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Anatomy of the feline and canine spleen and pancreas regarding vascular supply – an anatomical study comparing cats and dogs with the extant literature

Diploma thesis

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Submitted by

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Declaration of Authorship

I hereby declare that the work presented in this thesis is solely my own effort and I have not used any sources or aids other than those indicated. All passages taken from external sources have been clearly marked.

I have carried out the decisive work myself and have listed all contributors and their contributions to the work.

Vienna, 10.12.2024 Lara Kölch

ABSTRACT

The anatomy of the pancreas and spleen concerning blood supply in dogs and cats, as described in the literature, is revisited in this study and compared with the prevailing anatomy observed in dissections of six dogs and six cats. The aim of this thesis is to highlight individual variations and complement the existing literature, including illustrations. This is intended to better plan future surgical procedures in the cranial quadrant of the canine and feline abdomen, such as partial pancreatectomy or splenectomy, and to be prepared for possible individual variations.

To achieve this, six dogs and six cats were thoroughly examined through a laparotomy in the region of the pancreas and spleen, regardless of their size, gender, age and cause of death. The two organs were carefully dissected, and their blood vessels were identified and isolated. Subsequently, the vessels were meticulously traced and compared with the literature. After complete dissection, the results were documented in the form of a checklist, and the anatomical structures were photographed. Special emphasis was placed on the shape of the pancreas in cats, the branching of the *A.lienalis* into dorsal and ventral parts, and the number of *Aa.gastroepiploicae sinistrae* in both feline and canine cadavers.

During the dissections, deviations from the literature were found. This is primarily due to individual differences, as there were also variations within the sample. The right pancreatic lobe of the cats was partially circular instead of hook-shaped according to Angelou et al. (2023). The branching of the *A.lienalis* into dorsal and ventral parts occurred more than 1 cm away from the spleen (Langley-Hobbs et al. 2014). Additionally, contrary to the description by Nickel et al. (2004), an average of two *Aa.gastroepiploicae sinistrae* were found in both dogs and cats instead of just one. These results are precisely illustrated with photographs in this study.

ZUSAMMENFASSUNG

Die in der Literatur beschriebene Anatomie des Pankreas und der Milz bezüglich Blutgefäßversorgung bei Hund und Katze wird in dieser Arbeit erneut aufgegriffen und mit der vorherrschenden Anatomie bei Sektionen von sechs Hunden und sechs Katzen verglichen. Ziel ist es dabei, individuelle Abweichungen aufzuzeigen beziehungsweise die vorliegende Literatur inklusive Illustrationen zu ergänzen. Dies soll dazu dienen, zukünftige chirurgische Eingriffe im cranialen Quadranten des kaninen und felinen Abdomens, wie eine partielle Pankreatektomie oder eine Splenektomie, besser planen zu können und auf etwaige Individualitäten gefasst zu sein.

Um dies zu erreichen, wurden im Vorfeld sechs Hunde und sechs Katzen unabhängig von Größe, Geschlecht, Alter und Todesursache mittels einer Laparotomie in der Region des Pankreas und der Milz genau untersucht. Es wurden die zwei Organe sorgfältig freipräpariert und deren Blutgefäße identifiziert und freigelegt. In der Folge wurden die Gefäße genau verfolgt und mit der Literatur verglichen. Nach vollständiger Präparation wurden die Ergebnisse in Form einer Checkliste dokumentiert und die anatomischen Strukturen fotographisch festgehalten. Besonderer Wert wurde auf die Form des Pankreas bei Katzen, auf die Aufzweigung der *A.lienalis* in einen dorsalen und ventralen Ast, sowie auf die Anzahl der *Aa.gastroepiploicae sinistrae* sowohl bei felinen als auch kaninen Kadavern gelegt.

Während der Sektionen wurden Abweichungen von der Literatur vorgefunden. Dies ist vor allem auf individuelle Unterschiede zurückzuführen, da es auch innerhalb der Stichprobe Varietäten gab. Es zeigte sich der *Lobus pancreatis dexter* der Katzen zum Teil zirkulär anstatt hakenförmig laut Angelou et al. (2023). Die Aufzweigung der A.lienalis in einen dorsalen und ventralen Ast erfolgte durchaus mehr als 1 cm von der Milz entfernt (Langley-Hobbs et al. 2014). Zudem wurden im Gegensatz zu der Beschreibung von Nickel et al. (2004) im Durchschnitt zwei *Aa.gastroepiploicae sinistrae* sowohl bei Hunden als auch Katzen anstelle von nur einer vorgefunden. Diese Ergebnisse werden mit Hilfe von Fotographien in dieser Arbeit genau aufgezeigt

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List of Abbreviations

Abbreviation	
A.	Arteria
Aa.	Arteriae
cm	centimeters
Lig.	Ligamentum
R.	Ramus
Rr.	Rami
V.	Vena
Vv.	Venae

1. Introduction

The region of the feline pancreas and spleen with their specific blood supply have not been studied thoroughly and the literature about the surgical anatomy of the pancreatic and splenic area in cats is rare in comparison to dogs. It is sometimes assumed that cats are just small dogs, but the reality often proves otherwise, making it quite sensible to describe the anatomy of the cat separately.

Furthermore, understanding the vascular supply of the pancreas and the spleen is essential for minimizing risks and ensuring successful outcomes within surgical procedures such as total or partial splenectomy or pancreatectomy for the therapy of abscesses or tumors (Angelou et al. 2023). Based on observations during celiotomies, the shape of the right limb of the pancreas and the vascular supply of the spleen in cats differs from dogs. According to Hermanson et al. (2020) the canine *Lobus pancreatis dexter* is bigger than the left one and follows the descending duodenum with its caudal extremity lying in the concavity of the duodenal loop. Whereas in cats, the right pancreatic limb is shorter than the left and its ventral end curves cranially giving it a hook-like shape (Maher et al. 2019). During dissections also a rather circular shape of the right lobe of the feline pancreas was found.

According to Nickel et al. (2004), the splenic artery runs along the left pancreatic limb towards the spleen and divides into a dorsal and ventral main vessel, which give rise to the *A.gastroepiploica sinistra, Aa.gastricae breves* and *Rr.lienale*s.

This bifurcation of the *A.lienalis* occurs approximately one centimeter away from the spleen (Langley-Hobbs et al. 2014), with the ventral main vessel then entering the hilum in the middle of the spleen (Fossum et al. 2021). However, during laparotomies, it has been observed that the bifurcation of the splenic artery occurs 1,5 up to 5 cm away from the spleen, and the ventral main vessel enters the hilum further distally at the tail of the spleen than described, especially in cats.

In comparison to dogs, cats have two special branches arising from the dorsal main splenic vessel for the visceral surface of the stomach and the *Angulus ventriculi* (Nickel et al. 2004). This is a very important information for the planning and execution of surgeries in the splenic and ventricular region. However, an extensive literature review is necessary to uncover details or even illustrations or pictures about these vessels.

According to Orsini et al. (2022), Fossum et al. (2021) or Nickel et al. (2004), the ventral branch of the splenic artery continues as a single *A.gastroepiploica sinistra* to the stomach. Nevertheless, dissections revealed that in dogs there are on average three *Aa.gastroepiploicae sinistrae*, while in cats up to four sinistral gastroepiploic arteries were found. In both canine and feline cadavers, these arteries further divided into two smaller branches before reaching the greater curvature of the stomach.

Due to these findings, the aim of this diploma thesis is to accurately depict the shape and blood supply of the pancreas as well as the vascularization of the spleen and to compare it with the existing literature. Additionally, prevalent differences between cats and dogs will be highlighted. This is intended to optimize preparation and execution of surgical procedures in the cranial abdomen, such as pancreatectomy or splenectomy.

Therefore, extant literature was compared, and anatomical dissections were performed on six feline and six canine cadavers regardless of age, gender, race and cause of death. The animal carcass was placed in dorsal recumbency, and the abdominal cavity was accessed through a deep skin incision at the ventral abdominal midline. The situs was assessed and the *Omentum majus* dislocated to create access to the pancreas and spleen. A blunt dissection and visualization of the pancreas and its vessels was performed. A similar procedure was carried out for the spleen. Special attention was paid to variations and differences between the species and all observations were documented photographically. At the end, the cadaver was closed with sutures for a clean disposal. Subsequently, the collected data was analyzed and compared with the existing literature to identify any discrepancies or novel findings. Finally, the results are described in this diploma thesis. In addition, some photos should help for better understanding and perception of the anatomical structures.

2. Literature Review of the Anatomy

2.1. The Pancreas

2.1.1. Function of the pancreas

The pancreas, a large gland, is part of the digestive tract and consists of both endocrine and exocrine components. The endocrine part constitutes only about two percent of the total organ mass. The endocrine cell groups are known as the islets of Langerhans, which are embedded within the exocrine part of the pancreas. They regulate the blood sugar levels by producing hormones such as insulin and glucagon. Additionally, somatostatin and the pancreatic polypeptide are produced (Salomon et al. 2020).

The exocrine part of the pancreas makes up the majority of the organ. Its main role is to support digestion, the assimilation of nutrients and protection against auto-digestion. The secreted pancreatic juice contains enzymes for the breakdown of proteins, fats and carbohydrates. It is released into the proximal duodenum (Mansfield and Jones 2001). Apart from this, the exocrine pancreas neutralizes gastric acids by secreting bicarbonate and thereby maintains the alkaline environment in the small intestine. These functions are regulated by secretin and cholecystokinin (Salomon et al. 2020).

2.1.2. General anatomy of the pancreas

The pancreas of small animals is a large elongate gland in the cranial abdomen. Its surface is finely lobulated and pale in appearance in the fresh state. The gross anatomical pattern of the pancreas can be described as compact or mesenteric type varying by species. The entire feline and canine pancreas can be classified as the compact type (Maher et al. 2020, William 1979).

The pancreas in general is composed of three parts – the left and right pancreatic lobes, as well as the corpus, which unites the two parts. The shape of the pancreas in cats and dogs reminds of a caudally open “U” (König et al. 2019), a boomerang (Reese et al. 2012) or an inverted “V” located caudally to the hilus of the liver (Maher et al. 2020). In cats, the pancreas has an average size of 12 cm (Angelou et al. 2023), whereas in dogs an average length of 25 cm is described (Reese et al. 2012). In dogs the left pancreatic lobe is the shorter, but thicker one (Hermanson et al. 2020), while in cats the right pancreatic lobe is described as the short one (Angelou et al. 2023).

The *Lobus pancreatis dexter*, also called duodenal lobe, extends to the right and follows the descending part of the duodenum to the caudal duodenal flexure. It is embedded in the mesoduodenum (König et al. 2019). To visualize the dorsal aspect of the right pancreatic lobe, the duodenum must be lifted medially and ventrally. However, to view the central aspect, the duodenum is lifted laterally (Fossum et al. 2021).

In cats, the caudal end of the short *Lobus pancreatis dexter* bends cranially again, making it appear like a hook (Angelou et al. 2023). According to Hermanson et al. (2020) the right canine lobe is typically 1 to 2 cm wide, up to 1 cm thick and 15 cm long.

At the *Corpus pancreatis* both lobes unite close to the *Pars cranialis duodeni* and the pylorus. Such as the right pancreatic lobe, the corpus is also embedded into the mesoduodenum. The U-shape forms the *Incisura pancreatis*. The portal vein runs through this structure crossing the dorsal portion of the pancreatic corpus (König et al. 2019). Based on the findings from Hermanson et al. (2020) the two lobes unite in the corpus and create an angle of 45 degrees, which is sinistrocaudally open.

The *Lobus pancreatis sinister* extends to the left towards the *Curvatura gastrica major* and is therefore located cranially of the transverse colon (Orsini et al. 2022). The left lobe is found in the *Mesogastrium dorsale* and the *Paries profundus* of the greater omentum. It is also called the splenic lobe since it reaches the dorsal extremity of the spleen (König et al. 2019). To access this part of the pancreas, the stomach and omentum need to be pulled ventrally. It is also possible to open the omental bursa in order to reach the left pancreatic lobe (Angelou et al. 2023). According to Hermanson et al. (2020) the left canine lobe reaches two thirds of length and only half of the width of the other lobe. In numbers that would be 10 cm long and 4 cm wide.

Apart from this, it is described that along the gut of the cat sporadically exist accessory nodular pancreatic lobes particularly in the region of the portal mesentery and the duodenum (Langley-Hobbs et al. 2014). Occasionally also in dogs, aberrant glands are discovered, called accessorial pancreas. These can be found in the caudal region of the mesentery and in the wall of the gallbladder (Hermanson et al. 2020).

2.1.3. Ducts of the pancreas

The pancreas is a large gland of the digestive tract, which structurally consists of an exocrine and an endocrine component. Anatomically, due to its exocrine function, the pancreas has ducts that extend into the duodenum for the release of enzymes necessary for the digestion of proteins, nucleic acids, fats and carbohydrates (Salomon et al. 2020). In general, the *Ductus pancreaticus* and the *Ductus pancreaticus accessorius* are known in small animals. The *Ductus pancreatis* ends with the common bile duct on the *Papilla duodeni major* in the cranial part of the duodenum (König et al. 2019). The *Papilla duodeni minor* is situated caudally to the major duodenal papilla and forms the opening of the accessory pancreatic duct. In dogs, it is located up to five centimeters distal to the *Papilla duodeni major*, whereas in cats there are two centimeters between the two openings of the ducts (Salomon et al. 2020 and Angelou et al. 2023). Depending on the species, an alternative formation of the excretory ducts is present (König et al. 2019).

In dogs, both ducts are described. (Figure 1) They typically communicate or intersect within the organ. However, there is a possibility that the two ducts do not connect. In this case, the pancreatic duct acts as a drainage for the right limb and the accessory pancreatic duct acts as a drainage for the left limb. The canine *Ductus pancreaticus accessorius* is the bigger one of the two ducts and is always developed. As mentioned before, it opens into the *Papilla duodeni minor* running through the left wall of the duodenum directly, with the opening located to the left of the pancreticoduodenal vessels. Occasionally this is the only duct in dogs, since the *Ductus pancreaticus* may be absent. The latter is smaller and opens into the *Papilla duodeni major* along the *Ductus choledochus* 8 cm distal of the pyloric sphincter. It has an intramural part in the duodenal wall, which forms a mucosal ridge and opens to the right after a slight elevation (Hermanson et al. 2020).

In comparison to dogs, in cats, the development of the ducts is exactly the opposite. This means, that the pancreatic duct is the bigger one and the accessorial pancreatic duct is smaller and may be absent (König et al. 2019). In most cases, the *Ductus pancreaticus accessorius* is not present. Instead, the single existing pancreatic duct is also known as the main pancreatic duct. This duct is formed by a fusion of two smaller ducts in the right and left limb of the feline pancreas. Together with the *Ductus choledochus*, they open into the Pars descendens duodeni on the major duodenal papilla approximately 3 cm distal of the pylorus (Maher et al. 2020). (Figure 2) It is important to mention that the main pancreatic duct combines with the bile duct before entering the duodenum (Orsini et al. 2022). Similar to dogs, the feline pancreatic duct also comprises an intramural, but short part (Maher et al. 2020). According to Angelou et al. (2023) the *Ductus pancreaticus accessorius*, which opens 10 mm distal to the *Papilla duodeni minor*, has been found in estimated 20% of the feline population.

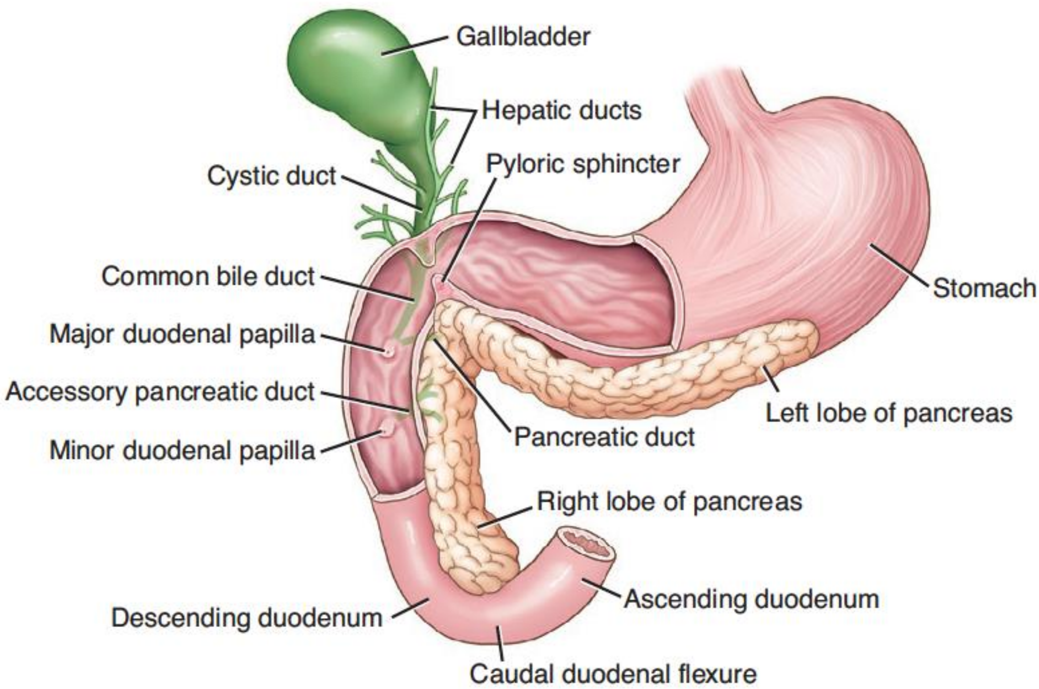


Figure 1: Shape of the canine pancreas and its pancreatic ducts (Orsini et al. 2022).

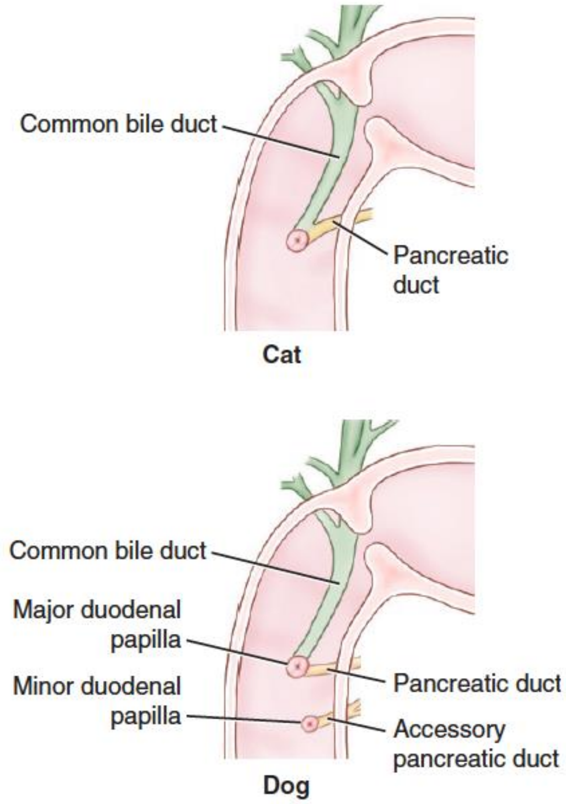


Figure 2: Illustration of the pancreatic ducts in cats and dogs (Orsini et al. 2022).

2.1.4. Blood supply of the pancreas

The blood supply of the canine and feline pancreas is secured by branches of the celiac artery (*A.coeliaca*) and cranial mesenteric artery *(A.mesenterica cranialis*). The proximal right pancreatic lobe is supplied by the *A.pancreaticoduodenalis cranialis*, which originates from the hepatic artery (*A.hepatica*), a branch of the *A.coeliaca*. Similarly, the *A.pancreaticoduodenalis caudalis*, a branch of the cranial mesenteric artery, ensures the blood supply of the distal duodenal respectively right pancreatic lobe. These two arteries form an anastomosis within the organ. The celiac artery also gives off the *A.lienalis* or also called *A.splenica*. This artery courses through the left pancreatic lobe and thereby supplies it via small pancreatic branches (*Rami pancreatici*) (Fossum et al. 2021). In dogs, it is described that the dorsal surface of the *Lobus pancreatis sinister* is also nourished by some small branches of the *A.hepatica* and that the left part near the *Corpus pancreatis* is supplied with one or two offsprings of the *A.gastroduodenalis* (Hermanson et al. 2020). The venous drainage occurs through the cranial and caudal pancreaticoduodenal veins (*Vv.pancreaticoduodenales cranialis* and *caudalis*), which converge into the *V.gastroduodenalis* and V*.mesenterica cranialis*. Additionally, the splenic vein (*V.lienalis*), collecting several pancreatic veins, arises from the left pancreas. Together with other visceral veins, they drain into the big *V.portae* (Nickel et al. 2004). (Figure 3 and 4) The detailed division of abdominal vessels for the supply of the pancreas and spleen will be explained in a later section.

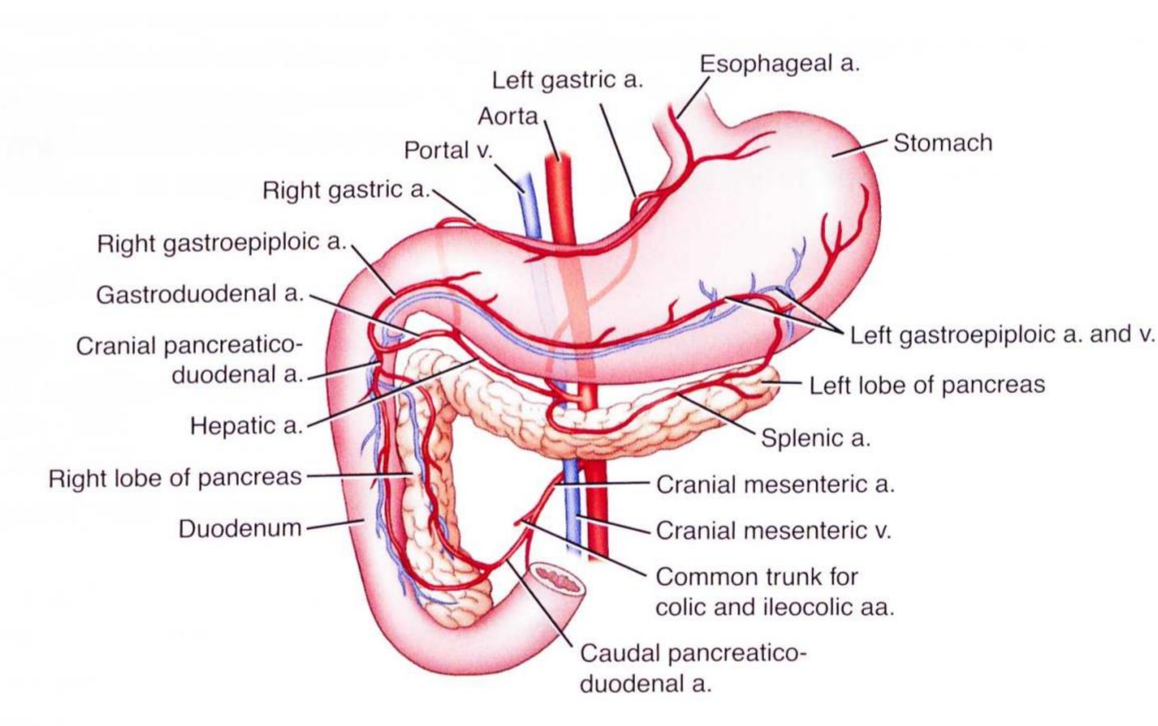


Figure 3: Blood supply of the pancreas in cats and dogs (Orsini et al. 2022).

