Original Article https://doi.org/10.47748/tjvr.1055929

TJVR 2022; 6 (1): 19-26

Turkish Journal of Veterinary Research

https://dergipark.org.tr/tr/pub/tjvr

e-ISSN: 2602-3695

A Macroanatomical study on coronary veins in Southern Karaman Sheep

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Received: 10.01.2022 Accepted: 11.03.2022

ABSTRACT

Objective: This study aimed to reveal the coronary veins and the branches that join it to provide venous drainage of the heart in Southern Karaman sheep.

Material-Method: Eight Southern Karaman sheep's heart tissues were used in the study. Latex injection techniques were used to determine the coronary veins and the branches that join it for providing venous drainage of the heart.

Result: In the study, vena cordis magna, vena cordis media, and vv. cordis dextra was observed as venous drainage providing vessels. The vena cordis magna began in the lower third of the sulcus interventricularis paraconalis, called vena interventricularis paraconalis. This vein reached the sulcus coronarius and continued as vena circumflexus sinister. Vena cordis media was named as vena interventricularis subsinosus in sulcus interventricularis subsinosus. The vv. cordis dextra was responsible for the venous drainage of the facies atrialis of the heart.

Conclusion: In the evaluation of the study findings, it was determined that the coronary veins and the branches joined it of Southern Karaman sheep were mainly similar to other sheep breeds in the literature. Still, there were some anatomical differences, for example; vena distalis ventriculi sinistri was opening into vena circumflexus sinister, vena apicis cordis was absent, vena semicircumflexa dextri was present.

Keywords: *Anatomy, Southern Karaman sheep, Coronary vein, Latex*

INTRODUCTION

The Southern Karaman sheep breed is a different species obtained by crossing the Karagül rams bred with Akkaraman and Dağlıç sheep. This breed is one of the most preferred breeds in Turkey due to its higher yields in meat and milk production (Kaymakçı, 2008; Ertuğrul et al., 2009).

The main vessels that provide venous drainage of the heart in mammals are; vena cordis magna, vena cordis media, vv. cordis dextra and vv. cordis minimae. All of these veins end by opening into the sinus coronarius. Besides, vv. cordis minimae may open to anterior cardiac veins as well as sinus coronarius in sheep (Yadm and Gad, 1992; Yadm, 1993; Dursun, 1994; Tıpırdamaz et al., 1999; Beşoluk and Tıpırdmaz, 2001; Constantinescu, 2001).

Sinus coronarius is localized in the ventral part of the bottom parts of the truncus pulmonalis and vena cava caudalis, as a continuation of the vena azygos sinistra, and it usually opens to the vena cava caudalis as well as it may also end by opening into the atrium dextrum (Yoldaş, 2007; Aydınlık et al., 2008; Gürbüz, 2015).

The vena cordis magna is the strongest of the coronary veins and begins as the vena

interventricularis paraconalis in the distal part of the sulcus interventricularis paraconalis. By continuing within the sulcus interventricularis paraconalis, it reaches the sulcus coronarius and continues on its way as the vena circumflexus sinister and ends after opening into the sinus coronarius. During its course, vena collateralis sinister distalis, vena collateralis sinister proximalis, vena coni arteriosa join it that they drain the ventriculus sinister and septum interventriculare (Nickel et al., 1981; Evans and Christensen, 1993; Koch and Berg, 1993; Aksoy et al., 2003; Yoldaş et al., 2013; Barszcz et al., 2020).

The vena circumflexus sinister is the continuation of the vena interventricularis paraconalis and begins at the intersection of the sulcus interventricularis paraconalis and sulcus coronarius. It continues in the sulcus coronarius along the ventral edge of the auricula sinistra and terminates after opening into the sinus coronarius. During its course, vena circumflexus sinister, vena proximalis ventriculi sinistri, vena distalis ventriculi sinistri, vena marginis ventricularis sinistri accessoria, and vena marginis ventricularis sinistri join it (Gürbüz, 2015; Barszcz et al., 2020).

Vena cordis media, after originating from apex cordis as vena interventricularis subsinosus in sulcus interventricularis subsinosus, courses towards basis cordis (Aksoy et al., 2001; Aksoy et al., 2009). After draining the ventriculus dexter and atrium dextrum in facies atrialis, it usually ends by opening into the sinus coronarius and sometimes into the atrium dextrum.

