

The Macroanatomy of Coronary Arteries in the Iranian Native Cats

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Abstract: The heart requires a great amount of nutriment and oxygen, as a result of continuous important functions. Also, the functional integrity of the heart is primarily dependent on the supply of the cardiac muscle. Taking the view that anatomical knowledge of the coronary arteries of cats might assist in conducting heart investigations; therefore, the aim of the present work was to observe the frequency and destination of coronary artery branches in the Iranian native cats. The investigation was carried out on fifteen coronary arteries of the hearts of adult Iranian native cats from either sex. The morphometry of the coronary arteries were performed using a metal wire extended along the artery and its branches. The left coronary artery present in all the hearts was single (100%). Its length ranged from 0.3 to 0.9 cm, with a mean of 0.63 cm. It terminated by forming the paraconal interventricular and circumflex branches (81.5%) or the paraconal, circumflex and diagonal interventricular branches (18.5%). The paraconal interventricular branch was located in the sulcus of the same name. It was present in all of the hearts and was single (94%) or double (6%). Its length ranged from 3.5 to 5.9 cm, with a mean of 4.7 cm. It issued 3-9 branches, with a mean of 5.7 branches, of which 47.9% went to the right ventricle and 52.1% to the left ventricle. This artery could terminate before reaching the apex of the heart (6.5%), at the apex (48.7%) or beyond the apex, continuing onwards to terminate at the subsinuosal interventricular sulcus (44.8%). The right coronary artery was located in the right coronary sulcus. It was present in all of the hearts and was single (100%). Its length ranged from 0.1 to 0.6 cm, with a mean of 0.38 cm. It issued 3-8 branches (mean of 4.7 branches) to the right ventricle and 0-3 branches (mean of 1.3 branches) to the right atrium. Its right marginal branch was present in 98.7% of the hearts. The subsinuosal interventricular branch was present in all of the hearts and was single (100%). Its length ranged from 0.3 to 4.8 cm, with a mean of 2.7 cm. It issued 1 to 5 branches (mean of 3.6 branches) and 88.1% of them were to the right ventricle and 11.9% to the left ventricle. In conclusion, the anatomical descriptions of the coronary arteries of the Iranian native cats provide an important baseline for further cardiovascular researches. Furthermore, these results may also be useful tool that will aid the experimental cardiologic procedures, clinical practice and heart surgery on this specie.

Key words: Macroanatomy • Coronary Arteries • Iranian Native Cats

INTRODUCTION

The heart requires a great amount of nutriment and oxygen, as a result of continuous important functions. Also, the functional integrity of the heart is primarily dependent on the supply of the cardiac muscle. The supplier arteries of the cardiac muscles are coronary arteries that have many small branches under the epicardium without entering deep cardiac tissue and follow a course at the surface of the heart. These branches form dense capillary nets after entering heart's muscle. It has been identified that the sudden

obstruction of any of the coronary arteries causes death in humans [1,2]. In addition, the important role of coronary arterial spasm in the pathogenesis of angina pectoris and acute myocardial infarction had been received significant support from investigations performed in patients with the use of coronary arteriography [3]. For this reasons, in the recent years, increasing numbers of studies on animal hearts especially their coronary arteries have been conducted. Their objective has been to examine the application of animal hearts to experimental pharmacological studies, clinical practice and heart surgery [4,5].

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Despite the important value of the coronary arteries of cats in the experimental heart studies [6,7], there are few references in the literature to detailed studies on the anatomy of these arteries [8,9]. Taking the view that anatomical knowledge of the coronary arteries of cats might assist in conducting heart surgical investigations; therefore, the aim of the present work was to observe the frequency and destination of coronary artery branches in the Iranian native cats.