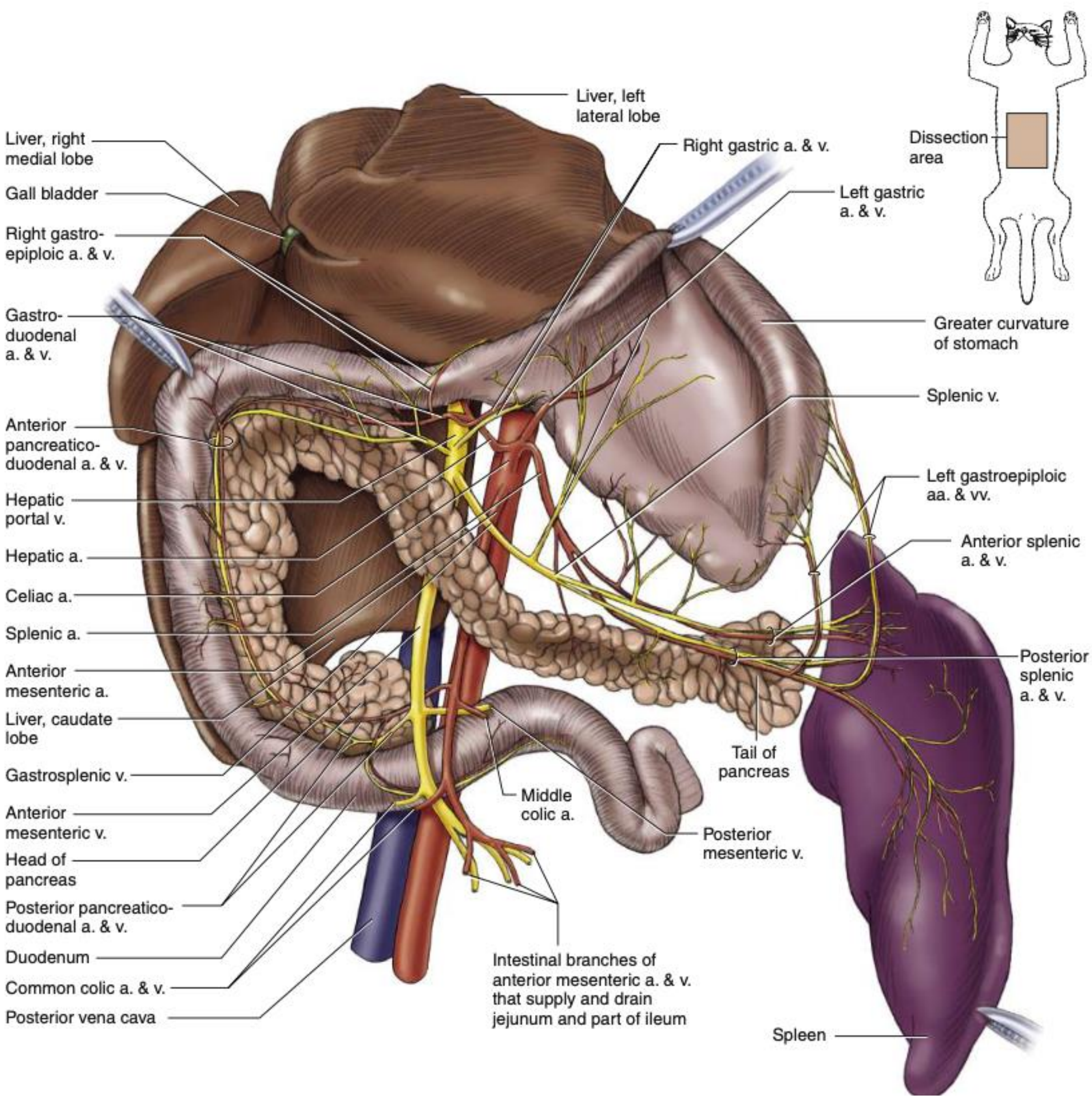


Figure 4: The shape and blood supply of the pancreas and its surrounding organs in cats (Iuliis and Pulera 2019).

2.2. The Spleen

2.2.1. Function of the spleen

The spleen develops from the differentiation of mesenchymal cells into reticulum cells and the organ capsule. Additionally, during development, blood stem cells migrate into the spleen. After the yolk sac has regressed, the spleen, in cooperation with the liver, takes on the task of hematopoiesis during the hepatolienal period in the fetus. During this time, erythrocytes, lymphocytes, granulocytes and megakaryocytes develop. In late fetal life and postnatally, the spleen is only capable of lymphopoiesis. Furthermore, the spleen is responsible for the sort out and breakdown of aging erythrocytes. Additionally, it serves as a blood storage. *Lienes accessorii* refers to so-called accessory spleen, which can form in the greater omentum as clusters of splenic tissue up to the size of a cherry (Salomon et al. 2020).

2.2.2. General anatomy of the spleen

The flat lymphatic organ is located near the greater curvature of the stomach and is embedded between the two serous layers of the *Omentum majus* (Salomon et al. 2020, Schaller and Constantinescu 2018). Thus, in cats and dogs it is situated in the left cranial quadrant of the abdomen in a vertical position. More specifically, it occupies the space between the left diaphragmatic crus, the cardia and the fundus of the stomach, and the left kidney. With the so-called *Ligamentum gastrosplenicum* it is connected with the *Curvatura gastrica major* with its dorsal end (Orsini et al. 2022). Based on a study from Maher et al. (2019) in cats there exists a further fixation of the base of the spleen to the left pancreatic lobe called splenopancreatic fold.

Apart from that, the position of the spleen depends on the degree of stomach filling. With increasing filling, it is displaced from its intrathoracic location caudally into the *Regio abdominalis*. However, there are differences between dogs and cats in this regard. In a dog with a moderately filled stomach, the organ lies between the seventh and tenth rib symphysis, with only the ventral end surpassing the costal arch. If the stomach is greatly enlarged, the spleen may partially shift entirely into the flank region. In the case of an empty stomach, the canine spleen lies completely intrathoracically, whereas the feline spleen never lies fully intrathoracically (Nickel et al. 2004).

One side of the spleen faces the abdominal wall and is referred to as the *Facies parietalis*, while the *Facies visceralis* faces the intestines. Moreover, the spleen can be described by its cranial and caudal margins (*Margo cranialis* and *caudalis*) as well as its *Extremitas ventralis* and *dorsalis*. Along the visceral surface, there is the *Hilus lienis*, which takes almost the entire length of the spleen and serves as an entry and exit point for vessels and nerves (Salomon et al. 2020, Schaller and Constantinescu 2018). According to Reese at al. (2012) the hilus splits the *Facies visceralis* into the *Facies gastrica* and *Facies intestinalis*. (Figure 5)

The spleen is slender and tongue-shaped with a widened ventral end, which is slightly angled caudally, making the tail broader than the body or head. (Figure 5 and 6) The spleen is approximately triangular in cross-section. In both cats and dogs, the tail and body can show some degree of free movement, but more in dogs than in cats. In a fresh state, it has a dark red color, although this can vary from light red to brownish red depending on factors such as breed, age, gender, nutritional status, and the functional stage regarding blood storage. In dogs, the length varies between 97 to 240 mm and the width between 25-46 mm. The spleen of a cat ranges in length from 114 to 185 mm and width from 14 to 31 mm (Nickel et al. 2004; Sayre and Spaulding 2013).

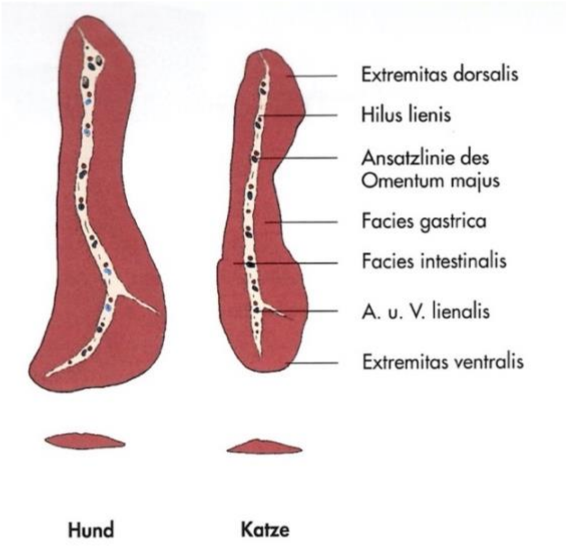


Figure 5: Comparison of the canine (left) and feline (right) spleen (König and Liebich 2019).

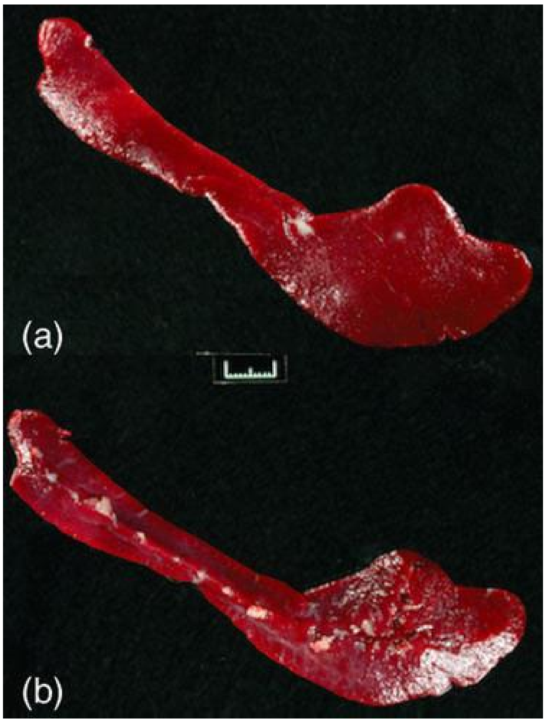


Figure 6: Feline spleen with anti-mesenteric surface (a) and mesenteric surface (b) (Sayre and Spaulding 2014).

2.2.3. Blood supply of the spleen

The entire blood supply of the spleen is provided by the splenic artery (*A.lienalis*), which arises from the celiac artery besides the *A.gastrica sinistra* and the *A.hepatica*. The *A.coeliaca* is the first branch of the abdominal aorta. The *A.lienalis* initially gives off three to five primary branches, with the first one heading towards the pancreas. The remaining branches continue towards the proximal part of the spleen, where then 20 to 30 small branches merge into the parenchyma along the *Hilus lienis* (Fossum et al. 2021).

The two ventrally coursing main vessels of the *A.lienalis* supply the middle and ventral regions of the spleen with their branches (*Rr.lienales*), which continue into the *A.gastroepiploica sinistra*. The latter curves to the right along the greater curvature of the stomach. Before the primary branches of the splenic artery enter the parenchyma of the spleen at the dorsal extremity, *Aa.gastricae breves* for the greater curvature of the stomach and *Rr.epiploici* for the omentum are given off. In addition, several omental branches (*Rr.epiploici*) arise from the ventral branches and extend over the *Extremitas ventralis*. Only in cats there exist two special branches, that stem from the dorsal main vessel and supply the visceral surface and the *Angulus ventriculi* of the stomach (Nickel et al. 2004). The venous drainage is carried out by the *V.gastroepiploica sinistra*, which leads into the *V.lienalis* and ends in the *V.portae* (Orsini et al. 2022). (Figure 7)

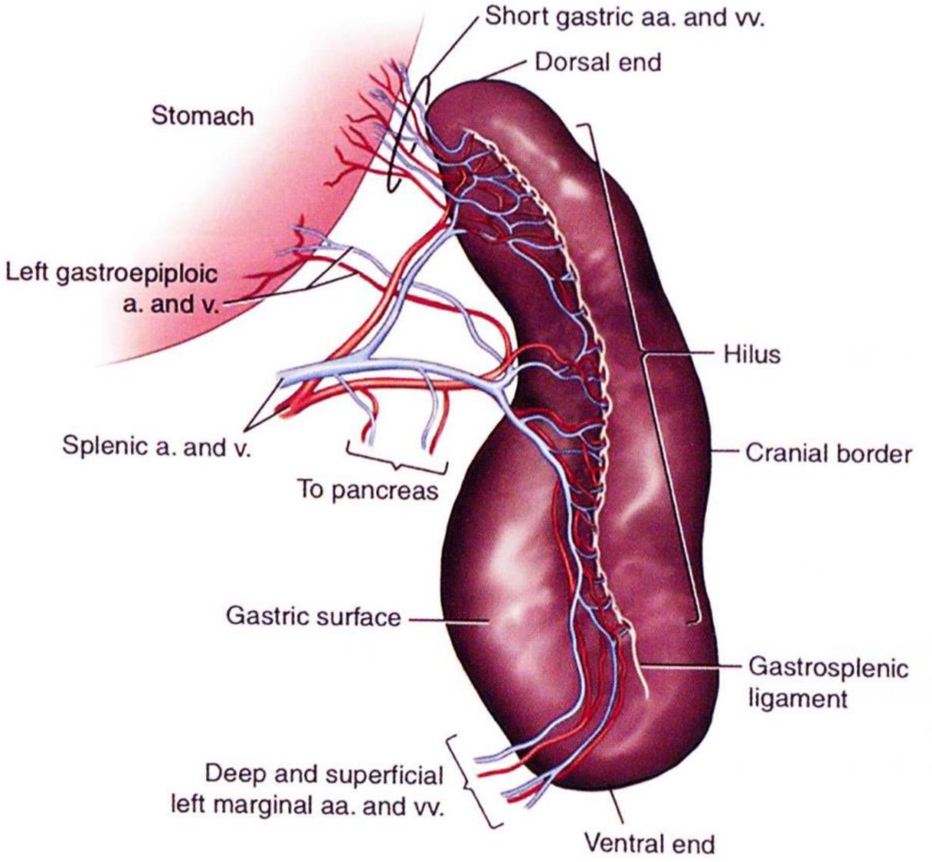


Figure 7: Visceral surface of the spleen with its major vessels of the dog and cat (Orsini et al. 2022).

2.3. The Aorta abdominalis and its visceral arteries

In this part, only the vessels and their origin relevant for the feline and canine pancreas and spleen will be explained in more detail for better understanding.

The *Aorta abdominalis* begins at the *Hiatus aorticus* of the diaphragm as a continuation of the thoracic aorta. It runs ventral of the inner lumbar muscles and is accompanied on the right side by the *Vena cava caudalis*. Along its course, it gives off several branches for the abdominal wall, as well as the in this part important visceral branches (Schroth 2021). These unpair visceral branches are running within the dorsal mesentery. Initially, the celiac artery branches off to supply the stomach, duodenum, liver, pancreas, and spleen. This is closely followed by the *A.mesenterica cranialis, A.renalis, A.mesenterica caudalis* and depending on the gender the *A.testicularis* or *A.ovarica* (Nickel et al. 2004). (Figure 8)

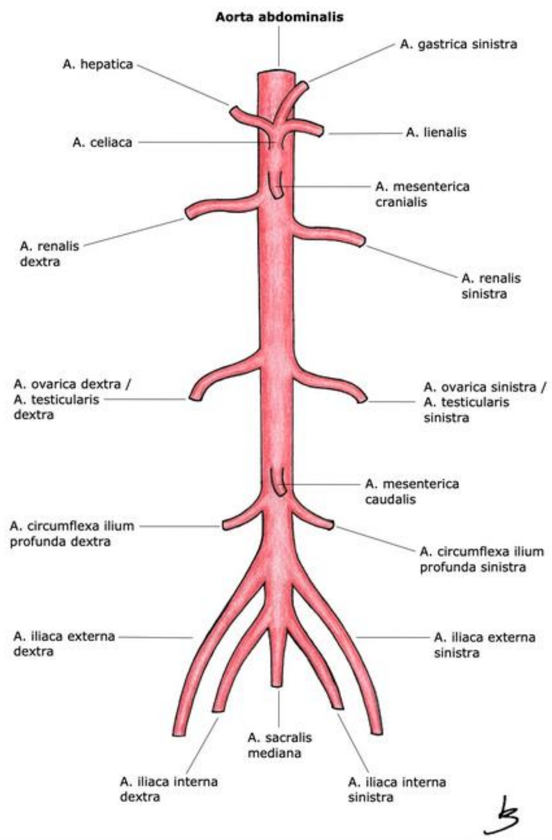


Figure 8: Branches of the Aorta abdominalis (Schroth 2021).

2.3.1. Arteria coeliaca

The celiac artery is the first visceral branch and originates at the level of the first lumbar vertebra. Partially, it first gives off the *A.phrenica caudalis* in cats and the *Aa.suprarenales craniales* in dogs. However, it generally divides into three main branches – the *A.lienalis* to the left, the *A.gastrica sinistra* cranially, and the *A.hepatica* to the right (Nickel et al. 2004).

2.3.1.1. Arteria lienalis

The splenic artery initially travels to the cranial edge of the left lobe of the pancreas and gives off *Rami pancreatici* to supply it. It then continues to the left and ventrally towards the splenic hilum. On the halfway, it divides into a dorsal and ventral *A.lienalis*, which supply the splenic parenchyma with *Rami lienales*. Before the dorsal branch of the splenic artery enters the spleen, the *Aa.gastricae breves* arise and run to the greater curvature of the stomach and *Rami epiploici* to the splenic omentum. In cats, there are two special branches for the visceral surface of the stomach and the *Angulus ventriculi*, which also stem from the dorsal branch. Additionally, a part of the ventral branch of the splenic artery continues as the *A.gastroepiploica sinistra* in an arc to the right towards the stomach. Several epiploic branches from the ventral branch extend over the *Extremitas ventralis* of the spleen towards the omentum (Nickel et al. 2004).

2.3.1.2. Arteria gastrica sinistra

From the left gastric artery, vessels for the distal esophagus (*R.oesophageus*) and the stomach (*Rr.gastrici*) arise. The *Rr.gastrici* run towards the short gastric arteries along the *Curvatura gastrica major*. In cats they also run towards branches of the splenic artery. In dogs, the *A.gastrica sinistra* often originates from the splenic artery instead of the celiac artery and may be partially paired (Nickel et al. 2004).

2.3.1.3. Arteria hepatica

The hepatic artery, as the name suggests, supplies the liver and gives rise to the right lateral and medial branches (*Rr.dexter laterales and mediales*), as well as the left branch (*R.sinister*). It then divides into the *A.gastrica dextra* and the *A.gastroduodenlis*. The gastroduodenal artery serves as the main vessel for the *A.pancreaticoduodenalis cranialis* for supplying a part of the pancreas, as well as the *A.gastroepiploica dextra* for a portion of the stomach (Nickel et al. 2004).

2.3.2. Arteria mesenterica cranialis

The cranial mesenteric artery arises caudal to the celiac artery from the abdominal aorta at the level of the second lumbar vertebra. It immediately enters the cranial mesentery and forms the *Radix mesenterii* caudal to the transverse colon. On the right, it is surrounded by the descending part of the duodenum and the ascending colon and on the left, by the ascending part of the duodenum and the descending colon. It supplies all segments of the digestive tract involved in the intestinal rotation. First, it gives off the *A.pancreaticoduodenalis caudalis*, which is important for the pancreas' supply. This is followed by the *Aa.jejunales, Aa.ilei, A.ileocolica, A.colica dextra* and *A.colica media* (Nickel et al. 2004).

2.3.2.1. Arteria pancreaticoduodenalis caudalis

The caudal pancreaticoduodenal artery branches off from the cranial mesenteric artery in caudal direction and travels within the mesentery of the *Pars ascendens* of the duodenum towards the *Flexura duodeni caudalis*. Along its course, it gives off the *A.jejunalis, Rami pancreatici* and *Rami duodenales*.

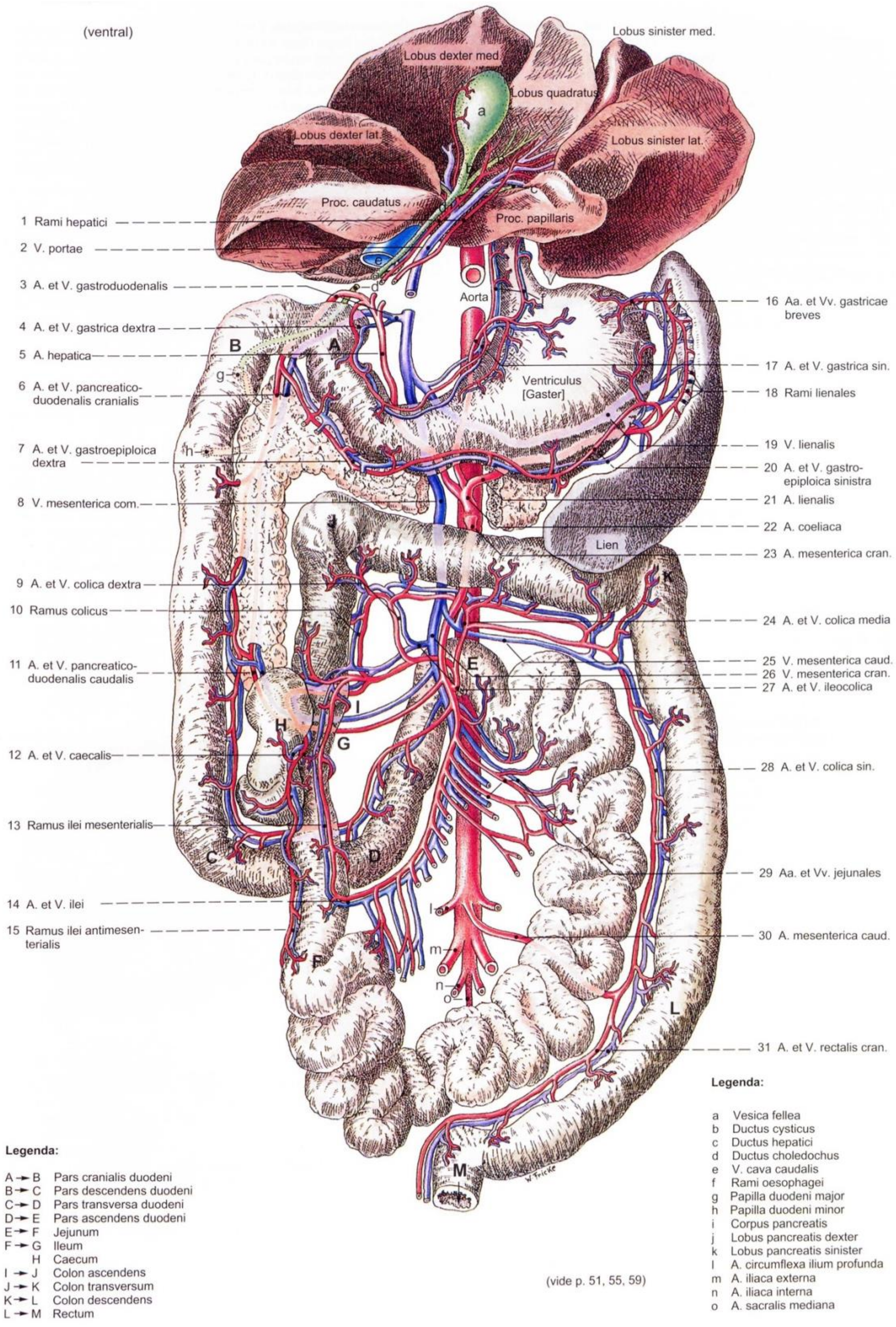


Figure 9: Illustration of the canine intestinal blood supply, including pancreas and spleen (Reese et al. 2012).