During its course, vena collateralis dexter proximalis, vena collateralis dexter distalis, vena obliqua ventriculi dextri open here from the atrial surface of the ventriculus dexter. From the auricular surface, the vena collateralis sinister proximalis, vena collateralis sinister intermedia, vena collateralis sinister distalis branches and vena apicis cordis open into this vein (Aksoy et al., 2009; Kabak and Onuk, 2012; Gürbüz, 2015; Barszcz et al., 2020)

Vv. cordis dextra reaches the sulcus coronarius by providing venous drainage of the atrium dextrum and ventriculus dexter located on the right side of the heart. During the course of vv. cordis dextra, v. proximalis atrii dextri, v. coni arteriosi, v. proximalis ventriculi dextri opens into this vein (Dursun, 1994; Tıpırdamaz et al., 1999; Beşoluk and Tıpırdmaz, 2001).

The numerous and thin cordis minimae branches were mainly observed in the atrium dextrum and less frequently in the atrium sinistrum and ventriculus dexter. They collect the venous blood in the surrounding tissues and empty it into the nearest cardiac cavity (Tıpırdamaz et al., 1999).

In this study, we aimed to investigate the coronary veins that provide venous drainage of the heart in Southern Karaman sheep, an indigenous breed in Turkey.

MATERIALS and METHODS

Animal Material

The study was conducted according to ethical guidelines and under the supervision of Atatürk University Local Ethics Committee board (*Decision no: 2021-35*). Eight Southern Karaman sheep's hearts were used in the study. The Southern Karaman sheep were obtained from Konya Bahri Dağdaş International Agricultural Institute.

Method

After the sheep were anesthetized with xylazine HCl (0.3 mg/kg/IV) and ketamine HCl (2.5 mg/kg/IV), they were injected Na-Heparin (5,000 IU/mL) at a dose of 0.1 mg/kg/IV to prevent blood clotting. Then, the abdominal cavities were opened under deep anesthesia and the venous circulatory system was cleaned with 0.9% saline solution with a plastic catheter placed in the v. cava caudalis. After removing the heart, the cannulas were placed in the vena azygos sinistra to examine the coronary veins of heart. According to the previous latex injection method (Aycan and Bilge, 1984), 200 cc of latex and 10 cc of fabric dye were mixed in a beaker to disperse the dyestuff. For demonstration, the latex mixture colored with blue fabric dye was injected into the coronary veins through the cannulas placed before, and then the hearts were preserved in 10% formaldehyde solution. They were kept in 10% formaldehyde solution for 72 hours to ensure their determination. The coronary veins were dissected, and structures were identified and labeled. The terminology employed has been referenced from the Nomina Anatomica Veterinaria 6th edition (2017).

RESULTS

In this study, we observed the vena cordis magna, vena cordis media, and vv. cordis dextra. These main branches were subepicardial and partly intramyocardial. These branches terminated after transmitting the venous blood they collected, to

the sinus coronaries. Then sinus coronaries opened into vena cava caudalis (Figure 1, Figure 2a and 2b, Figure 3a and 3b, Figure 4a and 4b).

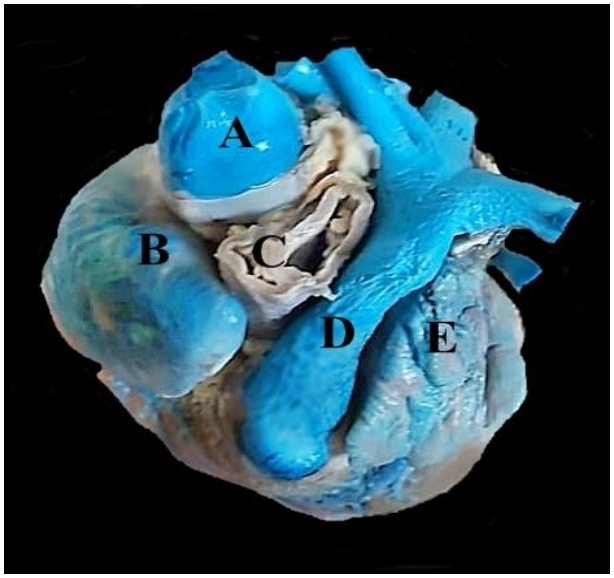

Figure 1. Dorsal view of Southern Karaman Sheep's heart;
A: vena cava caudalis, **B:** atrium dextrum, **C:** aorta, **D:** truncus pulmonalis, **E:** atrium sinistrum.

