

## **Specific Anatomical Aspects of the Aortic Opening (*Ostium Aortae*) and of the Left Cardiac Artery (*A. Coronaria Sinistra*) in Swine**

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**Abstract.** Our researches focused on high lightening the possible particularities existent at different subjects taken into study, regarding the aortic ventricular foramen, the semilunar valves and the original aperture of the left coronary artery. Also the possible trajectory and distribution variability of the left coronary artery was analyzed, taking into consideration the variations of this artery in human.

The left coronary artery were studied on fresh hearts, gathered from 11 subjects of different ages, sexes and sizes. The vascular and hollow lumen was washed repeatedly with water and then injected progressively with Palux substance colored for contrast with red pigment. The hearts injected were introduced for 48 hours in a formaldehyde 2% solution and afterwards the dissection under a magnifying glass was made.

In a single case the lack of the left arterial trunk was noticed, the paraconal artery and the left cardiac artery presenting a common foramen in the left aortic sinus. Regarding the existence of the left coronary artery, this was in a direct continuance with the paraconal artery and forming a right angle with the left cardiac circumflex artery. Through their distribution, the collaterals of the paraconal artery involve the right ventricular myocardium, as well as the left one in different proportions. The atrium collaterals of the left circumflex artery involve also the atrium-ventricular nodule.

The vascular foramen measurements and their trajectories are not related to the age and size of the subject. The sigmoid valves are reduced. In one case the lack of the left coronary arterial trunk was noticed.

**Key words:** pig, heart, coronary arteries.

### INTRODUCTION

Pig's heart could be used for conducting experiments on coronary arteries. As far as the coronary blood supply is concerned the heart of the pig was similar to that of man with small differences (Daisy Sahni et al., 2008).

The observations and researches made on the heart by different researchers had as main objective the anatomical particularities of the myocardium sanguine irrigation. No doubt these observations were and are correlated with the physiological and pathological aspects of this vital organ. Regarding the comparative anatomy it remains deficient in comparison with the high level of observations made on human hearts. So in this respect, the bibliographic data are illuminating taking into consideration the multiple origin variations of the coronary arteries (Edward-Luisada-Hollishead-Klein, quoted by Pop D. Popa, 1982), and then the observations concerning the representation of the percentage of different origin' versions of the cardiac vessels (Wernawsky quoted by Agnoletti et al., 2005), anatomical particularities of the cardiac vessels in human (Pop D. Popa, 1982).

## MATERIAL AND METHOD

Our observations and researches were made on a number of 11 hearts freshly collected from subjects of different ages, sexes and sizes, clinically healthy, being sacrificed for economic purposes, through exsanguinations. In order to protect the cardiac vessels, the hearts were gathered by sectioning the basilar vessels and extracted together with the parietal fibro-serous satchel of the pericardia. By opening of the aortic bulb, with the help of a cannul introduced in the arterial and hollow vascular lumen, by washing with water and easy compressions, the blood rest and possible intravascular blood clot were removed. The vascular trunk of the left coronary was injected progressively with the Palux substance colored for contrast with red pigment. For fixation, the hearts injected were introduced for 48 hours in a formaldehyde 2% solution. The observations began with the ventricular foramen of the aorta, the Löwer ring, the semilunar valve and the origin foramen of the cardiac artery. The dissection of the left cardiac artery was made by free eye observations and under the IOR x3 magnifying glass, after which the photos and anatomic sketches were taken. We mention the fact that in this present paper the particular aspects of the formation studied are briefly presented and we consider them as being relevant for this field of study.

## RESULTS AND DISCUSSIONS

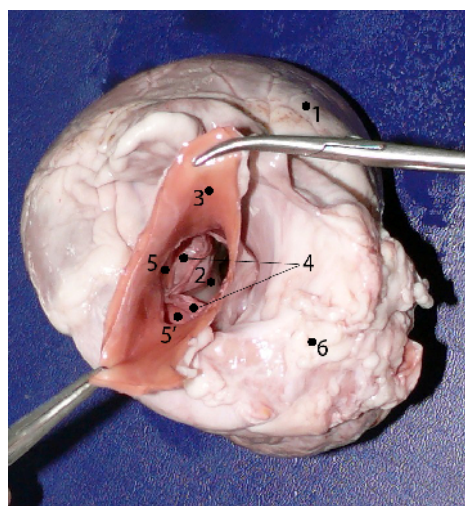


Fig. 1. The heart base at pig, with the left ventricle foramen originate of the aorta artery  
 1. Left ventricle; 2. Left ventricle cavity; 3. Open aortic bulb; 4. The sigmoid valves (s. semilunar); 5-5'. The aortic sinus (Valsalva); 6. The fat deposit from the heart base.

