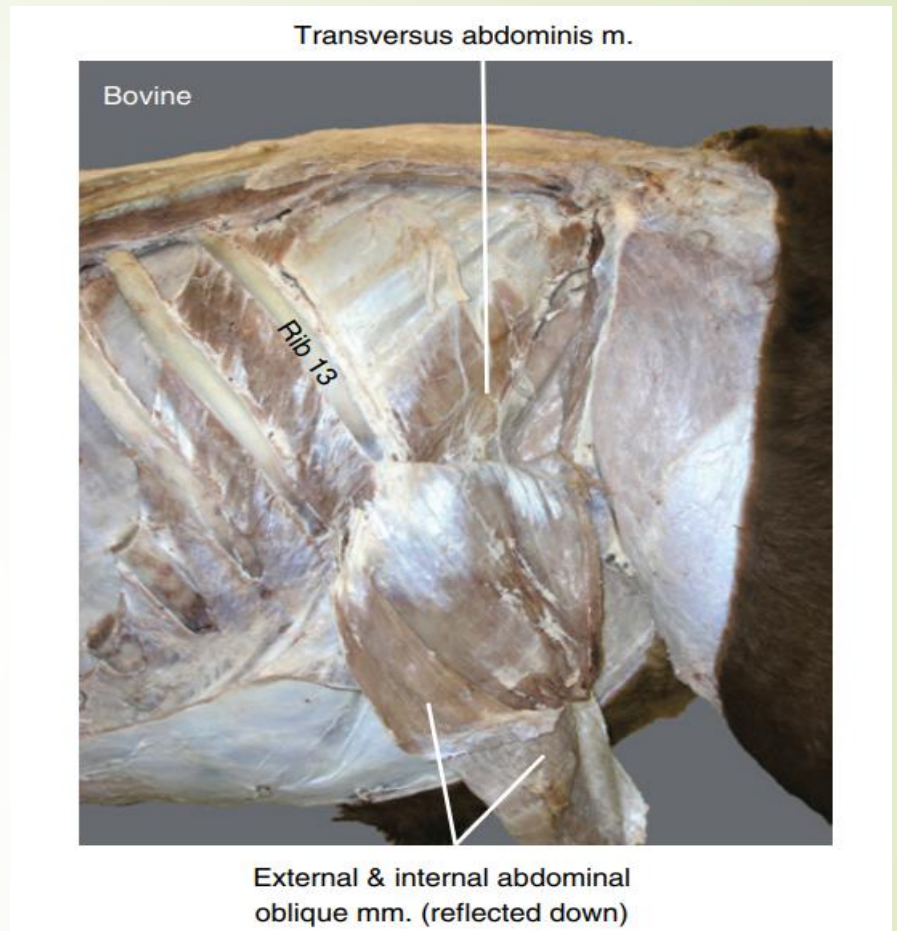
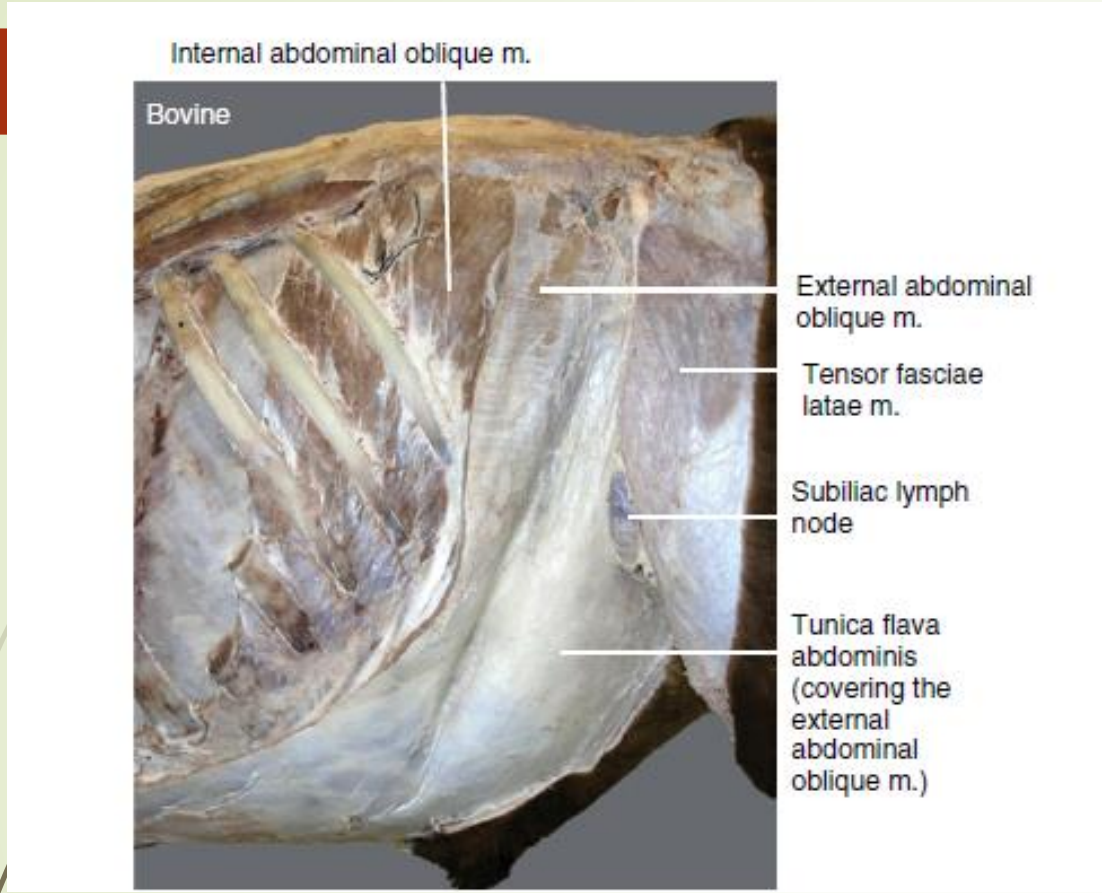


Rupture of the prepubic tendon (Rectus abdominalis) is reported in cows with heavy belly weight, resulting from twin pregnancy, which is an undesirable and rare situation.

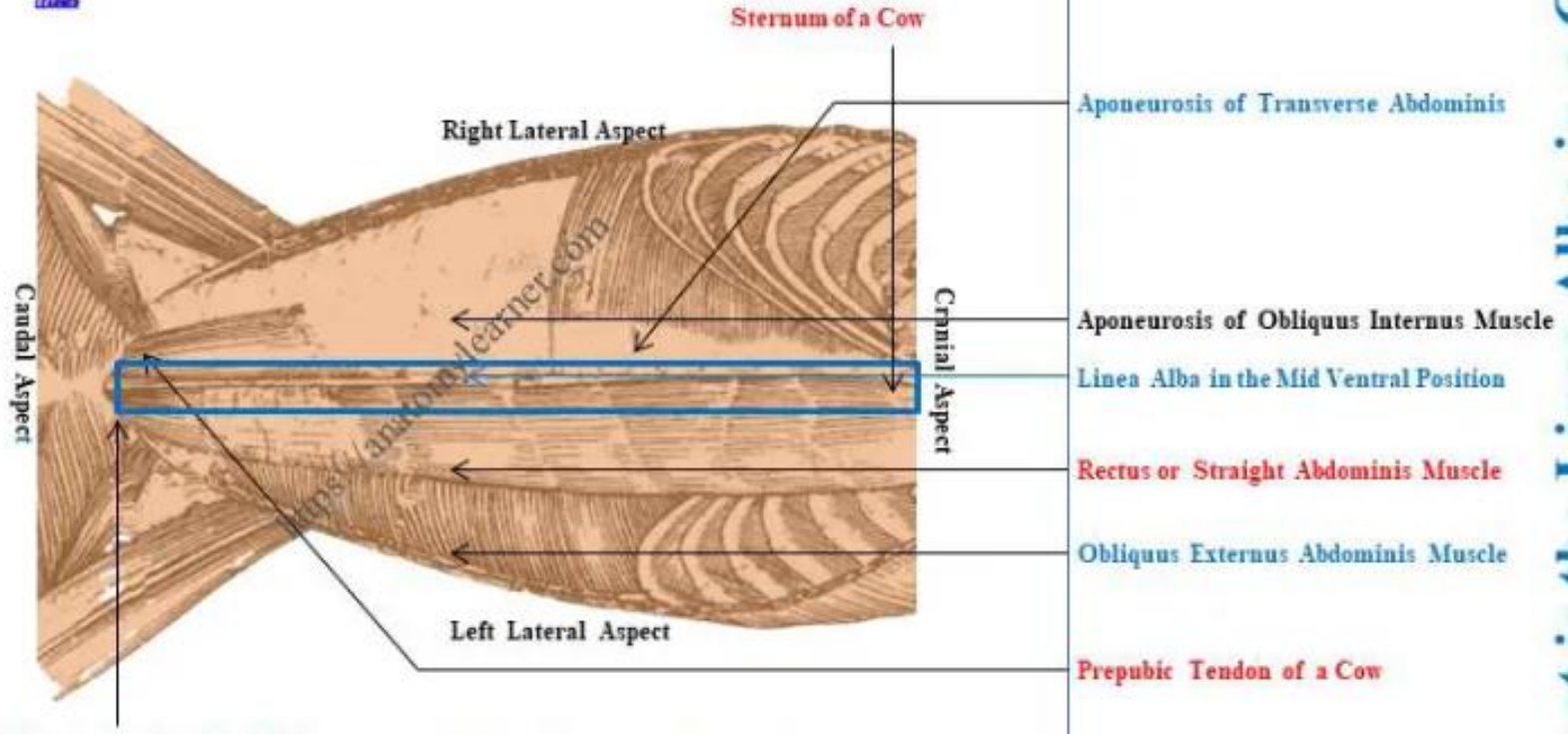


Rectus abdominalis

Internal abdominal oblique M.



You should know the layers and directions of the muscle fibers of the abdominal muscles as this information is important in abdominal surgery through the flank region. Surgical incision techniques that follow the direction of abdominal muscle fibers minimize damage to them. This approach in turns minimizes postoperative surgical complications. The abdominal muscles are responsible for the abdominal press that helps with forced expiration, defecation, urination, and parturition.



Hip Bone (Iliopubic Eminence) VENTRAL VIEW OF COW ABDOMEN

What is the Linea Alba in a Cow

Paralumber Fossa

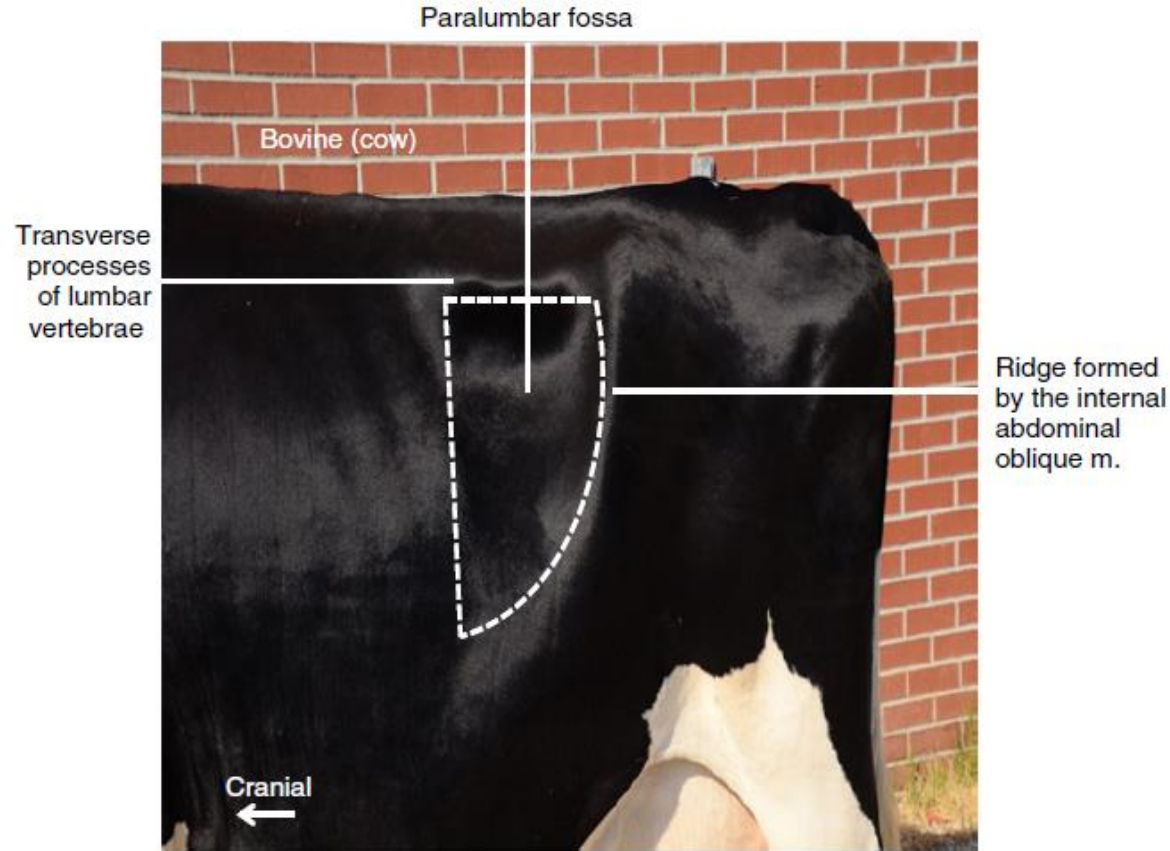
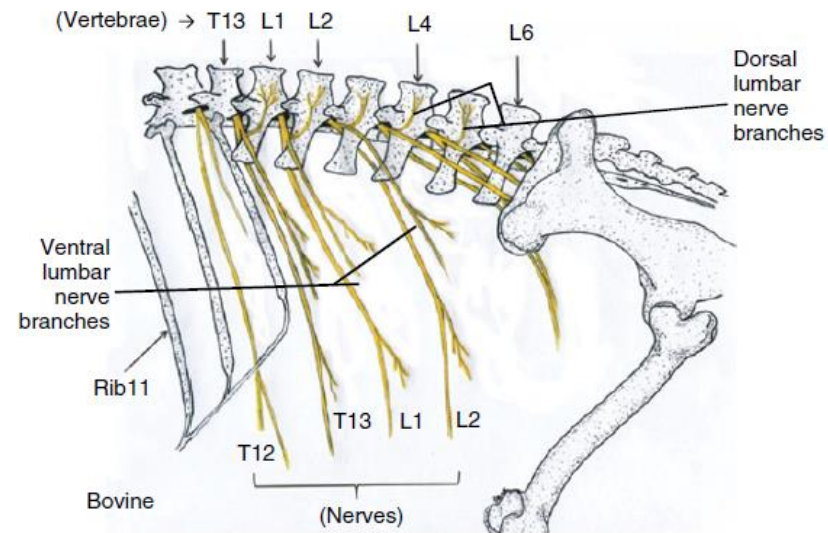
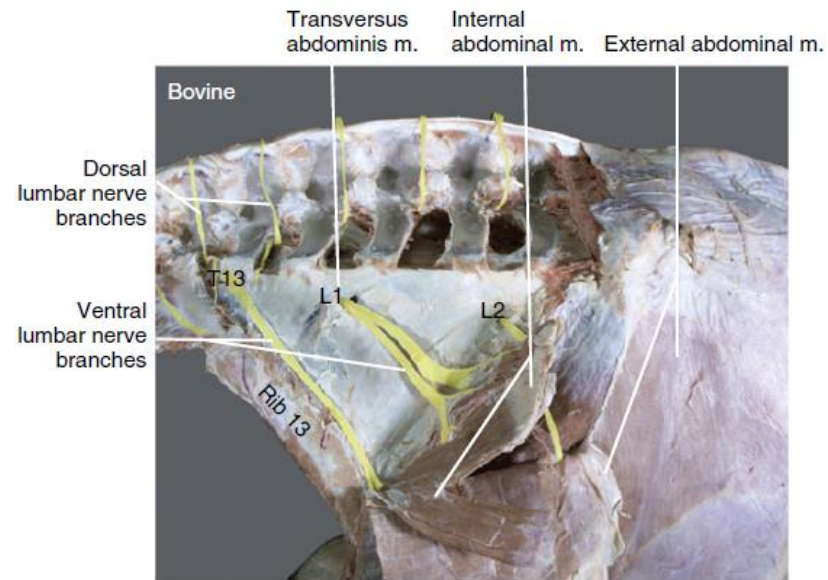


Figure 3.2 Bovine left paralumber fossa. Triangular depression bounded dorsally by the tips of transverse processes of lumbar vertebrae, caudoventrally by the ridge formed by the internal abdominal muscle, and cranially by the last rib (number 13).