3. Material and Methodology

3.1. Dissection Material and Animal Cadavers

In this section, I will detail the types of dissection materials used and describe the guidelines for the animal cadavers examined during the study.

For the dissection, it was necessary to prepare some materials in advance. First, a support for the storage of the carcasses on the table was needed and an inflatable pillow was used. Additionally, gloves, an electric razor and drapes were required for a clean dissection environment. Dry and wet swabs, as well as cotton-tipped applicators were essential for the preparation of the organs and vessels. The necessary surgical instruments included Backhaus towel clamps, a scalpel handle with blades, Adson-Brown forceps, sharp-blunt surgical scissors, Metzenbaum scissors and suture scissors. For closing the incision, a Mayo-Hegar needle holder and various suture materials were used. Apart from this, a checklist was created in advance and was followed and completed step by step during the procedure. Furthermore, anatomical illustrations of the pancreas and spleen from anatomy books (Orsini et al. 2022, Reese et al. 2012, Fossum et al. 2021 and Langley-Hobbs et al. 2014) were used for direct comparison with the situs.

In total 12 dead cats and dogs, regardless of age, gender, race, weight and cause of death, were dissected. The only exclusion criterion was a disease of the pancreas or spleen with pathologic changes in these organs. Therefore, six cats and six dogs were collected at the clinic for small animals at the University of Veterinary Medicine in Vienna and refrigerated in the cold room at a constant temperature of eight degrees Celcius until dissection. Table 1 provides a list of the 12 dissected bodies, including their breed and sex, as well as their age and reason of treatment if specified.

Table 1: Information about the dissected cadavers.

List of the canine and feline cadavers used.				
Species	**Breed**	**Sex**	**Age**	**Reason for**
Dog 1	Shih Tzu	Male spayed	10a 10m	Emergency
Dog 2	Mixed breed	Male	10a 4m	Fever, dyspnea
Dog 3	Mixed breed	Female	n.a.	n.a.
Dog 4	Mixed breed	Male	n.a.	n.a.
Dog 5	Mixed breed	Male spayed	7a 6m	Dyspnea
Dog 6	Chihuahua	Female spayed	15a 3m	Biting wound
Cat 1	British short hair cat	Male spayed	11a 9m	Apathy post-surgery
Cat 2	European short hair cat	Female spayed	4a	n.a.
Cat 3	European short hair cat	Female spayed	n.a.	n.a.
Cat 4	European short hair cat	Female spayed	n.a.	n.a.
Cat 5	European short hair cat	Female spayed	3a	n.a.
Cat 6	European short hair cat	Male spayed	n.a.	Emergency
A = years, m = months, n.a. = not available				

3.2. Methodology

The postmortem examination of the canine and feline corpses was always performed in the same order and one at a time. The dissection procedure was conducted similarly for both cat and dog cadavers, although of course, attention is paid to species-specific differences, such as the specific feline visceral branches of the *A.lienalis* to the visceral surface of the stomach.

3.2.1. Preparation

At the outset, the animal carcass must be prepared by placing it in a supine position with the head pointing to the left. During the dissection the body was partially tilted 45 degrees to the right for a better access and view on the organs. The abdomen was generously shaved. Subsequently, the entire animal body was covered with an operating drape to create a clean environment. In the abdominal area, where the incision then was performed, the surgical covering drape was cleared, by cutting out a sufficiently large rectangular portion of the drape. Afterwards the drape was fixed with Backhaus towel clamps to prevent it from shifting.

3.2.2. Opening of the Abdomen

After the preparation, the abdominal cavity was accessed through a deep incision in the skin. The skin incision was made ventrally in the midline with a scalpel, extending from the xiphoid process of the sternum to the palpable bony pelvis, in order to create an opening large enough for subsequent manipulation and visualization of the structures needed. The skin was then separated from the subcutaneous fat and muscle using Metzenbaum scissors and subsequently, the abdominal cavity was opened by making a stab incision into the *Linea alba*. This incision was then extended in both directions to match the length of the skin cut. In all cases, a relief incision for a better visualization of the internal organs was needed. This was made caudally to the right costal arch in the dorsal direction along the last costal bone. In two dogs with very deep chests, an additional relief incision along the left caudal rib cage was essential to adequately expose the pancreas and the spleen, including their supplying vessels. Afterwards it was important to gain an overview and assess the situs of the organs in the abdominal cavity. This was followed by a blunt dissection of the *Omentum majus superficialis* while protecting the vessels to create access to the pancreas and the *Facies visceralis* of the spleen.

3.2.3. Exposure of the Pancreas

First, the pancreas and its two lobes were exposed. The *Lobus pancreatis dexter*, the *Corpus pancreatis* and the *Lobus pancreatis sinister* were identified and, if present, freed from excessive fat tissue. Particular attention was paid on the shape of the right lobe, the duodenal lobe, as this can vary significantly in cats. After the appearance of the pancreas was assessed and documented, its blood supply was dissected and exposed.

Therefore, the *A.mesenterica cranialis*, which originates from the *Aorta abdominalis*, was located, dissected and traced. The origin of the *A.pancreaticoduodenalis caudalis* from the cranial mesenteric artery was identified and followed to its entry into the right lobe of the pancreas as the *Ramus pancreaticus* using blunt dissection. Since these vessels are particularly delicate in smaller animals, great care must be taken to preserve all relevant structures. The emerging point of the pancreatic branch into the *Lobus pancreatis dexter* is documented. Additionally, the *Rami duodenales* of the caudal pancreaticoduodenal artery are identified. (Figure 10)

Furthermore, the *V.portae* and its feeding vessels can be exposed. The portal vein can be visualized in the *Incisura pancreatis* of the *Corpus pancreatis*.

In the case of the left lobe of the pancreas, the *A.lienalis*, which originates from the *A.coeliaca*, was first determined. The course of this artery along the *Lobus pancreatis sinister* was traced and exposed. Particular attention was paid on the fine *Rami pancreatici* of the splenic artery that supply the splenic lobe of the pancreas.

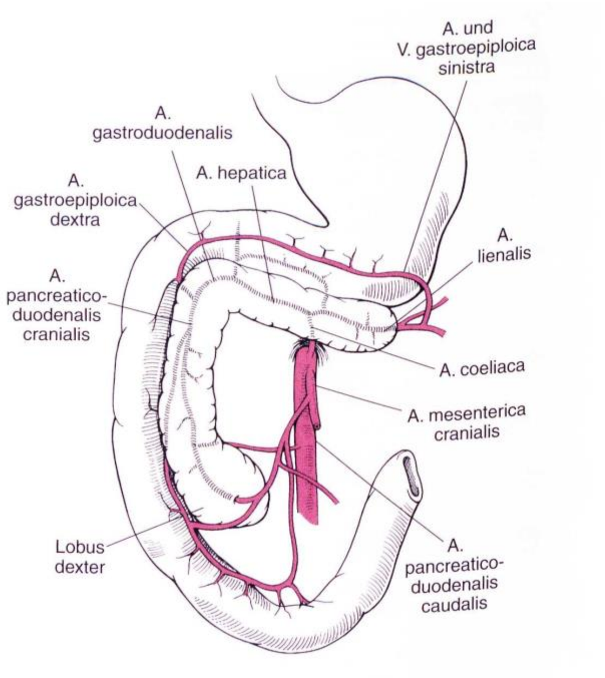


Figure 10: Blood supply of the pancreas in cats and dogs (Fossum et al. 2021).

3.2.4. Exposure of the Spleen

In a similar manner, the spleen and its vessels were prepared. After the extrication of the spleen the remaining omentum and excessive fatty tissue connected to the organ were bluntly dissected. Starting from the spleen, the individual vessels were carefully separated from fat and mesentery. At the dorsal end of the spleen are the *Aa.gastricae breves*, which run towards the greater curvature of the stomach within the gastrosplenic ligament. These are very fine vessels and required meticulous dissection. At the dorsal end of the spleen, the dorsal splenic artery merges into the *Hilus lienis*, this artery was followed back to the bifurcation of the *A.lienalis* into a dorsal and ventral branch. Subsequently, the *A.lienalis ventralis* was identified at the bifurcation of the bigger splenic artery. This artery was followed to its branches and its entry into the splenic parenchyma. The branches of the ventral splenic artery, which form the continuation into the *Ae.gastroepiploicae sinistrae*, were dissected and identified. There particular attention was paid on the number of these sinistral gastroepiploic arteries leading to the *Curvatura major* of the stomach. The further course of the ventral splenic artery was dissected, while preserving the epiploic branches. The hilum was cleared of fat as much as possible to clearly display the entry points of the *Rami lienales* into the spleen. (Figure 11) The insertion points were documented precisely, as there are minor discrepancies in the literature, which will be discussed at a later point. Apart from that, special attention was paid to the visceral vessels of the *A.lienalis* for the stomach in cats.

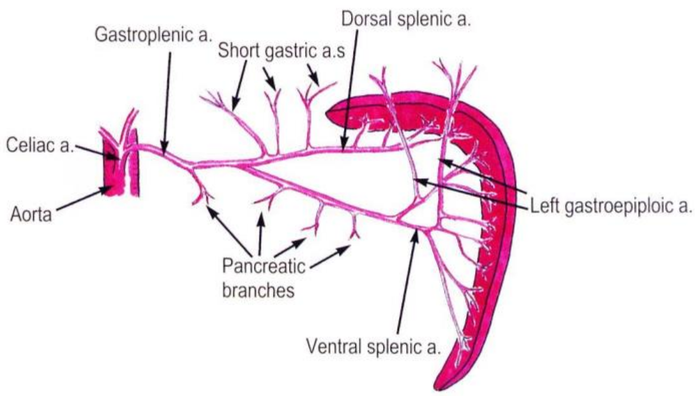


Figure 11: Blood supply of the spleen in cats and dogs (Langley-Hobbs et al. 2014).

3.2.5. Documentation of the findings

During the dissections, any special findings or deviations from the literature were noted in the checklist mentioned before for each animal. The shape of the pancreas and its exposed vessels were documented photographically. The spleen and its blood supply were also recorded through photos. Care was taken to position the spleen properly and to clearly display the course of the vessels. For optimal visualization, the organ was partially exteriorized from the abdominal cavity. All photos were subsequently labeled.

Once the exploration was completed and all points on the checklist have been examined and documented, the abdominal cavity was closed with a simple skin suture to facilitate the clean removal of the animal carcasses.

4. Results

4.1. Pancreas

4.1.1. Shape of the Pancreas

To start with the dogs, it is worth mentioning that the canine pancreas in the six dissections was consistent with the descriptions found in the literature. It exhibited a lobulated surface and had the shape of a V opening caudally. The *Lobus pancreatis dexter* showed like described as the thinner but longer lobe of the pancreas, while the *Lobus pancreatis sinister* was shorter but thicker (Hermanson et al. 2020). Furthermore, the right lobe of the pancreas extended to the *Flexura duodeni caudalis* but did not show a significant hook-like shape or even a ring structure as seen in cats, which will be discussed shortly. The pancreas of canids was thick enough to allow a rather good dissection without causing tissue loss, enabling clear and detailed representation like in Figure 12.

In comparison to dogs, differences from the extant literature and significant individual variations in the shape of the pancreas were found in cats. In three out of the six dissected cats, a pancreas as described in the literature was observed. It exhibited a lobulated and V-shaped structure (Maher et al. 2019). As described by Hudson et Hamilton (2010), the *Lobus pancreatis dexter* was thinner than the longer *Lobus pancreatis sinister*. Overall, this organ was very delicate in felids, requiring careful preparation to avoid damage or distortion of the pancreas representation. Additionally, as stated, the right pancreatic limb hooked back cranially at the *Flexura duodeni caudalis*. Interestingly, in two out of the six cats, the duodenal limb of the pancreas appeared circular-shaped. In this case, the right limb also hooked back cranially at the caudal duodenal flexure, but the tail of the pancreas reached the cranial beginning of the *Lobus pancreatis dexter* or the *Corpus pancreatis*. This is shown in Figure 13. Furthermore, the duodenal limb of one cat out of the six showed a nearly circular-shaped configuration, which did not quite reach the *Corpus pancreatis* but extended much further cranially compared to the hook-like tail according to Langley-Hobbs et al. (2014).

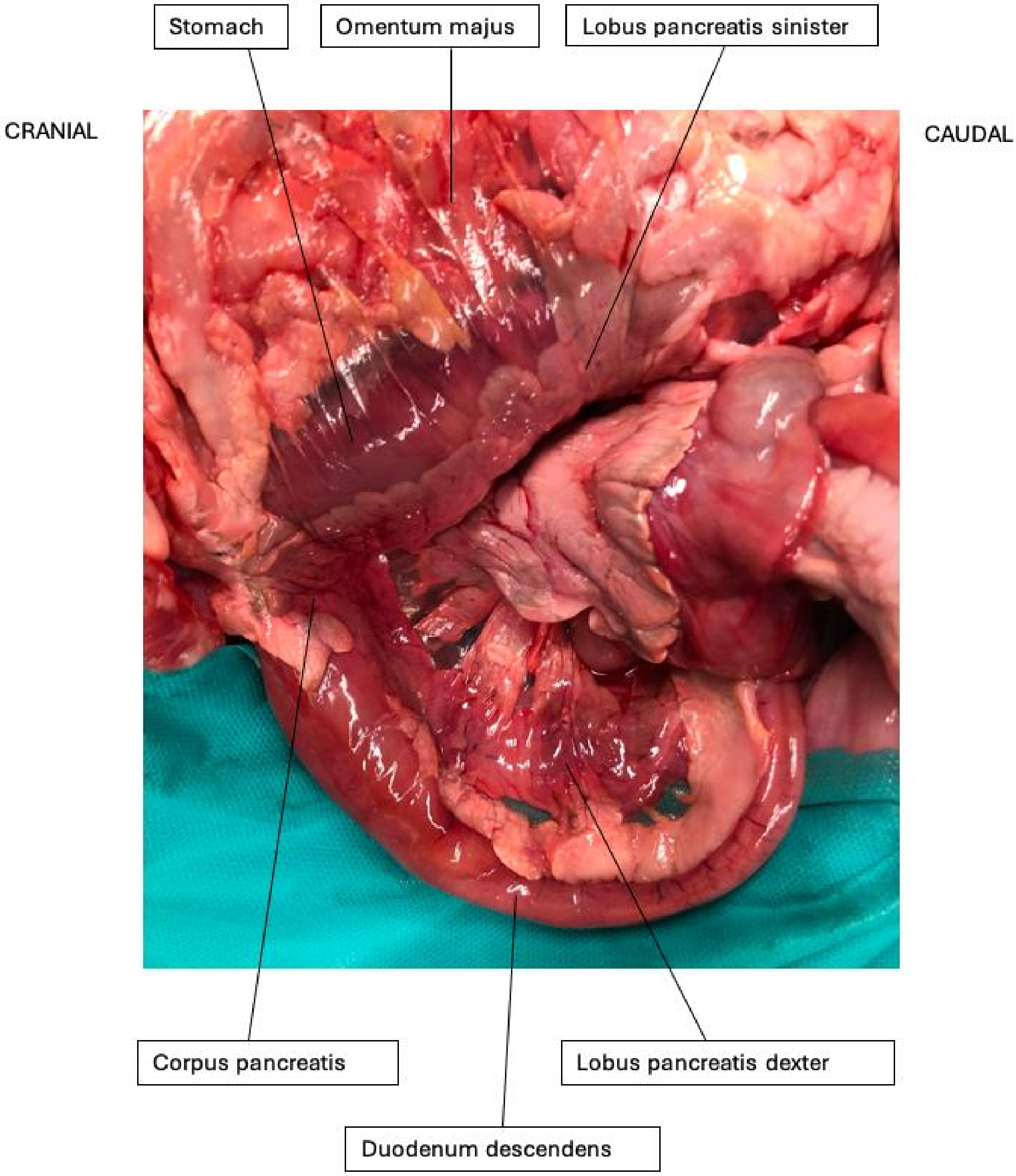


Figure 12: Photography of the canine pancreas with its lobes (dog 1).

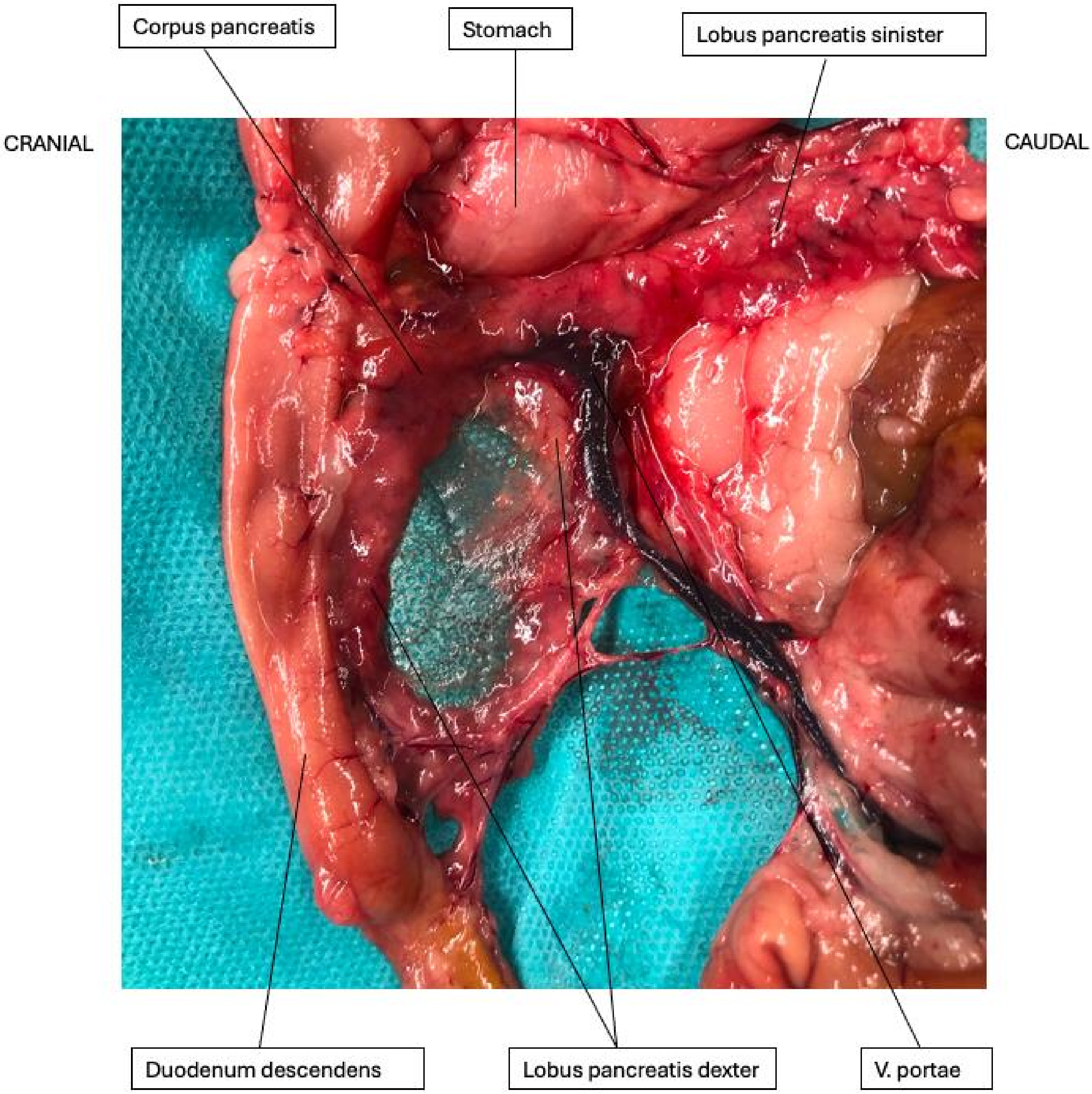


Figure 13: Photo of the feline pancreas inclusive the circular Lobus pancreatis dexter (cat 3).

4.1.2. Blood supply of the Pancreas

This section describes only the arteries, as the corresponding veins run mostly parallel to the arteries. Furthermore, only the blood supply of the right pancreatic lobe is primarily described, as the *A.lienalis* consistently runs with the *Lobus pancreatis sinister* and supplies it with small *Rami pancreatici* as described by Fossum et al. (2021). No significant individual variations were found there.

The illustrations of the blood supply of the cranial right pancreatic limb were a challenging task in both dogs and cats due to the difficult accessibility and fineness of the vessels. However, no significant deviations from the existing publications were found. As described by König and Liebich (2019), the cranial part of the duodenal limb of the pancreas is supplied by the *A.hepatica*, which branches off from the *A.coeliaca*. This supply is specifically provided by the *A.pancreaticoduodenalis cranialis*, which primarily runs within the pancreatic parenchyma, forming an anastomosis with the *A.pancreaticoduodenalis caudalis*.