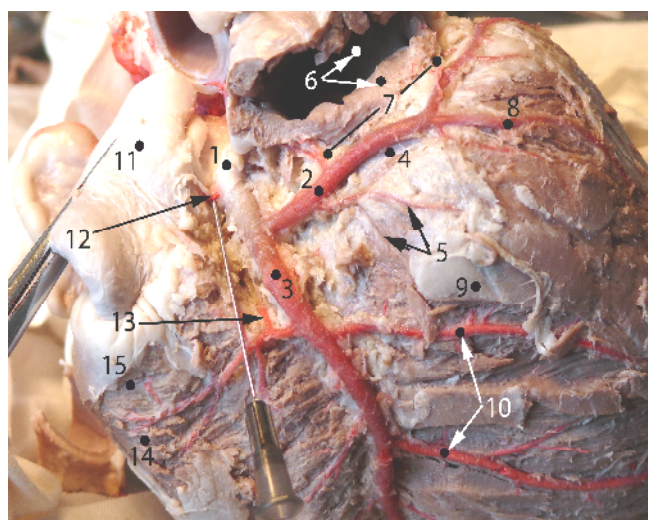


Fig. 2. The left coronary artery, terminals and their distribution aspect at the base of the heart

1. The left coronary artery; 2. The left circumflex coronary artery; 3. The paraconal artery; 4. The left atrium ventricle channel; 5. Atria collateral branches of the circumflex artery. 6. The left atrium (sectioned); 7. The collateral atria branches of the circumflex artery; 8. The origin of the intermediate collateral artery; 9. The left ventricle; 10. The diagonal ventricle branches of the paraconal artery; 11. The pulmonary arterial trunk; 12. The collateral branch of the left coronary artery for the pulmonary arterial base trunk; 13. The collateral branch of the paraconal artery for the pulmonary arterial trunk; 14. Right ventricular branches collateral artery paraconale 15. Right ventricle.

From the beginning we mention that our observations revealed the fact that some measures of the anatomic formation studied are not related to the age and size of the subjects from which the hearts were collected, aspects that we attribute to individual particularities taking into account the fact that these observations were made on corpses and preserved organs.

The aortic ventricular foramen (Fig. 1) is well high lightened having a diameter of 1,5-1,8 cm, and the fibro Löwer ring is nicely represented without any calcifying nucleus, even at old animals. The semilunar aortic cusps are reduced and extremely thin. These bodies cover partially the aortic bulb sinus (Valsalva), respectively the origin foramen of the coronary arteries (Fig. 1, no. 4).