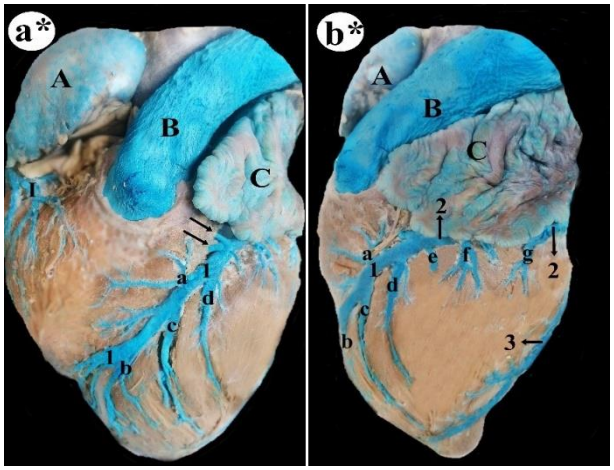

Figure 2. Vena interventricularis paraconalis and vena circumflexus sinister forming the vena cordis magna in the Southern Karaman sheep;
a*: vena interventricularis paraconalis and the branches opening into it;
A: atrium dextrum, **B:** truncus pulmonalis, **C:** atrium sinistrum, **a:** vena coni arteriosi, **b:** vena collateralis sinister distalis, **c:** vena collateralis sinister intermedia, **d:** vena collateralis sinister proximalis, **I:** the common root of vena coni arteriosi and vena proximalis ventriculi dextri, **1:** vena interventricularis paraconalis, **arrows:** septal branches.
b*: The branches opening into vena circumflexus sinister;
A: atrium dextrum, **B:** truncus pulmonalis, **C:** atrium sinistrum, **a:** vena coni arteriosi, **b:** vena collateralis sinister distalis, **c:** vena collateralis sinister intermedia, **d:** vena collateralis sinister proximalis, **e:** vena angularis, **f:** vena proximalis ventriculi sinistri, **g:** vena distalis ventriculi sinistri, **1:** vena interventricularis paraconalis, **2:** vena circumflexus sinister, **3:** vena marginis ventricularis sinistri.

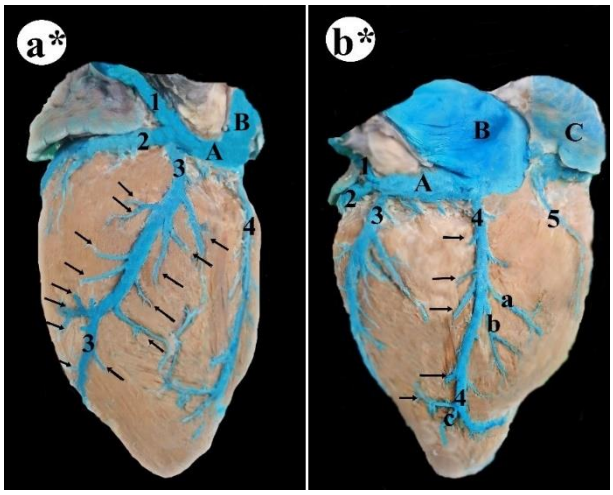

Figure 3. Sinus coronarius, vena azygos sinistra, vena marginis ventricularis sinistri and vena cordis media (vena interventricularis subsinosus) in Southern Karaman sheep;
a*: The branches opening into the vena marginis ventricularis sinistri;
A: sinus coronarius, **B:** vena cava caudalis, **1:** vena azygos sinistra **2:** vena circumflexus sinister, **3:** vena marginis ventricularis sinistri, **4:** vena cordis media (vena interventricularis subsinosus), **arrows:** the branches opening into vena marginis ventricularis sinistri over the auricular and atrial surface of ventriculus sinister.
b*: The branches opening into vena cordis media (vena interventricularis subsinosus);
A: sinus coronarius, **B:** vena cava caudalis, **C:** atrium dextrum, **a:** vena collateralis dexter proximalis, **b:** vena collateralis dexter distalis, **c:** vena apicis cordis, **1:** vena azygos sinistra **2:** vena circumflexus sinister, **3:** vena marginis ventricularis sinistri, **4:** vena cordis media (vena interventricularis subsinosus), **5:** vena distalis ventriculi dextri, **arrows:** the branches opening into vena cordis media (vena interventricularis subsinosus) from ventriculus sinister.