The caudal blood supply of the right pancreatic lobe could be well dissected and demonstrated, showing a vascular pattern consistent with that described in textbooks. In six out of six dissected cats, the origin of the *A.pancreaticoduodenalis caudalis* from the *A.mesenterica cranialis* and its course was evident, as reported by Langley-Hobbs et al. (2014). It ran past the hooked end or the most caudal end of a circular pancreatic lobe, giving off a R*amus pancreaticus* to this point. Additionally, a larger *Ramus duodenalis* was given off, which divided into smaller branches that extended to the duodenum. (Figure 14)

Despite that, there are some individual variations in the course of the *A.pancreaticoduodenalis caudalis* and its branches in canids, which will be discussed in the next chapter.

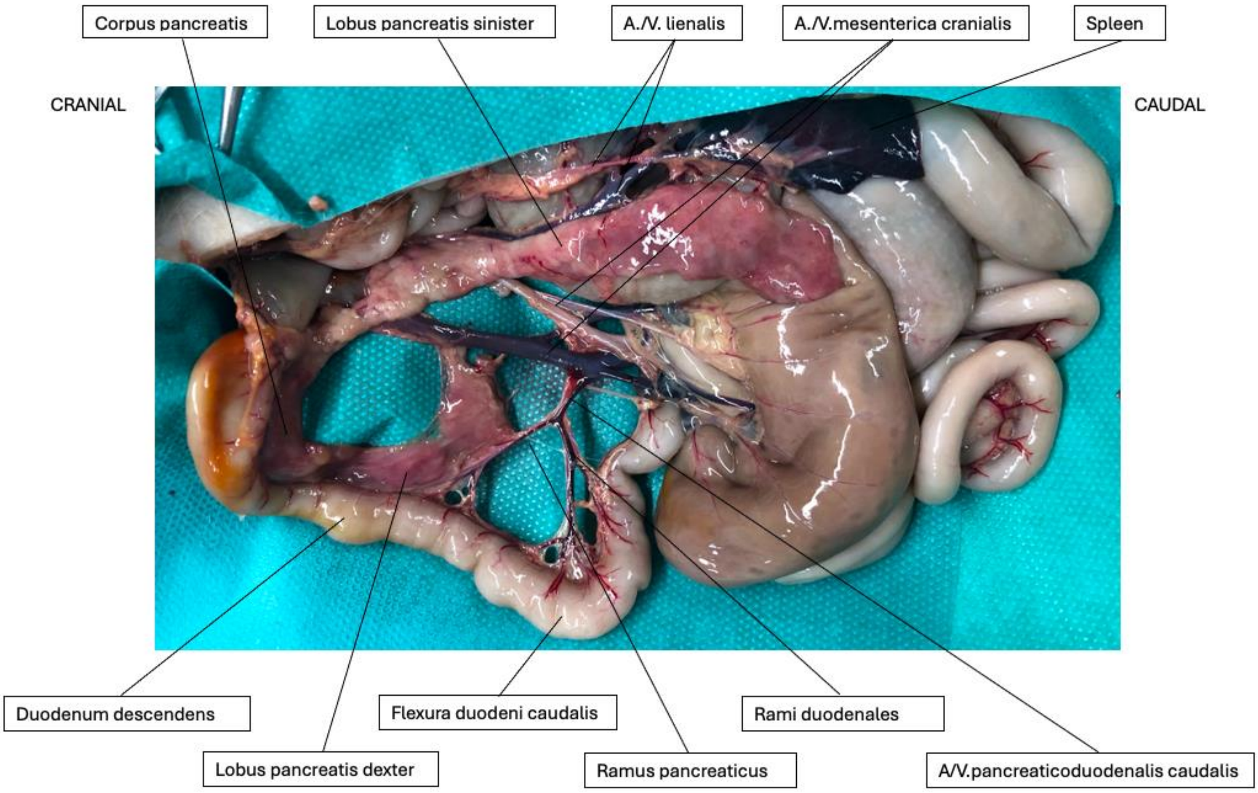


Figure 14: Photography of the caudal blood supply of the feline Lobus pancreatis dexter (cat 4).

4.1.2.1. Variations of the Arteria pancreaticoduodenalis caudalis in dogs

In four of the six dissected dogs, the blood supply appeared as depicted in Orsini et al. (2022). (Figure 3) The *A.mesenterica cranialis* was identified, which gives off the *A.pancreaticoduodenalis caudalis*. The latter extended towards the tail of the right pancreas and the duodenum. Along the *Pars descendens duodeni*, it ascended cranially, giving off several Rami duodenales, as well as one *Ramus pancreaticus* precisely to the tip of the tail of the pancreatic lobe and further ones along the limb. (Figure 15)

In Figure 16 a variant of the course of the caudal pancreaticoduodenal artery is depicted. In two out of the six dogs the *A.pancreaticoduodenalis caudalis* separated into two branches after its origin from the *A.mesenterica cra*nialis. The first branch ran directly to respectively through the middle of the right pancreatic limb and continued as *Rami duodenales* to the *Pars* *descendens duodeni*. There was a direct connection to the pancreas. The second branch extended slightly more caudally over the tail of the pancreas towards the duodenum and continued along the descending part of the duodenum cranially. Subsequently before reaching the duodenum, this branch gave off a *Ramus pancreaticus* to the tail of the right limb.

In Figure 15 and 16, the duodenal limb of the pancreas was repositioned to the left side of the body to allow a better photographic representation.

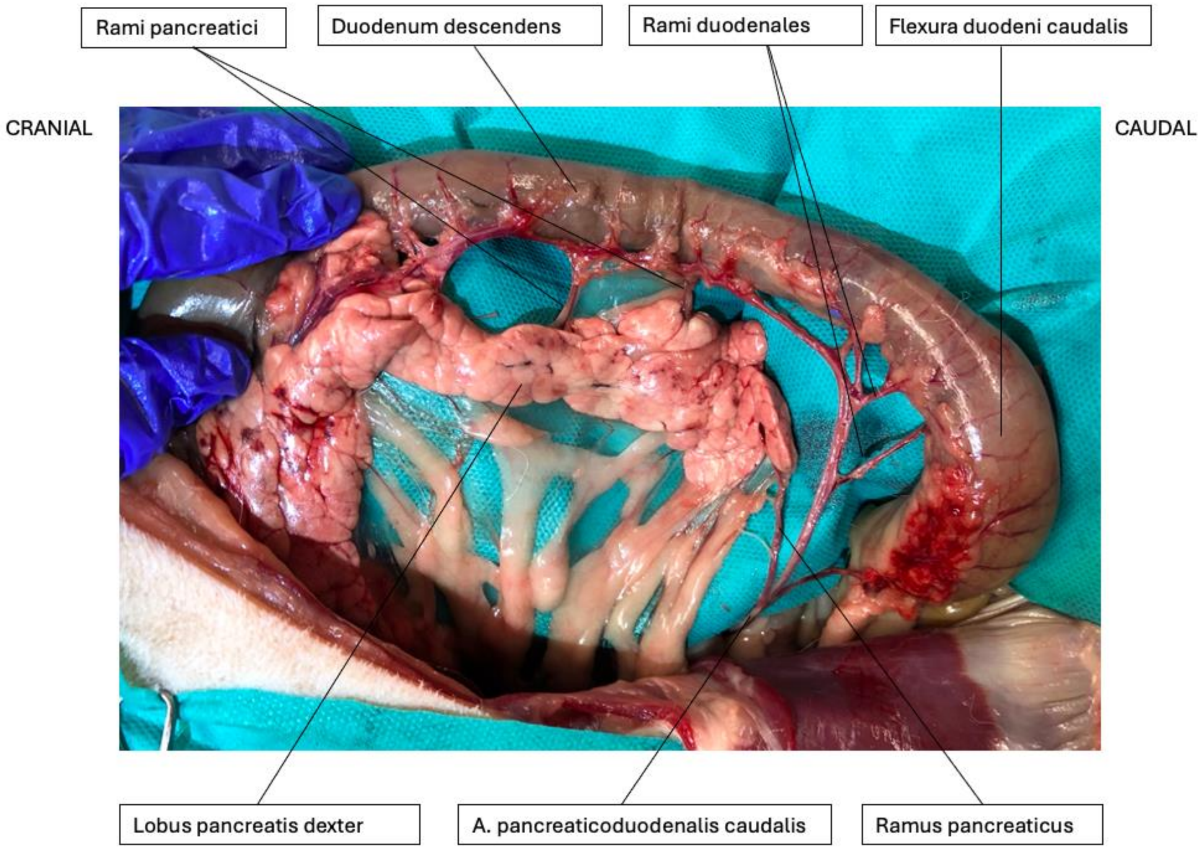


Figure 15: Photography of the blood supply of the canine Lobus pancreatis dexter (dog 5).

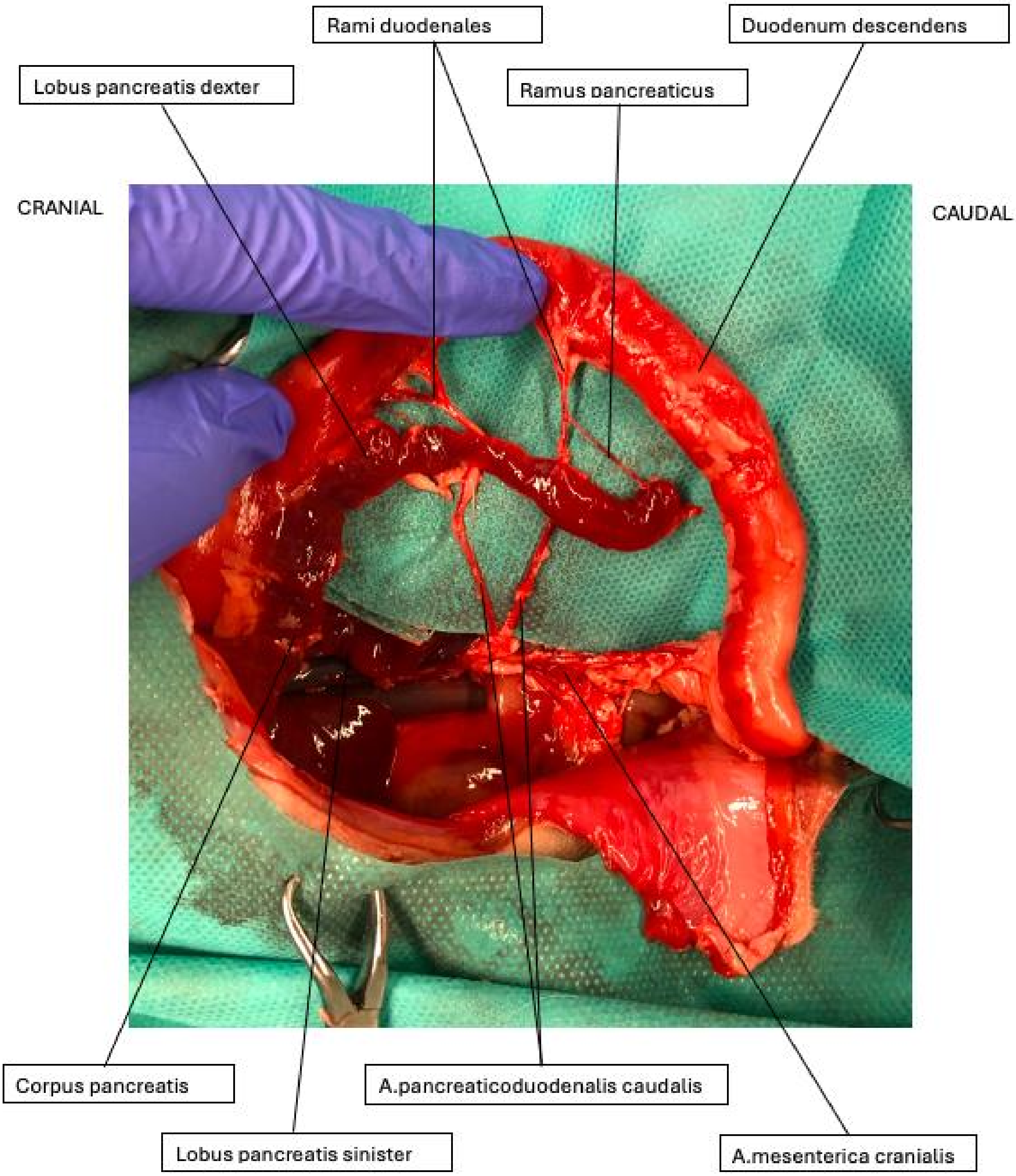


Figure 16: Photography of a variation of the canine A.pancreaticoduodenalis caudalis (dog 6).

4.2. Spleen

The spleen, along with its vessels, could be very well prepared and demonstrated in all 12 dissected cadavers. However, a few individual differences regarding the branching, number and entry of the vessels into the spleen were noted. This will be explained in the following chapters.

4.2.1. Arteria lienalis

The *A.lienalis*, as described in previous chapters, originates from the *A.coeliaca* and runs along the left pancreatic lobe towards the spleen. Before the splenic artery reaches the organ, it divides into a dorsal and ventral branch. The dissections revealed in all six dogs and six cats that this bifurcation of the *A.lienalis* occurs 1,5 cm up to 5 cm away from the *lien* depending on the size of the animal. After the division, the dorsal branch could be traced to the head of the spleen, where it gave off the *Aa.gastricae breves* before entering the *Hilus lienis* about 0,5 to 1,5 cm apart from the edge of the spleen. The ventral branch could also be well dissected and traced. This vessel divided further into two branches near the spleen. The first branch gave off the left gastroepiploic artery, respectively arteries, and continued to the middle or the beginning of the ventral third of the spleen, where it entered the parenchyma. The more caudal second branch of the ventral branch of the *A.lienalis* gave rise to several delicate branches for the supply of the omentum, known as the deep and superficial left marginal arteries. Afterwards, it merged into the tail of the spleen. (Figure 17 and 18)

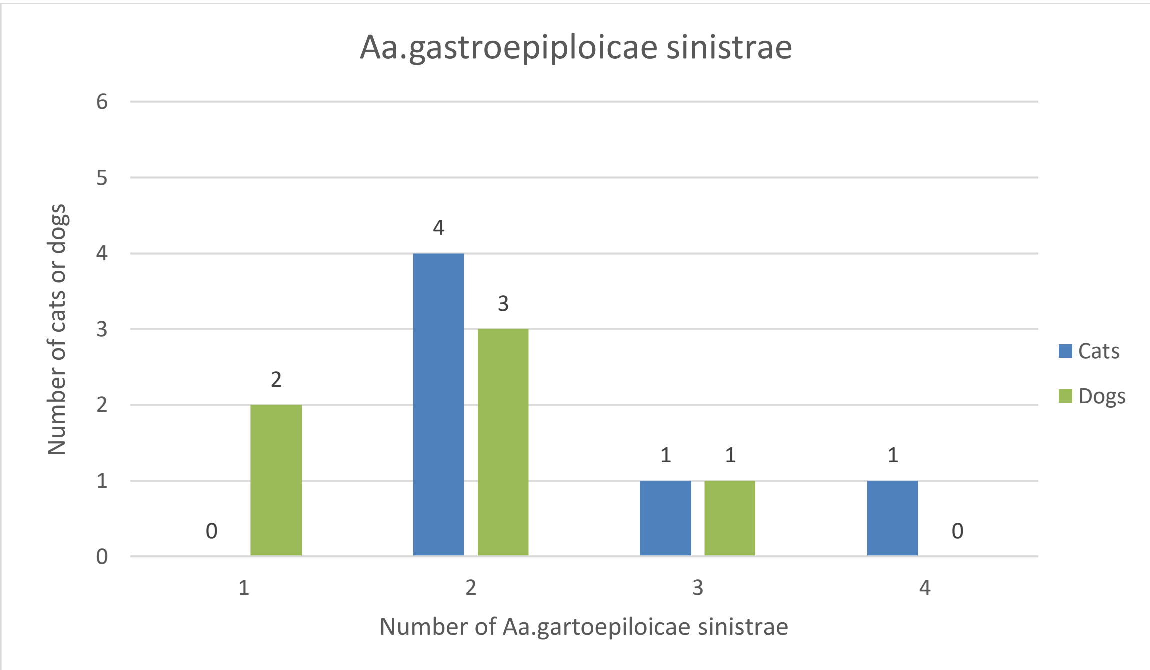
4.2.2. Arteriae gastricae breves

The *Aa.gastricae breves* originate from the dorsal *A.lienalis* and extend to the greater curvature of the stomach within the *Ligamentum gastrosplenicum* (Orsini et al.2022). The literature does not typically specify the number of these vessels. In the dissections, an average of three arteries were observed in both cats and dogs. However, it is important to note that determining the exact number was challenging because the delicate short gastric arteries were very prone to damage during preparation. (Table 3)

4.2.3. Arteriae gastroepiploicae sinistrae

In the dissections of the 12 cadavers, deviations were found in the present number of the sinistral gastroepiploic arteries compared to illustrations and descriptions in the literature. Nickel et al. (2004), Fossum et al. (2019) and Orsini et al. (2022) describe a single *A.gastroepiploica sinistra* branching off from the *A.lienalis* and extending to the *Curvatura gastrica major.* However, in the majority of the dissected feline and canine carcasses, multiple such vessels were found. These vessels must be *Aa.gastroepiploicae sinistrae*, as they physiologically branch off from the ventral branch of the *A.lienalis* in the observed area and extend to the stomach in this direction. Table 2 shows the number of these arteries, comparing cats and dogs. It was found that cats had an average of two *Aa.gastroepiploicae sinistrae,* with one cat having up to four. In dogs, an average of two were found as well, with a maximum of three. This can also be seen in Figure 17 and 18.

Table 2: Number of the Aa.gastroepiploicae sinistrae in cats compared to dogs.



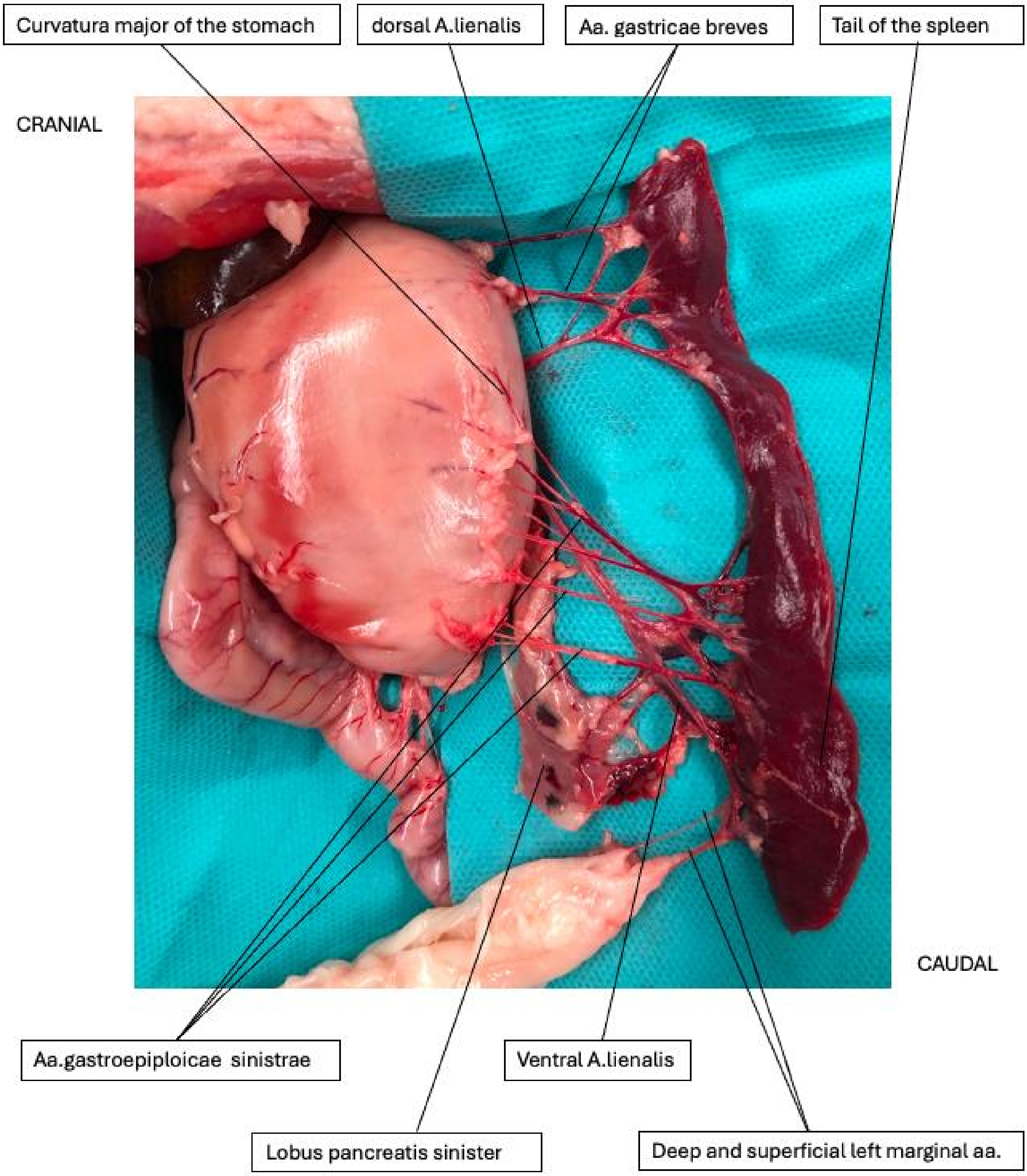


Figure 17: Photography of the blood supply of the feline spleen (cat 6).

