

# Ramification of Celiac artery in the pine marten (*Martes martes*)

Mohammad Hasan Yousefi

Department of Anatomy, Faculty of Veterinary Medicine, Semnan University, Semnan, Iran

## Keywords

anatomy, celiac artery, *Pine marten*

## Abstract

The pine marten (*Martes martes*) is a medium sized carnivore rarely found in Iran. The aim of this study was to describe species-specific characteristics of the celiac artery in pine marten. In pine marten examined in this study, it was observed that the celiac artery originated from the ventral aspect of abdominal aorta. The celiac artery was divided into two branches. A thick branch was the common trunk of the splenic and the left gastric arteries, namely the gastrosplenic trunk and the other branch which was thin and longer, namely the hepatic artery. The splenic artery was divided into three branches that supplied the spleen. In the examined pine marten, there were two left gastroepiploic arteries, one originated from the splenic, and the other from the left gastric artery. The hepatic artery was extended to the portal fissure of liver and had five following branches: pancreatic branch, gastroduodenal, right gastric, left hepatic, and right hepatic arteries. The right gastroepiploic artery was originated from the gastroduodenal artery. This is the first report on

ramification of the celiac artery in the pine marten.

## Introduction

The pine marten (*Martes martes*) is a native species of Northern Europe (Figure 1), distributed in Europe and Western Asia and belonging to the *mustelidae* family that also includes mink, otter, badger, wolverine and weasel (Leach, 1977). The pine marten is a rare species in Iran (Baradarani and Moqanaki, 2014). Several authors have studied the ramification of the celiac artery in vertebrates (Abidu-Figueiredo et al., 2008, Alsafy, 2009, Atalar and Yilmaz 2004, Bednarova and Malinovsky, 1984, Bednarova and Malinovsky 1990, Bisailon and Bherer 1970, Bisailon et al., 1988, Borelli and Boccalletti, 1974, Enge and Flatmark, 1972, Niza et al., 2003). The celiac artery originates from the ventral aspect of the abdominal aorta as its first visceral branch and usually divides into three branches: the hepatic, splenic and the left gastric arteries. In some specimens, the left gastric and splenic arteries emerge from a short common trunk (Dyce et al., 2010, Getty, 1975, Nickel et al., 1979). It has been reported that the celiac artery divides into two branches of splenic and hepatic arteries (Atalarand Yilmaz, 2004).

## Materials and methods

The carcass of female adult pine marten which was found by the Department of Environment, Semnan, Iran, in forests of Golestan province was sent to the Faculty of Veterinary Medicine of Semnan University for anatomical studies.

The dorsal half of five last ribs at left side was removed and descending aorta was exposed. Then, 30 ml red latex was injected into the terminal part of the thoracic aorta and was kept in water for a period of 48 h to ensure complete polymerization of latex. To increase the durability of carcass, 500 ml of 10% formaldehyde were also injected into the abdominal and the thoracic cavities and the carcass was placed into the container of 10% formaldehyde for 10 days. After fixation, the right wall of the abdominal cavity was removed (Figure 2) and abdominal aorta and celiac arteries were dissected.

## Results

In the examined pine marten, it was observed that the celiac artery was the first visceral main branch originated from the ventral aspect of the abdominal aorta (Figure 3). In this study, the celiac artery was bifurcated into the thick branch (namely the gastrosplenic artery) including the splenic and left gastric arteries and thin branch (namely hepatic artery) (Figures 4 and 5). It was determined that the gastrosplenic trunk was short and divided into two branches. One was the splenic artery, the great branch given off by the gastrosplenic trunk that extended caudoventrally on the left side of median line into the spleen. The splenic artery was divided into three branches (Figure 5), proximal, middle and distal splenic branches. These branches were entered into the spleen via the hilus. The small branch arose from the proximal splenic branch was observed to extend to the greater curvature of stomach. This branch can be the left gastroepiploic artery (Figure 6).

The other branch from gastrosplenic trunk was left gastric artery. This artery was the smallest branch given off by the gastrosplenic trunk extended cranioventrally to the cardiac region of the stomach (Figure 6). This artery supplied the esophagus and stomach. It was determined that the left gastric artery was divided into two main branches immediately. A thin branch was extended cranially to the cardiac region. This branch supplied the stomach and divided finally into two small branches included the esophageal branch and left gastroepiploic artery. The left gastroepiploic artery was entered to the greater curvature of the stomach next to the esophagus (Figures 6 and 7).