The paralumber fossa is clinically important in anesthesia of the flank as it is commonly incised to enter the rumen on the left flank (e.g., in rumen cannulation procedure, removal of foreign body), or to access the cecum by incising the skin on the right dorsal flank region. Rumen cannulation, for example, allows for insertion of fistula for long-term studies that require regular rumen sampling.



(a)

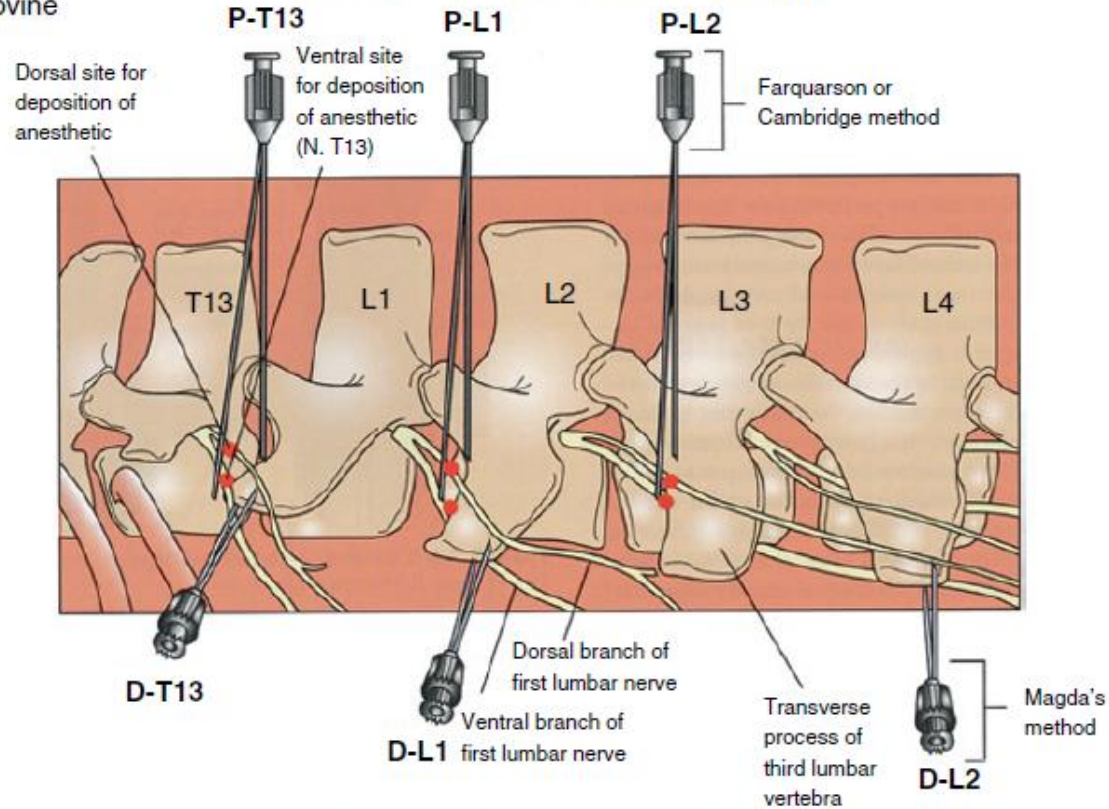


(b)

Spinal nerves of the left lateral flank in a goat. T13 (costoabdominal), L1 (iliohypogastric), and L2 (ilioinguinal) are blocked in flank anesthesia.

P. Proximal (dorsal) paravertebral nerve block (Cambridge or Farquharson) at the intervertebral foramina

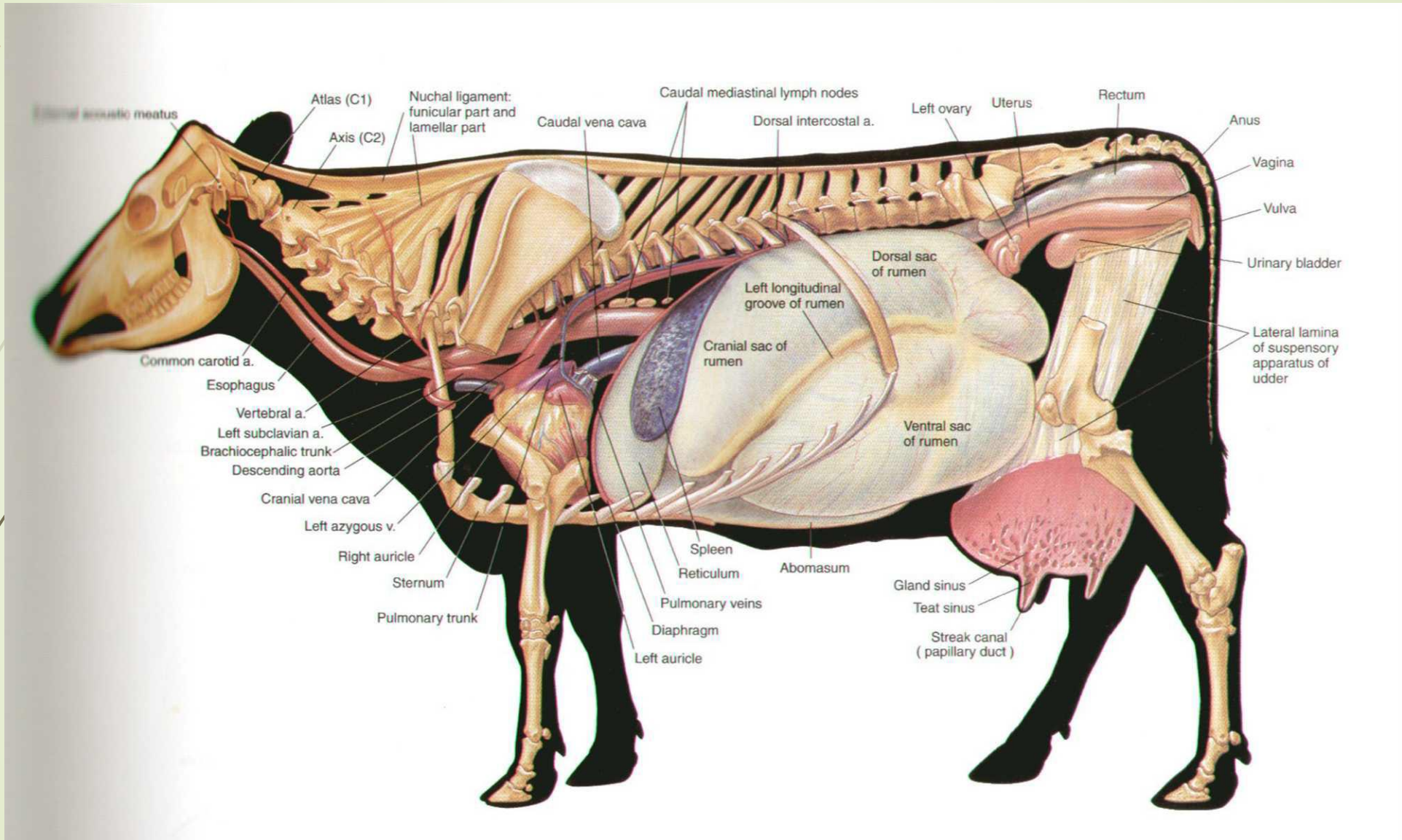
Bovine



D. Distal (lateral) paravertebral nerve block (Magda or Cornell) at the tips of the transverse processes

(c)

Needle placement for anesthesia of the flank using **proximal (P)** or **distal (D)** paravertebral nerve blocks in cattle. In the proximal paravertebral nerve block, the dorsal and ventral nerve roots of T13, L1, and L2 spinal nerves are blocked close to where they emerge from their respective intervertebral foramina. In the distal paravertebral nerve block, ventral and dorsal rami of T13, L1, and L2 are blocked at the distal ends of the transverse processes of L1, L2, and L4, respectively. Because of variations in the pathways of spinal nerves, L2 branches should be blocked at tips of the transverse processes of both L3 and L4 vertebrae.



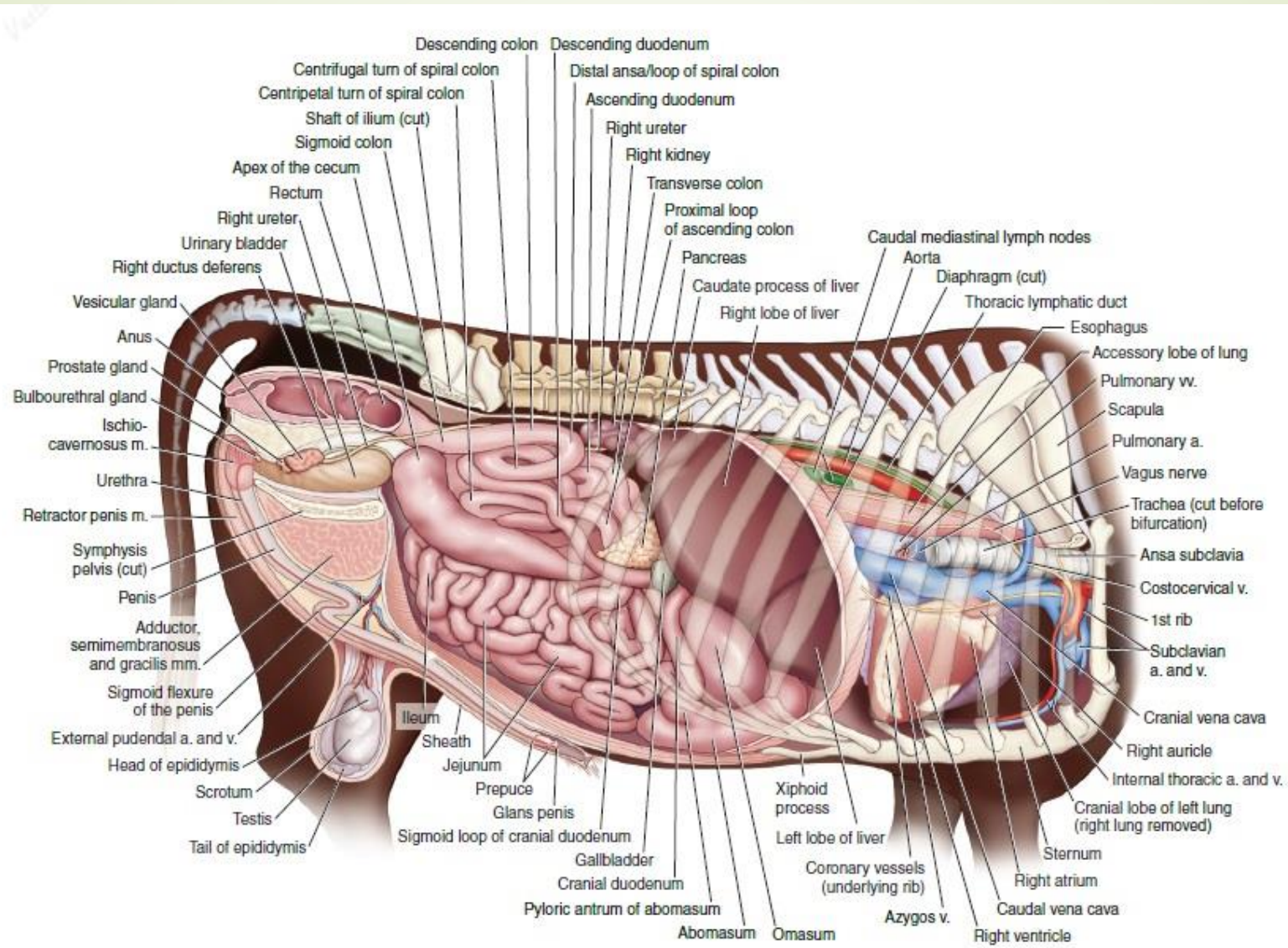


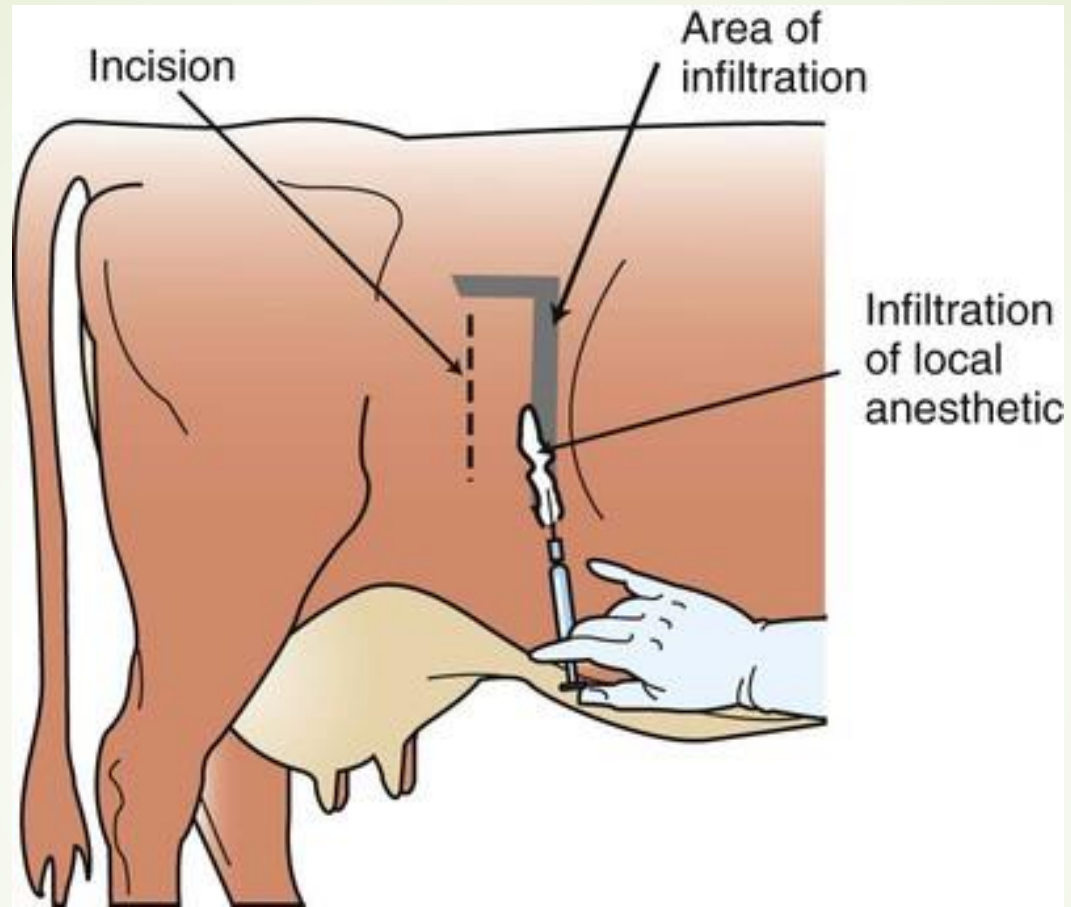
FIG. 5-7 Right view of the bovine thoracic and abdominal cavities and pelvis (male).

Inverted L-block or line block: the anesthetic agent is injected along a line parallel with the transverse processes of the lumbar vertebrae and along the caudal border of the last rib. The line block is technically less challenging than the paravertebral anesthesia, which could be more difficult in obese and heavily muscled cattle. In addition, the scoliosis that may develop in the proximal paravertebral block could make closure of the skin much more difficult.



scoliosis





Left flank surgery: Because the rumen dominates the left abdomen, left flank exploratory surgery is not performed. Procedures typically done on the left include rumenotomy and C-section.

Right flank surgery: Right flank surgery can be performed for abdominal exploration following an abnormal sign on ultrasound. Several organs can be accessed on the right. These include the kidneys, abomasum, liver, duodenum, cecum, and small intestine.

Congenital abnormalities are more common in calves in addition to urachal remnants, umbilical infections with adhesions, volvulus and intussusceptions. Interestingly, intussusceptions in calves occur throughout the intestinal tract and are proposed to develop because calves have less mesenteric fat compared to adults. General anesthesia is preferred for exploratory surgery using a right flank approach.