MATERIALS AND METHODS

The investigation was carried out on fifteen coronary arteries of the hearts of adult Iranian native cats from either sex. For premedication, xylazine (Rompun, Bayer) was used at a dose of 2 mg/kg. Subsequently, 25 mg/kg ketamine (Rotexmedica, Germany) were injected to achieve 45 minutes of general anesthesia. Heparin (5000 IU/ ml) at a dose of 0.1 mg/kg was injected prior to perfusion into the cranial branch of the small femoral artery to prevent coagulation of the blood. The abdomen was opened and the abdominal aorta was cut to allow drainage of blood from the circulation. Then the abdominal aorta was perused with saline solution (0.9%) to remove small blood clots from blood vessels. The heart was removed from the body and the relevant arteries were ligated. Then, the heart cavities were filled with cotton wool to maintain the shape. The coronary arteries were identified and dissected. In some specimens, to expose the arteries and their branches better, we introduced a plastic catheter into the arteries to inject red-colored neoprene latex. Next, we dissected the arterial branches as far as their macroscopically visible terminations. Morphometric study was performed using a metal wire extended along the artery and its branches. These lengths were then measured using a digital caliper. The reference point of the *Crux cordis* was used in this study and was defined as the location where the interatrial, subsinuosal interventricular (posterior interventricular) and coronary sulci crossed.

RESULTS AND DISCUSSION

Left Coronary Artery: This artery was originated from the bulbus aortae at the level of the free edge of left semilunar valvule and then located in the left coronary sulcus. The left coronary artery present in all the hearts was single (100%). Its length ranged from 0.3 to 0.9 cm, with a mean of 0.63 cm. It terminated by forming the

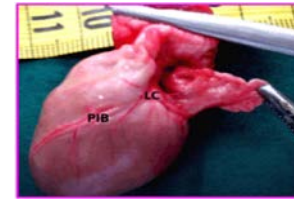


Fig. 1: Cat heart; auricular surface showing the paraconal interventricular branch (PIB) and the left coronary artery (LC).

paraconal interventricular and circumflex branches (81.5%) or the paraconal, circumflex and diagonal interventricular branches (18.5%) (Figure 1).

Previous investigations have shown that the left coronary artery in cat is large, usually single and it is arises from the left aortic sinus [8]. Observations in the present study support these findings. As reported by other authors [6,7,8,10], it was observed in the Iranian native cats that left coronary artery was very strong in comparison with right coronary artery.

Paraconal Interventricular Branch: The paraconal interventricular branch was located in the sulcus of the same name. It was present in all of the hearts and was single (94%) or double (6%). Its length ranged from 3.5 to 5.9 cm, with a mean of 4.7 cm. It issued 3-9 branches, with a mean of 5.7 branches, of which 47.9% went to the right ventricle and 52.1% to the left ventricle. This artery could terminate before reaching the apex of the heart (6.5%), at the apex (48.7%) or beyond the apex, continuing onwards to terminate at the subsinuosal interventricular sulcus (44.8%).

It was reported that left coronary artery in cat was divided into two branches; paraconal interventricular and circumflex [6-8,11]. Similarly, in the present study, it was observed that the vessel was divided into two above mentioned branches.

In the current investigation, the paraconal interventricular branch of the left coronary artery was usually terminated in the apex and or beyond the apex of heart which continuing onwards to terminate at the subsinuosal interventricular sulcus. Similar observations have been reported by previous anatomical studies on the dog [12], cat [8,9] and also Angora rabbit [10].

Circumflex Branch: The circumflex branch was located in the coronary sulcus. It was present in all of the hearts and was single (92 %) or double (8%). Its length ranged from 0.8 to 2.9 cm, with a mean of 1.9. This artery could

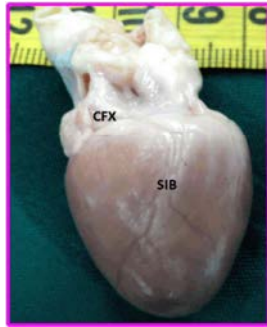


Fig. 2: Cat heart; atrial surface showing the subsinoosal interventricular branch (SIB) and circumflex branch (CFX) of the left coronary artery.

terminate before reaching the *Crux cordis* (7.3%), at the *Crux cordis* (51.6%) or beyond the *Crux cordis* (41.1%). Its left ventricular marginal branch was occasionally present (89.4%) and this could terminate before reaching the apex (55.9%) or at the apex (44.1%) (Figure 2).

Right Coronary Artery: This artery was located in the right coronary sulcus. It was present in all of the hearts and was single (100%). Its length ranged from 0.1 to 0.6 cm, with a mean of 0.38 cm. It issued 3-8 branches (mean of 4.7 branches) to the right ventricle and 0-3 branches (mean of 1.3 branches) to the right atrium. Its right marginal branch was present in 98.7% of the hearts.