Another branch for left gastric artery was a thick branch that extended ventrally to the lesser curvature of stomach. Therefore, this branch was considered as the left gastric artery (Figures 6 and 7) that anastomosed with right gastric artery.

The hepatic artery was one of the two main branches

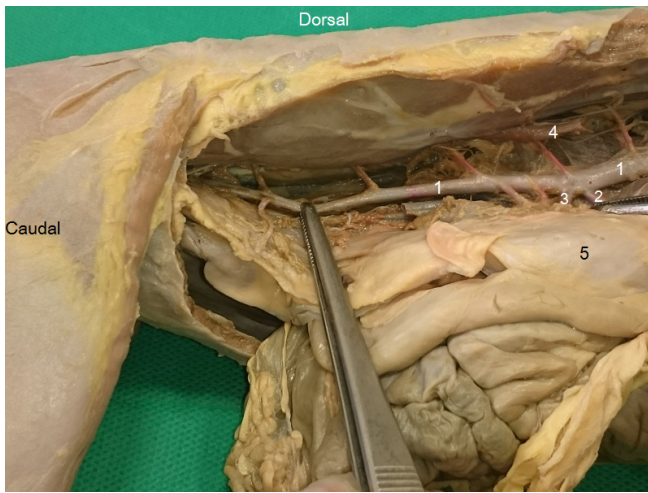


**Figure 1**  
Pine marten (*Martes martes*)

of the celiac artery that was determined longer than the gastrosplenic trunk. This artery was extended cranioventrally on the right side of median line to the visceral surface of liver and portal fissure. Five following branches arose from the hepatic artery (Figures 8 and 9). A) Pancreatic branch, a small branch given off by the hepatic artery that entered into the cranial part of left lobe of pancreas (Figure 8). B) Gastroduodenal artery, arising from the hepatic artery and extended caudally into the beginning of the descending duodenum. It was determined that this artery supplied a branch to pancreas. In this study, gastroduodenal artery was divided into cranial pancreaticoduodenal artery and right gastroepiploic artery (Figure 8). The right gastroepiploic artery was extended to greater curvature of stomach next to the pyloric part of stomach. C) Right gastric artery that extended to the lesser curvature next to the pyloric part of stomach (Figure 9). D) Left hepatic artery rising from the hepatic artery and extended to the left part of liver (Figure 9). E) Right hepatic artery given off by the hepatic artery that supplied the gall bladder and the right part of the liver (Figure 9).



**Figure 2**  
Abdominal cavity (Right side). 1) Diaphragm, 2) Parietal peritoneum, 3) Greater omentum, 4) Pyloric part of stomach, 5) Descending duodenum, 6) Right kidney.



**Figure 3**  
Abdominal aorta in Pine marten. 1) Abdominal aorta, 2) Celiac artery, 3) Cranial mesenteric artery, 4) Right crus of diaphragm, 5) Right kidney.



**Figure 4**  
The branches of celiac artery in Pine marten. 1) Celiac artery, 2) Gastrosplenic trunk, 3) Hepatic artery, 4) Splenic artery, 5) Left gastric artery, 6) Spleen, 7) Left kidney, 8) Left crus of diaphragm, 9) Right crus of diaphragm