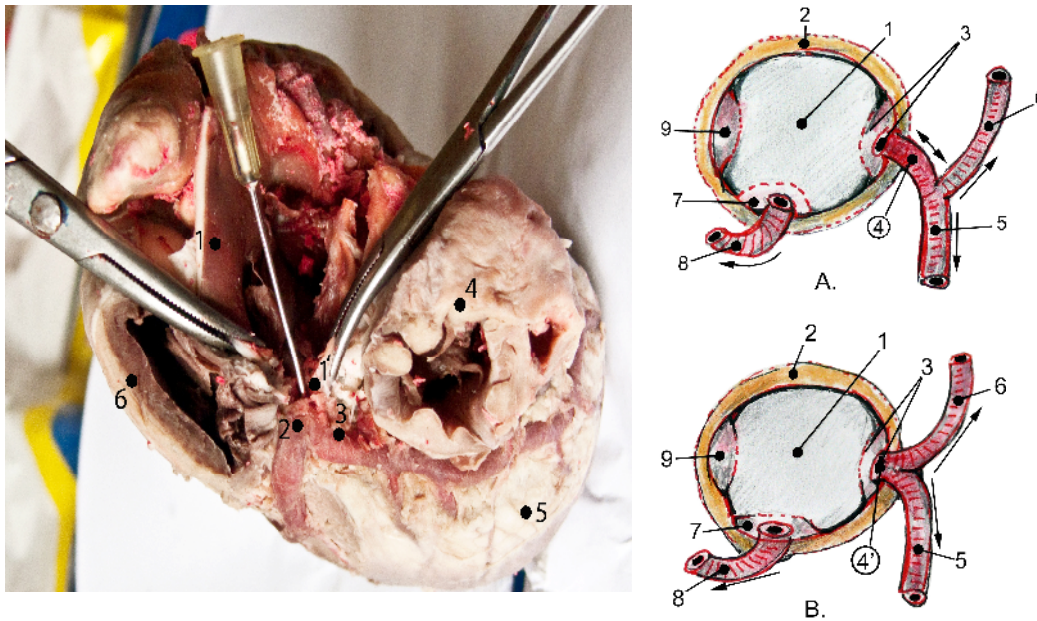


Fig. 3. Origin versions of the left coronary arteries (sketches A-B)

1. Aortic bulb (open); 1'. The left aortic sinus and common foramen of the paraconal artery and left circumflex artery; 2. The paraconal artery; 3. The left circumflex artery; 4. The left atrium (sectioned); 5. The left ventricle; 6. The base of the pulmonary arterial trunk.

Sketches A and B

1. Aortic foramen; 2. The aorta walls; 3. The left aortic sinus; 4. The common foramen of the left coronary artery; 5. The paraconal artery; 6. The left circumflex artery; 7. The anterior aortic sinus; 8. The left coronary artery; 9. The right aortic sinus.

Taking into consideration the anatomical topographic position of the heart in domestic animals, compared to humans, the aortic bulb sinus are situated prior, precedent left and medial right (Fig. 1, no. 5, 5'). According to the common rule, the origin foramen of these two cardiac arteries at all the subjects was found to be normal. In this respect, the left cardiac artery has an origin foramen in the left sinus and the right cardiac artery in the previous sinus. The left cardiac foramen diameter is of 3-3,5 mm.

The trajectory of the left cardiac artery is of approximately 2-2,5-3 cm covered by an abundant fat tissue situated between the base of the pulmonary arterial trunk and the left atrium (Fig. 2, no. 1, 2, 3). Taking in consideration the direct continuance aspect of the paraconal artery and the detachment angle of the circumflex coronary there can be made some appreciations concerning the blood's speed flow, as well as the physiologic and pathologic aspects regarding these cardiac vessels.

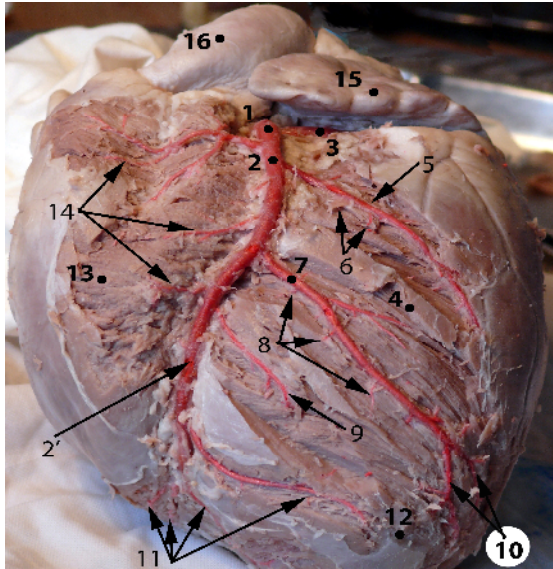


Fig. 4. Ventricular collateral of the paraconal artery  
 1. The left coronary artery; 2-2'. The paraconal artery; 3. The left circumflex artery; 4. The left ventricle myocardium; 5. The first left diagonal collateral 6. The profund collateral branches of artery no.5; 7. The large diagonal collateral branch; 8. The profund collaterals of the large diagonal artery; 9. The secondary collateral diagonal branch; 10. The terminal distribution branches of the large diagonal artery; 11. The apical terminal branches of the paraconal artery; 12. The cardiac apex; 13. The right ventricle; 14. The right ventricle collateral branches; 15. The left atrium; 16. The pulmonary arterial trunk.