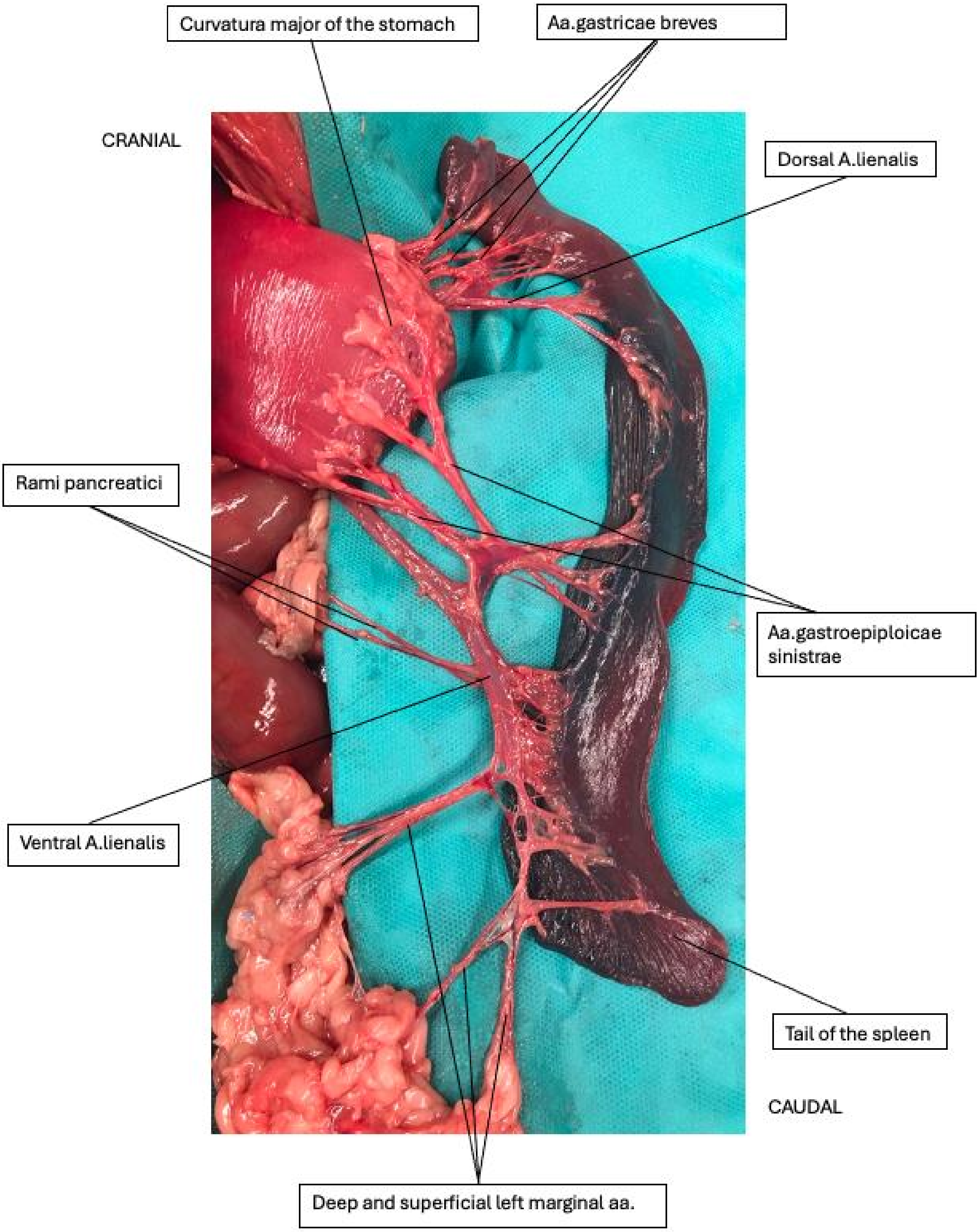


Figure 18: Photography of the blood supply of the canine spleen (dog 4).

Table 3: Summary of the number of the main splenic vessels in the 12 dissected bodies.

Numbers of splenic vessels in the 12 dissected dogs and cats.		
Species	**Aa.gastricae breves**	**Aa.gastroepiploicae sinistrae**
Dog 1	4	1
Dog 2	3	2
Dog 3	3	3
Dog 4	3	2
Dog 5	3	1
Dog 6	3	2
Cat 1	2	2
Cat 2	3	2
Cat 3	3	4
Cat 4	3	2
Cat 5	3	2
Cat 6	3	3

4.2.4. Special considerations in cats

Since the literature search revealed specific branches of the *A.lienalis* for the supply of the *Facies visceralis* and the *Angulus ventriculi* of the stomach only in very detailed sources and only in Nickel et al. (2004), illustrations of these two particular branches are included in this small section to highlight them for future surgical procedures in this area. These two branches diverged at the level of the ventral *A.lienalis* branching off from the splenic trunk artery and traveled a short distance to the visceral surface of the stomach, where they branched into several small arteries before insertion. (Figure 19)

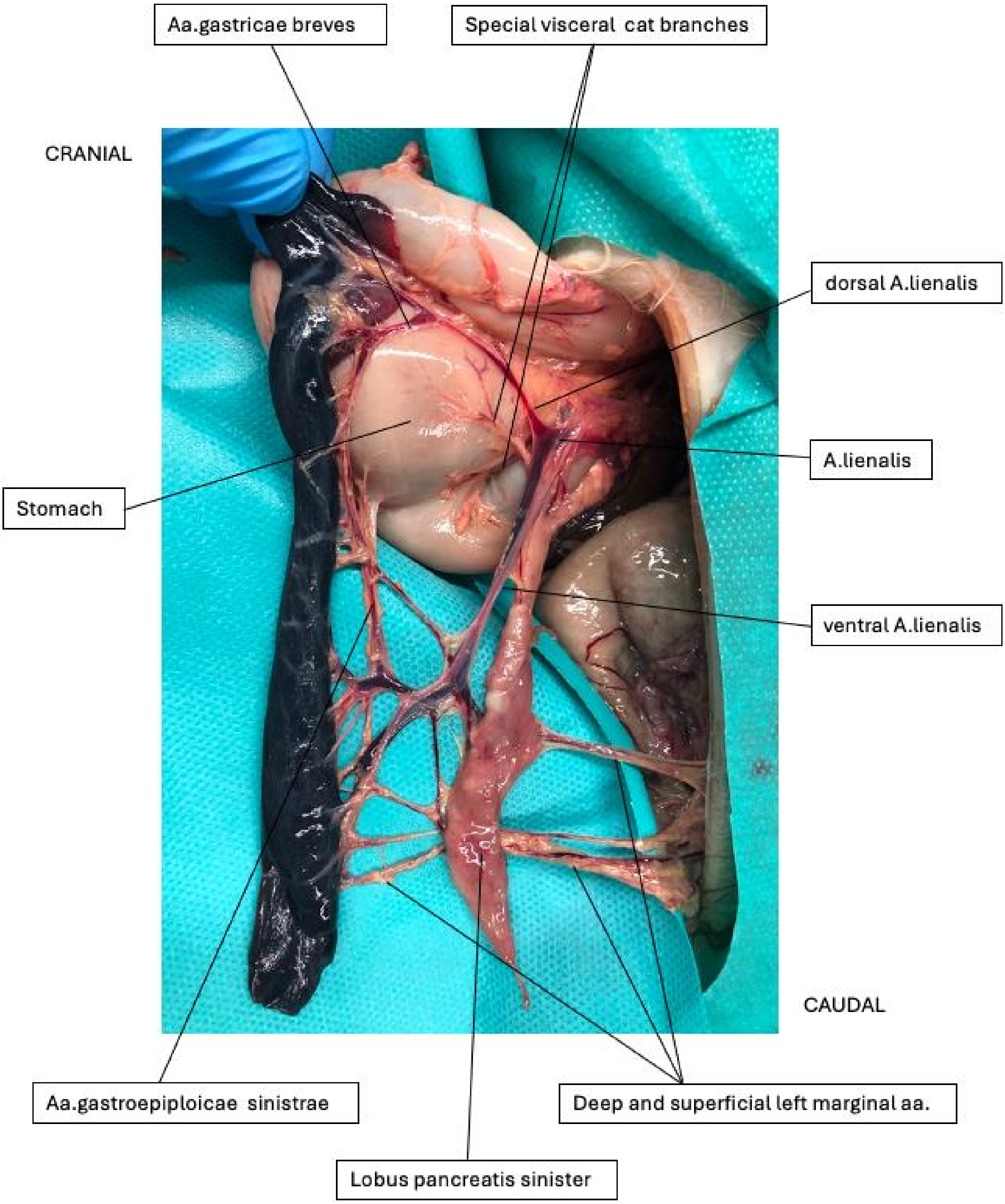


Figure 19: Illustration of the special branches in cats (cat 4, spleen and left lobe of the pancreas lifted to the right).

5. Discussion

Surgeries in the cranial quadrants of the abdomen in the veterinary medicine especially in small animal surgery have become more and more important and it is becoming increasingly essential to carefully plan surgical interventions, prevent operative risks and respond to them as quickly as possible when they occur. Therefore, knowledge about the anatomical structures in the region to be operated is of great importance.

The goal of this diploma thesis is to facilitate safe and reproducible techniques for interventions in the area of the pancreas and spleen in cats and dogs. This is ensured by a precise description of the anatomy of the feline and canine pancreas and spleen, their location, shape and the course of their vessels. This work also highlights individual differences regarding the shape of the pancreas in cats and the blood supply of the spleen in dogs and cats. This aims to help better prepare for individual circumstances during surgeries and to be mindful of deviations from the literature. To achieve this, precise dissectional work was performed in order to expose the pancreas and the spleen. This was done in six feline and six canine cadavers regardless of age, weight, sex and reason of death. The two organs were carefully dissected, and their vessels were exposed, identified and traced. The findings were recorded both in writing and photographically. The results of this study show that there exist significant individual differences, which need to be evaluated when planning a surgical procedure. It should be stated that data in the literature can be supplemented by this work, while the results of these dissections cannot refute established literature. However, it must be mentioned that some deviations were observed. This can be attributed to significant individual variations, as different anatomical conditions were found as well within the twelve dissections. Therefore, I would like to emphasize that, while the fundamental shapes of the organs and vessels generally correspond in each cat respectively dog, individual differences should be taken into consideration.

The most significant observation regarding the pancreas during the dissections was the varying shape of the right pancreatic lobe in the dissected feline cadavers. The literature contains several descriptions and illustrations of the duodenal lobe of the pancreas in cats. For instance, Hudson and Hamilton (2010) describe that the right lobe extends along the mesenteric portion of the duodenum and reaches up to the caudal flexure of the duodenum. Another description states, “The right lobe of the pancreas, which is short and has a hook-like shape, is closely related to the duodenum and located in the mesoduodenum.” (Angelou et al. 2023). Similarly, Langley-Hobbs et al. (2014) describe the tail of the *Lobus pancreatis dexter* as well hook-shaped and depicting it as a small hook in the *Flexura duodeni caudalis*. In the dissection, this hook-like shape was observed in only three out of the six dissected cats. In two cats, a circular structure was observed. There the tail of the right pancreatic lobe looped back cranially at the caudal duodenal flexure and reached with its actual distal end to the *Corpus pancreatis* running along the portal vein. In one cat, an almost circular shape was noted. There the hook-like tail extended much further cranially than described by Langley-Hobbs et al. (2014) but without reaching the pancreatic body.

The course of the blood vessels supplying the caudal portion of the right pancreatic lobe was consistent with the descriptions in the literature for all six cats and for four out of the six dogs. Nickel et al. (2004), Reese et al. (2012) and Fossum et al. (2021) describe and illustrate that the *A.pancreaticoduodenalis caudalis* branches off *the A.mesenterica cranialis* in caudal direction and runs towards the caudal duodenal flexure, while giving off pancreatic and duodenal branches to the tip of the tail of the *Lobus pancreatis dexter*. However, in two of the dissected canine carcasses, a division of the caudal pancreaticoduodenal artery was observed into two branches, with the first branch running through the middle of the right lobe and the second branch passing over the tail of the lobe, giving off a *Ramus pancreaticus* to the tip.

Another finding from the dissections concerns the division of the *A.lienalis* into a dorsal and a ventral branch for the supply of the spleen. The dissections revealed that this division does not occur immediately near the spleen, as stated for example by Langley-Hobbs et al (2014), who reported it to be about one centimeter from the spleen. In all twelve dissected animals the bifurcation was located from minimum 1,5 cm up to 5 cm away from the *Hilus lienis*. Furthermore, several illustrations, such as those by Orsini et al. (2022), Fossum et al. (2021) and Langley-Hobbs et al. (2014), depict the ventral branch of the splenic artery converging with the hilum at the center of the spleen. However, it was observed that this junction was indeed located further distally, either at the beginning or in the middle of the broader tail of the spleen in both cats and dogs.

A particularly striking observation was the variability of the number of the *Aa.gastroepiploicae sinistra*e in all the dissected cats and dogs. This is a crucial point in procedures such as a splenectomy, as this vessel must be preserved to maintain the blood supply to the stomach. The literature typically describes and illustrates only a single left gastroepiploic artery. For instance, it is stated that “the ventral branch [of the *A.lienalis*] arborizes with the left gastroepiploic artery after supplying the main body [of the spleen]” (Langley-Hobbs et al. 2014). Similarly, Orsini et al. (2022) and Fossum et al. (2021) describe the presence of one *A.gastroepiploica sinistra*. Nickel et al. (2004) also notes that the continuation of the ventral branch of the splenic artery forms a left gastroepiploic artery, which arches to the right along the greater curvature of the stomach. However, the dissections revealed that cats had between two and four *Aa.gastroepiploicae sinistrae*, while dogs had one to three of these arteries. On average, two of these separate arteries were found in all twelve dissections.

In comparison between cats and dogs, no differences in the course of the blood vessels were found during these twelve dissections. The previously mentioned differences from the literature were observed within the cat and dog groups but not between the two species. The only noticeable and significant difference was the presence of the special branches of the ventral branch of the *A.lienalis* supplying the visceral surface of the stomach and the *Angulus ventriculi*. According to Nickel et al. (2004) these vessels exist only in cats. This was confirmed in this study, as these vessels were also only observed in the dissected cats. However, Nickel et al. (2004) described that these special cat branches stem from the dorsal *A.lienalis*, whereas in the dissection they were found to branch off from the ventral *A.lienalis*. Apart from this, the blood vessels in cats, due to their smaller size compared to dogs, require greater care during manipulation, as they are more prone to damage.

Surgical interventions on the pancreas are primarily performed in cases of pancreatitis, pancreatic abscesses, pseudocysts or tumors. Examples of pancreatic tumors include insulinomas and gastrinomas, as well as more common exocrine pancreatic carcinomas in dogs and cats (Angelou et al. 2023 and Fossum et al. 2021). Pancreatitis is quite prevalent in both dogs and cats. For accurate diagnosis, a laparoscopic or surgical pancreatic biopsy may be necessary. Diagnosing pancreatitis in cats is particularly challenging compared to dogs, often making biopsy more frequently indicated in cats. In dogs, a pancreatic biopsy is occasionally performed to distinguish benign pancreatic changes like pancreatitis and pancreatic fibrosis from neoplastic diseases. This can be done using ultrasound, but usually, an exploratory laparotomy and direct inspection of the pancreatic tissue are required. If larger lesions such as abscesses or tumors are present and these focal lesions are located on the outer edge of the organ, a partial pancreatectomy is performed. A total resection is rarely done in animals due to the high mortality associated with it. This is due to the necessity of an additional cholecystoenterostomy and partial resection of the duodenum due to the location of the pancreas (Fossum et al. 2021).

Partial pancreatectomy can be performed using the suture-fracture technique, blunt dissection with ligation or resection with a thoracoabdominal stapler (Kramer et al. 2016). In advance, access to the pancreas must be ensured. This is achieved through a ventral midline incision extending from the xiphoid process to caudal to the umbilicus. The organ is initially inspected and palpated. The greater omentum is displaced cranially, and its visceral layer can be bluntly dissected to provide a direct view on the left pancreas. In the presence of a tumor, lymph nodes along the splenic vessels, portal vein, hilus of the liver and pancreatic head are examined for metastases. The suture-fracture technique is used for lesions in the distal pancreas sections. First, an incision is made in the mesoduodenum respectively omentum on both sides of the pancreas, and the portion to be removed is carefully dissected (Kramer et al. 2016, Monnet 2023). It is important to note that all manipulations on the pancreas must be performed with care, as any intervention can trigger pancreatitis (Fossum et al. 2021). Next, a monofilament and absorbable suture is placed over the incisions around the pancreas. It should encompass the entire parenchyma and be positioned proximal to the section to be removed. The suture is tightened, thus ligating vessels and ducts. Subsequently, the distal end of the pancreas is resected and finally, the mesoduodenum is closed in an appositional manner with either interrupted or continuous sutures (Kramer et al. 2016).

According to Kramer et al. (2016), blunt dissection can be used in all sections of the pancreas. Therefore, an incision is made in the mesoduodenum and omentum over the lesion. Then, with artery clamps and swab sticks, the section to be resected is carefully isolated from the intact parenchyma. Subsequently, the blood vessels and ducts of the section to be removed are identified and separately ligated. To prevent necrosis of the adjacent duodenum, the duodenal branches of the pancreaticoduodenal artery must be preserved during resection of the right pancreatic lobe. Once this is done, the affected pancreatic section is removed, and as with the suture-fracture technique, the mesoduodenum is closed in an appositional manner with either interrupted or continuous sutures.

The resection with a thoracoabdominal stapler is similar to the suture-fracture technique, but instead of using a ligature, titanium clips are placed in the incision with a TA stapler to achieve a secure closure of the ducts (Kramer et al. 2016).

Far more common surgeries in the cranial abdomen involve changes to the spleen. Surgical interventions include splenic aspiration, laparoscopic and surgical spleen biopsies for investigating splenomegaly or suspected metastases and splenic neoplasia. In cases of trauma-related splenic ruptures or lacerations, surgical management or splenectomy may also be necessary. Partial splenectomy is performed in patients with traumatic or focal lesions of the spleen. Whereas total removal of the spleen is indicated in cases of splenic tumors, torsions or severe trauma. The most common splenic tumor in dogs is a malignant hemangiosarcoma. Additionally, liposarcomas, fibro histiocytic nodules, lymphomas, blastomas, and adenocarcinomas are among the malignant splenic tumors in canids. Hyperplasia, hemangiomas, and splenitis, on the other hand, are benign (Fossum et al. 2021, Mansfield et al. 2001). In felines, splenic tumors are relatively rare. More commonly, generalized splenomegaly is due to infiltrative involvement of the entire organ by tumor cells. Mast cell tumors and malignant lymphomas constitute the majority in these cases. Localized mass enlargements, such as hemangiosarcoma are less frequent (Kessler 2022).

In partial splenectomy, the portion of the spleen to be removed is determined, and the vessels coming from the hilum to this area are doubly ligated and severed. This creates an ischemic area, which serves as a guideline for the resection. The spleen is compressed in this area using the thumb and index finger and the splenic pulp is massaged toward the ischemic part. Two clamps are then placed on the flat region and the spleen is divided between them. The incision is then closed using an absorbable suture with a continuous stitch (Fossum et al. 2021).

For a total splenectomy, after opening and exploring the abdomen, the spleen is retracted onto moist swabs. All vessels at the *Hilus lienis* are doubly ligated with absorbable sutures and then cut. Alternatively, a LigaSure device can be used instead of ligatures. The *Aa*. and *Vv.gastricae breves*, as well as the *Aa*. and *Vv.gastroepiploicae* sinistrae should be preserved as much as possible as they supply the gastric fundus. An alternative approach involves opening the omental bursa. The *A.lienalis* gets isolated. The vessels supplying the left pancreatic limb are identified and distal to these vessels a double ligature is placed on the splenic artery. Afterwards this big vessel is severed (Fossum et al. 2021).

When considering the procedures of these operations, it becomes clear that the anatomy plays a crucial role for setting correct incisions and ligatures. Therefore, this thesis can contribute to improved procedures due to the anatomical descriptions provided. However, a drawback of this study is that only six cats and six dogs were dissected. This is a rather small number of cadavers to clearly evaluate the individual differences. Furthermore, a fraction of the bodies was preserved in the refrigerating room and the vessels and organs were more prone to lesions, potentially leading to skewed results. For sure, using only fresh cadavers would have been ideal. Apart from that, this area leaves space for further anatomical studies, supplemented with computer tomographic scans or vessel injections for a more precise and complementary depiction of the structures. In conclusion, differences from the literature were found, which are certainly significant and should be considered in future surgeries. For instance, in a pancreatectomy in cats, where a circular structure of the right pancreatic limb is present, or in a splenectomy with a varying number of *Aa.gastricae breves* and *Aa.gastroepiploicae sinistrae*, which should be preserved to maintain the blood supply to the gastric fundus. Differences between dogs and cats were less pronounced in this study, apart from the shape of the feline pancreas compared to the one of dogs and the specific visceral vessels of the *A.lienalis* supplying the stomach in cats. This leads to the conclusion that surgeries in the region of the pancreas and spleen can be performed in a similar manner in both dogs and cats.

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7. Appendix

7.1. Dissection of the cats

7.1.1. Cat 1

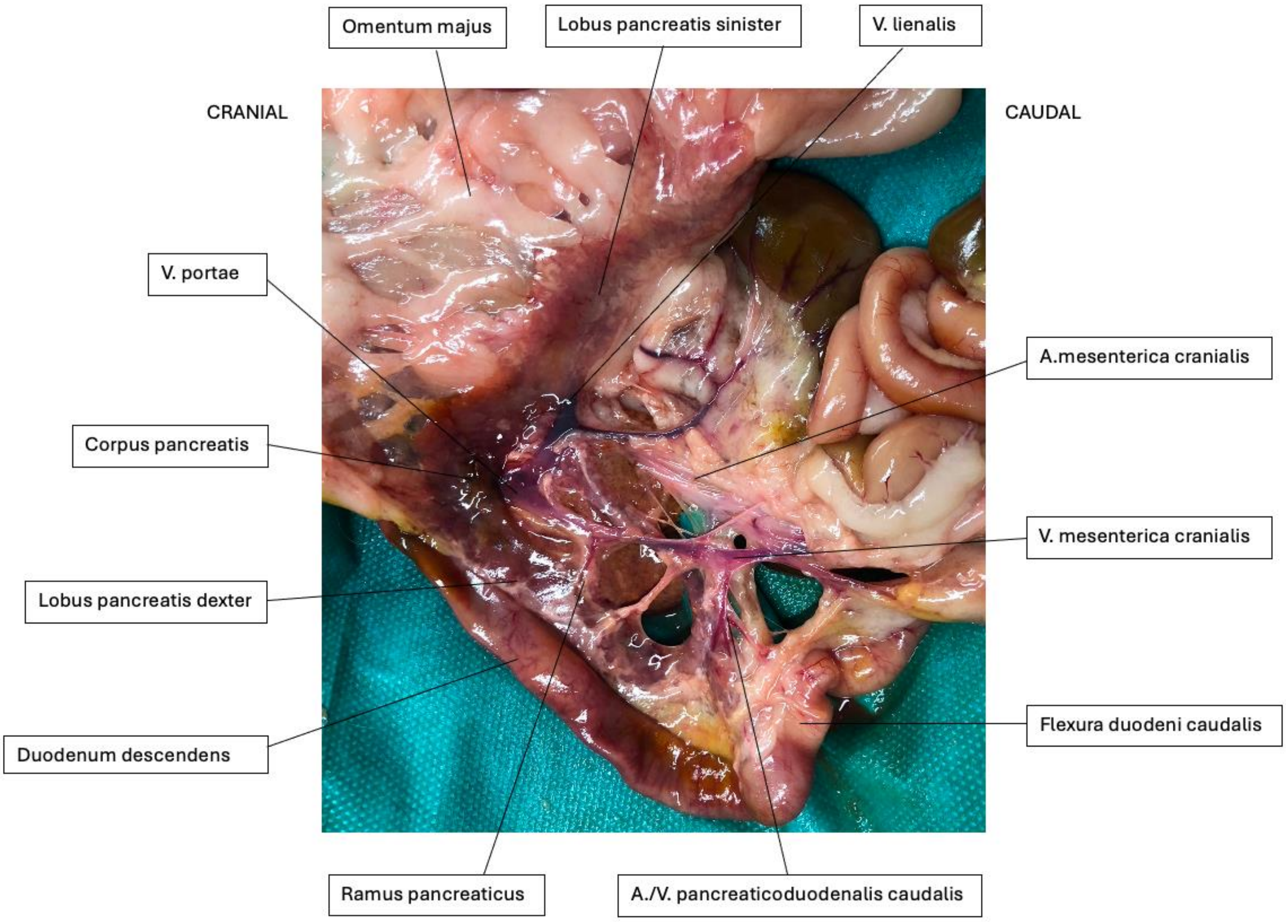

Figure 20: Photo of the pancreas and its vascular supply of the first dissected cat.