The sinus coronarius is the continuation of the vena azygos sinistra and is located in the sulcus coronarius at the bottom of the vena cava caudalis. It ended at the sulcus interventricularis subsinosus level by opening into the vena cava caudalis (Figure 3a and 3b). It was identified that the main branches forming the sinus coronarius by coming together were the vena cordis magna, vena cordis media, and vena marginis ventricularis sinister. It was observed that the vena azygos sinistra

progressed towards the cranial between the atrium sinistrum and the vena cava caudalis, which is the continuation of the sinus coronarius (Figure 3a and 3b).

The vena cordis magna was the most powerful vessel involved in the hearts drainage. It started in the lower 1/3 of the sulcus interventricularis paraconalis around the apex cordis, called vena interventricularis paraconalis. Upon reaching the sulcus coronarius, it continued as vena circumflexus sinister (Figure 2a and 2b). It was observed that it progressed in the caudoventral of the atrium sinistrum and ended by opening into the sinus coronarius at the margo ventricularis sinister level. During its course, branches from the atrium sinistrum and ventriculus sinister opened into it (Figure 3a and 3b).

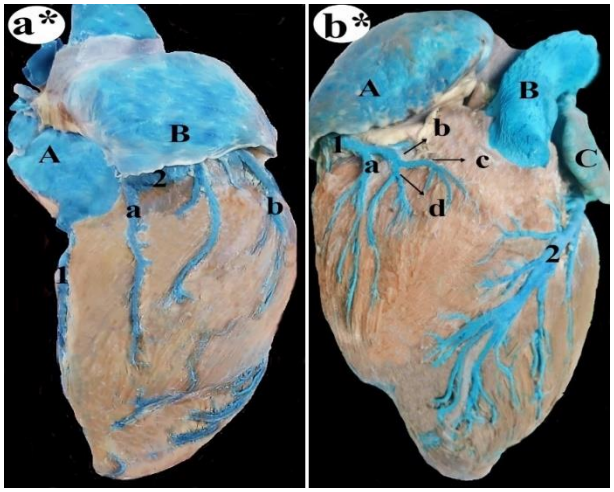

Figure 4. Vena semicircumflexa dextri formed by vv. cordis dextra in Southern Karaman sheep;

a*: The branches opening into vena semicircumflexa dextri;

A: vena cava caudalis**, B:** atrium dextrum, **a:** vena distalis ventriculi dextri, **b:** vena marginis ventricularis dextri, **1:** vena cordis media **(**vena interventricularis subsinosus), **2:** vena semicircumflexa dextri.

b*: The branches opening into vena semicircumflexa dextri;

A: atrium dextrum, **B:** truncus pulmonalis, **C:** atrium sinistrum, **a:** vena marginis ventricularis dextri, **b:** common root of vena coni arteriosi and vena proximalis ventriculi dextri, **c:** vena coni arteriosi, **d:** vena proximalis ventriculi dextri, **1:** vena semicircumflexa dextri **2:** vena interventricularis paraconalis.

The vena interventricularis paraconalis was originated on the facies auricularis of the heart, above the apex cordis, from the lower 1/3 of the sulcus interventricularis paraconalis. It moved towards the basis cordis in the cranial direction in the region close to the apex cordis after anastomosis with its thin branches with vena marginis ventricularis sinistri, vena interventricularis subsinosus, and partially vv. cordis dextra (Figure 2a). During its course, from distal to proximal, it was identified that it received vena collateralis sinister distalis, vena collateralis sinister intermedia, vena coni arteriosi, vena collateralis sinister proximalis draining ventriculus dexter, ventriculus sinister, and septum interventriculare. These main branches also received varying numbers of thin lateral branches. It was observed that the two septal branches in the proximal, close to the sulcus coronarius, were thicker than the branches draining the septum interventriculare. Collateral veins were coursed intramyocardially, obliquely, below the epicardium (Figure 2a and 2b). The branches draining the ventriculus sinister were thicker than draining the ventriculus dexter. In all studied materials, vena collateralis sinister proximalis et intermedia was stronger than vena collateralis sinister distalis. It was identified that there was a partial anastomosis between the vena collateralis sinister distalis et intermedia. and the vena marginis ventricularis sinistri's branches. The vena collateralis sinister distalis was reaching the vena interventricularis paraconalis through two main branches. It was observed that the vena coni arteriosi opened into the vena interventricularis paraconalis through two main branches between vena collateralis sinister proximalis et intermedia and oppositely with the vena collateralis sinister proximalis (Figure 2a and 2b, Figure 4b).