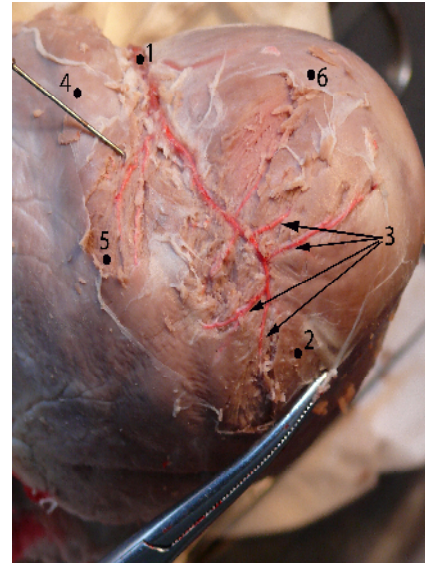


Fig. 5. The terminal ramification of the paraconal artery  
 1. The paraconal artery; 2. The cardiac apex area; 3. The apical distribution terminal branches of the paraconal artery; 4. The right ventricle; 5. The collateral branches for the myocardium apex of the right ventricle; 6. The left ventricle.

A particular aspect, described in humans and found by us in the consulted bibliography regarding the cardiac arteries at animals, especially in our researches at pig we found that arterial trunk of the left artery is missing. In this situation, the left aortic sinus does not present a personal foramen of the left cardiac artery, but a common large foramen with the paraconal artery and left circumflex coronary (Fig. 3, no. 1', 2, 3 and sketches A-B).

The paraconal artery or the left inter ventricular artery (Fig. 4, no. 2, 2') traverses descendent the homologous ditch being accompanied by the large cardiac vein. It is noticeable the fact that the fat subepicardic tissue that covers the vessel is very adherent to its walls (Fig. 4). The collateral of the arteries were destined to the irrigation of the right ventricular myocardium, as well as the left one. Another remark is the fact that in a majority, the left ventricular collaterals have emerging straight angles, and along their trajectories some of them are ascendant towards the base of this ventricle (Fig. 4, no. 14). Despite the left ventricle collaterals, the ones destined to the left ventricle describe the emergence in sharp angles oriented towards the cardiac apex from which their name is derived, diagonal arteries (Fig. 4, no. 5, 7, 9). From the medial surface of the paraconal artery and its collaterals numerous septal and parietal arteriole are detached, which in their turn are distributed in the admirable myocardium and subendocardium network (Fig. 4, no. 6, 8 and Fig. 8). By its caliber, all the hearts examined by us, the large diagonal artery can be considered as a paraconal terminal, arriving to be distributed in the cardiac apex area (Fig. 4, no. 7, 10). The

paraconal artery ends in two branches in the cardiac apex area, one of them having an ascendant trajectory towards the medial interventricular groove (Fig. 5, no. 3).

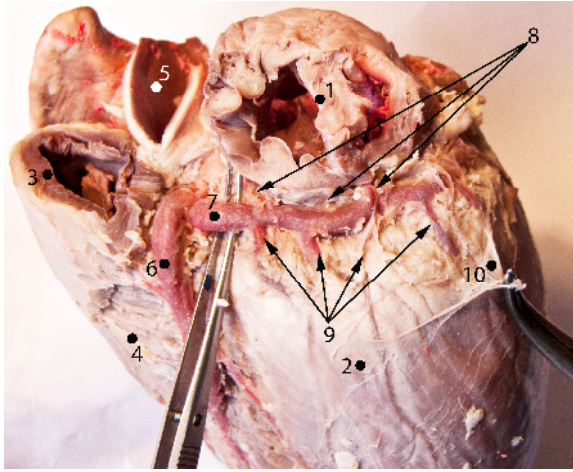


Fig. 6. The left circumflex cardiac artery  
1. The left artery – opened; 2. The left ventricle; 3. The sectioned right atrium; 4. The right ventricle; 5. The pulmonary arterial trunk; 6. The paraconal artery; 7. The left cardiac circumflex artery; 8. The left atria collaterals; 9. The left ventricle collaterals; 10. The serous visceral pericardia.