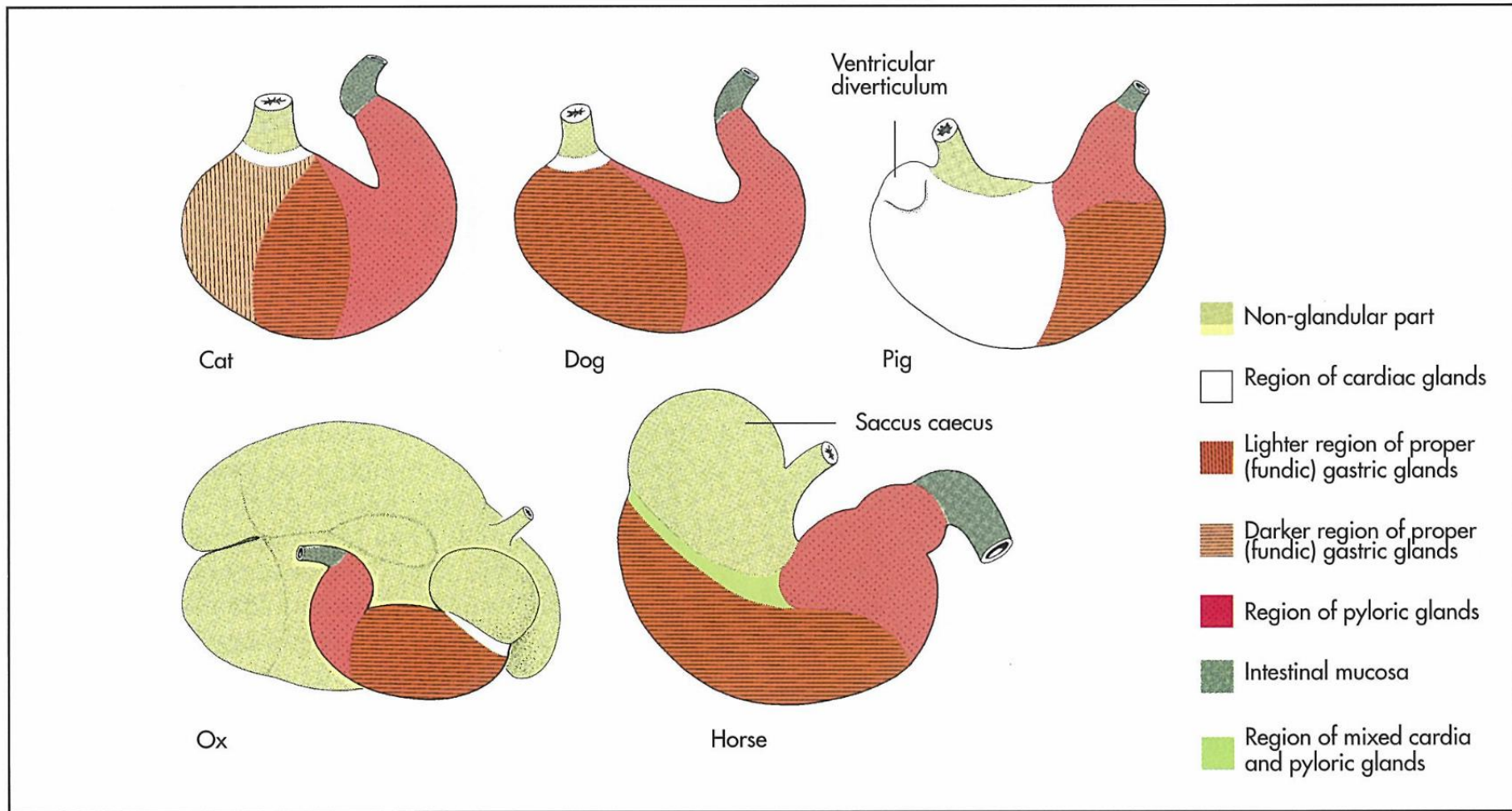


Fig 7-49. Distribution of the gastric mucosa in the domestic mammals, schematic (Liebich, 2004).

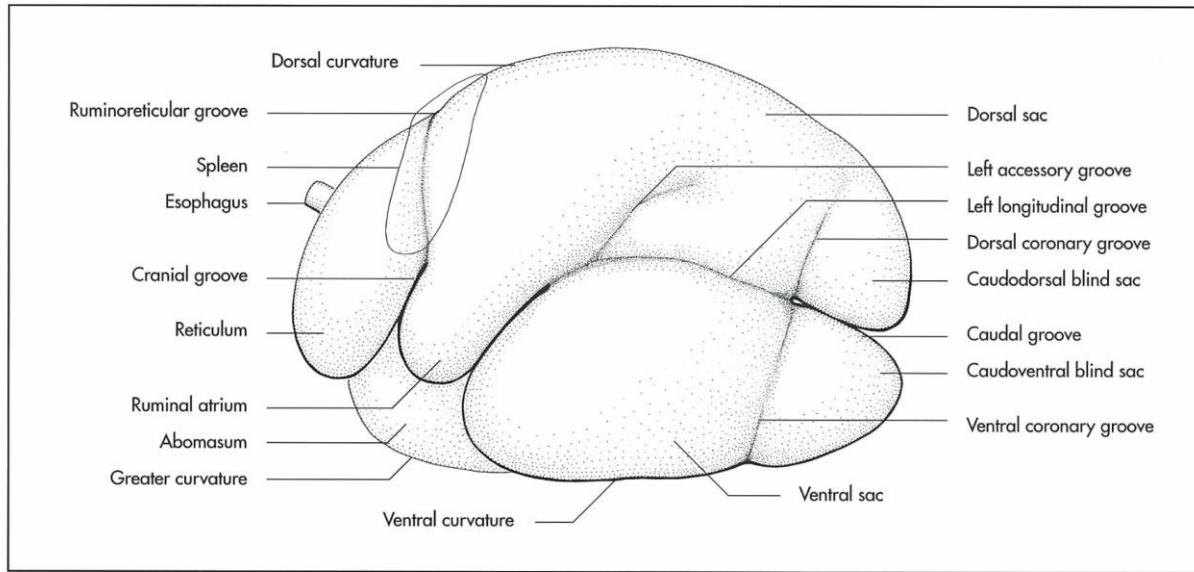


Fig 7-65. Compartments of the stomach of the ox, left lateral aspect, schematic (Schaller, 1992).

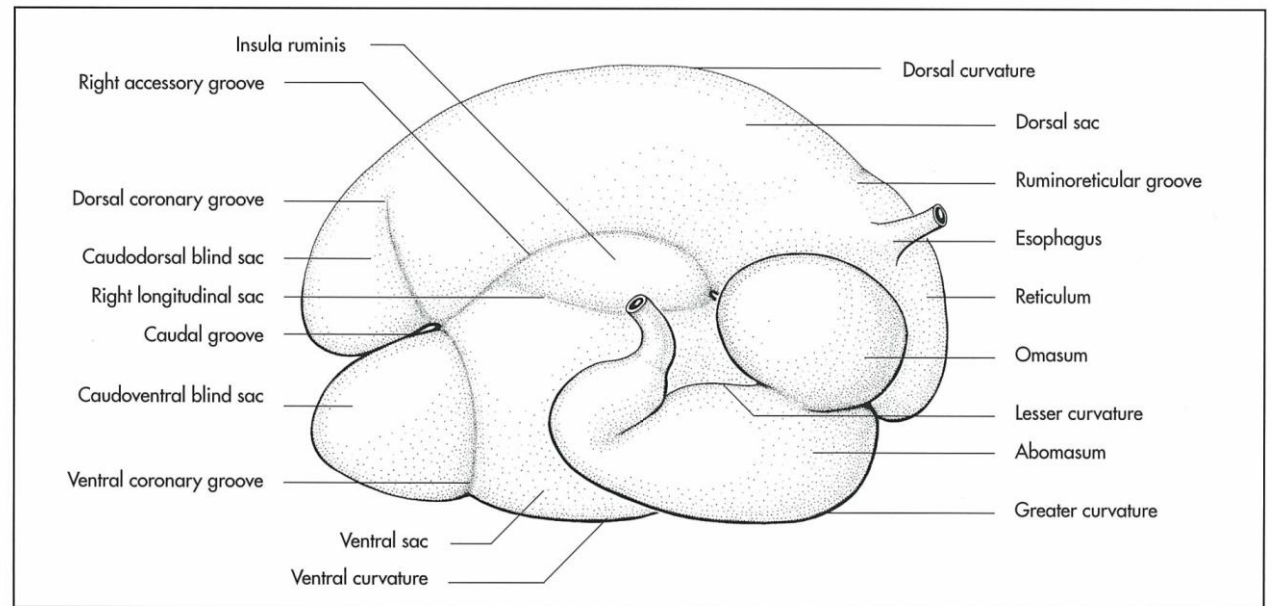


Fig 7-66. Compartments of the stomach of the ox, right lateral aspect, schematic (Schaller, 1992).

RUMEN



RETICULUM

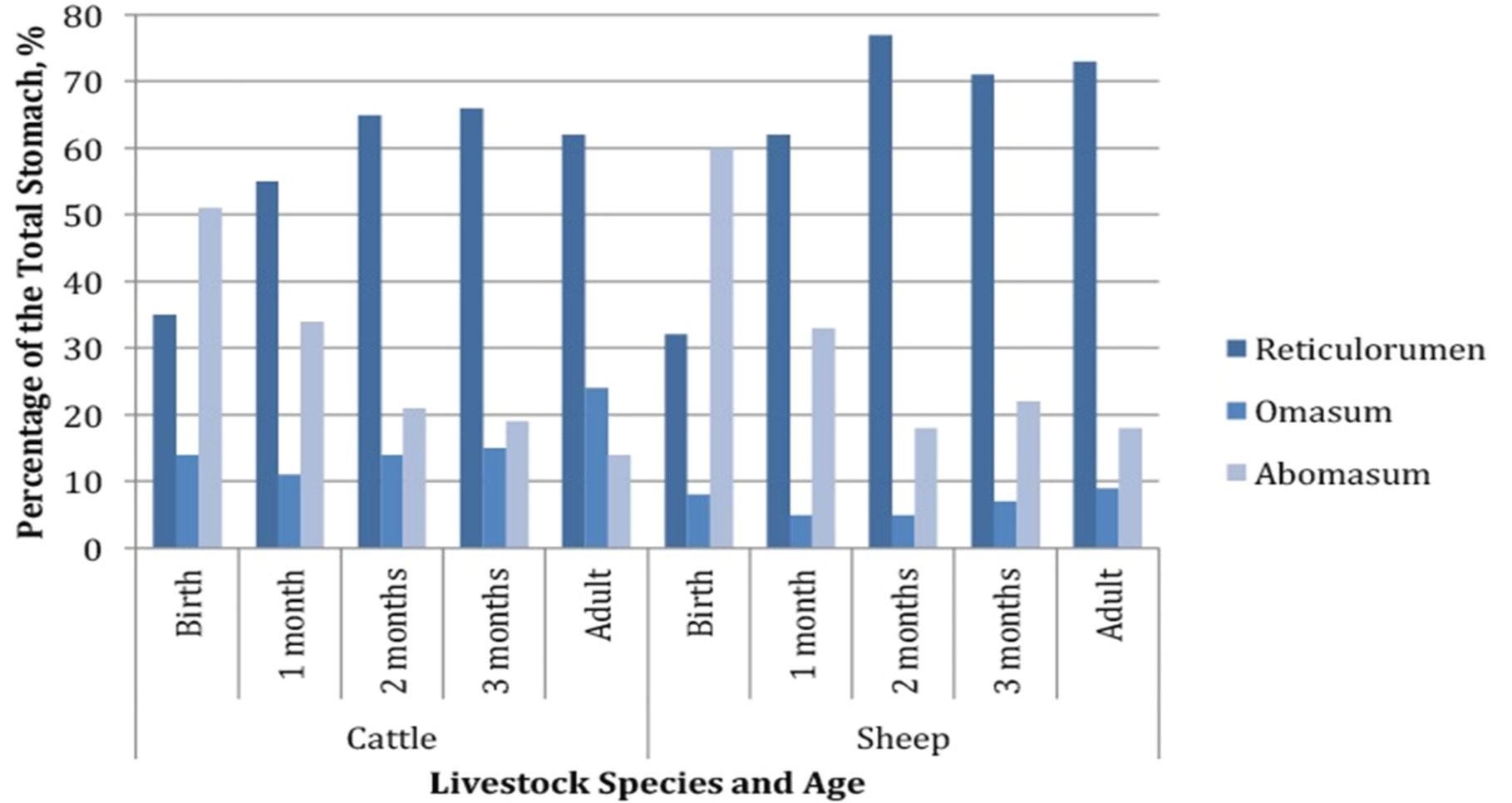


OMASUM



ABOMASUM





Relative proportions of stomach compartments in cattle and sheep at various ages.

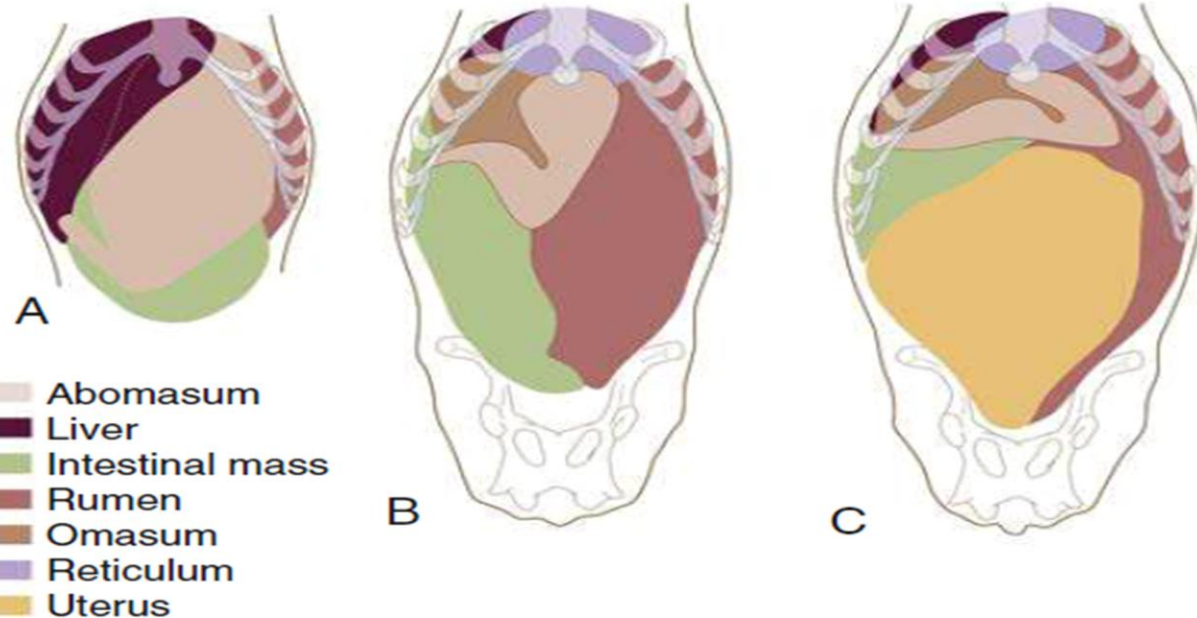
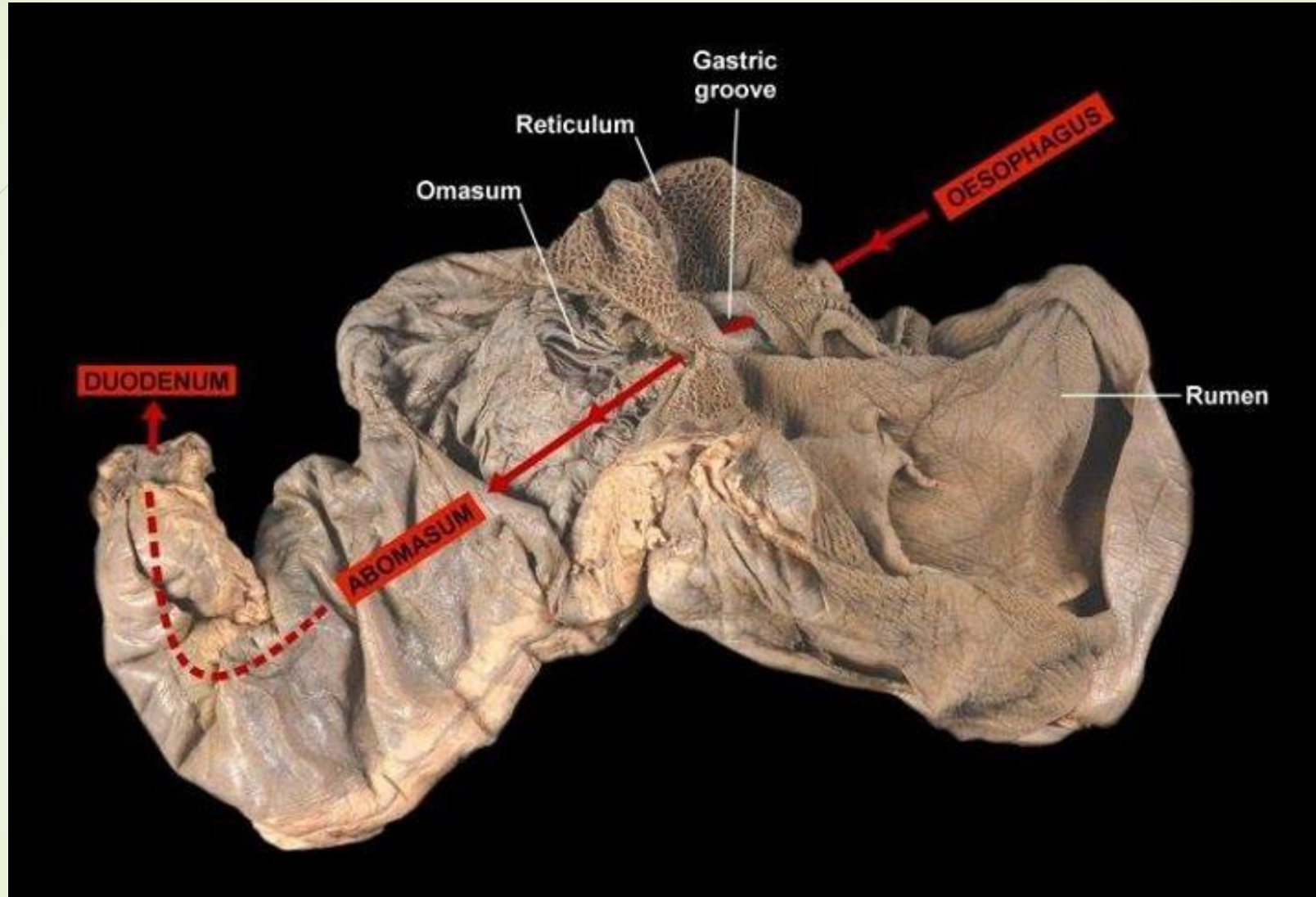