The vena circumflexus sinister was a continuation of the vena interventricularis paraconalis and coursed in the sulcus coronarius. Its origin was where the sulcus interventricularis paraconalis and the sulcus coronarius intersect. It coursed in the caudoventral of the atrium sinistrum, within the sulcus coronarius, and ended after opening into the sinus coronarius (Figure 3a and 3b). During its course, it receives vena proximalis atrium sinistri, vena intermedius atrium sinistri, and vena distalis atrium sinistri draining the atrium sinistrum. Furthermore, it was identified that it took branches from vena angularis, vena proximalis ventriculi sinistri, vena distalis ventriculi sinistri, and vena marginis ventricularis sinistri that drained the ventriculus sinister. It was determined that the vena angularis opened into it close to the origin of the vena circumflexus sinister. The vena proximalis ventriculi sinistri subepicardially opened into the vena circumflexus sinister, starting

as several branches with a course parallel to the margo ventricularis sinister in the facies auricularis. The vena distalis ventriculi sinistri was stronger than vena proximalis ventriculi sinistri, and the lateral branches of these two vessels made partial anastomosis. Apart from these branches, it was seen that the thin branches draining the proximal 1/3 of the ventriculus sinister were also opened into the vena circumflexus sinister (Figure 2b, Figure 3a and 3b).

The vena marginis ventricularis sinistri, the strongest of the ventricular branches, started in the apex cordis region by anastomosis with the vena interventricularis paraconalis and partially the vena interventricularis subsinosus through its thin lateral branches. It was directed towards the atrial surface from the auricular surface with an oblique course on the margo ventricularis sinister (Figure 3a and 3b). After its origin, the branches ranging from 8 to 12 from the auricular surface and 6 to10 from the atrial surface opened into it. The branches that were taken from the auricular surface were more numerous and stronger. In all of the materials studied, the vena marginis ventricularis sinistri ended by opening into the sinus coronarius. It was observed that the lateral branches taken from the atrial and auricular surfaces also anastomose with the other branches in the vicinity (Figure 2b, Figure 3a and 3b).

The vena cordis media was formed by the union of several branches above the apex cordis. It coursed from the apex cordis to the basis cordis in the sulcus interventricularis subsinosus as vena interventricularis subsinosus. It ended by opening into the sinus coronarius (Figure 3a and 3b). The first branch it taked on was the vena apicis cordis coming from the auricular surface's direction. The atrial face of ventriculus dexter was taken branches from vena collateralis dexter proximalis and vena collateralis dexter distalis from the proximal to the distal. Apart from these branches, it was determined that it received branches draining ventriculus dexter, ventriculus sinister, and septum interventriculare (Figure 3a and 3b, Figure 4a).

The vv. cordis dextra was responsible for venous drainage of the facies atrialis of the heart. Vv. cordis dextra coursed just caudoventral to the atrium dextrum (Figure 4a). During its course, it formed the semicircumflexa dextri and the vena coni arteriosi, vena proximalis ventriculi dextri, and vena marginis ventricularis dextri joined it. The branch draining the conus arteriosus area was the vena coni arteriosi, and after joining with the vena proximalis ventriculi dextri, it opened into the vena semicircumflexa dextri. The vena proximalis ventriculi dextri started in two branches from the middle 1/3 of the ventriculus dexter and progressed closely with the vena marginis ventricularis dextri. Both these veins opened into the vena semicircumflexa dextri (Figure 2a, Figure 4b). It was determined that the vena distalis ventriculi dextri originated from the lower 1/3 of the ventriculus dexter on the atrial surface and ended by opening directly into the atrium dextrum, not to the vena semicircumflexa dextri. Apart from these branches, the vv. cordis dextra also received branches that take part in venous drainage of atrium dextrum and ventriculus dexter (Figure 4a).

DISCUSSION

Coronary circulation in mammals has been studied in various vertebrates (Budras and Habel, 2003; Budras and Röck, 2009; Kupczyńska et al., 2015), such as birds (Bartyzel et al., 2009) and reptiles (Hagensen et al., 2008). Also, there are no studies on coronary veins of Southern Karaman sheep in the literature. Therefore, this study aimed to investigate the morphology of the coronary veins in Southern Karaman sheep.