## Discussion

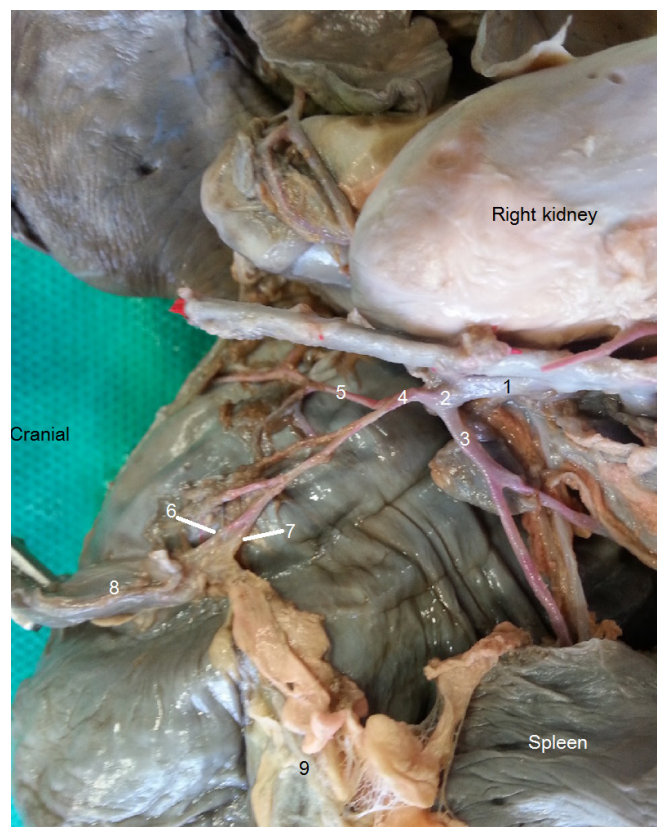
In the present study, it was observed that the celiac artery originated from the ventral aspect of the abdominal aorta as an independent trunk. This finding is similar to what has been reported in badger (Rahm and Frewein, 1982, Yilmaz et al., 2004), dogs (Getty, 1975, Nickel et al., 1979), beaver (Bisaillon and Bherer, 1979), muskrats (Bisaillon et al., 1988), wood mouse (Lopez-Fuster and Ventura, 1992) and rabbit (Abidu-Figueiredo et al., 2008, McLaughlin and Chiasson, 1990). Rarely, it has been seen that a common trunk of celiac and cranial mesenteric artery is separated from abdominal aorta (Getty, 1975).

In pine marten examined in this study, the celiac artery divided into two branches, the hepatic artery and short gastrosplenic trunk. However, in badger (Rahm and Frewein, 1982, Yilmaz et al., 2004), dogs (Getty, 1975, Nickel et al., 1979), goat (Alsafy, 2009), and rabbit (Abidu-Figueiredo et al., 2008), celiac artery divides into three main branch-

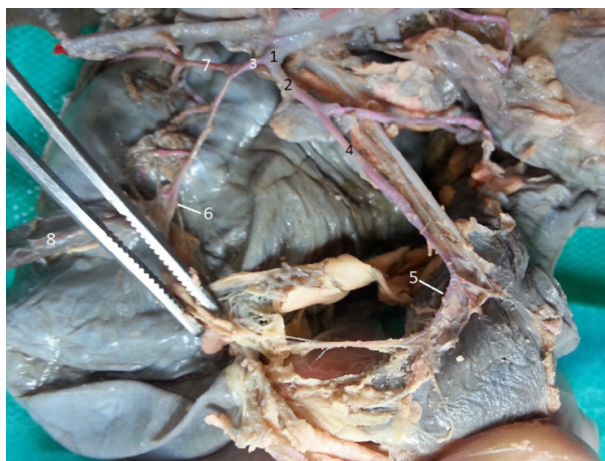
es, left gastric, hepatic, and splenic arteries. Several researchers has reported that the celiac artery in porcupines (Atalar and Yilmaz, 2004), rats (Walker and Homberger, 1998), and pigs (Getty, 1975) is divided into two branches, splenic and hepatic arteries. On the other hand, it has been reported in chinchillas that the celiac artery divides into four branches, where gastrolial artery has been seen in



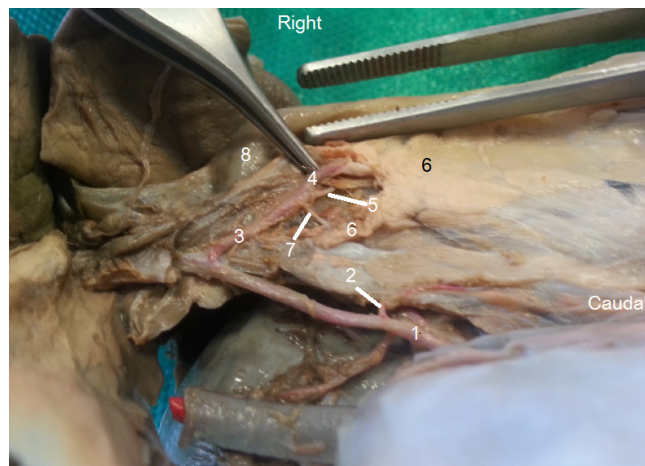
**Figure 5**  
The branches of splenic artery in Pine marten. 1) Celiac artery, 2) Gastrosplenic trunk, 3) Hepatic artery, 4) Splenic artery, 5) Left gastric artery, 6) Proximal splenic branch, 7) Middle splenic branch, 8) Distal splenic branch, 9) Esophagus.