Fig. 28.20 Ventral views of the abdominal viscera of (A) a newborn calf, (B) a 5-year-old cow, and (C) a 6-year-old heavily pregnant cow based on reconstructions of transverse sections of animals frozen in the standing position.

Abomasal length decreases and abomasal width increases during the last 3 months of gestation in response to the progressively developing fetus in the uterus. In addition, the abomasum assumes a position more on the left side of the abdomen during this same time period. In the first 14 days after calving, the uterus returns to its more caudal and right sagittal position, thus allowing the abomasum to return to its normal position.

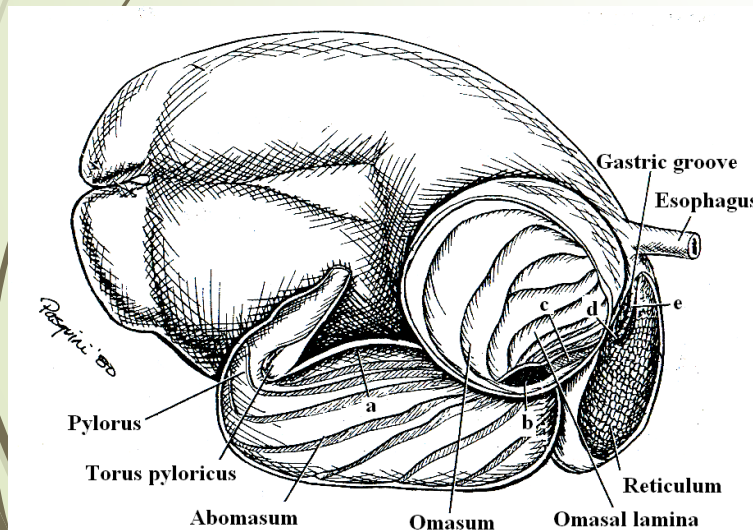


A fixed calf stomach. The red arrow demarcates the route of milk flow i.e. bypassing of the forestomachs to the abomasum via the gastric groove. Note large abomasum relative to rumen in this suckling animal

Gastric groove

The muscular lips of the **reticular groove** and the rest of the **gastric groove** can be stimulated to form a continuous channel by the act of suckling in young calves.

This effect can be mimicked by drugs containing copper and/or nicotine sulfates. These chemicals stimulate the pharyngeal nerve endings that reflexly induce closure of the gastric groove.



a) Abomasal groove b) Omasoabomasal opening c) Omasal groove
d) Reticuloomasal opening e) Reticular groove



Mechanical extraluminal obstruction of the reticulo-omasal groove by a mass (abscess) and adhesions, such as seen in TRP cases, results in type 2 vagal indigestion (also called omasum transport failure). Motility of the rumen may continue normally, but the ability of the reticulum and omasum to move ingesta into the abomasum is impaired.

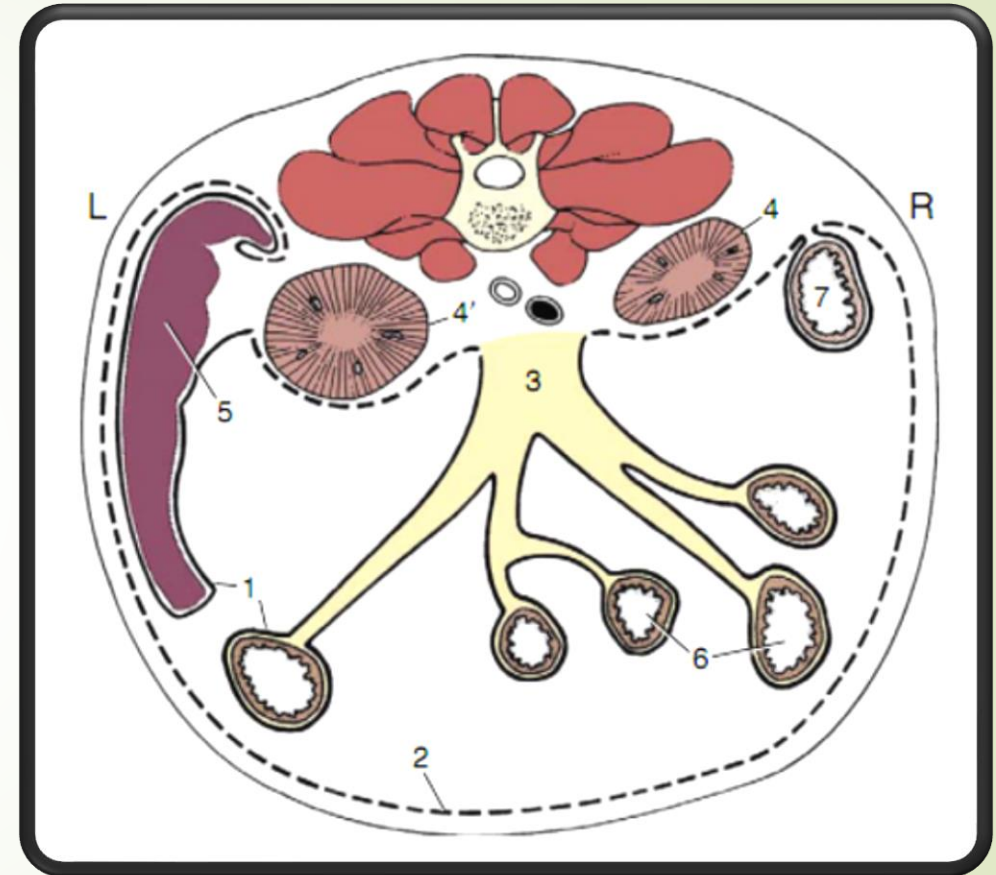


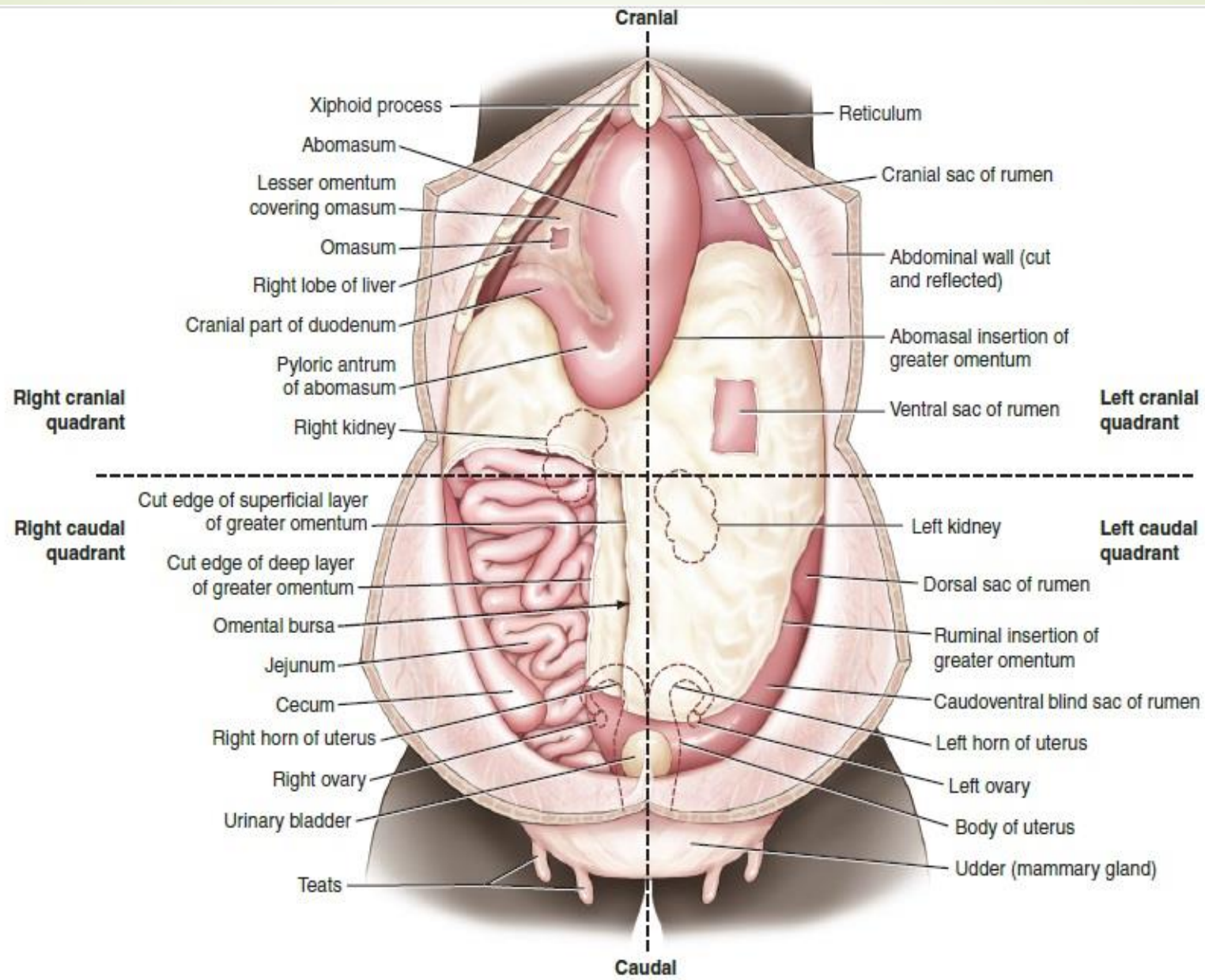
Vagal Indigestion

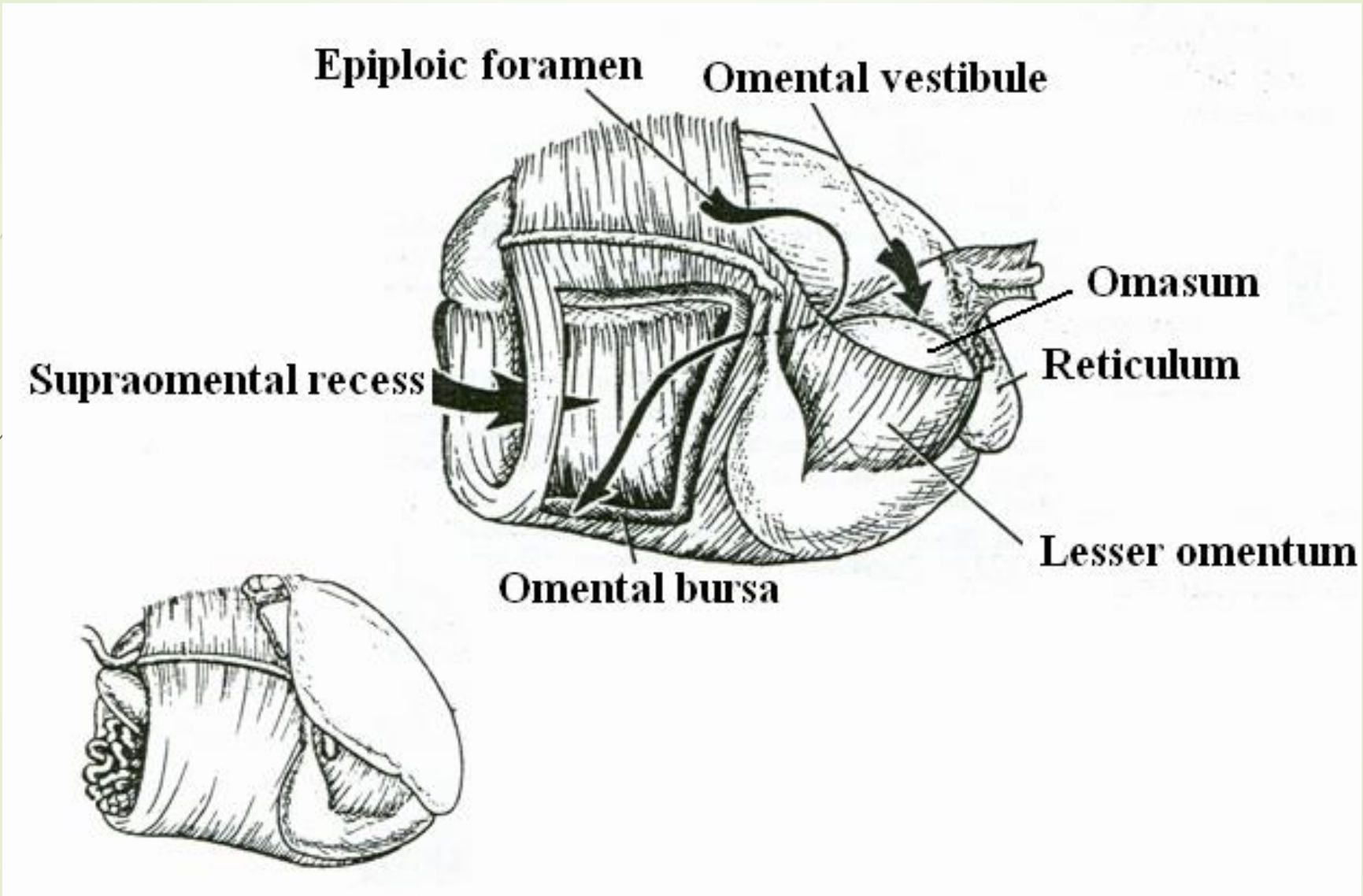
- Not a single disease, but a syndrome of many different causes that can cause abdominal distention
- Classic “papple” shape. Ventral sac more distended than dorsal sac (fluid/ingesta)
- 4 types
 - Type 1: Free gas bloat
 - Type 2: Failure of transport out of rumen (blockage)
 - Type 3: Failure of transport out of abomasum (blockage)
 - Type 4: Indigestion of advanced pregnancy

