

# Macro-Anatomical Investigations on the Course and Branches of the Celiac Artery in the Sparrow Hawk (*Accipiter nisus*)

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**Keywords:** anatomy, aorta, celiac artery, sparrow hawk and splenic artery.

**Abstract.** The aim of this study was to investigate the course and distribution of the celiac artery in the sparrow hawk. The present work was carried out with 7 sparrow hawks of different ages and sexes. Non-curable birds were injected with 5–10 mg/kg doses of xylazine for premedication and 20–40 mg/kg doses of ketamine for anaesthesia intramuscularly. Under deep anaesthesia, their blood was drained by cutting off the apex of the heart and the vessels were cleaned out by administering 0.9% of normal saline water into the vessels. Latex coloured with dye was injected into the ventriculus sinister of the heart through the aorta at 7 materials. Then the specimens were subjected to fine dissection to demonstrate the origin, course and distribution of the celiac artery. The celiac artery originated from the aorta at the beginning of the synsacrum and provided the arterial nutrition of the last part of the oesophagus, cecum, small intestines, pancreas, lien, liver, ventriculus and proventriculus. Along its course, it was found to terminate splitting into the right branch of the celiac artery and the left branch of the celiac artery after giving off the common root of the oesophageal artery with the superior proventricular artery and splenic artery. The left branch of the celiac artery was determined to extend cranioventrally in the proximity of isthmus gaster. After it gave off the right hepatic artery to nourish the lobus hepatis dexter of the hepar, it was passed to the left side of the hepar. In this part, this blood vessel was found to terminate splitting into the inferior proventricular artery, left inferior gastric artery and left gastric artery after giving off the left hepatic artery to the lobus hepatis sinister of the liver with three to four branches. The right branch of the celiac artery was determined to run along under the lien in a caudoventral direction. It was observed to lie on the junction of the gaster with duodenum. It was found to give off the right superior gastric artery before reaching the indicated junction. At the level of the indicated junction, the right branch of the celiac artery was determined to split into its terminal branches which extended in different directions, namely ileocecal artery, gastroduodenal artery, pancreaticoduodenal artery, duodenojejunal artery and right inferior gastric artery.

## Introduction

Sparrow hawk is a bird of prey in the order of daytime predators (*Falconiformes*), family *Accipitridae* and subfamily *Accipitrinae*. Sparrow hawks have short, rounded wings, a long tail, a hooked beak, and curved claws. Unlike raptors belonging to the *Falconidae* family, it kills its prey not with its beak, but with its feet and claws. Therefore, the feet are relatively well developed compared with the beak (Sustaita, 2008). The most important route of raptors, especially sparrow hawks, is Turkey, where they come from Europe and Asia and pass to the Black Sea Region (Greenberg and Marra, 2004).

The celiac artery originating from the aorta nourishes proventriculus, gizzard, ventriculus, liver, lien, pancreas and small intestines (Doğuer and Erençin, 1964; Malinovsky and Novotna, 1977; Baumel et al., 1993; Dursun, 2002). During its course, this artery bifurcates into the right branch

of the celiac artery and the left branch of the celiac artery after giving off oesophageal artery and superior proventricular artery (McLeod et al., 1964; Malinovsky, 1965; Gadhoke et al., 1975; Getty, 1975; Baumel et al., 1993; Pinto et al., 1998; Cardoso et al., 2000). The superior proventricular artery gives off the oesophageal branches and the dorsal gastric artery (Baumel et al., 1993; Dursun, 2002).

The inferior proventricular artery, left gastric artery, rami sacci, inferior gastric artery, left hepatic artery and gastroduodenal artery arise from the left branch of the celiac artery; meanwhile, splenic artery, right hepatic artery, ileocecal artery, pancreaticoduodenal artery, duodenojejunal artery, right superior gastric artery, right inferior gastric artery and rami sacci have their origin from the right branch of the celiac artery (Baumel et al., 1993).

This study aimed to increase the knowledge of the gross morphology of the celiac artery, especially in sparrow hawks, and to compare it with other birds, and also to contribute to veterinary comparative anatomy.