**Figure 6**  
Branches of left gastric artery in Pine marten. 1) Celiac artery, 2) Gastrosplenic trunk, 3) Splenic artery, 4) Left gastric artery, 5) Continuation of the left gastric artery to lesser curvature, 6) Esophageal branch, 7) Left gastroepiploic artery, 8) Esophagus, 9) Greater omentum.



**Figure 7**  
Left gastroepiploic artery in Pine marten. 1) Gastrosplenic trunk, 2) Splenic artery, 3) Left gastric artery, 4) Proximal splenic branch, 5) Left gastroepiploic artery arises from splenic artery, 6) Left gastroepiploic artery arises from left gastric artery, 7) Continuation of the left gastric artery to lesser curvature, 8) Esophagus.



**Figure 8**  
Hepatic artery in Pine marten. 1) Hepatic artery, 2) Pancreatic branch, 3) Gastroduodenal artery, 4) Cranial pancreaticoduodenal artery, 5) Right gastroepiploic artery, 6) Pancreas, 7) Pancreatic branch arises from gastroduodenal artery, 8) Duodenal beginning.

addition to other three vessels (Özdemir et al., 2013).

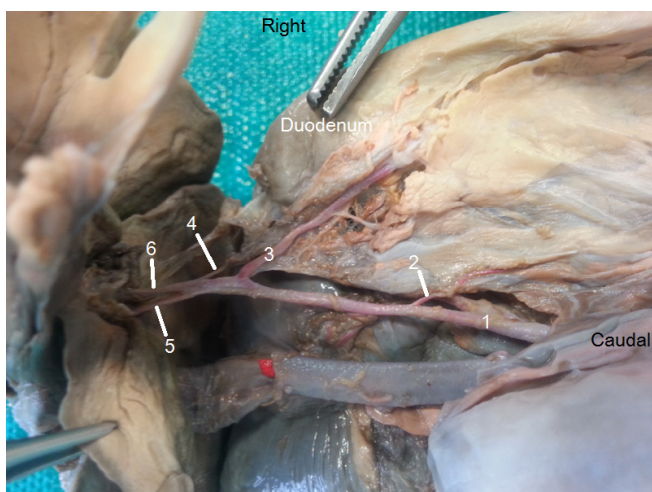
It was observed that the splenic artery divides into three branches that entered to proximal, middle and distal third of the spleen. It has been reported that the spleen is supplied by the branches of the splenic artery in the badgers (Yilmaz et al., 2004), dogs (Getty, 1975, Nickel et al., 1979), guinea pigs (Bednarova and Malinovsky, 1990), and porcupines (Atalar and Yilmaz, 2004). Different studies reported that in carnivores (Evans and Lahunta, 1993) and rabbits (Abidu-Figueiredo et al., 2008, McLaughlin and Chiasson, 1990), the splenic artery before entering the hilus of spleen is divided into two or three branches. Similar observations have also been reported in porcupines (Atalar and Yilmaz, 2004).

In the present case, the left gastric artery originated from the gastrosplenic trunk of the celiac artery. There are reports that the left gastric artery arose from the splenic

artery in pigs (Nickel et al., 1979), and the hepatic artery in porcupines (Atalar and Yilmaz, 2004) and the celiac artery in muskrats (Bisaillon et al., 1988), badgers (Yilmaz et al., 2004), chinchillas (Özdemir et al., 2013), rabbits (Abidu-Figueiredo et al., 2008) and rats (Walker and Homberger, 1998).