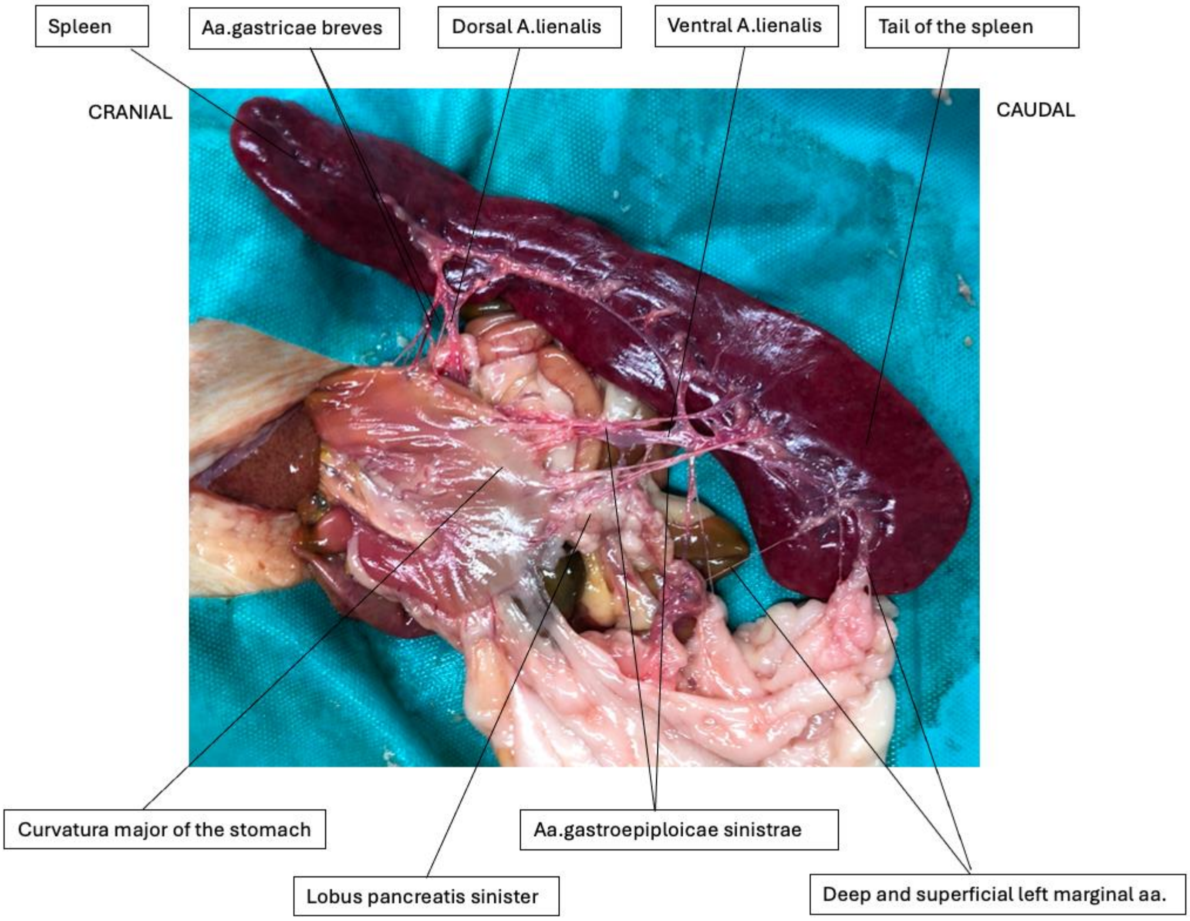

Figure 21: Photo of the spleen and its vascular supply of the first dissected cat.

7.1.2. Cat 2

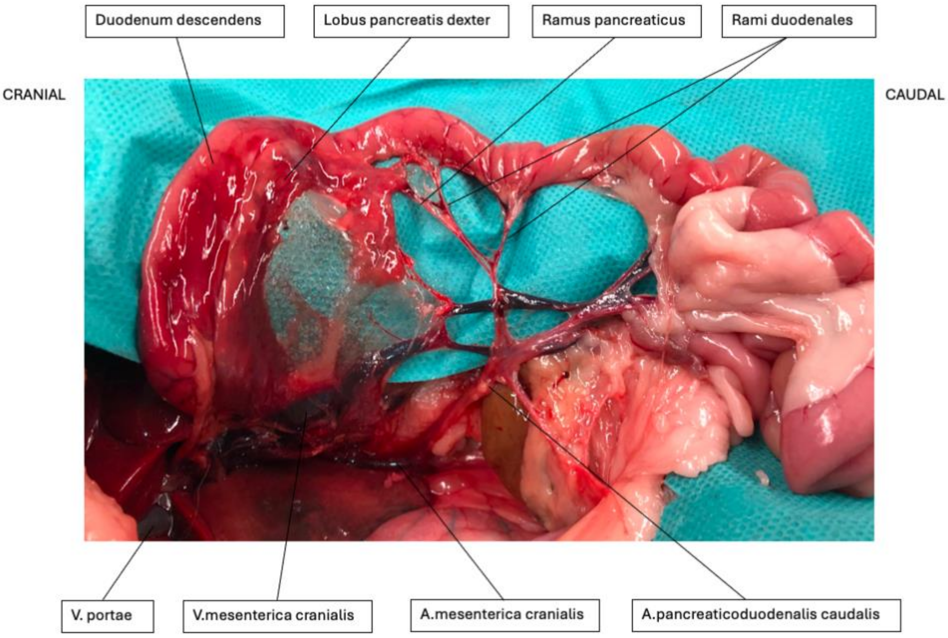

Figure 22: Photo of the Lobus pancreatis dexter and its vascular supply of the second dissected cat (right lobe lifted to the left).

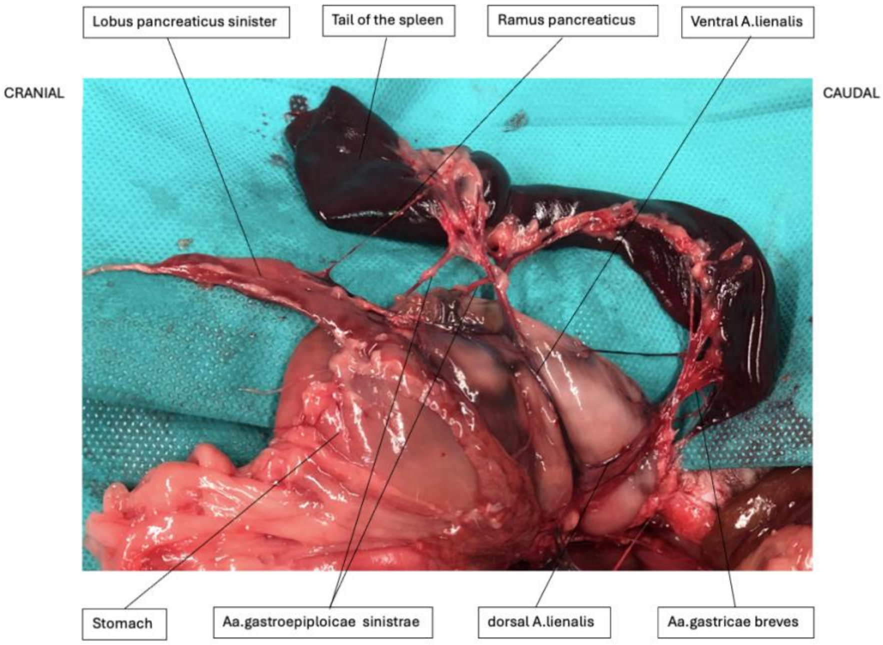

Figure 23: Photo of the spleen and its vascular supply of the second dissected cat.

7.1.3. Cat 3

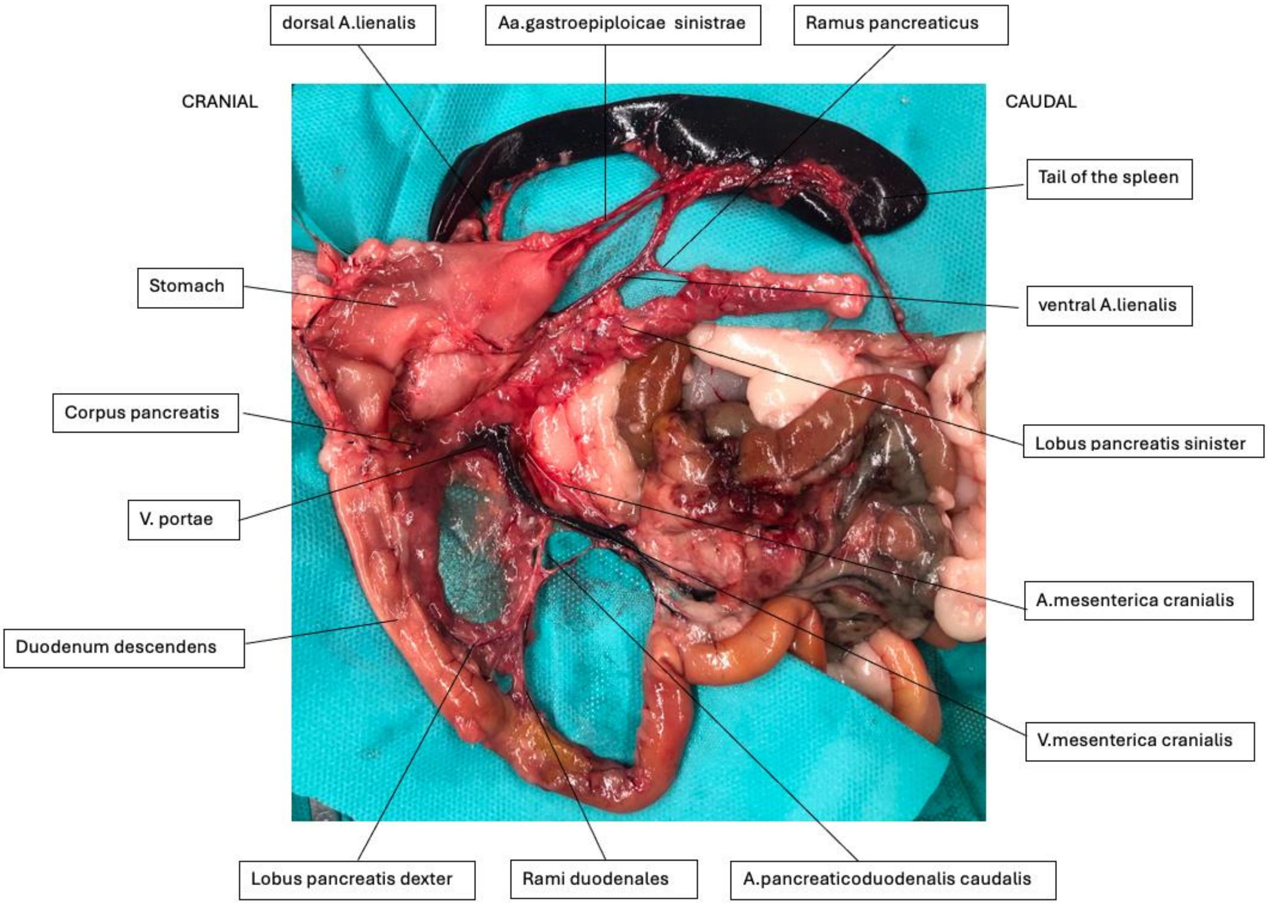

Figure 24: Photo of the pancreas and spleen inclusive vascular supply of the third dissected cat.

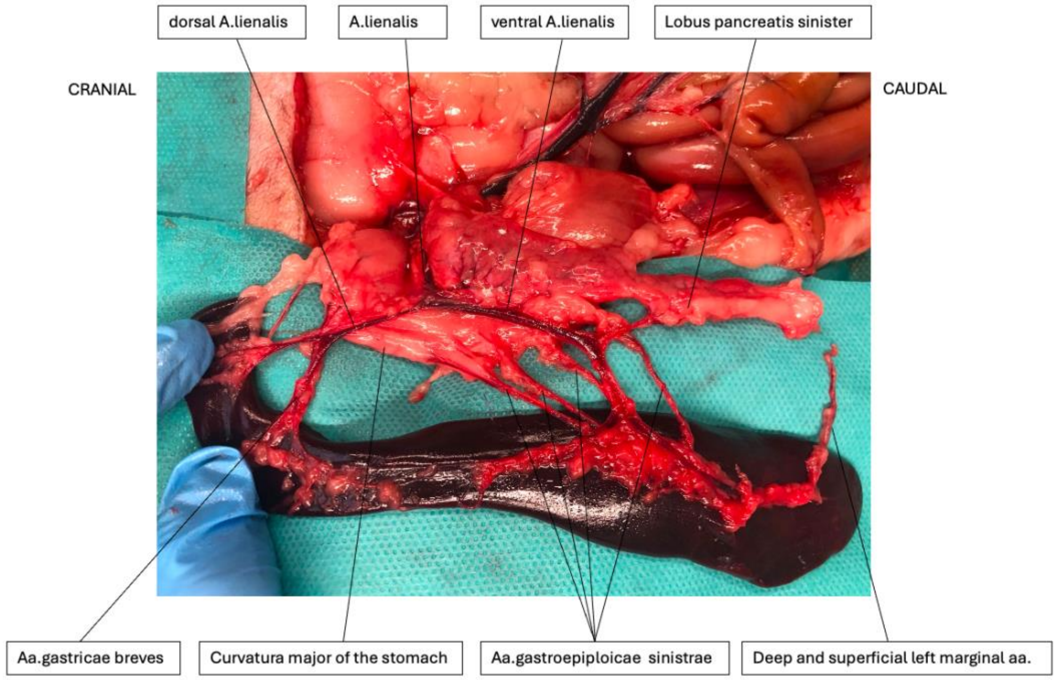

Figure 25: Photo of the spleen and its vascular supply of the third dissected cat (spleen lifted to the right).

7.1.4. Cat 4

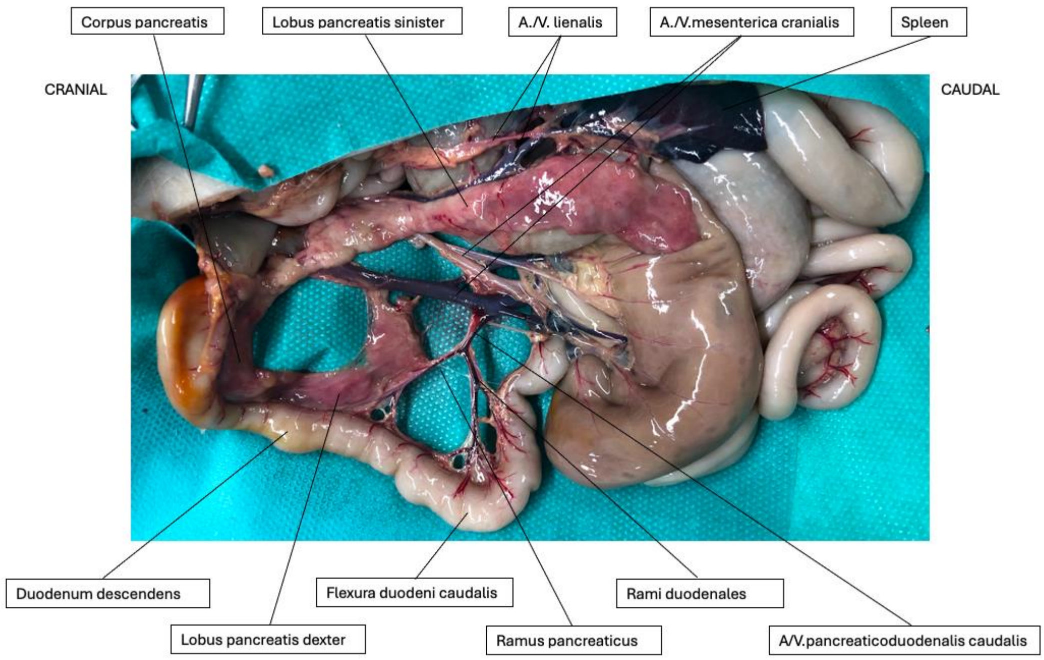

Figure 26: Photo of the pancreas and its vascular supply of the fourth dissected cat.

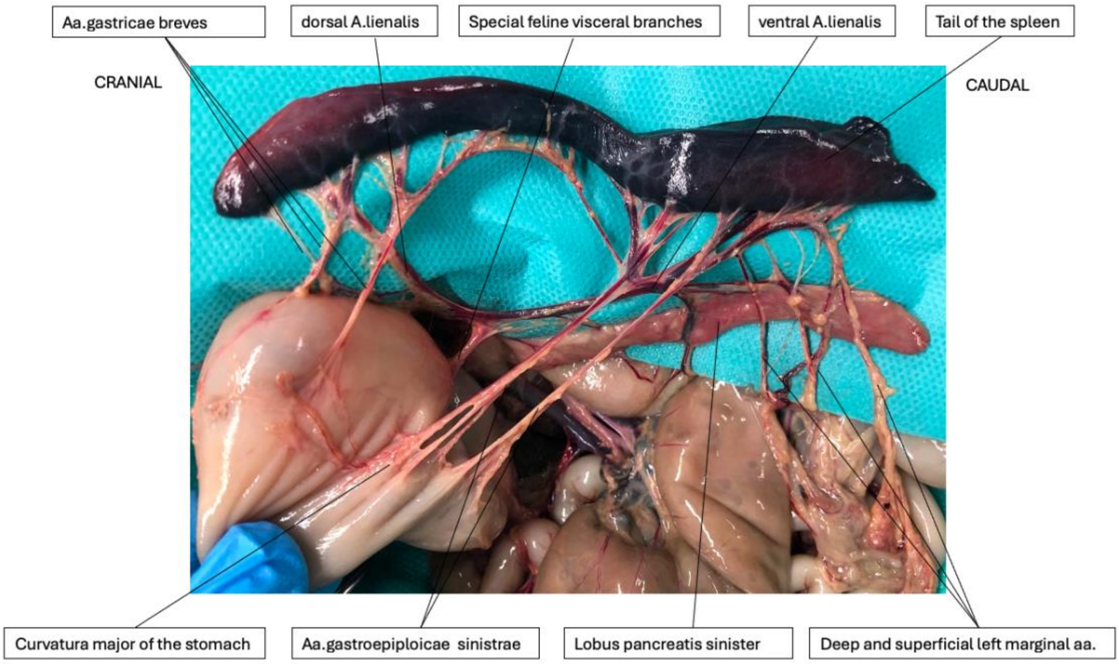

Figure 27: Photo of the spleen and its vascular supply of the fourth dissected cat.

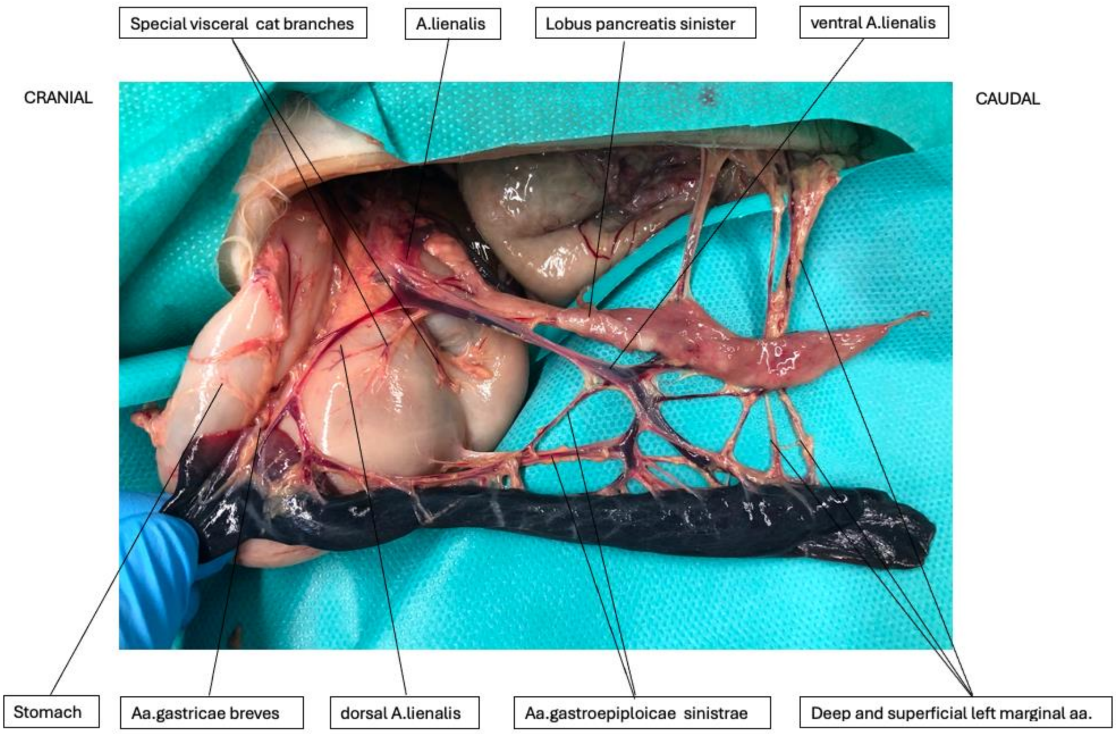

Figure 28: Photo of the spleen and pancreas inclusive the special visceral cat branches of the fourth dissected cat (spleen lifted to the right).