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### Materials and Methods

In this study, 7 sparrow hawks were used. Their weights ranged from 150 to 250 g and sex differences were not considered. These hawks were birds that were brought to the surgical clinic of Atatürk University, Faculty of Veterinary Medicine, Erzurum, Turkey, for treatment purposes because they had broken wings or legs and were euthanized after it was confirmed that treatment was not possible. After injecting 5–10 mg/kg xylazine for premedication and 20–40 mg/kg ketamine for anaesthesia intramuscularly (Flecknell, 1987; Belge and Bakır, 1999), surgical clinic staff performed euthanasia by cutting the apex of the heart under deep anaesthesia. Then, the vessels were cleaned by giving 0.9% physiological saline to the vessels. Latex coloured with dye was injected into the ventriculus sinister of the heart through the aorta at 7 materials (Hassa, 1967). After keeping in tap water at room temperature for 24 hours, photographs of the cadavers were taken, dissecting of the celiac artery and its branches.

For angiography, 45 kW doses of barium sulphate solution were injected into the aorta in 3 materials. Angiographies were taken at a ventrodorsal position, and 100 kW 30 mAS Poskom brand x-ray was used for angiography.

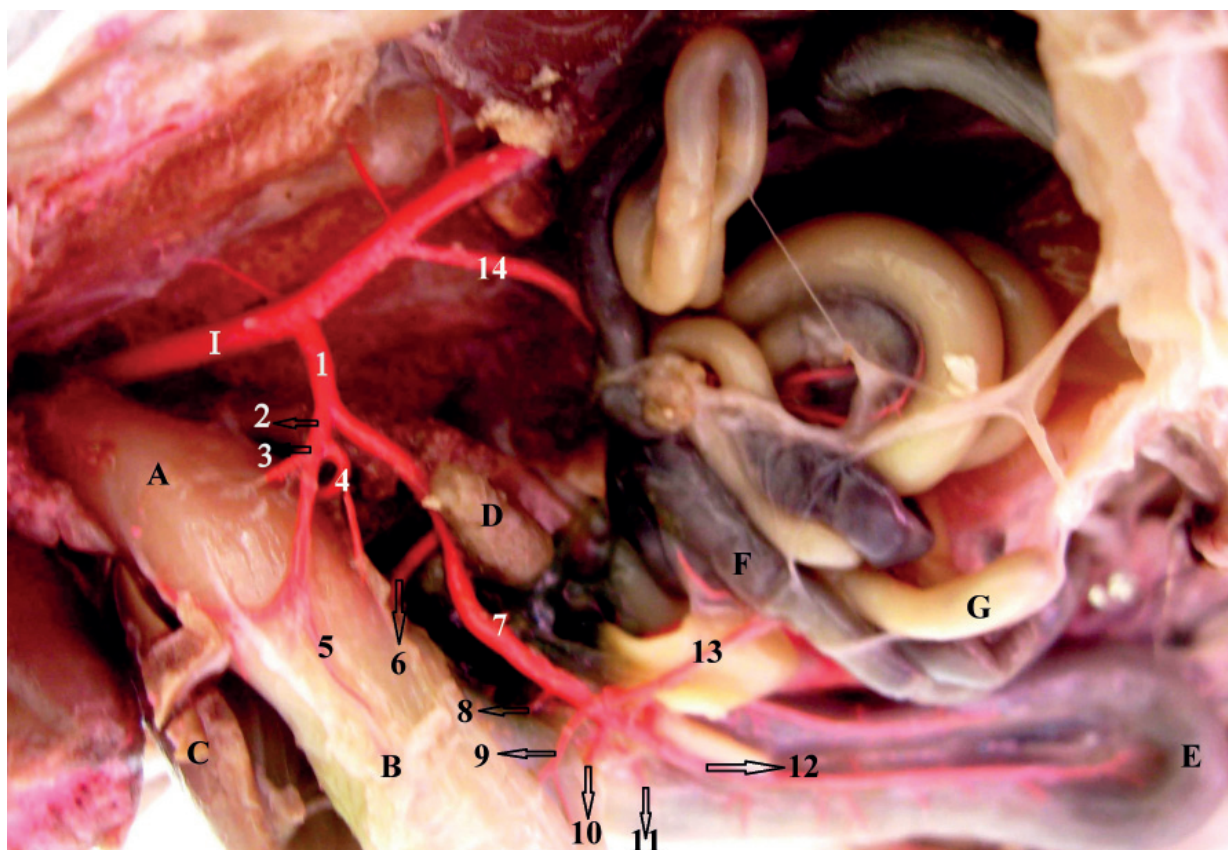
In the presented study, mathematical–statistical evaluation was not performed because the number of animals was not high and there were gender and age differences.