The results of this study showed that the left gastroepiploic artery originated from the proximal branch of splenic artery and entered into the greater curvature of stomach like dogs and equids (Getty, 1975, Nickel et al., 1979), chinchillas (Özdemir et al., 2013) and porcupines (Atalar and Yilmaz, 2004). Also it was observed that the left gastric artery supplied the esophagus like the badgers (Yilmaz et al., 2004), dogs (Getty, 1975, Nickel et al., 1979), chinchillas (Özdemir et al., 2013) and muskrats (Bisaillon et al., 1988), while this vessel was not observed in the porcupines (Atalar and Yilmaz, 2004). In pine marten examined in the present study, the left gastric artery divided into two main branches, one that supplies the stomach, esophagus and finally the left gastroepiploic artery, and the other that is continuity of the left gastric artery entering into the lesser curvature of stomach exactly like the goat (Alsafy, 2009). Results showed there were two branches which were entered into the greater curvature as the left gastroepiploic artery (Figures 7 and 8). Similar findings have not been reported in any other animal.

In pine marten examined in this study, the hepatic artery divided into five branches, pancreatic, gastroduodenal, right gastric, right hepatic, and left hepatic arteries. It was reported that the hepatic artery is divided into two branches just before reaching the portal fissure in equids and ruminants (Nickel et al., 1979), or it is divided into three branches in carnivores and pigs (Nickel et al., 1979). It has also been reported that the hepatic artery in porcupines is divided into two branches above the portal fissure,



**Figure 9**  
Hepatic artery in Pine marten. 1) Hepatic artery, 2) Pancreatic branch, 3) Gastroduodenal artery, 4) Right gastric artery, 5) Left hepatic artery, 6) Right hepatic artery.

similar to equids, ruminants (Nickel et al., 1979) and rabbits (Abidu-Figueiredo et al., 2008).

In the present study, the hepatic artery divided into right and left hepatic arteries. Hepatic artery divides into cystic, right hepatic and left hepatic arteries in goat (Alsafy, 2009). It was reported that the hepatic artery is divided into the left, right medial and right lateral branches in badgers (Yilmaz et al., 2004), while the left and right branches were reported in the porcupines (Atalar and Yilmaz, 2004) and left lateral, left medial and right branches in the chinchillas (Özdemir et al., 2013). Similar to our results, it was reported that the cranial pancreaticoduodenal artery is a branch of the gastroduodenal artery in the badgers (Yilmaz et al., 2004) and carnivores (Getty, 1975, Nickel et al., 1979), muskrats (Bisaillon et al., 1988), guinea pigs (Bednarova and Malinovsky, 1990), and porcupines (Atalar and Yilmaz, 2004). However in chinchillas, this vessel arose from the hepatic artery directly (Özdemir et al., 2013). Right gastroepiploic artery in this pine marten originated from the gastroduodenal artery. The gastroduodenal artery was the second branch of the hepatic artery which divided into the cranial pancreaticoduodenal artery and the right gastroepiploic artery. Right gastroepiploic artery was entered to greater curvature of stomach and anastomosed with the left one at the greater curvature like the goat (Alsafy, 2009). Similar results were reported in ruminants (Anis, 1997, Getty, 1975), goats, and sheep (El Gendy, 2007, Hagra and Swielim, 1990, May, 1977).

In conclusion, this study represents the first report on ramification of the celiac artery in pine marten (*Martes martes*). In this study the celiac artery and its branches were examined and its anatomic characteristics were compared with available data from other animals.

## Acknowledgements

The author of this investigation would like to thank Dr. Behnam (D.V.M) and Mr. Adiby from the Department of Environment, Semnan, Iran, for providing the specimen, Dr. Mehdizadeh Mood for reviewing this manuscript, and Mr. Omidbakhsh, Mr. Taherdoost (students of the Faculty of Veterinary Medicine), and Mr. Rostami and Mr. Pourafshar (the senior technologists of the faculty of Veterinary Medicine) for their help.