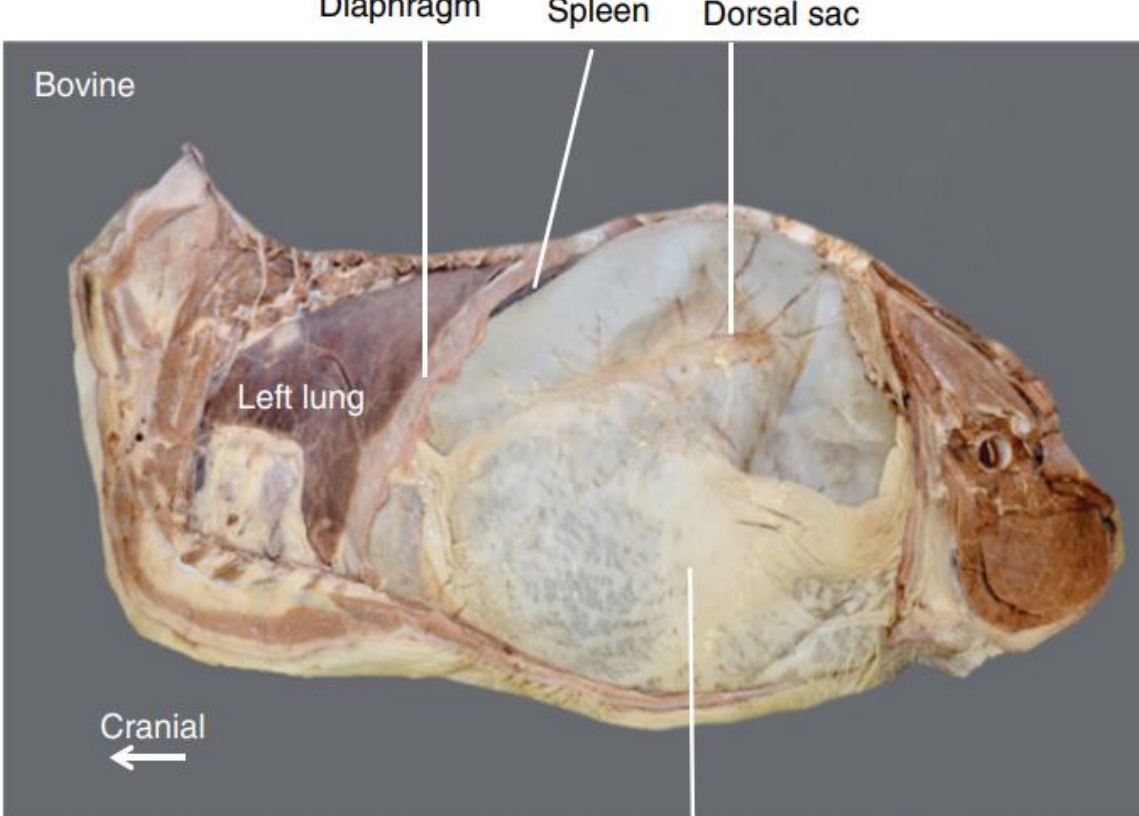
The peritoneum plays a crucial role in the abdominal cavity of ruminant:

1. **Protective barrier:** The peritoneum, specifically the parietal peritoneum, lines the inner surface of the abdominal wall and provides a protective barrier against infection and injury.
2. **Facilitating organ positioning:** The connecting peritoneum extends between organs and helps position the abdominal organs, including the large ruminoreticulum, in the abdominal cavity.
3. **Fluid dynamics:** The peritoneum allows for the exchange of fluids, electrolytes, and inflammatory mediators during conditions like peritonitis. Increased capillary permeability leads to leakage of protein-rich fluid into the peritoneal cavity.
4. **Diagnostic value:** Analysis of peritoneal fluid can provide valuable diagnostic information, such as differentiating septic from non-septic peritonitis based on parameters like lactate concentration and acute phase proteins.
5. **Surgical access:** The peritoneal cavity provides access for various surgical interventions in ruminants, such as rumenotomy, abomasal displacement procedures, and exploratory laparotomies.

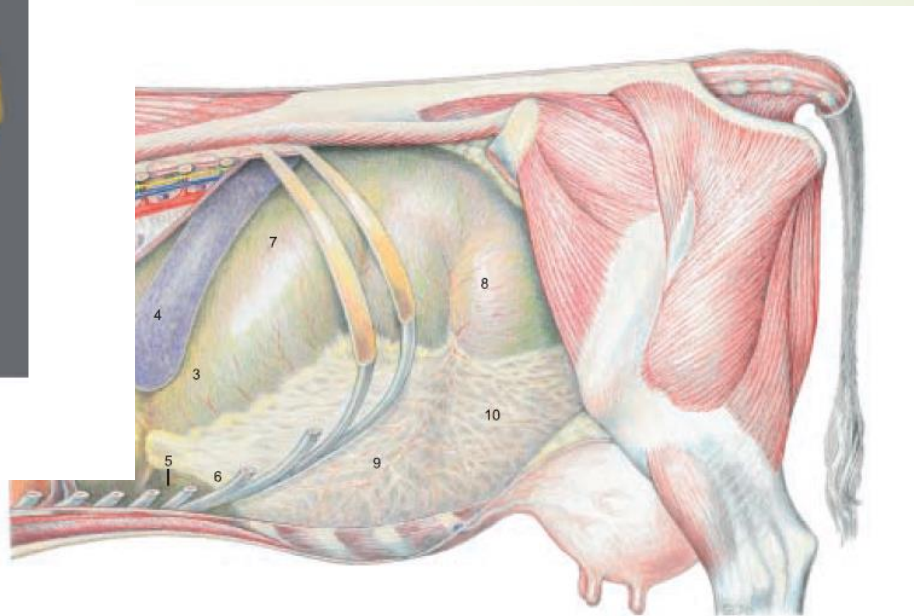








Ventral sac covered by superficial leaf (or layer) of the greater omentum



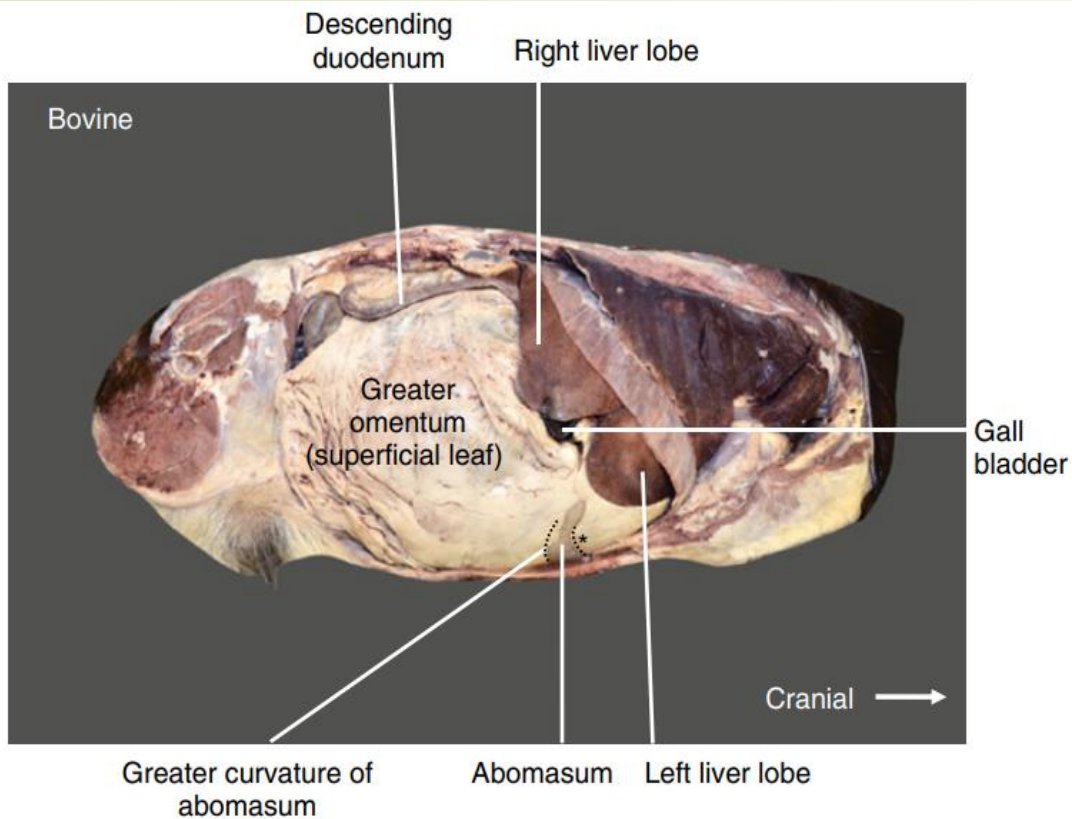
Legend:

- 1 Left lobe of liver
- 2 Reticulum
- 3 Atrium of rumen
- 4 Spleen

- 5 Fundus of abomasum
- 6 Recess of ventral sac of rumen covered by omentum
- 7 Dorsal sac of rumen

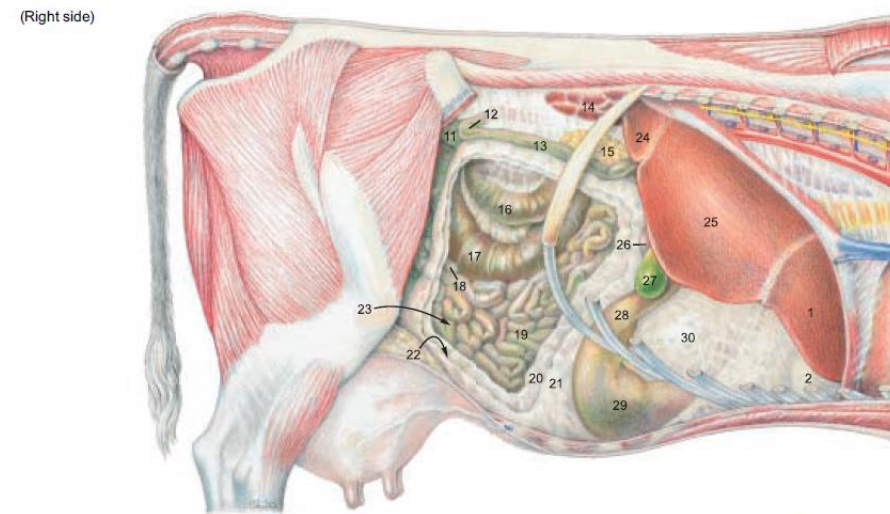
- 8 Caudodorsal blind sac of rumen
- 9 Ventral sac of rumen covered by omentum
- 10 Caudovernal blind sac of rumen covered by omentum

- 11 Sigmoid part of descending colon
- 12 Caudal flexure of duodenum
- 13 Descending duodenum
- 14 Right kidney
- 15 Right lobe of pancreas



The supraomental recess helps keep the intestines away from the incision site in right flank laparotomy (right paralumbar celiotomy).

The omentum provides storage sites for visceral abdominal fat. Clinically, the omentum helps in tissue repair when sutured over surgical wounds. It readily adheres to sites of inflammation and provides vascularization and leukocytes for local immune defense. Omentopexy is a surgical procedure whereby the greater omentum is sutured to the body wall to prevent displacement of organs from their normal position (e.g., left abomasal displacement).



(See pp. 17, 63, 65, 67)

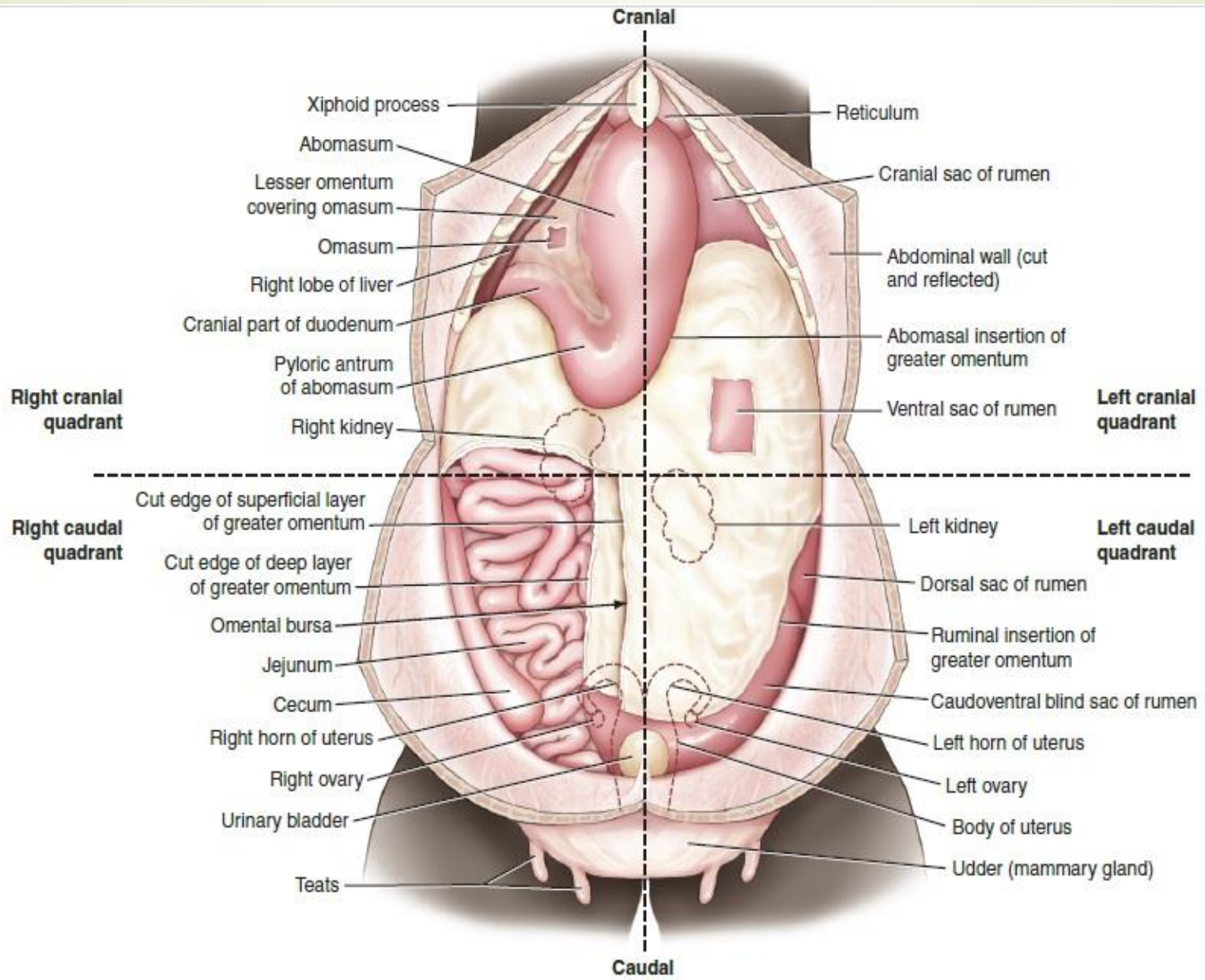
Legend:

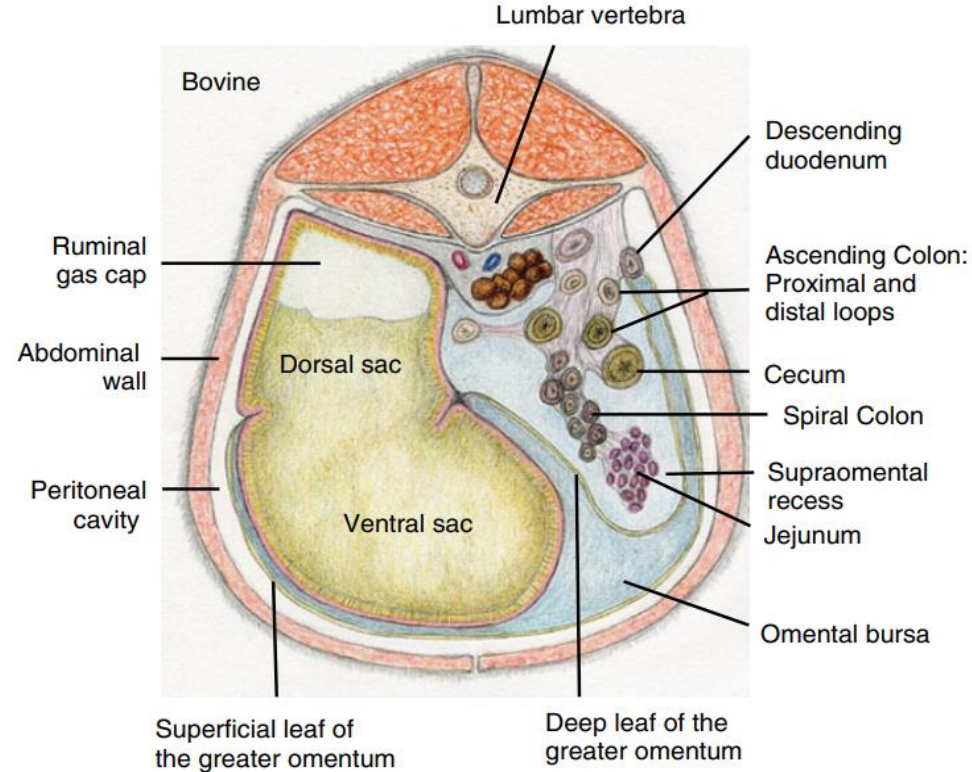
- 16 Prox. loop of ascending colon
- 17 Cecum
- 18 Ileum
- 19 Jejunum

- Greater omentum:
- 20 Deep wall
- 21 Supf. wall
- 22 Caudal recess

- 23 Supraomental recess
- 24 Caudate process of liver
- 25 Right lobe of liver
- 26 Cranial part of duodenum

- 27 Gall bladder
- 28 Pyloric part of abomasum
- 29 Body of abomasum
- 30 Omasum covered by lesser omentum

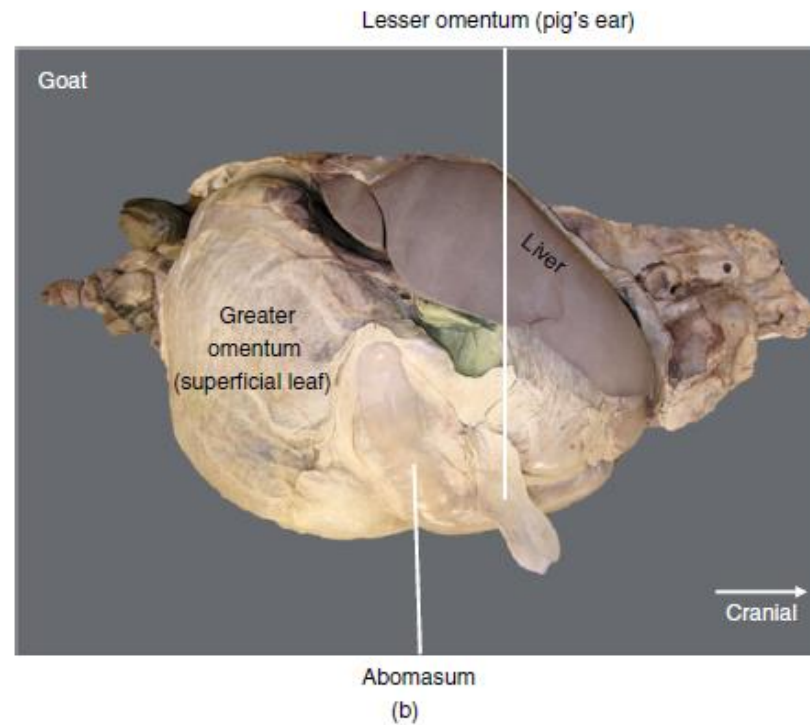
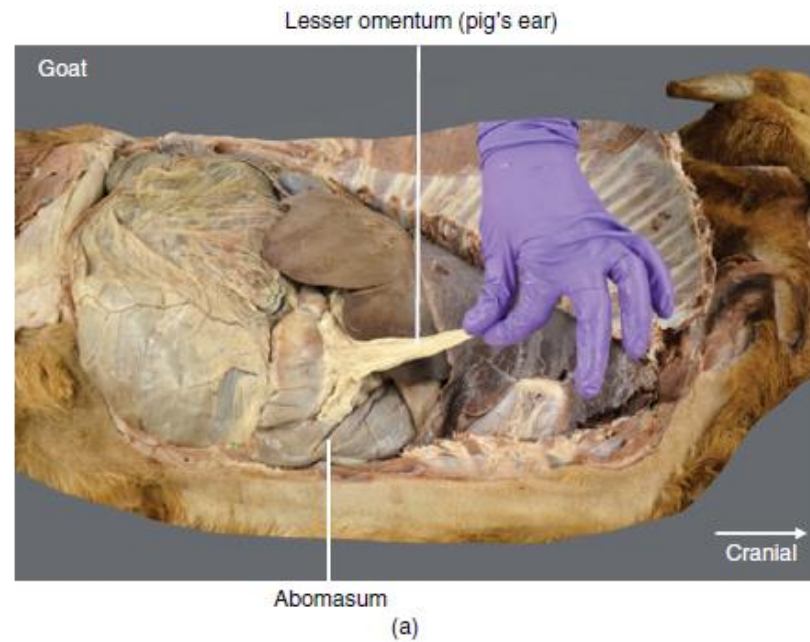




(a)

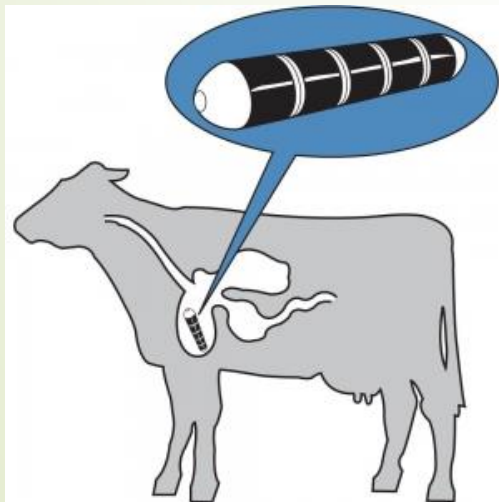
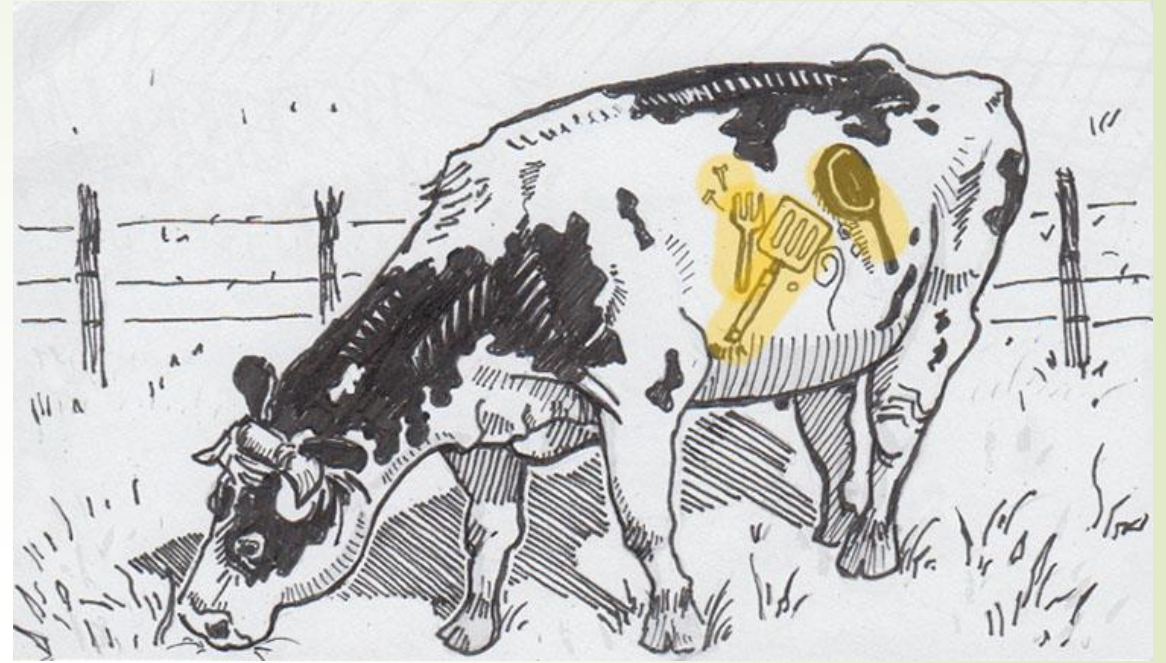
The omentum have a unique ability to promote hemostasis and healing because of their pronounced angiogenic activity and rich leukocyte cellular contents. Because of their ability to adhere to adjacent structures, they are frequently used in abdominal surgery to seal off gastrointestinal defects and promote healing in various types of abdominal surgery.

A free slip of the lesser omentum has the appearance of an ear of a pig and is colloquially known as the “pig’s ear”. The pig’s ear can be used in omentopexy, and in identifying the abomasum in cases of left abomasal displacement. The “pig’s ear” in the bovine is usually associated with the greater omentum near the pyloric region. However, the presence of this structure in the bovine can vary and may even be absent.



Hardware disease (TRP):

This condition is also known as traumatic reticulopericarditis or traumatic reticuloperitonitis (TRP). Note the close proximity of the reticulum to the diaphragm and heart. Cattle use their tongues to graze and in doing so they may ingest sharp objects such as nails and wires. Metal objects could drop to the bottom of the reticular floor and become lodged within the reticulum. Contraction of the stomach could cause sharp objects to penetrate the wall of the reticulum and diaphragm and reach the heart.