7.1.5. Cat 5

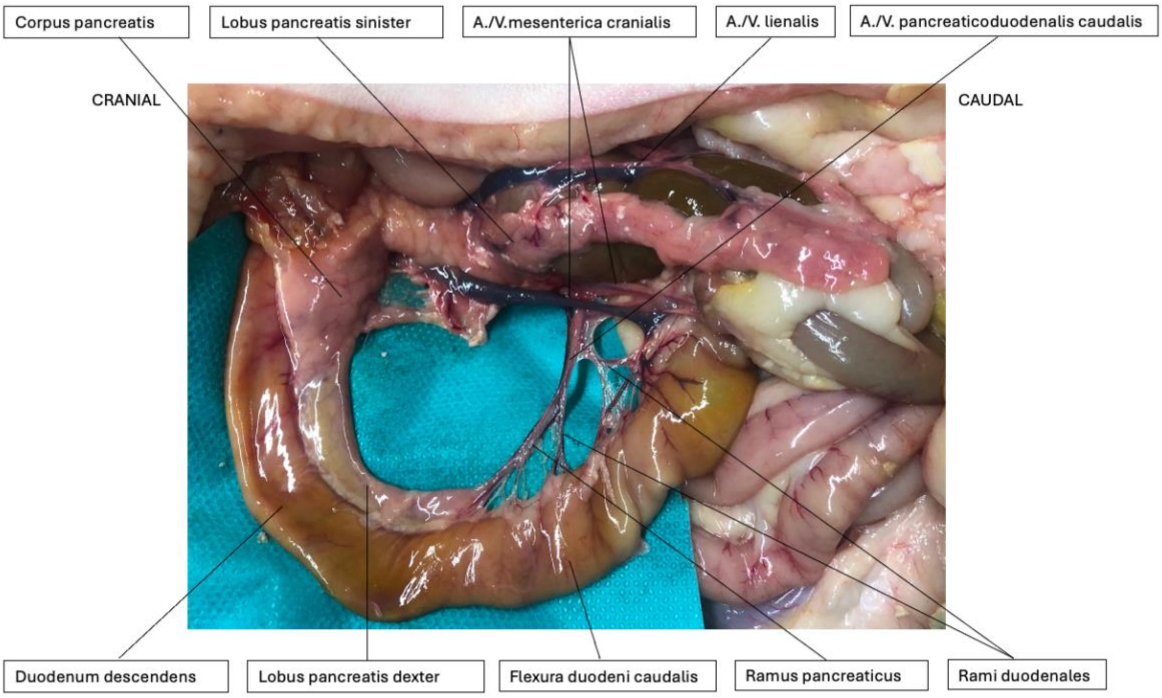

Figure 29: Photo of the pancreas and its vascular supply of the fifth dissected cat.

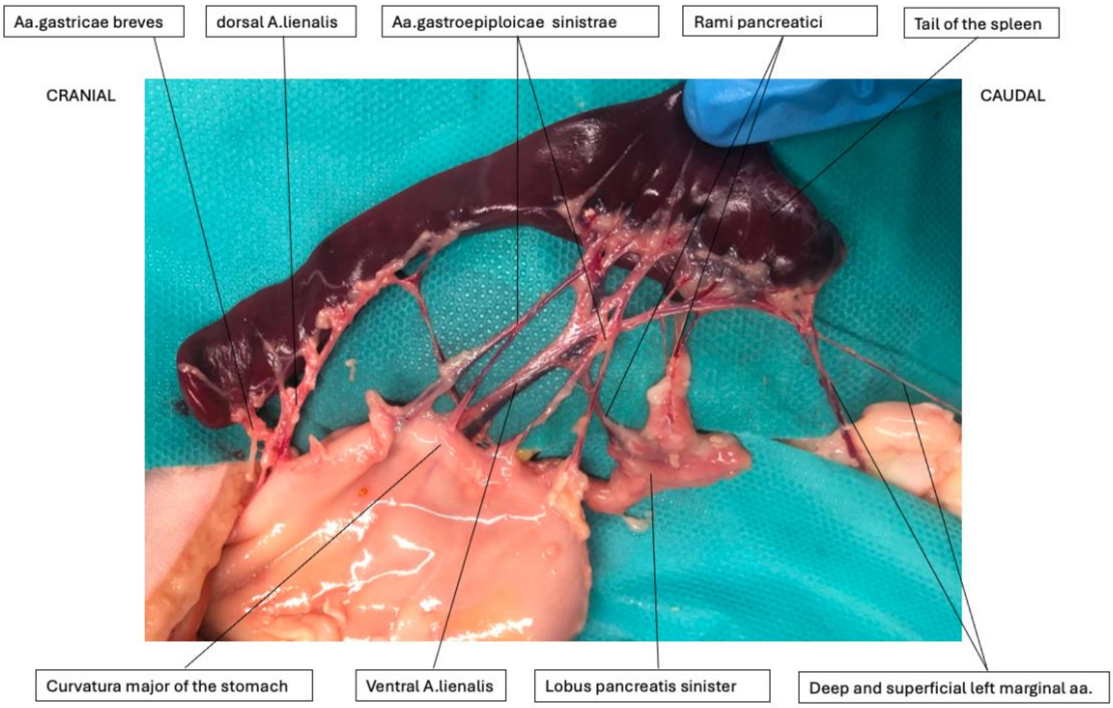

Figure 30: Photo of the spleen and its vascular supply of the fifth dissected cat.

7.1.6. Cat 6

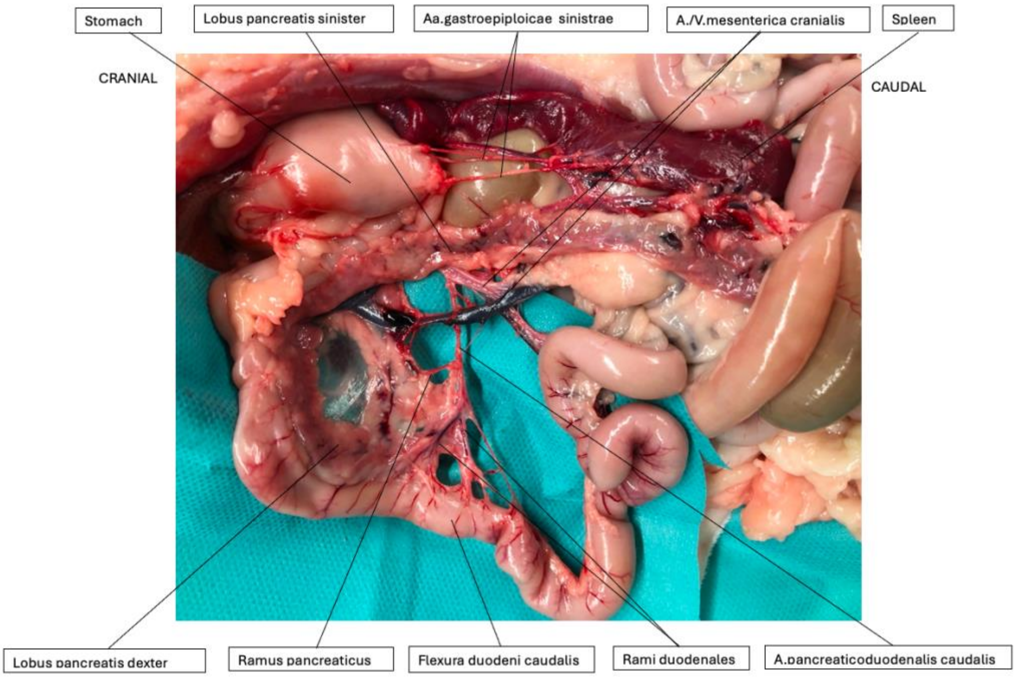

Figure 31: Photo of the pancreas and its vascular supply of the sixth dissected cat.

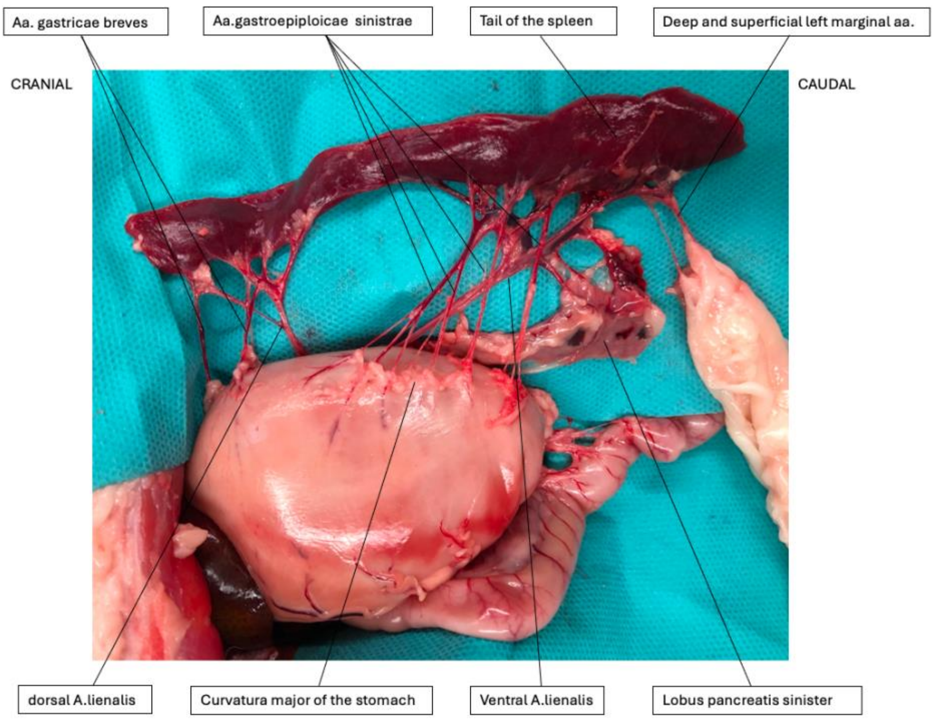

Figure 32: Photo of the spleen and its vascular supply of the sixth dissected cat.

7.2. Dissection of the dogs

7.2.1. Dog 1

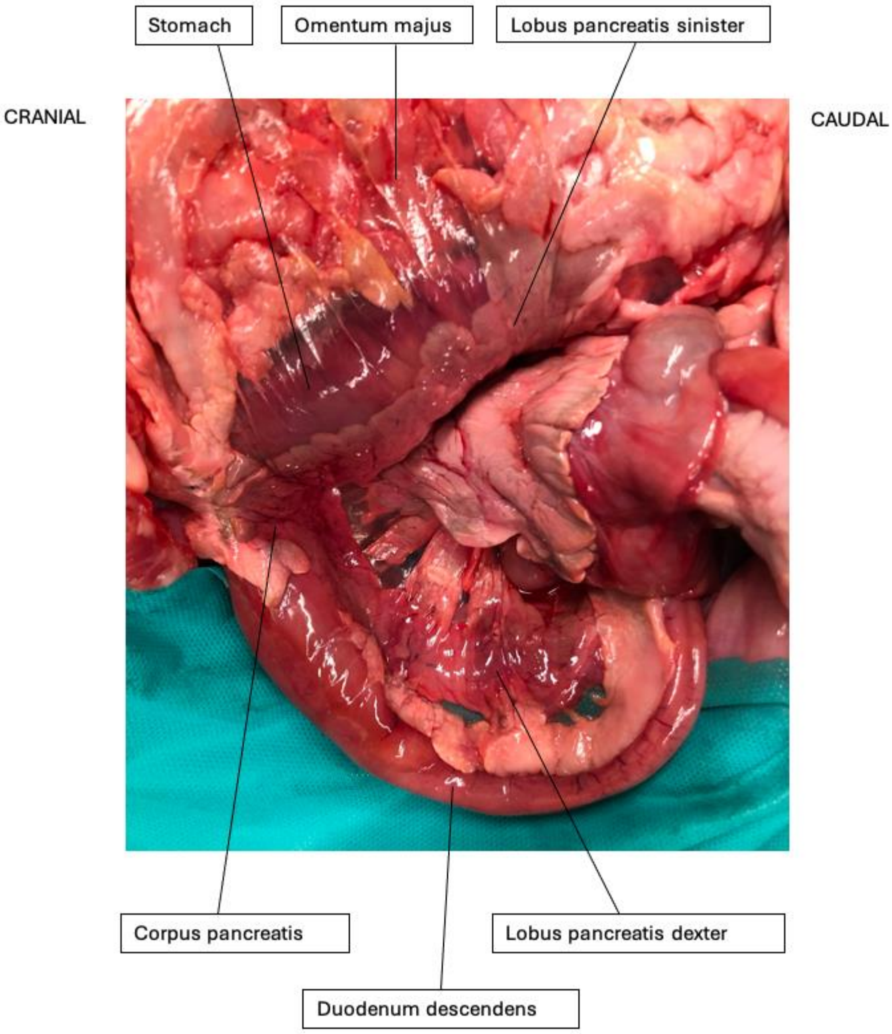

Figure 33: Photo of the pancreas of the first dissected dog.

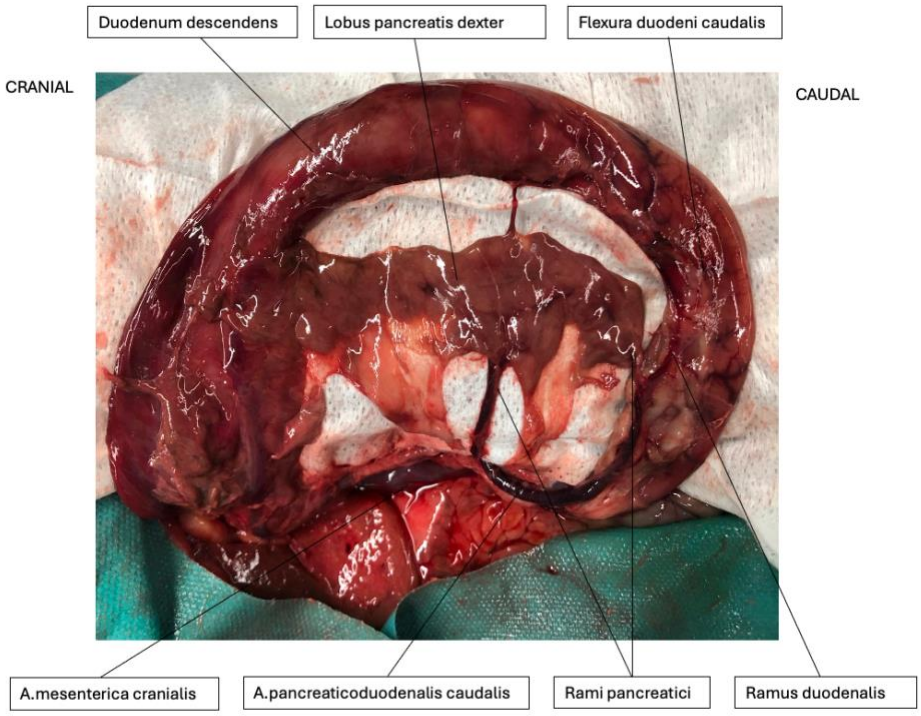

Figure 34: Photo of the Lobus pancreatis dexter and its vascular supply of the first dissected dog (right lobe lifted to the left).

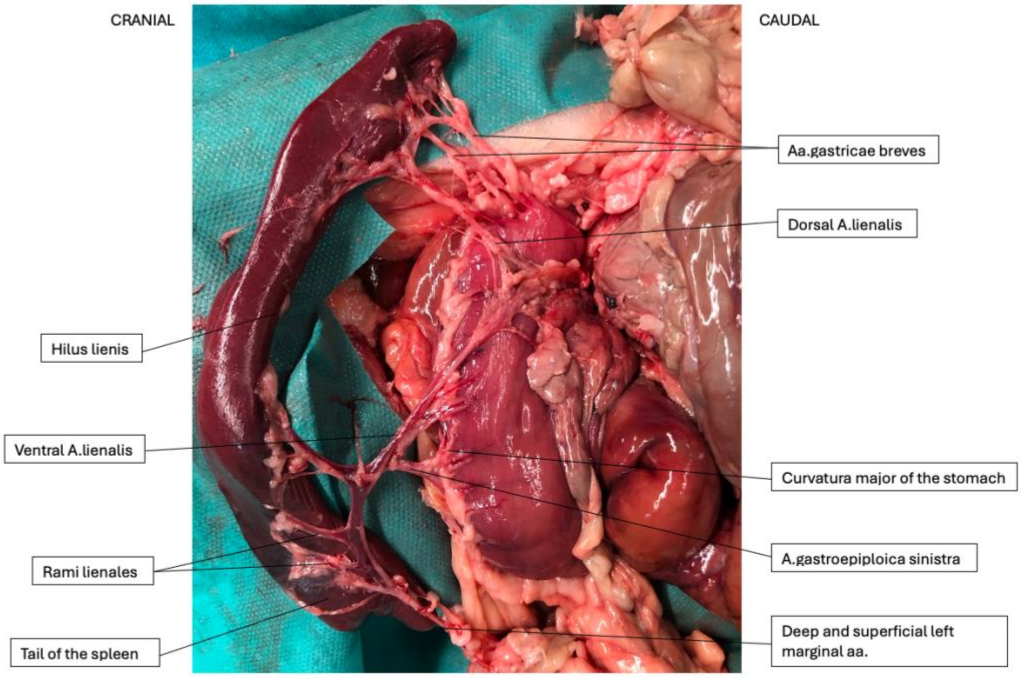

Figure 35: Photo of the spleen and its vascular supply of the first dissected dog (spleen lifted to the right).

7.2.2. Dog 2

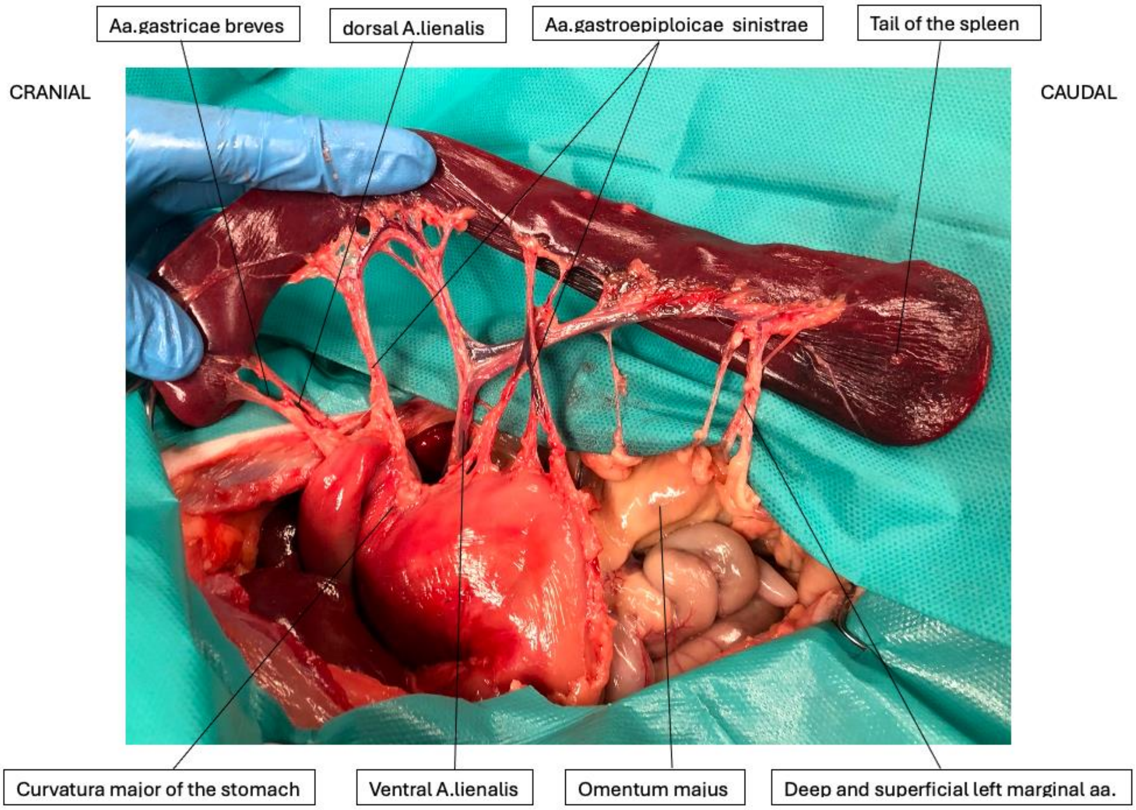

Figure 36: Photo of the spleen and its vascular supply of the second dissected dog.