## References

- Abidu-Figueiredo, M., Xavier-Silva, B., Cardinot, T. M., Babinski, M. A., and Chagas, M. A., (2008) Celiac artery in New Zealand rabbit: Anatomical study of its origin and arrangement for experimental research and surgical practice. *Pesquisa Veterinaria Brasileira*. 28, 5, 237-240.
- Alsafy, M. A. M., (2009) Celiac trunk and the variability of its branches in goats. *Journal of Applied Biological Sciences*. 3, 3, 65-70.
- Anis, H., (1997) Some anatomical studies on the liver of the buffalo in Egypt (*Bos bubalis*). M.V.Sc thesis Zagazig University, Zagazig.
- Atalar, O., and Yilmaz, S., (2004) The branches of the arteria celiac in the porcupine (*Hystricx cristata*). *Veterinary Medicine- Czech*. 49, 52-56.
- Bednarova, Z., and Malinovsky, L., (1984) Ramification of celiac artery in the domestic cat. *Folia Morphology*. 34, 1, 36-44.
- Bednarova, Z., and Malinovsky, L., (1990) Variability of branching of the a. coeliaca (truncus coeliacomesentericus) in the guinea pig (*Cavia aperea f. porcellus*). *Folia Morphology*. 38, 382-395.
- Bisaillon, A., and Bherer, J., (1970) Gross anatomy of the arterial supply of the stomach of the North American beaver (*Castor canadensis*). *Acta Anatomica*. 104, 79-85.
- Bisaillon, A., Grenier, A., and Bousquet, R., (1988) Arterial blood supply to the stomach of the muskrat (*Ondatra zibethicus*). *Anatomy Histology Embryology*. 17, 7-11.
- Borelli, V., and Boccalletti, D., (1974) Ramificação das artérias celiaca e mesentérica cranial no gato (*Felis Catus Domestica*),” *Revista Faculdade de Medicina Veterinaria, Zootec. Universidade de São Paulo*. 11, 263-70.
- Bradarani, K., Moqanaki, E. M., (2014) A recent record of Pine marten *Martes martes* from the Caspian region of Iran. *Small Carnivore Conservation*. 51, 82-84.
- Dyce, K. M., Sack, W. O., and Wensing, C. J. G., (2010) “Textbook of Veterinary Anatomy. 4th ed. Saunders, Elsevier.
- El Gendy, S. A. A., (2007) Surgical anatomical approach of the abdomen in the goat. Ph.D thesis, Faculty of Veterinary Medicine, Alexandria University, Alexandria.
- Enge, I., and Flatmark, A., (1972) Selective coeliac and hepatic artery angiography in normal dogs. *Scandinavian Journal of Gastroenterology*. 7, 361-8.
- Evans, H. E., and Lahunta, D. E., (1993) Guide to the dissection of the dog. 5th ed. Philadelphia, W. B. Saunders Company.
- Getty, R., (1975) Sisson and Grossman's the anatomy of the domestic animals. 5th ed. W.B. Saunders Company, Philadelphia.
- Hagra, S. B., and Swielim, G. F. A., (1990) Gross anatomy on the blood vessels and bile duct in the liver of sheep. *New Egyptian Journal of Medicine*. 4, 2, 1066-1082.

- Leach, D., (1977) The forelimb musculature of marten (*Martes americana* Turton) and fishes (*Martes pennanti* Erxleben). *Canadian Journal Zoology*. 55,1, 31–41.
- Lopez-Fuster, M. J., and Ventura, J., (1992) Arrangement of the branches of the aorta abdominalis in the wood mouse (*Apodemussylvaticus*). *Anatomy Histology Embryology*. 21, 146–151.
- May, N. D. S., (1977) *The anatomy of the sheep*. 3rd ed, University of Queensland Press Brisbane.
- McLaughlin, C. A., and Chiasson, R. B., (1990) *Laboratory anatomy of the rabbit*. WMC, Brown Company, USA.
- Nickel, R., Schummer, A., and E. Seiferle, E., (1979) *The viscera of domestic mammals*. 2nd ed, Berlin, Verlag Paul Parey.
- Niza, M. M. R. E., Vilela, C. L., Ferreira, A. J. A., Gonçalves, M. S., and Pisco, J. M., (2003) Irrigação arterial hepática em canídeo. *Revista Portuguesa de Ciências Veterinárias*. 98, 546, 69.
- Özdemir, V., Çevik Demirkan, A., and Akosman, M. S., (2013) Subgross and macroscopic investigation of the coeliac artery in the chinchilla (*chinchilla lanigera*). *Folia Morphology*. 72, 3, 258–262.
- Rahm, S., and Frewein, J., (1982) Arterial blood supply of the digestive tract in badgers. *ActaAnatomica*. 113, 202–210.
- Walker, W. F., and Homberger, D. G., (1998) *Anatomy and dissection of the rat*. W.H. Freeman and Company, England.
- Yilmaz, S., Atalar, O., and Aydin, A., (2004) The branches of the arteria celiac in badger. *Indian Veterinary Journal*. 81, 183–187.