Consistent with the literature (Beşoluk and Tıpırdamaz, 2001; Gürbüz, 2015; Barszcz et al., 2020; Gürbüz and Aksoy, 2020), this study determined that the main vessels providing venous drainage of the heart in Southern Karaman sheep were vena cordis magna, vena cordis media, and vv. cordis dextra.

Similar to the findings of our study, sinus coronarius was found in cattle, sheep, goat (Nickel et al., 1981), European bison (Barszcz et al., 2020), and in Tuj and Hemshin sheep (Gürbüz and Aksoy, 2020) and it drained most of the coronary veins of the heart (Genain et al., 2018). Likewise, in Hemshin sheep (Gürbüz, 2015), the sinus coronarius opened into the vena cava caudalis. Contrary to our study, it was reported that the sinus coronarius opened into the atrium dextrum (Nickel et al., 1981; Aksoy et al., 2009; Tıpırdamaz et al., 2009). Different from the study findings, Yadm and Gad (1992) reported that the sinus coronarius continued as the vena cordis magna in goats. However, in the study, similar to the literature, it was observed that the sinus coronarius was a continuation of the vena azygos sinistra (Tıpırdamaz et al., 1999; Beşoluk and

Tıpırdamaz, 2001; Aydınlık et al., 2008; Kabak and Onuk, 2012).

In Southern Karaman sheep, cattle (Budras and Habel, 2003), goats (Noor et al., 2015), Tuj sheep (Aksoy et al., 2009), Angora goats and Akkaraman sheep (Beşoluk and Tıpırdmaz, 2001), and European bison (Barszcz et al., 2020), the vena cordis magna is formed by the vena interventricularis paraconalis and vena circumflexus sinister. It ends by opening into the sinus coronarius.

In the study, unlike the findings of Barszcz et al. (2020), and Gürbüz (2015), the vena interventricularis paraconalis started from the upper side of the apex cordis. Unlike the literature findings (Beşoluk and Tıpırdamaz, 2001; Aksoy et al., 2009; Barone, 2011), we found that the vena interventricularis paraconalis anastomosed with the vena marginis ventricularis sinistri and partially with vv. cordis dextra through the lateral branches in addition to the vena media in the apex cordis region. Similar to the literature findings (Noor et al., 2015; Barszcz et al., 2020), it was determined that the branches draining the ventriculus sinister and opening into the vena interventricularis paraconalis were stronger than the branches draining the ventriculus dexter and opening into the vena interventricularis paraconalis. Unlike the findings in the literature (Aksoy et al., 2009; Kabak and Onuk, 2012; Gürbüz, 2015; Barszcz et al., 2020), this study showed that the vena collateralis sinister intermedia was as strong as the vena collateralis sinister proximalis. Similar to the literature findings (Beşoluk and Tıpıdamaz, 2001; Barszcz et al., 2020), this study identified that the vena collateralis sinister proximalis was stronger than vena collateralis sinister distalis.

Similar to the literature findings (Gürbüz, 2015; Barszcz et al., 2020; Gürbüz and Aksoy, 2020), the vena interventricularis paraconalis turned into vena circumflexus sinister in the sulcus coronarius in Southern Karaman sheep, and these two branches together shaped the v. cordis magna. Similar to Gürbüz and Aksoy's (2020) study, the vena proximalis ventriculi sinistri ended by opening into the vena circumflexus sinister. Gürbüz (2015) reported that vena marginis ventricularis sinistri in Hemshin sheep and vena angularis in two Tuj and three Hemshin sheep anastomosed with a proximal branch opening into vena interventricularis paraconalis. Unlike these findings, this study identified that the vena proximalis ventriculi sinistri made partial anastomosis with the lateral branches of the vena distalis ventriculi sinistri. It has been reported that the vena distalis ventriculi sinistri opens into the sinus coronarius in five Tuj sheep (Aksoy et al., 2009), roe deer (Kabak and Onuk, 2012), and Akkaraman sheep (Beşoluk and Tıpırdamaz, 2001). Different from these findings, the study found that the vena distalis ventriculi sinistri opened to the vena circumflexus sinister. Unlike the study's findings, Gürbüz (2015) and Aksoy et al. (2009) found that this vein did not exist.