In line with present observations, it was reported that the right coronary artery in cats and dogs is smaller than the corresponding left artery. Additionally, this vessel after arising from the right aortic sinus it passes to the right and ventro-cranially inside the coronary groove [8].

Subsinoosal Interventricular Branch: This branch was located in the sulcus of the same name. It was present in all of the hearts and was single (100%). Its length ranged from 0.3 to 4.8 cm, with a mean of 2.7 cm. It issued 1 to 5 branches (mean of 3.6 branches) and 88.1% of them were to the right ventricle and 11.9% to the left ventricle (Figure 2).

This artery could terminate before reaching the apex of the heart (79%) and or at the apex (21%) or beyond the apex of heart. Similar observations have been reported by previous researchers on the dog [12] and cat [8,9].

In conclusion, the anatomical descriptions of the coronary arteries of the Iranian native cats provide an important baseline for further cardiovascular researches. Furthermore, these results may also be useful tool that will aid the experimental cardiologic procedures, clinical practice and heart surgery on this specie.

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REFERENCES

1. Odar, I.V., 1986. Anatomi Ders Kitabı. İkinci Cilt (İc Organları, Hazim, Solunum, Urogenital, Sirkulasyon Sistemleri ve İc Salgı Bezleri). Hacettepe TAS Kitapçılık Ltd. Sti. Ankara, pp: 417-426.
2. Özel, O., A.C. Haligur, N. Dursun and E. Karakurum, 2004. The macroanatomy of coronary arteries in donkeys (*Equus asinus* L.). *Anatomia, Histologia, Embryologia*, 33(5): 278-283.
3. Maseri, A., R. Mimmo, S. Chierchia, C. Marchesi, A. Pesola and A. Labbate, 1975. Coronary artery spasm as a cause of acute myocardial ischaemia in man. *Chest*, 68: 625-633.
4. Sukmawan, R., T. Yada and E. Toyota, Y. Neishi, T. Kume, Y. Shinozaki, H. Mori, Y. Ogasawara, F. Kajiya, K. Yoshida, 2007. Edaravone preserves coronary microvascula endothelial function after ischemia/reperfusion on the beating canine heart *In vivo*. *Journal of Pharmacological Science*, 104: 341-348.
5. Del Rio, C.L., P.I. McConnell, M. Kukiela, R. Dzwonczyk, B.D. Clymer, M.B. Howie and G.E. Billman, 2008. Electronic remodeling following myocardial infarction in dogs susceptible and resistant to sudden cardiac death. *Journal of Applied Physiology*, 104: 286-293.
6. Brown, A.M., 1966. The depressor reflex arising from the main left coronary artery of the cat. *Journal of Physiology*, 184: 825-836.
7. Brown, A.M., 1968. Motor innervation of the coronary arteries of the cat. *Journal of Physiology*, 198(2): 311-28.

8. Ghoshal, N.G., 1975. Carnivore heart and arteries. In: Sisson and Grossman's the Anatomy of the Domestic Animals (Getty R. ed), 5th edn, vol. 2. Philadelphia and London: W.B. Saunders Company, pp: 1594-1651.
9. Aksoy, G., H. Karadag and Z. Ozudogru, 2003. Morphology of the Venous System of the Heart in the Van Cat. Anat. Histol. Embryol., 32: 129-133.
10. Bahar, S., V. Ozdemir, E. Eken and S. Tipirdamaz, 2007. The distribution of the coronary arteries in the Angora rabbit. Anatomia, Histologia, Embryologia, 36(5): 321-327.
11. Nur, I.H. and G. Aksoy, 2000. A macroanatomic and subgross investigation on the coronary arteries in the Van cat. J. Faculty Vet. Med., Univ. Yuzuncu Yil, 11: 83-92.
12. Oliveira, C.L., D. Dornelas, M. de Oliveira Carvalho, G. Cavallini Wafae, G.S. David, S. Araújo, N.C. da Silva, C.R. Ruiz and N. Wafae, 2010. Anatomical study on coronary arteries in dogs. European Journal of Anatomy, 14(1): 1-4.