7.2.3. Dog 3

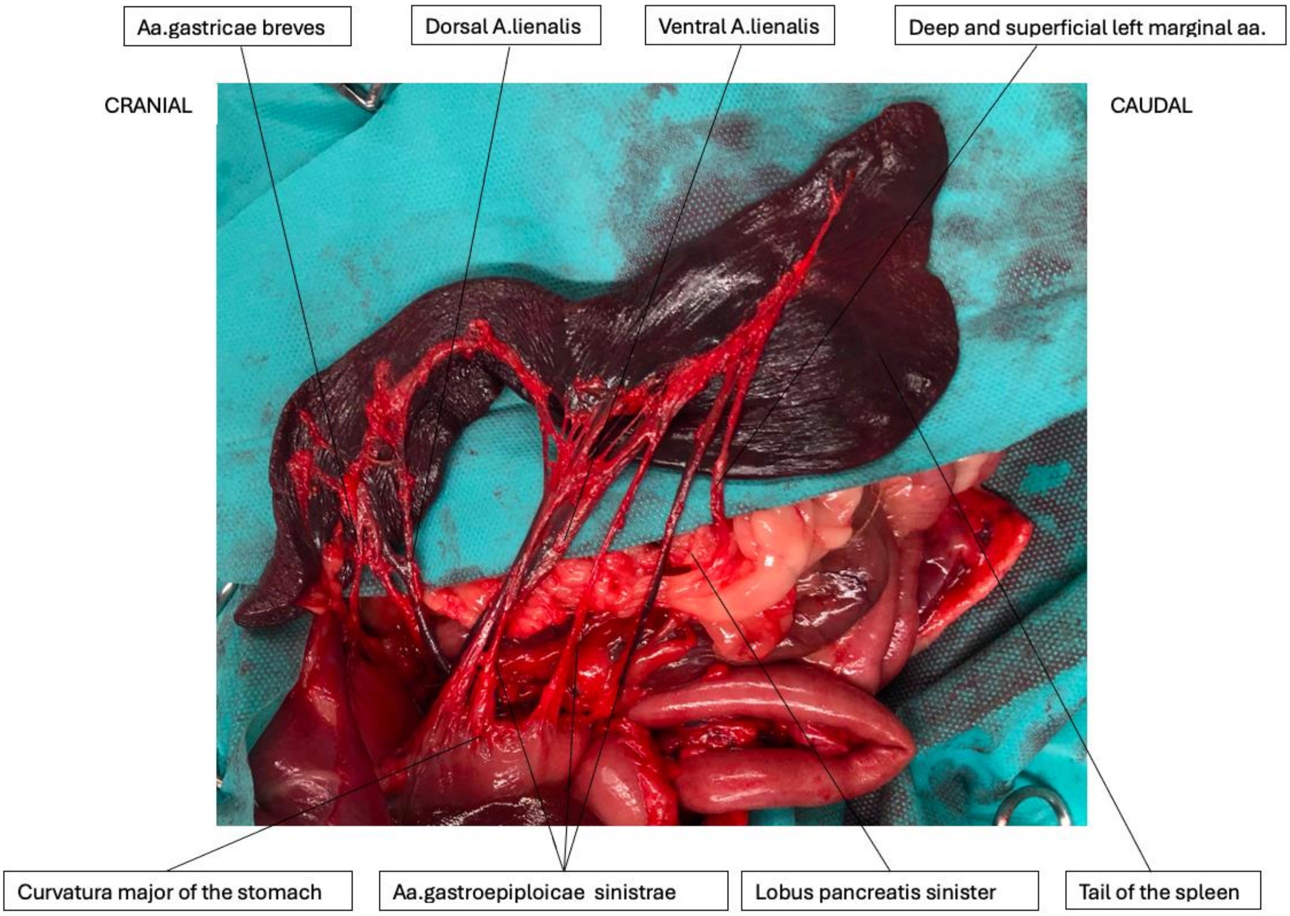

Figure 37: Photo of the spleen and its vascular supply of the third dissected dog.

7.2.4. Dog 4

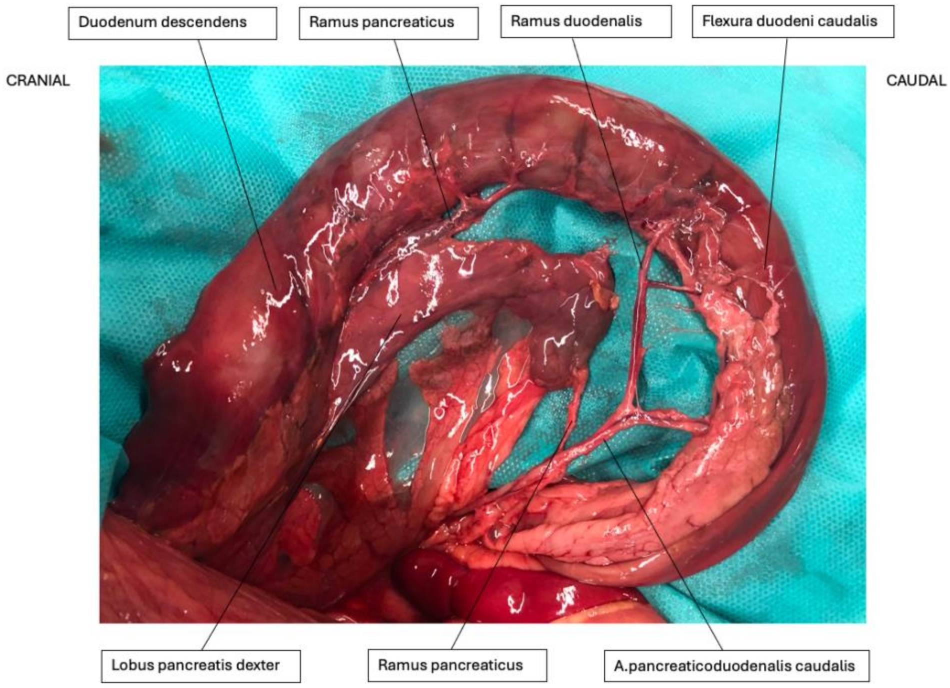

Figure 38: Photo of the Lobus pancreatis dexter and its vascular supply of the fourth dissected dog (right lobe lifted to the left).

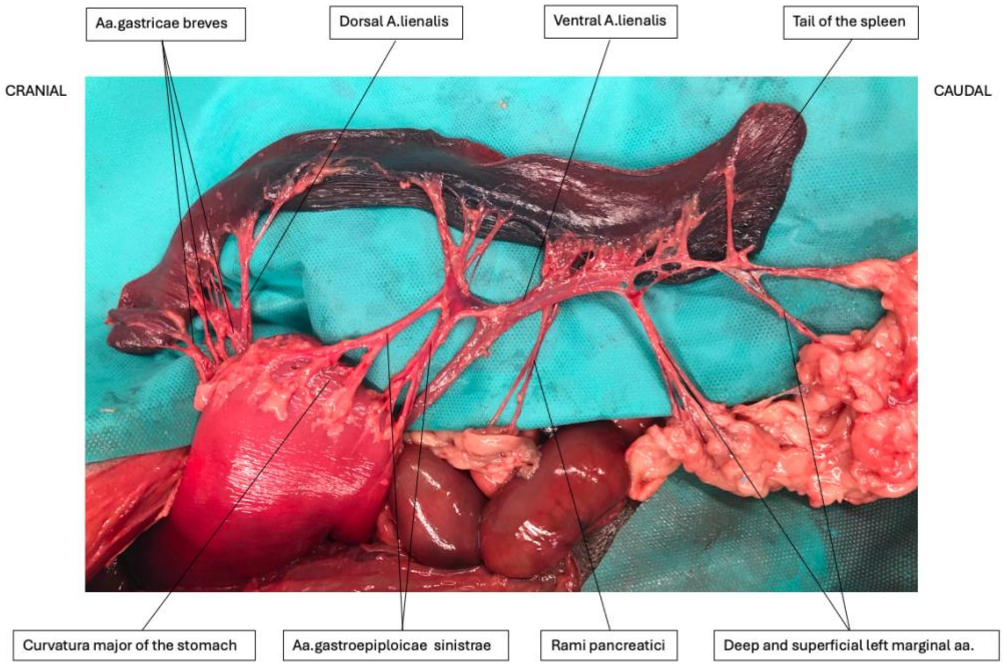

Figure 39: Photo of the spleen and its vascular supply of the fourth dissected dog.

7.2.5. Dog 5

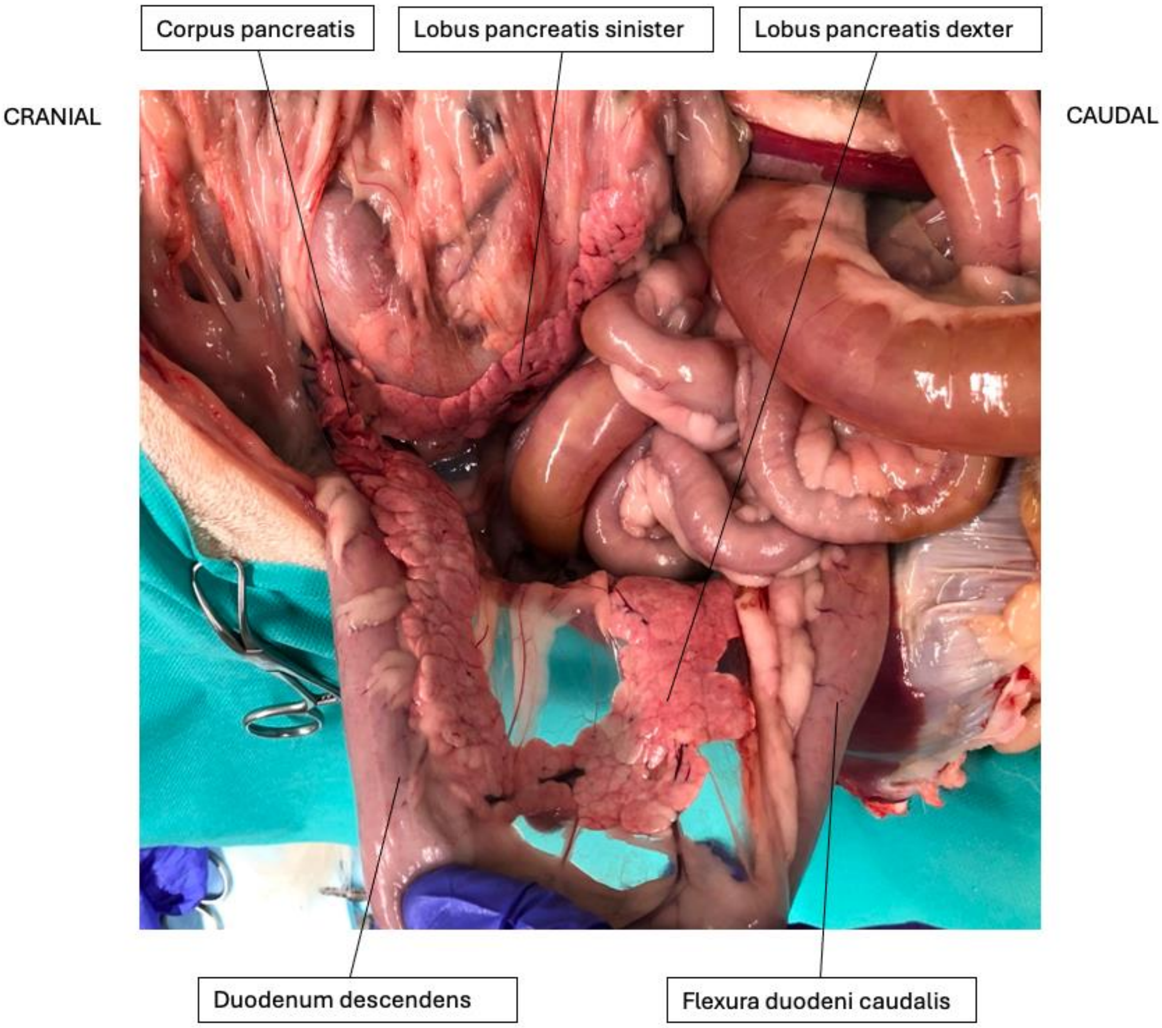

Figure 40: Photo of the pancreas of the fifth dissected dog.

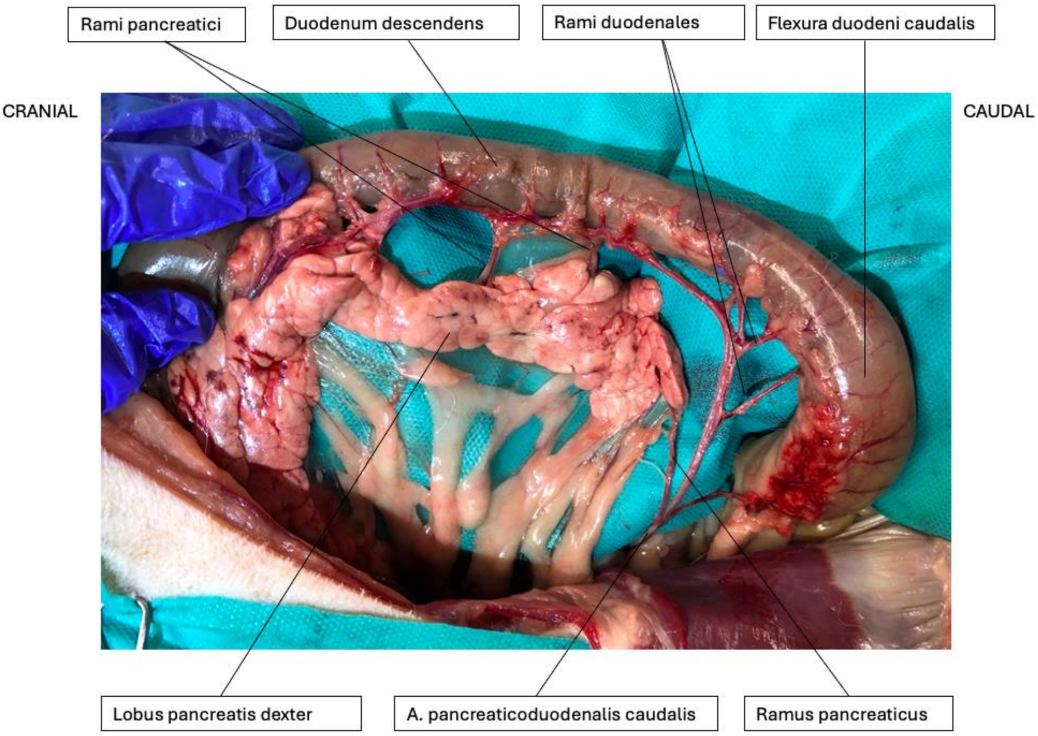

Figure 41: Photo of the Lobus pancreatis dexter and its vascular supply of the fifth dissected dog (right lobe lifted to the left).

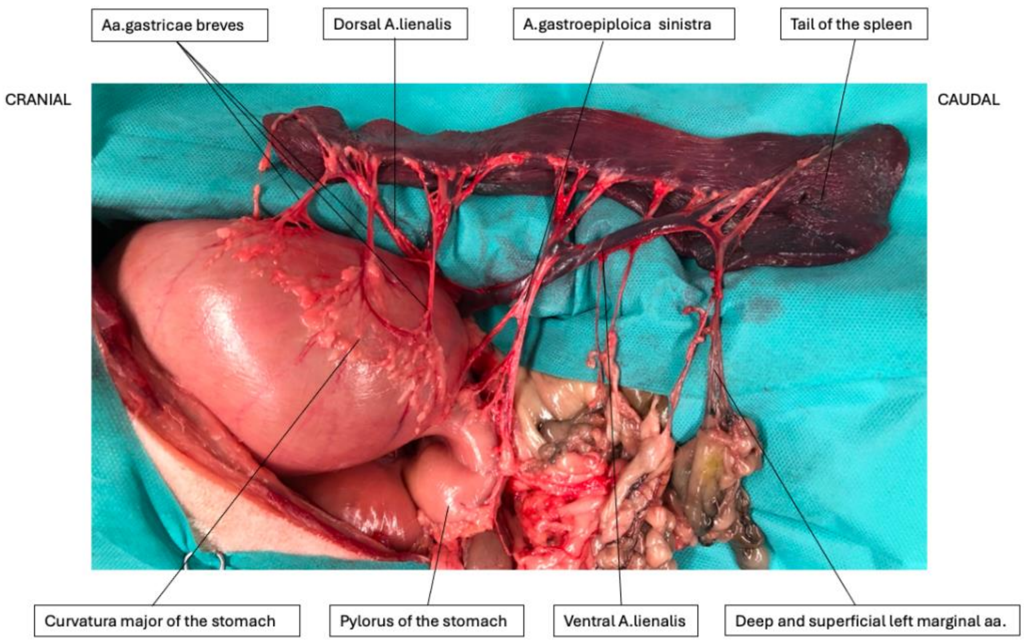

Figure 42: Photo of the spleen and its vascular supply of the fifth dissected dog.

7.2.6. Dog 6

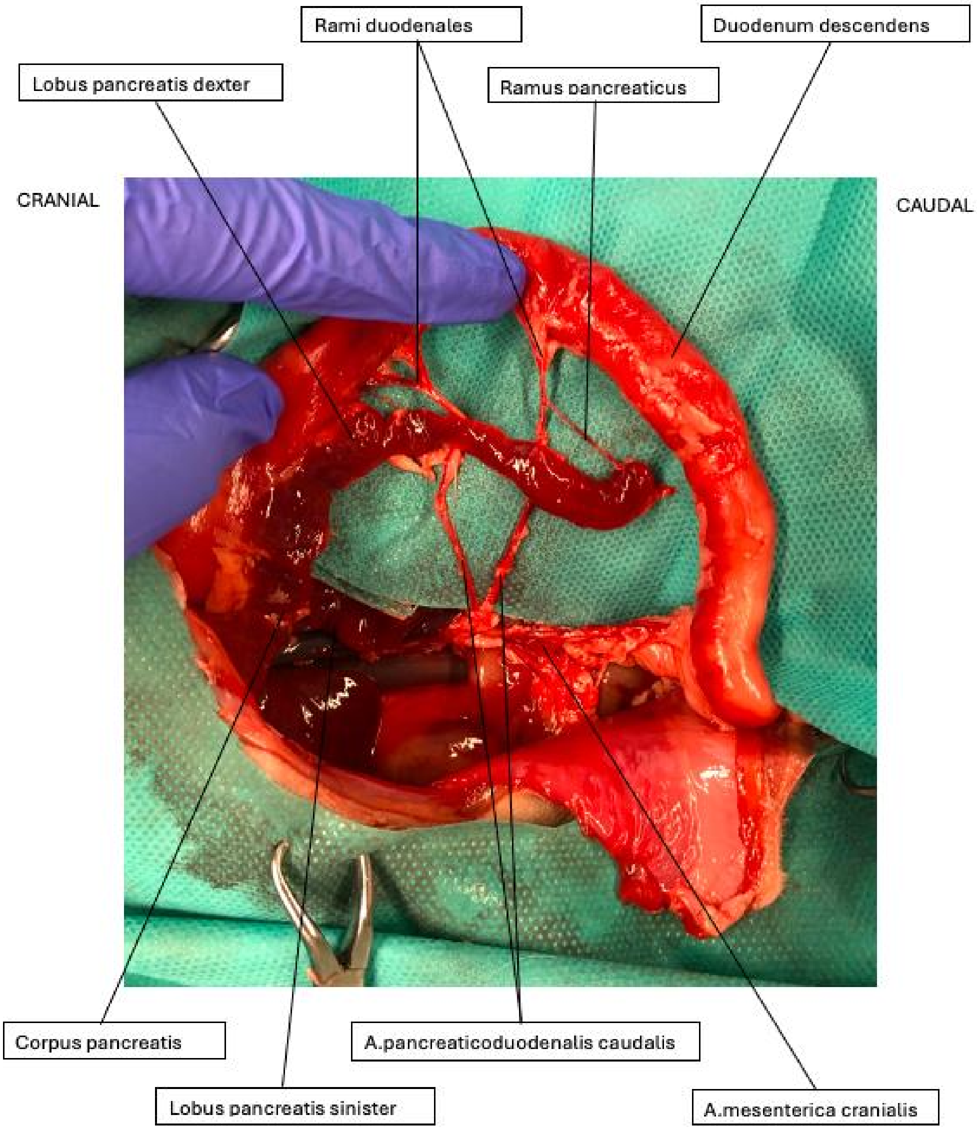

Figure 43: Photo of the Lobus pancreatis dexter with a variation of the A.pancreaticoduodenalis caudalis of the sixth dissected dog (right lobe lifted to the left).

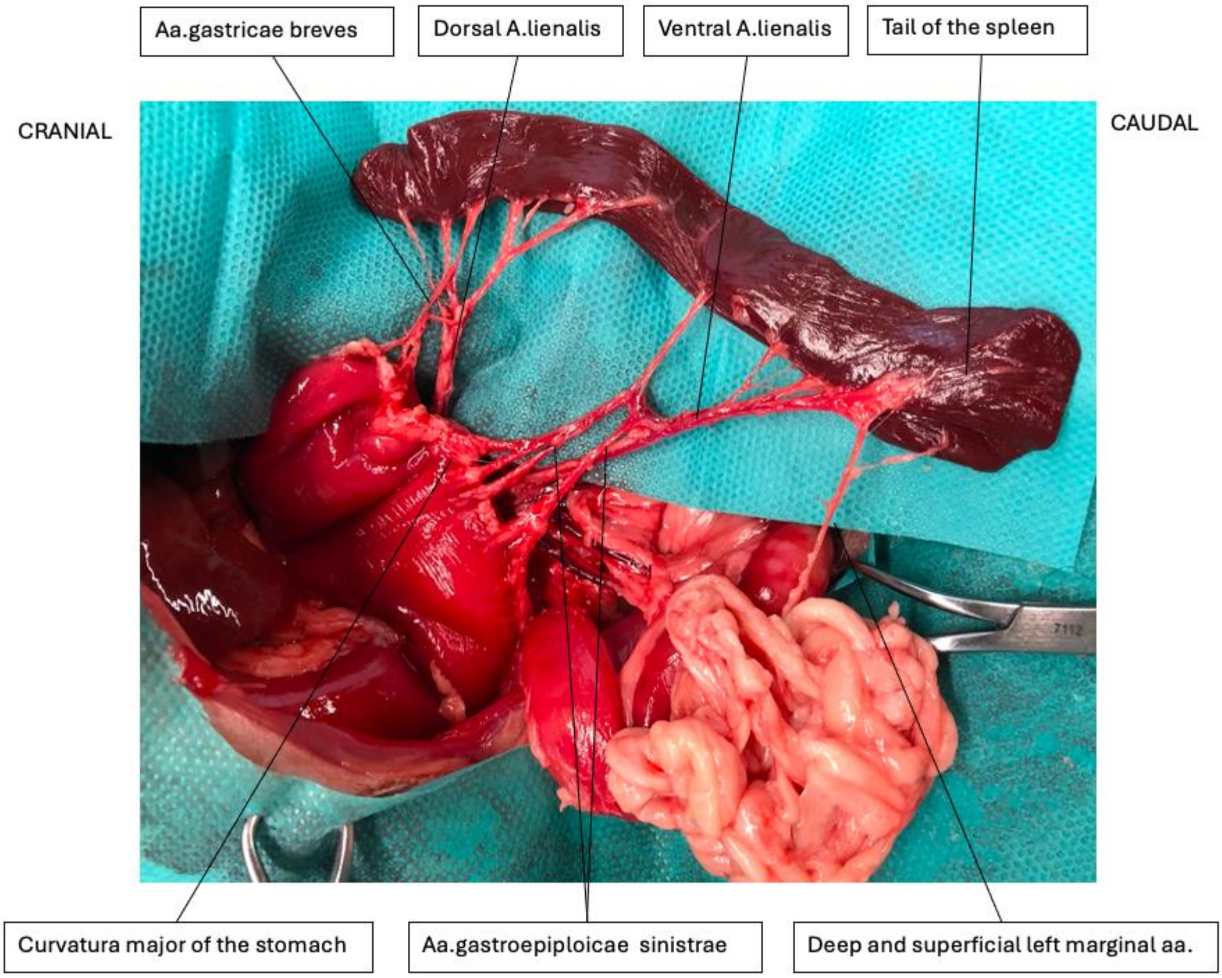

Figure 44: Photo of the spleen and its vascular supply of the sixth dissected dog.

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