Barszcz et al. (2020) reported that the vena marginis ventricularis sinistri started in the middle of the apex cordis or margo ventricularis sinister. As reported by Gürbüz (2015) it began in the apex cordis region of the vena marginis ventricularis sinistri. As reported by Beşoluk and Tıpırdamaz (2001), it started with anastomosis with vena interventricularis paraconalis and partly with the vena interventricularis subsinosus through its thin lateral branches. Similar to the literature findings (Beşoluk and Tıpırdamaz, 2001; Gürbüz, 2015; Barszcz et al., 2020) it was found that it ended by opening into the sinus coronarius. It has been reported that in European bison (Barszcz et al. 2020) various numbers of branches in the auricular and atrial surface join it and also, it receives 6-9 branches in the auricular surface, and 5-8 branches in the atrial surface in Tuj and Hemshin sheep (Gürbüz, 2015). In this study, it was seen that the vena marginis ventricularis sinistri received branches ranging from 8 to 12 from the auricular surface and 6 to10 from the atrial surface. It was determined that there were more branches taken from the auricular surface and they were stronger. Similar to the study's findings, the literature has reported (Gürbüz, 2015) that the strongest branch is the vena marginis ventricularis sinistri draining ventriculus sinister.

Barszcz et al. (2020) reported that vena cordis media began its course with its two branches getting together; following the study's findings, the first branch was the vena apicis cordis coming from the auricular surface direction. Unlike the study findings, some studies in the literature (Beşoluk and Tıpırdamaz, 2001; Aydınlık et al., 2008; Aksoy et al., 2009, Gürbüz, 2015) did not mention the vena apicis cordis. Similar to the study's findings, Gürbüz (2015) determined that the vena cordis media moved towards the basis cordis within the sulcus interventricularis subsinosus as vena interventricularis subsinosus.

Many domestic animal studies detected vena cordis media (Dursun, 1994; König and Liebich, 2009). Sinus coronarius sometimes directly opens into the atrium dextrum in cattle (Nickel et al., 1981) and European bison (Barszcz et al., 2020). In this study we observed that the vena cordis media opened into the sinus coronarius, unlike European bison (Barszcz et al., 2020), and cattle (Nickel et al., 1981). Similar to the Gürbüz's (2015) findings, it was observed that the branches draining the ventriculus dexter, ventriculus sinister, and septum interventriculare opened into the vena cordis media.

Similar to the literature findings (Yadm and Gad, 1992; Tıpırdamaz et al., 1999; Beşoluk and Tipırdamaz, 2001, Aksoy et al., 2009), in the study it was found that vv. cordis dextra was the vein responsible for venous drainage of the facies atrialis of the heart, and this vein ended by opening into the atrium dextrum. Unlike the findings of this study, Gürbüz and Aksoy (2020) in five Hemshin sheep, reported that there was no vena semicircumflexa dextri. This study determined that the vena semicircumflexa dextri was present, similar to some literature findings (Nickel et al., 1981; Aksoy et al., 2009; Kabak and Onuk, 2012). Similar to the findings of this study, Tıpırdamaz et al. (1999), Aksoy et al. (2009), and Gürbüz (2015) reported that the vena distalis ventriculi dextri opened directly into the atrium dextrum. As Gürbüz (2015) reported in eight Tuj and two Hemshin sheep, the vena coni arteriosi and vena proximalis ventriculi dextri merged to form a common root and opened into the vena semicircumflexa dextri.

CONCLUSION

In this study we found that vena cordis magna, vena cordis media, and vv. cordis dextra were the main veins responsible for the venous drainage of the heart. However, some morphologic differences of the heart vein were determined in Southern Karaman sheep than other species in the literature. The differences were as follows;

- Sinus coronarius was a continuation of vena azygos sinistra, and it was opening into vena cava caudalis.
- Vena collateralis sinister intermedia was as strong as vena collateralis sinister proximalis.
- Vena distalis ventriculi sinistri was opening into vena circumflexus sinister,
- The vena apicis cordis was absent.
- The vena cordis media was opening into the sinus coronaries.
- The vena semicircumflexa dextri was present.

ACKNOWLEDGMENTS

Conflict of Interests: The authors declared that there is no conflict of interests.

Financial Disclosure: The authors declared that this study has received no financial support.

Author's Contributions:
HK and ZÖ designed the study. HK and ZÖ performed surgeries. HK participated in drafting and revising the manuscript. HK: Hülya Kara, ZÖ: Zekeriya Özüdoğru

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