For the terminology, *Nomina Anatomica Avium* (NAA) was used (Baumel et al., 1993).

### Results

The celiac artery originated from the ventral wall of the aorta at the beginning of the synsacrum, at the junction where the glandular stomach joins the oesophagus. This artery was determined to provide the nutrition of the last part of the oesophagus, proventriculus, ventriculus, liver, lien, pancreas, small intestines and cecum. The celiac artery was found to run along in between the lobus hepatis dexter et sinister of the liver on the right side of the proventriculus in caudoventral direction and, along its course, it terminated by splitting into the right branch of the celiac artery and the left branch of the celiac artery in-between the medial surface of the lien after first giving off the common root of the oesophageal artery and superior proventricular artery and then splenic artery (Fig. 1.1 and 2.2).

The first vessel originating from the celiac artery was found to be the common root of the superior



*Fig. 1.* Lateral view of the celiac artery. I: Aorta, 1: Celiac artery, 2: Common trunk of the esophageal artery and superior proventricular artery, 3: Esophageal artery, 4: Superior proventricular artery, 5: Superior gastric artery, 6: Left branch of the celiac artery, 7: Right branch of the celiac artery, 8: Right superior gastric artery, 9: Right inferior gastric artery, 10: Gastroduodenal artery, 11: Pancreaticoduodenal artery, 12: Duodenojejunal artery, 13: Ileocecal artery, 14: Cranial mesenteric artery, A: Esophagus, B: Proventriculus, C: Lobus hepatis sinister, D: Lobus hepatis dexter, E: Duodenum, F: Ileum, G: Cecum.

proventricular artery and the esophageal artery. Immediately after its origin, the oesophageal artery was terminated by giving off the branches, namely, rami oesophagi, which nourish the oesophagus, extending in craniodorsal direction (Fig. 1.3 and 3c).

The superior proventricular artery was found to distribute to the dorsal surface of the proventriculus as 3 to 4 branches (Fig. 1.4; 1 A–C and 3d). The superior gastric artery emanated from the superior proventricular artery and was observed to provide the vascularisation of the left and dorsal surface of the ventriculus (Fig. 1.5).

The splenic artery was the last branch given by the celiac artery before splitting into the right branch of the celiac artery and the left branch of the celiac artery. These vessels were determined to vary from 3 to 4 in number and to nourish the medial and distal part of the lien (Fig. 2.4).

The left branch of the celiac artery, one of the last two branches of the celiac artery, was determined to extend cranioventrally in the proximity of isthmus gaster. After it gave off the right hepatic artery to nourish the lobus hepatis dexter of the hepar, it passed to the left side of the hepar. In this part, this blood vessel was found to terminate splitting into the inferior proventricular artery, the left inferior gastric artery and the left gastric artery after giving off the left hepatic artery to the lobus hepatis sinister of the liver with 3 to 4 branches (Fig. 1.6 and 3f).

The first branch given off the left branch of the celiac artery prior to reaching the portae hepatis, the right hepatic artery, was established to terminate distributing to the lobus hepatis dexter of the hepar. In addition, the right hepatic artery was determined to give off the artery of the gall bladder which provides the arterial nourishment of the vesicae fellae before terminating (Fig. 2.7).