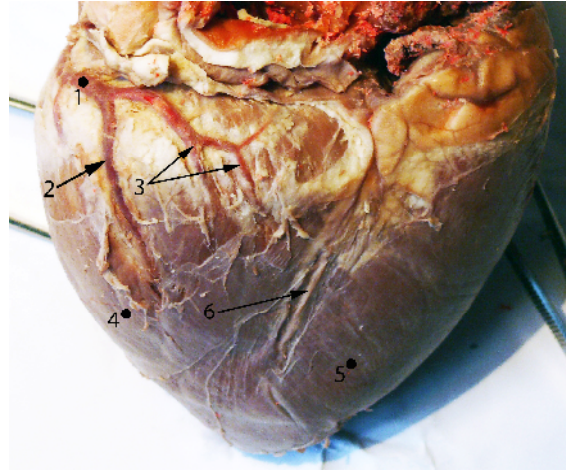


Fig. 7. The terminals of the left cardiac circumflex artery  
1. The left cardiac circumflex artery; 2. The intermediate branch; 3. The terminal branches of the left cardiac circumflex artery; 4. The left ventricle; 5. The right ventricle; 6. The right interventricular groove (s. subsinuosal) groove.

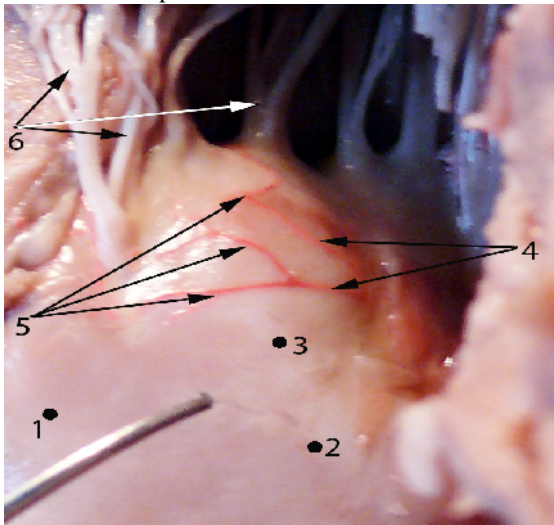


Fig. 8. Detail of left ventricular arterioles  
1. Left ventricular cavity; 2. The endocardium; 3. The papillary muscle; 4. Arteriola subendocardica; 5. The arteriolar branches; 6. Chordae tendineae.

opposite to the paraconal artery these ones have short trajectories penetrable in the base of the left myocardium ventricle (Fig. 6, no. 9).

In the terminal segment, the circumflex artery emits intermediate collateral very well developed, so as in the end the circumflex artery to be spread in a number of branches that do not reach the medial interventricular groove (Fig. 7).

The left cardiac circumflex in our study is either terminal to the left cardiac artery, either has an origin directly from the left aortic sinus, the vessel being well represented also by its caliber, as well as by its numerous collateral branches (Fig. 6).

The vessel's trajectory in the coronary groove, covered by the left auricular sinus and left atrium as well as a fat deposit tissue characteristic for this specie, gives this artery an anatomical topographic settlement and also a particular function. The artery emerges numerous arterial arteries as well as important collateral ventricle branches. We noticed the fact that the collateral ventricle branches are very well developed and

## CONCLUSIONS

- The aortic foramen is well shaped by the Löwer ring having a diameter of 1,5-1,8 cm.
- The semilunar valves are extremely thin and cover partially the cardiac arteries foramen.
- In all the cases, the origin of the left cardiac artery was found in the left aortic sinus.
- In one case the lack of the left cardiac artery, in the left aortic sinus had a common foramen of the paraconal artery and the left circumflex artery, without a left cardiac arterial (coronary) trunk.
- The well-developed diagonal collateral can be considered one of the paraconal terminals.
- The emergence angles of the ventricle collateral and left paraconal artery are noticeable.
- Between the ages and sizes of the subjects and their anatomical particularities of the left coronary artery there is no significant correspondence.

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