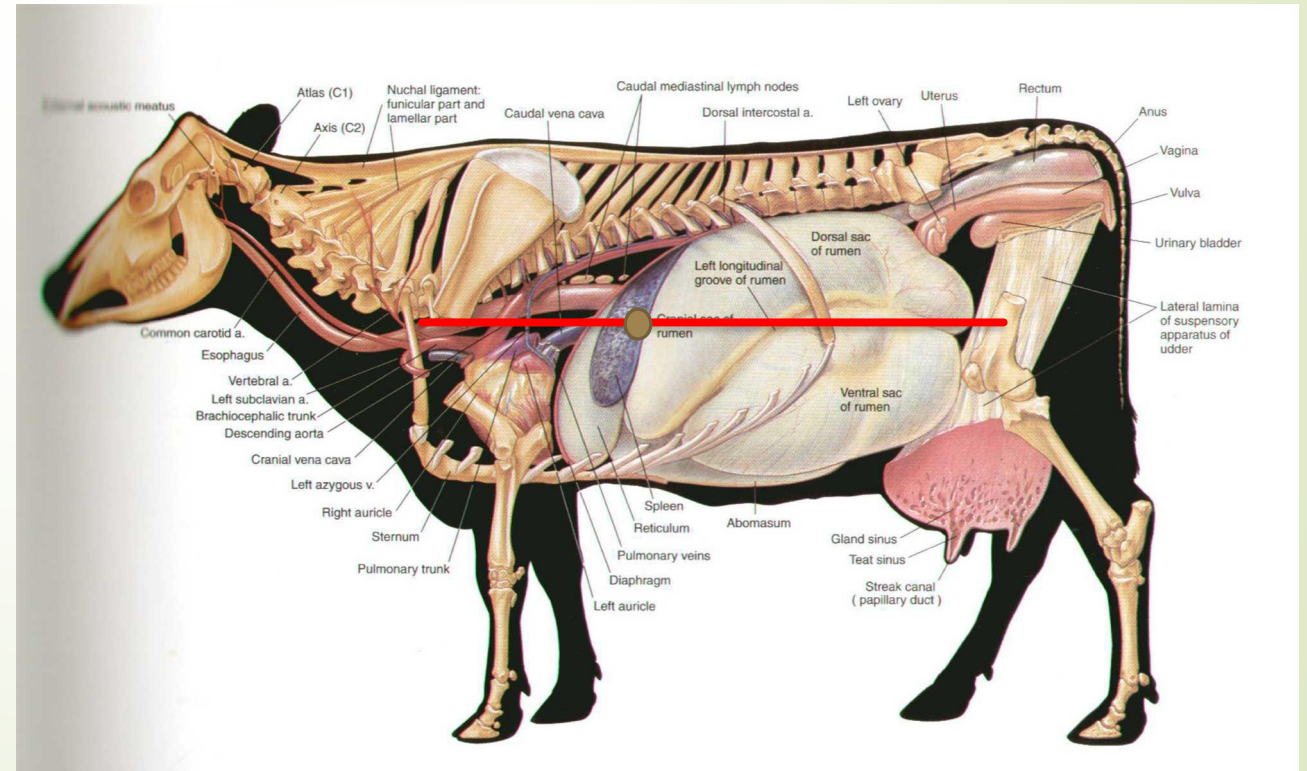


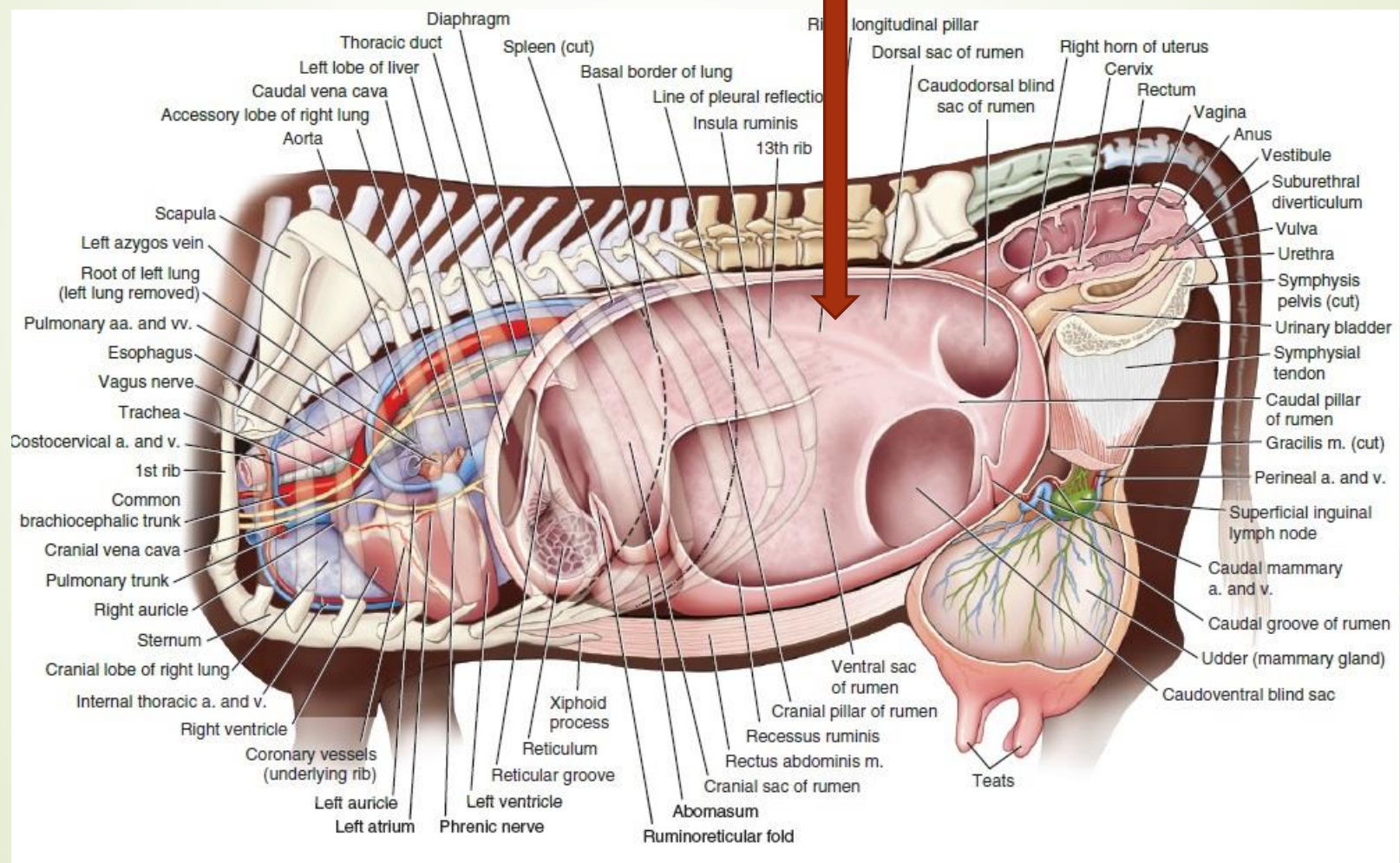
Cardia

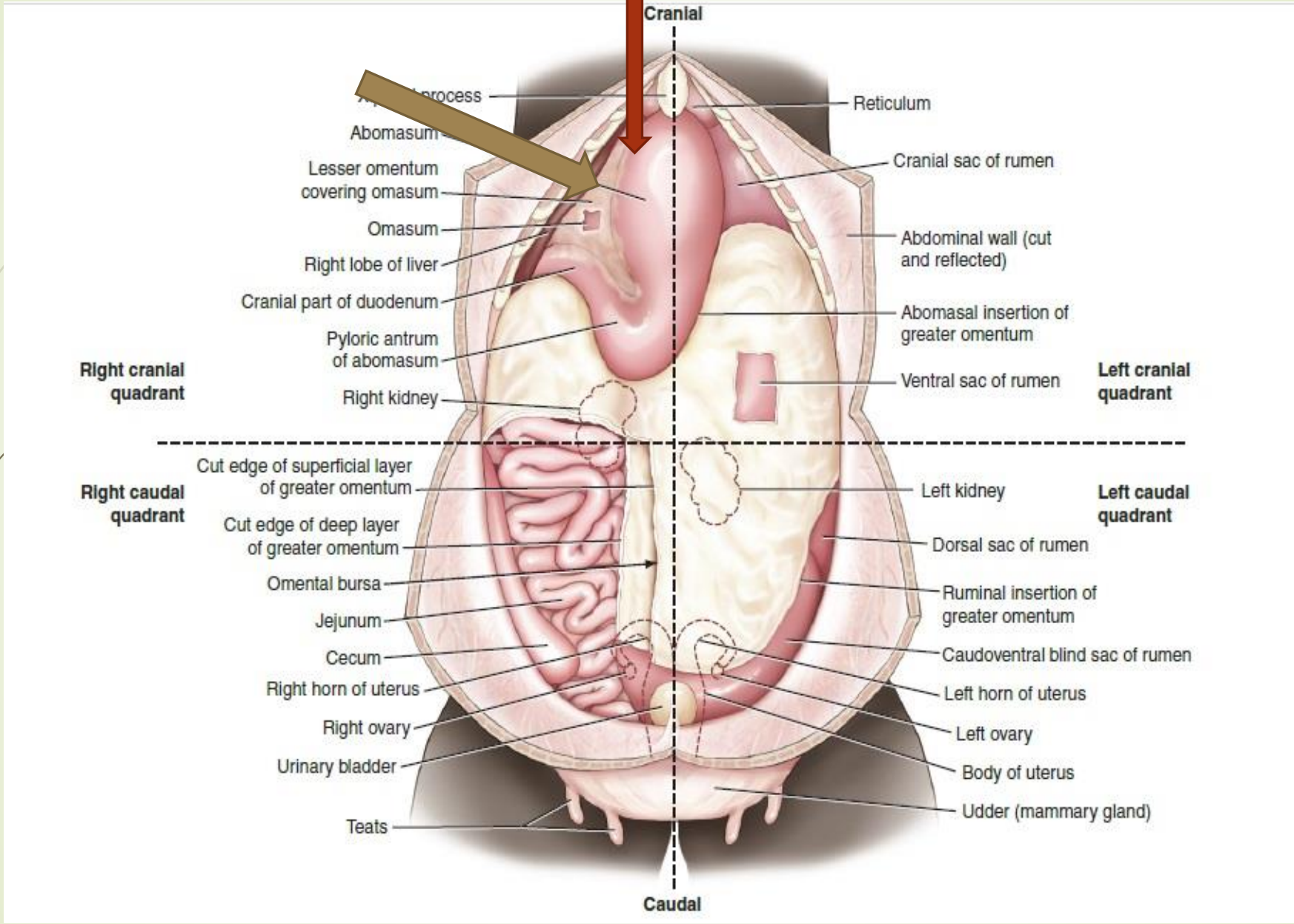
In the live animal, the cardia is located at the level of the seventh intercostal space or eighth rib.

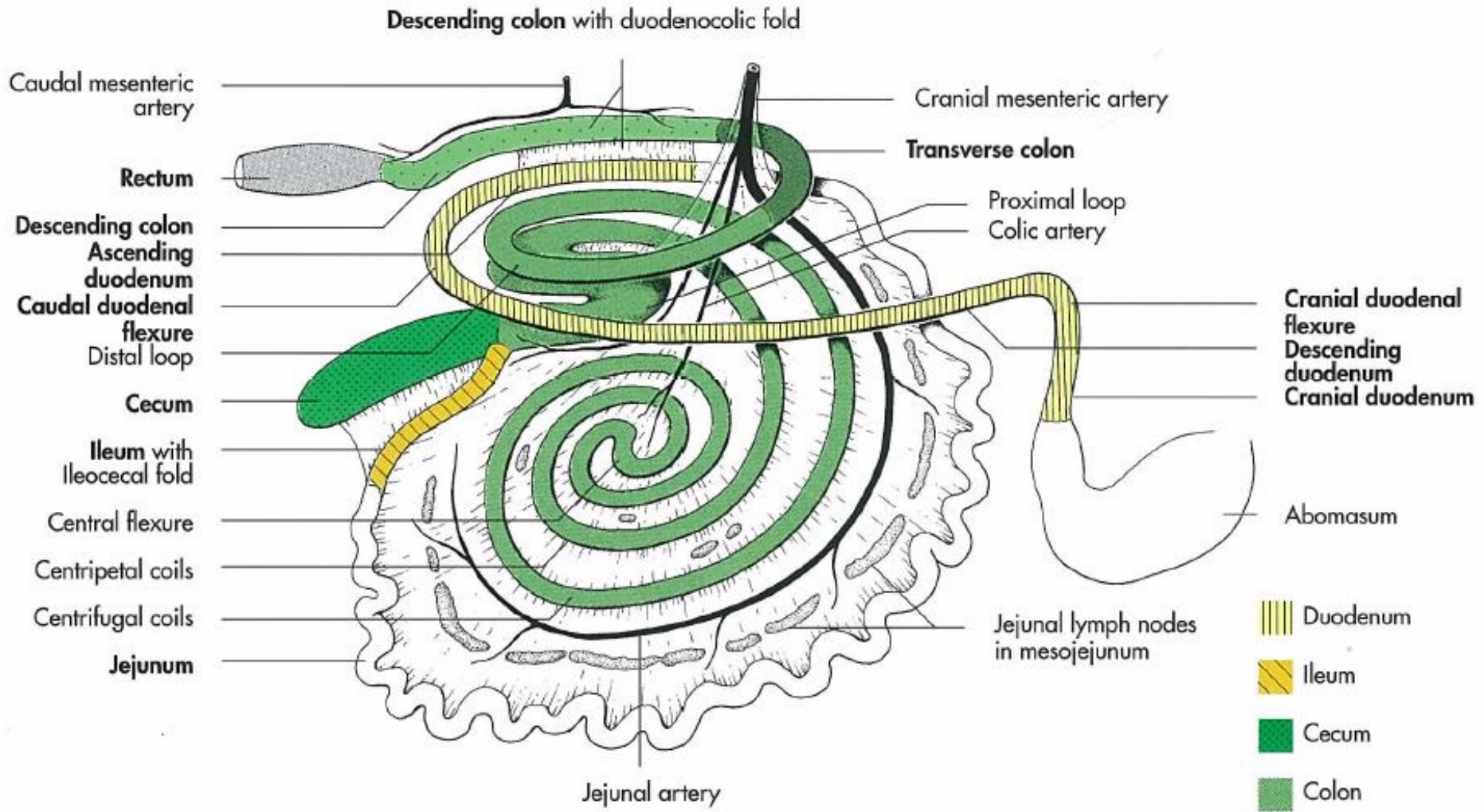
This information is useful in determining the length of an esophageal feeder in nursing calves or gastric tube in yearling steers or adult cows.

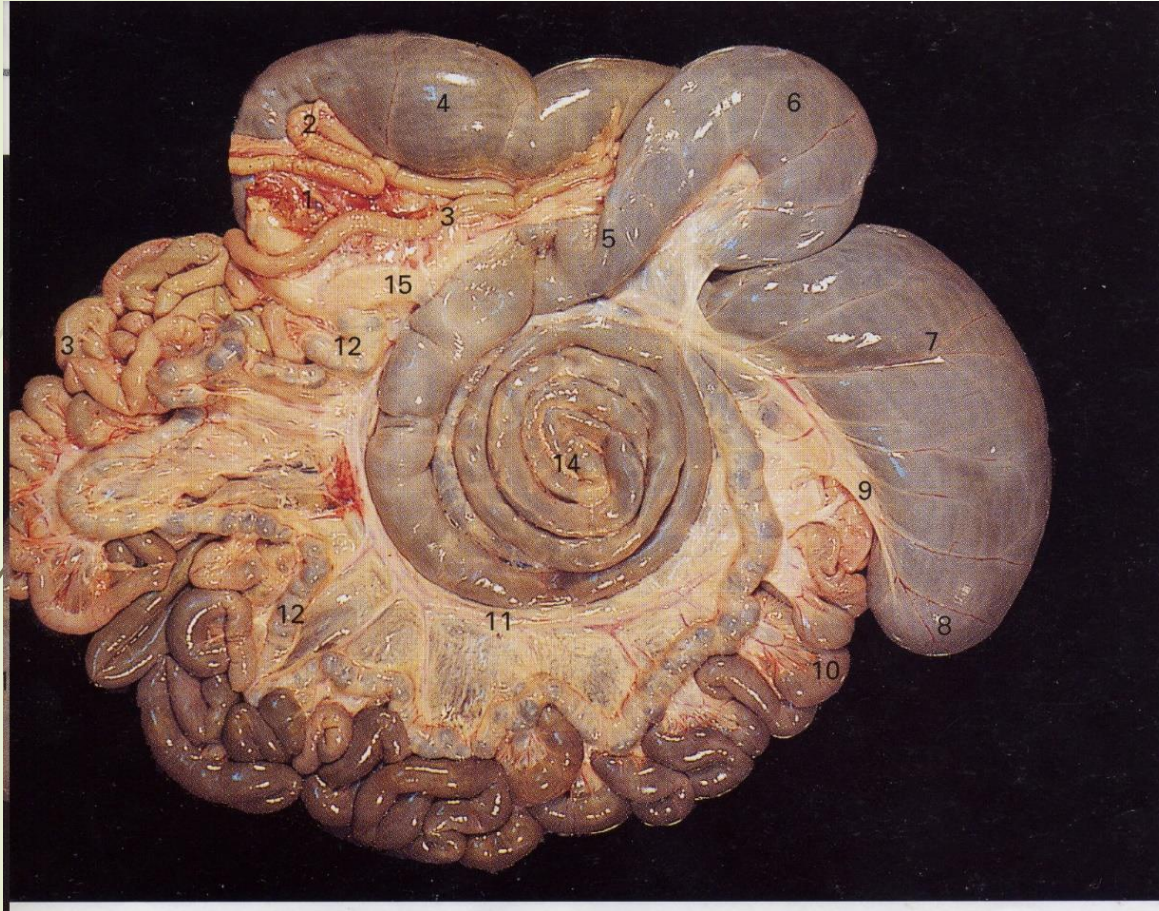
The distance can be marked on the tube by measuring the distance from the mouth to the seventh intercostal space or point of the shoulder.









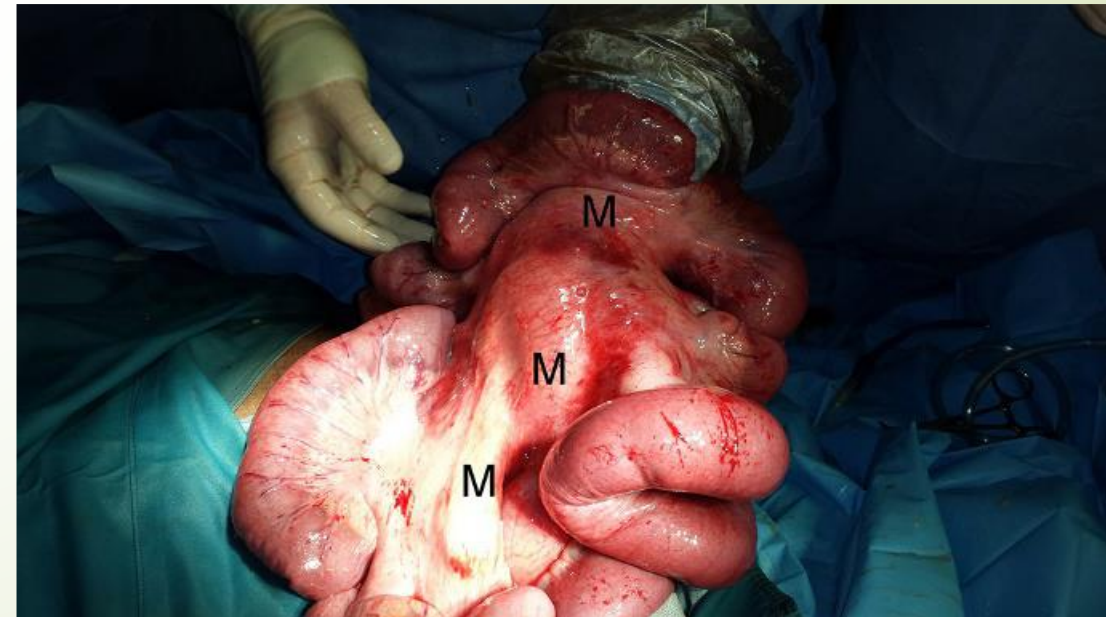


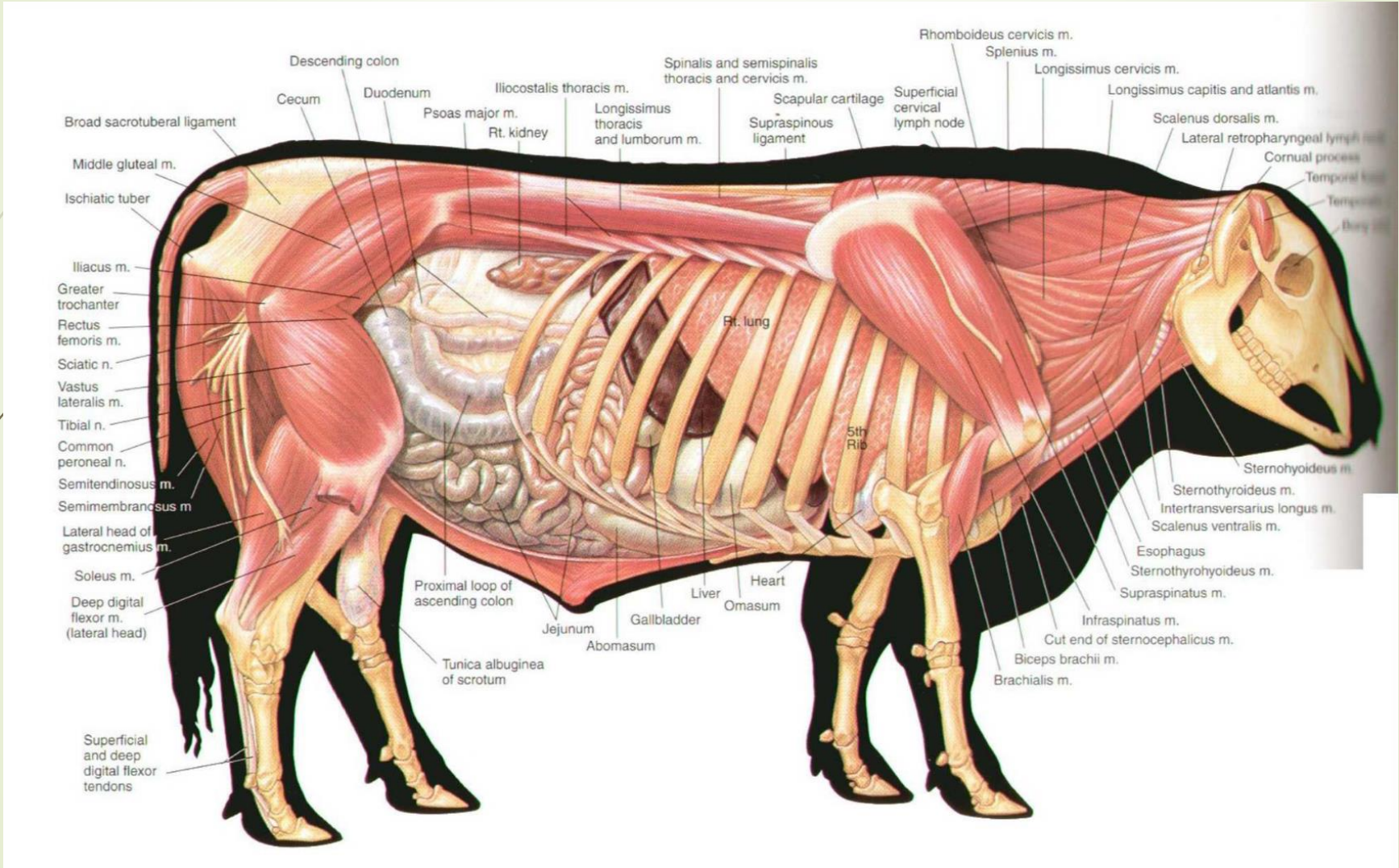
286. Left view of the intestinal mass of a sheep. The transverse colon and the descending colon were retained within the abdomen and are not seen in the specimen.