Arising from the left branch of the celiac artery at the cranial region of the vesicae fellae, the left hepatic artery was observed to provide the vascularisation of the lobus hepatis sinister of the hepar (Fig. 2.9–9a–b). In addition, the left hepatic artery was determined to be thicker than right hepatic artery in all materials.

Having its origin at the left branch of the celiac artery at the caudal of the proventriculus as 2 to 3 branches, the inferior proventricular artery was observed to nourish the ventral region of the proventriculus.

Arising from the left branch of the celiac artery at the cranial region of the ventriculus as 2 to 3 branches, the left inferior gastric artery was observed to nourish of the ventral region of the ventriculus (Fig. 1.9).

The left gastric artery was determined to be the prolongation of the left branch of the celiac artery and terminating to distribute at the left surface of the ventriculus.

After stemming from the celiac artery, the right branch of the celiac artery was determined to run

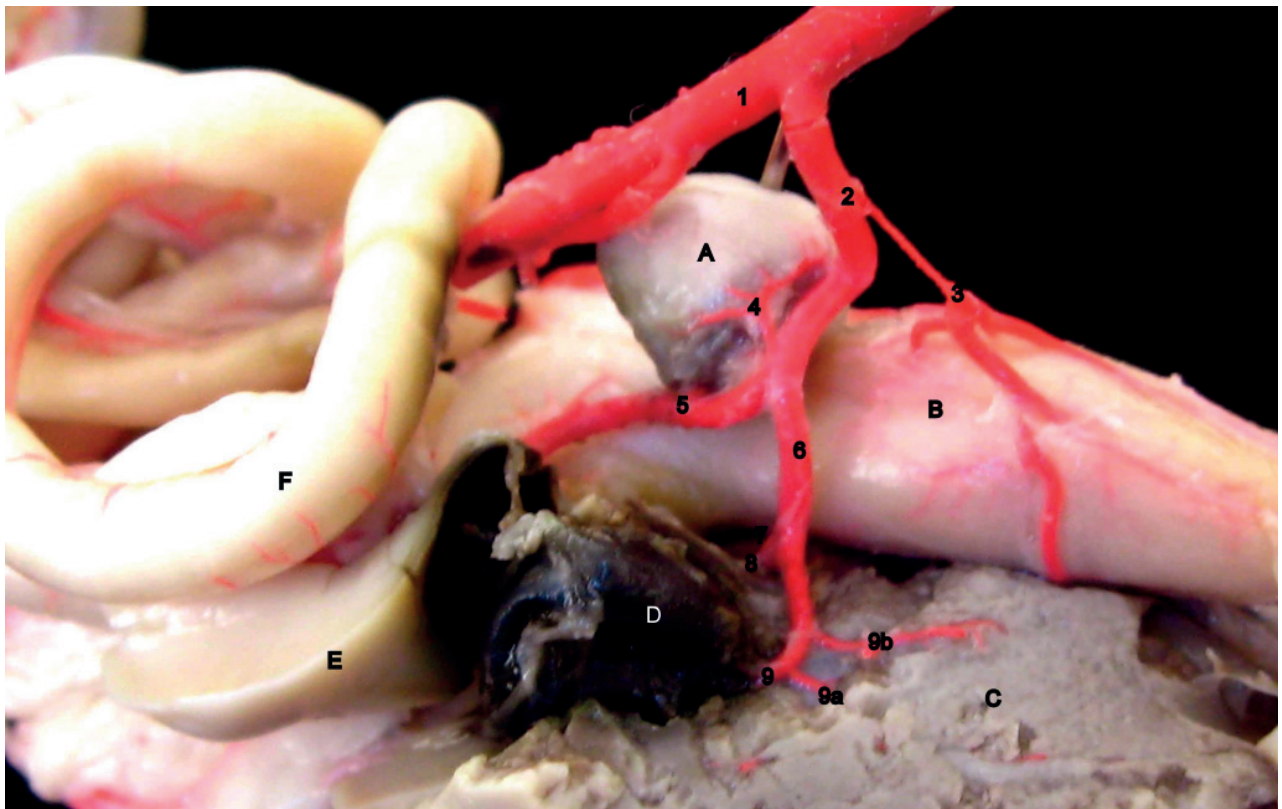


Fig. 2. Dorsal view of the celiac artery. 1: Aorta, 2: Celiac artery, 3: Common trunk of esophageal artery and superior proventricular artery, 4: Splenic artery, 5: Right branch of celiac artery, 6: Left branch of celiac artery, 7: Right hepatic artery, 8: Artery of gall bladder, 9-9a-b: Left hepatic artery, A: Lien, B: Proventriculus, C: Hepar, D: Vesicae fellae, E: Pancreas, F: Jejunum.

