Anatomical Contributions Regarding Aortic Opening (Aortic Orifice) and the Right Coronary Artery in Swine

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Abstract. The study has been done on seven fresh state hearts of adult healthy pigs that had been slaughtered by exsanguinations. Anatomical observations had been effectuated in the aim of describing the particularities of the cardiac orifices configuration and cardiac vascular system in swine. For this purpose we emphasize the peculiarities of the aortic opening and the right coronary artery origin, trajectory and branches in this species.

Keywords: heart, aortic opening, right coronary artery, pig.

INTRODUCTION

In the context of general description of heart anatomical configuration peculiarities as well as arterial cardiac system in domestic mammals, we consider the different anatomical topographic position of the heart in these species compared to humans. The specific conformation of the thoracic cavity in animals, with a deep dorsal - ventral diameter and being easily flattened lateral-laterally, had ontogenetically determinate the heart to suffer a rotation of the longitudinal axis. In this way the sternal face of the heart in humans becomes the left lateral costal face (Facies paraconalis) in animals and the posterior face is named the medial mediastinal face (Facies subsinusalis).

MATERIALS AND METHODS

The study was conducted in the Department of Anatomy, Faculty of Veterinary Medicine Cluj Napoca. Our observations have been effectuated on a number of seven fresh state hearts coming from adult healthy pigs of common breed. The pigs were slaughtered by exsanguinations. In order to distinguish the cardiac aortic bulb, specific anatomical incisions were made, followed by longitudinal sections through which sinuses of Valsalva and the origin orifices of coronary arteries were put in evidence. For the identification of the right coronary artery, we injected the lumen of the vessel with a plastic material colored with an organic dye. The heart was fixed for 24 hours in 2% formaldehyde. The macroscopic dissection of the trajectory and the branches of right coronary artery was completed with observations under the magnifying glass. For the documentary purposes, enlightening photos have been realized.
RESULTS AND DISCUSSIONS

The aortic orifice is situated in an infundibulum at the base of the left ventricle, between the atrial concentric facets. The fibrous Lower ring is thick. The sigmoid valves are thin and very developed, covering the origin orifices of the coronary arteries (Fig.2). Results from here showed that the cardiac arterial system is filled with blood during the ventricular diastole.

The sinuses of Valsalva are deep (Fig.3, no. 3) and in all the subjects of our study, the orifices of the coronary arteries are disposed following the next pattern. In the left sinus the opening of the left coronary artery is situated, in the anterior sinus is the opening of the right coronary artery. These two sinuses are the coronary cusp. The right sinus is the noncoronary cusp, with no orifice.

Noteworthy is that the openings of the coronary arteries are very large with a diameter between 5-6 mm, and they have an elliptical shape with the great axis disposed transversally (Fig.3, no. 6).

The right coronary artery in swine compared to the other species, is more developed reaching a caliber of 3-4 mm. The trajectory is flexuous and is situated deep in the homonym coronary groove, being covered by the auricular appendix of the right atrium. Throughout the distance, the artery is surrounded by a rich subendocardial adipose tissue that intimately adheres to the wall of the vessel (Fig.4 and 6).

In the initial part of the trajectory, the right coronary artery gives off a branch that is orientated to the base of the arterial pulmonary trunk (Fig.4, no 2-3). The right ventricular branches are flexuous situated superficially, subendocardial, and directed deep toward the base of the right ventricular wall (Fig.6, no. 4-5).

The right coronary artery has two dorsal branches out of which the first one runs in the subatrial space and reaches the sinoatrial node (Fig.7, no.2). The second collateral extends on the ventral face of the right atrium and supplies through numerous branches the walls of the atrium (Fig.7, no.3, 4).

The terminal part of the right coronary artery is flexuous having an “S” – shape like, and continues downwards with the right interventricular artery (the real terminal branch) and with a secondary branch—the right circumflex artery (Fig.8).

The right interventricular artery passes downwards on the homonym groove towards the apex of the heart, belonging to the left ventricle, where it presents a rich apical arterial arborization (Fig.10). Histological studies of this area do not exclude interarteriolar anastomosis. More ventricular branches arose from the right ventricular artery, and they supply both the right and the left ventricle (Fig.9).

The right circumflex artery, the second terminal branch of the right coronary artery, is reduced. It extends retrograde in the left coronary groove, being covered by the auricular appendix of the left atrium (Fig. 8, no.4 and Fig. 9, no.3), where it encounters the left circumflex artery.

The deep ventricular collateral branches of the right coronary artery supplies with blood the myocardium, reaching the endocardium and implicit the papillary muscles of the right atrioventricular orifice (Fig.11).
Fig. 1. The heart – facies paraconalis
1. Right atrium;
2. Left atrium;
3. Right ventricle;
4. Left ventricle,
5. Paraconal interventricular groove.

Fig. 2. The sigmoid valves
1. The cavity of left ventricle;
2. The anterior valve;
3a and 3b - The right valve (sectioned);
4. The anterior valve;
5. The aortic bulb (opened) – the origin of the right coronary artery.
Fig. 3. The left and anterior sinuses of Valsalva
1. The left ventricular cavity;
2. The aortic wall (longitudinal section);
3. Sinuses of Valsalva – a. left, b. anterior;
4. The sigmoid valves of the aorta: a. left, b. anterior;
5 a, b: the right valve (sectioned);
6. The origin of the right coronary artery.

Fig. 4. The initial part of the right coronary artery
1. Right coronary artery;
2. Pulmonary arterial trunk;
3. Branches for the pulmonary trunk;
4. Adipose tissue;
5. Right atrium (elevated).

Fig. 5.
1. The orifice of the right coronary artery;
2. The orifice of the left coronary artery.
3. Aortic wall.
Fig. 6.  
1. The trajectory of the right coronary artery;  
2. The right coronary groove;  
3. Right ventricle;  
4. The superficial ventricular branches;  
5. The deep ventricular branches;  
6. The serous epicardium-visceral layer.

Fig.7. The collateral branches of the right coronary artery  
1. Right coronary artery;  
2. Subatrial branch;  
3. Right atrial branch – ascending;  
4. The ventral face of the right atrium;  
5. Ventricular branches.
Fig. 8.

Fig. 9. The terminal arborization of the right coronary artery
1. Right coronary artery;
2. The right interventricular branch (subsinuosalis artery);
3. The right circumflex artery;
4. The right ventricle;
5. The left ventricle;
6. The right ventricular collateral branch;
7. The left ventricular branches;
8. Left atrium.
CONCLUSIONS

1. The aortic opening presents a strong Lower ring, fitted with thin and tall sigmoid valves, that covers with their superior border the orifices of the coronary arteries.
2. The opening of the right coronary artery is situated in anterior sinus of Valsalva from the aortic bulb.
3. Compared to the other species, in swine the right coronary artery is very well developed and emits numerous branches: ventricular, sinoatrial, branches for the right atrium, the cardiac venous sinus and the pulmonary trunk.
4. The coronary groove is covered with an abundant subepicardial adipose layer that intimately adheres to the arterial walls.
5. The right coronary artery has a flexuous trajectory.
6. The main terminal branch of the right coronary artery is the right interventricular artery that through its branches supplies the right ventricle and partially the left ventricle. It ends branched at the cardiac apex.
7. The deep subendocardial branches strongly irrigate the papillary muscles.

BIBLIOGRAPHY