- | | |
|--|--|
| 1 Cut root of the mesentery | 9 Free edge of the ileocaecal fold |
| 2 Ascending duodenum | 10 Distal part of the jejunum |
| 3 Descending duodenum | 11 Mesenteric vessels |
| 4 Proximal loop of the ascending colon | 12 Outermost centrifugal coil of the spiral loop |
| 5 Beginning of the outermost centripetal coil of the spiral loop | 13 Proximal part of the jejunum |
| 6 Terminal part of the proximal loop of the ascending colon | 14 Centre of the spiral loop of the ascending colon |
| 7 Body of the caecum | 15 Beginning of the distal loop of the ascending colon |
| 8 Apex of the caecum | |

Excessive accumulations of fat in the mesentery makes intestinal surgery more difficult. The fat may have a protective effect in some cases of volvulus, as it may limit the obstruction of arterial inflow and venous outflow and minimize the severity of strangulation. Intestinal resection is made more complicated by fatty infiltrates because the fat obscures identification of blood vessels and extrudes from cut edges, exacerbating the ill effects of handling the bowel.

Intra-operative image of partially exteriorized jejunum through a right flank laparotomy incision. The jejunoileal flange is cradled by the surgeon with the long mesentery (*M*). The fatty mesentery in cattle makes recognizing blood vessels difficult.





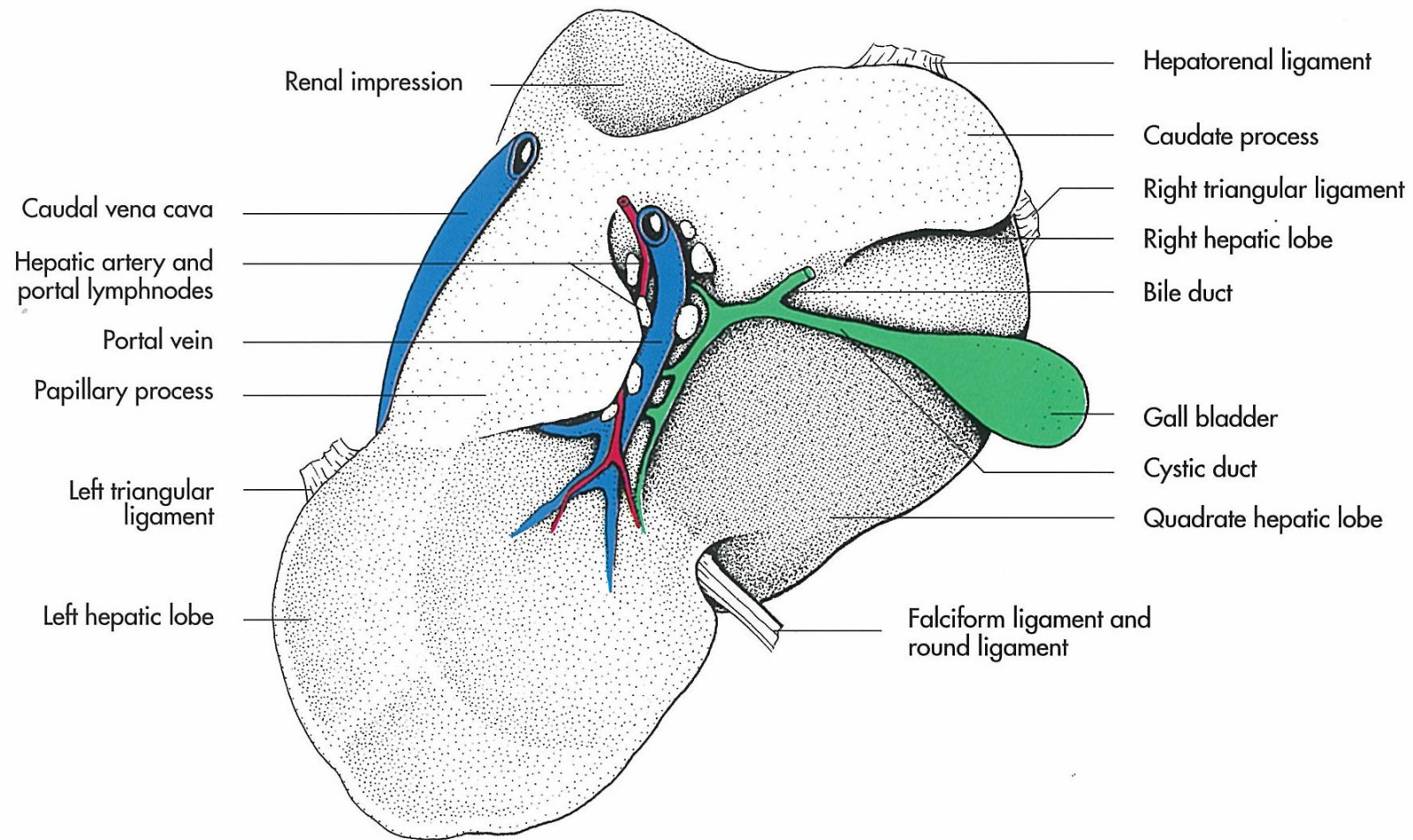


Fig 7-99. Liver of the ox, schematic, visceral surface.

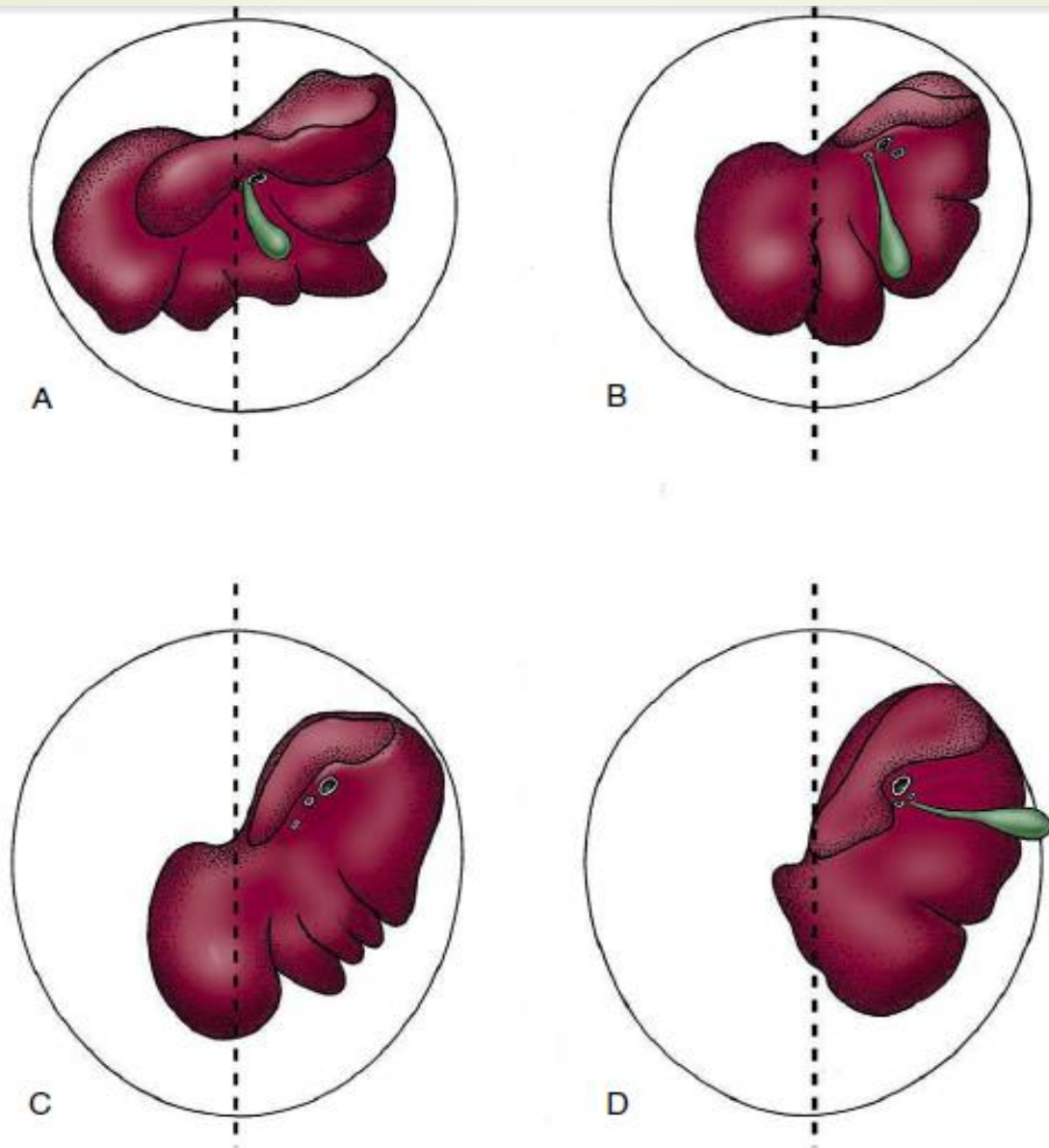
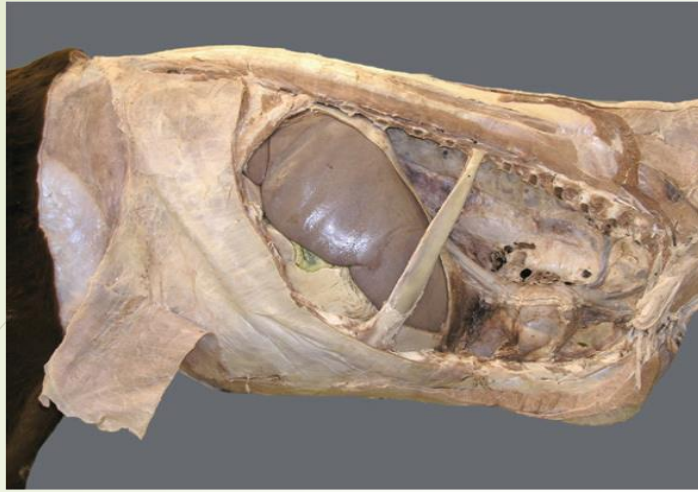


Figure 3–51 Caudal surface of the liver of the dog (A), pig (B), horse (C), and cattle (D). The median planes are indicated. The liver is asymmetrical, less so in the dog, more so in the pig and horse, and most in cattle, in which the bulk of the organ is displaced to the right. Note the absence of a gallbladder from the horse liver.



Liver biopsies in cattle are obtained on the right side at the 10th or 11th intercostal space at the level of an imaginary line between the tuber coxae and the olecranon. In clinical practice, liver biopsies are often collected using ultrasound guidance, which allows easy visualization of the liver and avoids puncturing hepatic vessels. Liver abscesses are common in feedlot and dairy cattle. Generally, it is associated with rumen acidosis and can lead to caudal vena cava thrombosis.

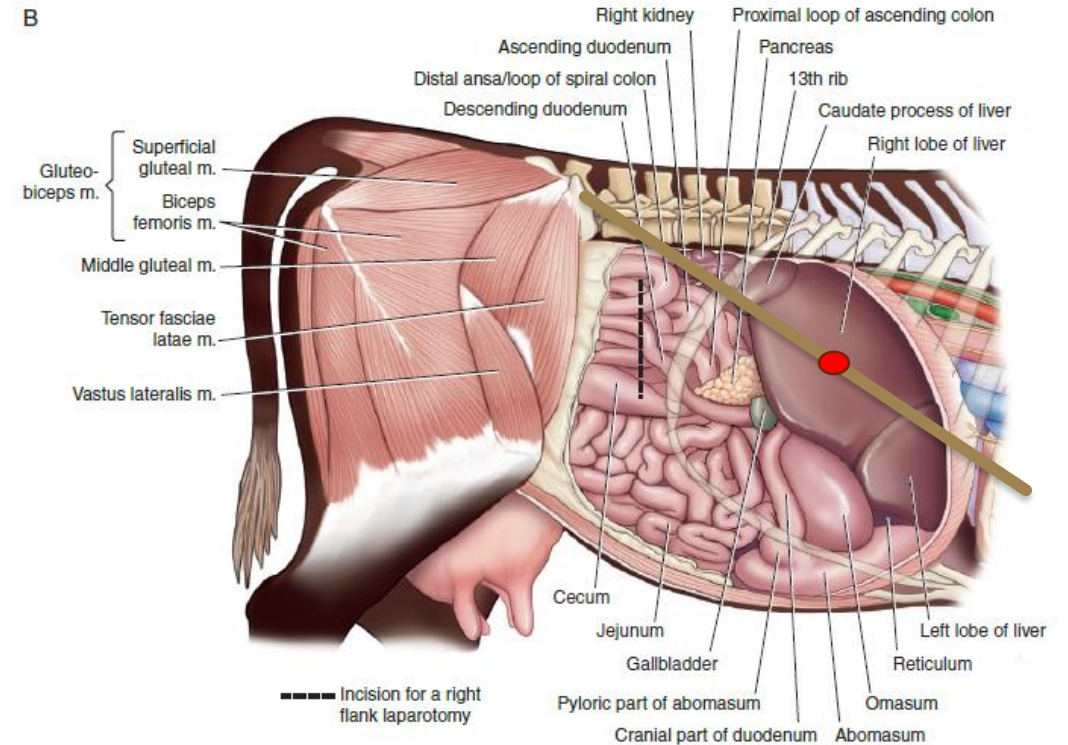
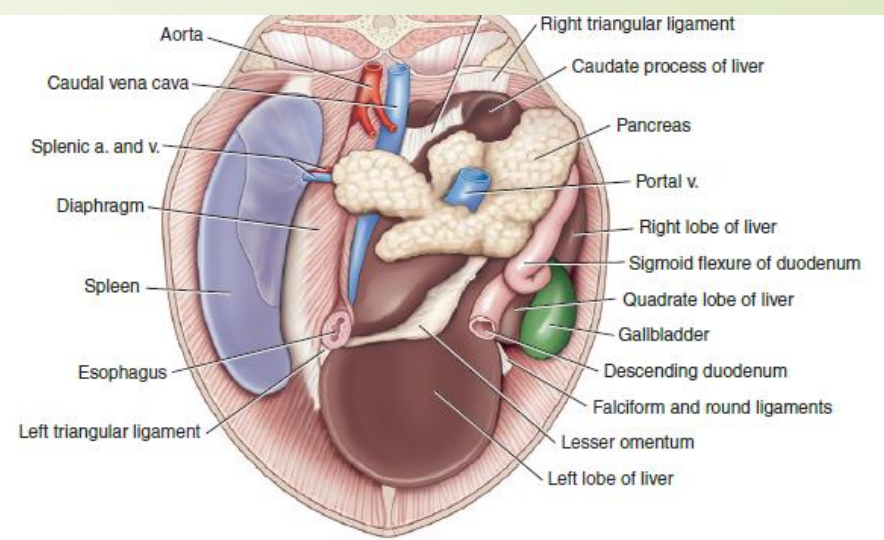


FIG. 19.6-4 The location in situ (A) and anatomy (B) of the liver. (A) Note the hepatic ligaments. (B) The incision for a right flank laparotomy is illustrated (dashed line) to highlight its proximity to the liver.