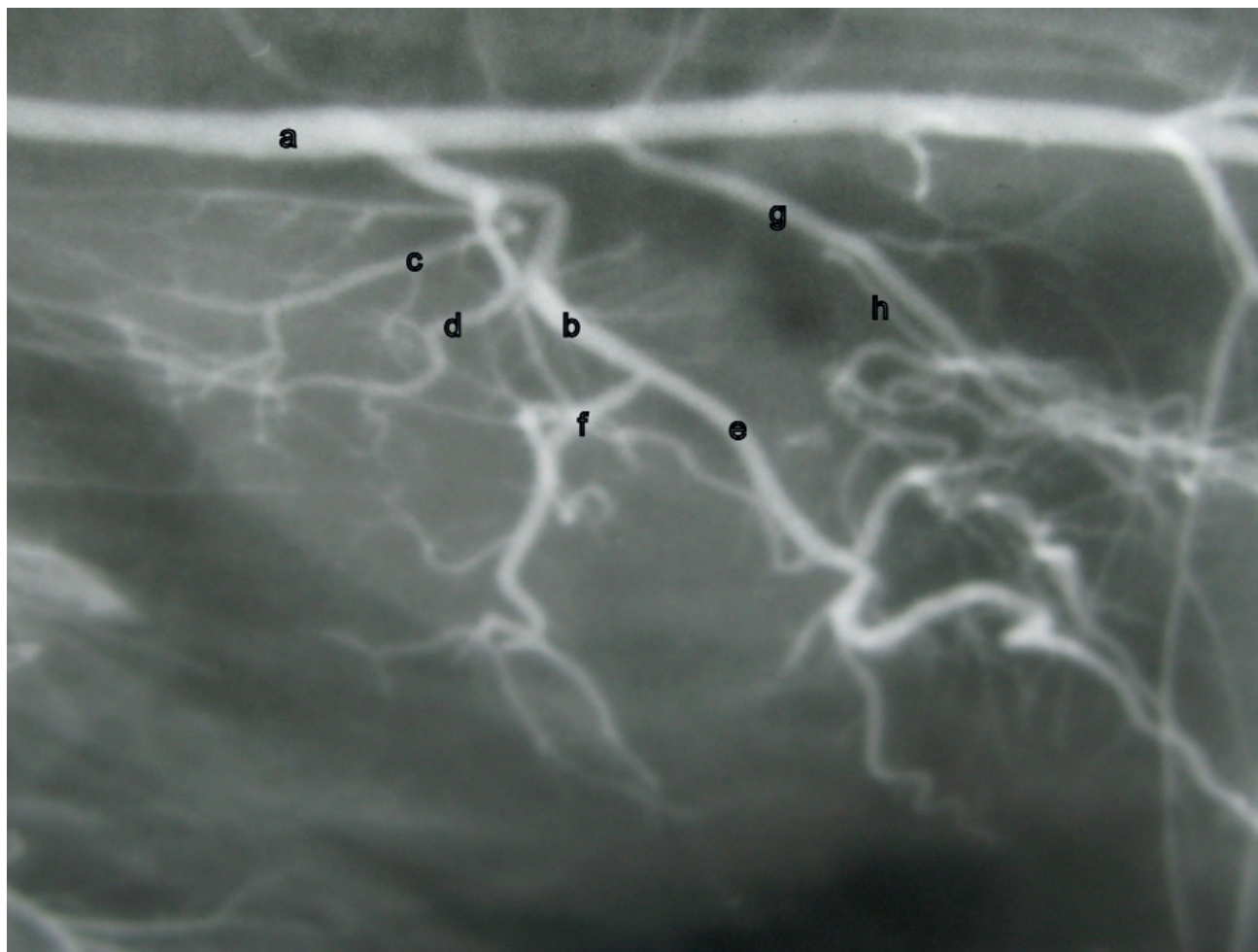


Fig. 3. Radiograph of the celiac artery. a: Aorta, b: Celiac artery, c: Esophageal artery, d: Superior proventricular artery, e: Right branch of celiac artery, f: Left branch of celiac artery, g: Cranial mesenteric artery, h: Ileocecal artery.

along under the lien in a caudoventral direction. This blood vessel was observed to lie on the junction of the gaster with the duodenum. It was determined to give off the right superior gastric artery before reaching the indicated junction. At the level of the indicated junction, the right branch of the celiac artery was determined to split into its terminal branches which extended in different directions, namely the ileocecal artery, the gastroduodenal artery, the pancreaticoduodenal artery, the duodenojejunal artery and the right inferior gastric artery (Fig. 1.7 and 3e).

Having its origin at the caudal region of the gaster, the right superior gastric artery was determined to nourish the right surface of the ventriculus, running along in the dorsocaudal direction (Fig. 1.5).

The ileocecal artery was observed to spring from the right branch of the celiac artery at the craniodorsal of the right surface of the ventriculus and gave off branch only for ileum (Fig. 1.13).

The gastroduodenal artery was detected to separate from the right branch of the celiac artery at the caudal region of the ventriculus as one branch. This vessel was terminated to give off 2 to 3 branches which nourish the pars descendens region of the duodenum (Fig. 1.10).

One of the last branches separating from the right branch of the celiac artery, the pancreaticoduodenal artery, was established to bifurcate into 2 branches at the beginning part of the duodenum by extending to the caudal direction. The first branch was determined to terminate distributing to the duodenal fold and pars descendens duodeni and the second to the pars ascendens duodeni. The two bifurcated branches were determined to anastomose with each other at the ansa duodenalis. One small vessel ramifying from the second branch was determined to nourish the lobus pancreaticus dorsalis et ventralis of the pancreas (Fig. 1.11).

Originating from the right branch of the celiac artery at the level of the junction of the duodenum and ventriculus, the duodenojejunal artery was determined to give off 3 to 5 branches to the duodenum along its course to the jejunum (Fig. 1.12).

The right inferior gastric artery was separated from the right branch of the celiac artery. This blood vessel was observed to distribute to the ventral surface of the gaster as 2 to 4 branches extending to the ventral direction (Fig. 1.9).

## Discussion

The results of this study showed that the celiac artery was established to have its origin from the aorta at the beginning of synsacrum at the junction where the proventriculus joins the oesophagus. This result is similar in falcons, buzzards, chickens, roosters, ducks, pigeons, eagle owls, white turkeys, red falcons, domestic geese, cattle egrets and hooded crows (Malinovsky, 1965; McLeod et al., 1965; Malinovsky et al., 1973; Malinovsky et al., 1975; Kuru, 1996; Aycan and Duzler, 2000; Dursun, 2002; Kurtul and Hazirolu, 2002; Kurtul, 2002; Ari et al., 2010; Haligur and Duzler, 2010; Ragap et al., 2013; Khalifa, 2014; Hassan and El-Sayed, 2018).

In various reports, the celiac artery was reported to split into the right branch of the celiac artery and the left branch of the celiac artery. Similarly, in 7 sparrow hawks examined in the present study, the celiac artery was also determined to split into right branch of the celiac artery and left branch of the celiac artery (Getty, 1975; Malinovsky and Novotna, 1977; Schummer and Seifirle, 1977; Baumel et al., 1993; Nickel et al., 2014; Alan et al., 2016; Hassan and El-Sayed, 2018). Contrary to the above reports, Aycan and Duzler (2000) and Chiasson (1964) reported that this vessel was not split into the above-mentioned branches.

In 7 sparrow hawks examined, the superior gastric artery was found to spring from the superior proventricular artery. This is in agreement with the findings of previously conducted studies that have reported the superior gastric artery to originate from the superior proventricular artery (Getty, 1975; Baumel et al., 1993; Dursun, 2002; Kuru, 2010; Rezk and El-Bably, 2014). In contrast to this, in the literature, Aycan and Duzler (2000), Ari et al. (2010), and Haligur and Duzler (2010) have indicated that the superior gastric artery was determined to spring from the celiac artery.

Kuru (1996), Aycan and Duzler (2000), Ari et al. (2010), Nickel et al. (1977) and Rezk and El-Bably (2014) have reported the oesophageal artery to be the first branch originating from the celiac artery. Kurtul and Hazirolu (2002) in roosters, ducks, and pigeons and Hassan and El-Sayed (2018) in hooded crows have reported that the first branch of the celiac artery was the dorsal proventricular artery. Alan et al. (2016) have observed that the oesophageal artery stemmed from the superior proventricular artery. However, Haligur and Duzler (2010) and Ragap et al. (2013) have determined the oesophageal artery to have its origin from the celiac artery as a common root with the superior proventricular artery. Similarly, in sparrow hawks examined in the present study, the oesophageal artery originated from the celiac artery as a common root with the superior proventricular artery.

Chiasson (1964), Kuru (1996), Aslan and Takçı (1998), Aycan and Duzler (2000), and Rezk and El-

Bably (2014) have reported that the splenic artery stemmed from the right branch of the celiac artery. In contrast to these studies, Pinto et al. (1998), Cardoso et al. (2000), and Dursun (2002) have reported that the splenic artery stemmed from the left branch of the celiac artery. Contrary to the above reports, Malinovsky et al. (1973), Baumel et al. (1993), Kuru (1996), Ari et al. (2010) and Khalifa (2014) have reported that the splenic artery originated from the celiac artery. In the present study, the splenic artery was determined to spring from the celiac artery and not to the right branch or left branch of the celiac artery.

Alan et al. (2016) have determined that right hepatic artery arose from the right branch of the celiac artery in 2 flamingos, in other 2 birds it stemmed from the left branch of the celiac artery, and in the fifth flamingo it was observed that 2 separate right hepatic arteries originated as one vessel from the right and left branch of the celiac artery. Ari et al. (2010) have reported the right hepatic artery to spring from the right branch of the celiac artery and the left hepatic artery from the left branch of the celiac artery. In contrast to this study, in the present study, which was carried out in the sparrow hawks, the right hepatic artery was determined to spring from the left branch of the celiac artery, which is in agreement with a report of Haligur and Duzler (2010).

Reports exist that the left gastric artery arises from the left branch of the celiac artery (Baumel et al., 1993; Dursun, 2002; Haligur and Duzler, 2010; Khalifa, 2014). Similarly, in the present study, the left gastric artery was also determined to arise from the left branch of the celiac artery stem from truncus celiacus.

In the sparrow hawks examined, contrary to the above reports, Nishida et al. (1969) describes that the left gastric artery originating from the artery of the gall bladder was detected to spring from the right hepatic artery. This is in agreement with the findings of previously conducted studies (Malinovsky, 1965; Malinovsky 1973; Malinovsky and Visnanska, 1975; Malinovsky, 1977; Baumel et al., 1993; Aslan and Takçı, 1998; Aycan and Duzler, 2000; Dursun, 2002; Kurtul, 2002; Ari, 2010; Kuru, 2010; Alan et al., 2016). In contrast to this, Haligur and Duzler (2010) have indicated that the artery of the gall bladder was determined to originate from the left branch of the celiac artery.

In conclusion, in the present study, origin and branches of the celiac artery, which were specific to the sparrow hawk, were determined and compared those reported in the literature available for other avian species.

## Conflict of Interests

The authors declare that they have no conflict of interest.

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