The Coronary Arteries of A Model Porcine Animal

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Abstract: The animal models are used in basic biomedical research to explain various phenomena of both basic science and other clinical and surgical disciplines, within these bio models, porcine, has been classically used for the study of cardiovascular entities both central and peripheral, from this, the use of heart valves for exoingests and the conceptual and cardio physiological bases of interventions and hemodynamics techniques that today “save so many lives” are derived; It has also been used in studies of arrhythmia derived from occlusive coronary disease and in the management of cardiac trauma; however the basic research on the subject has not been completed, opening new horizons as new therapeutic and surgical management are developed Day by day, the present work aims to characterize the arterial vascular ire of the porcine animal model Pig Breed from the implementation of the Corrosion injection technique. It was found that this animal model meets the criteria described by the International Committee on Veterinary Gross Anatomical Nomenclature.

Keywords: Anatomical Nomenclature.

1. Introduction

Animal models are used in basic biomedical investigation in order to explain many diverse phenomena within basic science while also in other clinical and surgical areas. Within these bio models, the porcine has been classically used in the study of cardiovascular entities, both central and peripheral. This produces the use of heart valves for exo grafts and the conceptual and cardio physiological bases of hemodynamics techniques and interventions that today “save so many lives”. It has also been used in studies involving arrhythmia deriving from occlusive coronary disease and in cardiac trauma management; however, the basic research on the subject has not been completed, opening new horizons as new therapeutic and surgical management are developed day by day1, 2, 3.

From the vascular point of view, the coronary arteries are blood vessels that transport oxygenated blood and are in charge of providing irrigation to the myocardium from the cardiac cavities; they originate in the ascending aorta in the right aortic sinuses (RAS) and left aortic sinuses (LAS) 4, 5. Studies conducted in the United States and Japan in porcine animals reported that the anatomic description of the right coronary artery (RCA) differs from that of the left coronary artery (LCA) in its longitude, the right is longer than the left as the right coronary artery after turning from the coronary sulcus to the cardiac cross it itself becomes to become inter ventricular subsinusal (IVSS), while the left coronary artery, after a journey of a few millimeters bifurcates, or, divides into the paracoral inter ventricular (IVPC) and the circumflex (ACx) 6, 7, 8. The nomenclature of the coronary arteries differs slightly in human medicine and veterinary medicine; for human medicine the reference of nomenclature is Federative Committee on Anatomical Terminology. The reference for veterinary medicine is International Committee on Veterinary Gross Anatomical Nomenclature. The correspondence of the following terms should be taken into account based on these references. (Table 1)

<table>
<thead>
<tr>
<th>Federative Committee on Anatomical Terminology</th>
<th>International Committee on Veterinary Gross Anatomical Nomenclature</th>
<th>Description</th>
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<tbody>
<tr>
<td>Left Coronary Artery</td>
<td>Left Coronary Artery (LCA)</td>
<td>Left Aortic Sinus Blood Vessel</td>
</tr>
<tr>
<td>Right Coronary Artery</td>
<td>Right Coronary Artery or Right Circumflex Artery (RCA)</td>
<td>Right Aortic Sinus Blood Vessel</td>
</tr>
<tr>
<td>Interventricular Artery or Anterior Descending</td>
<td>Inter Ventricular Paracoral Artery (PIA)</td>
<td>Left Coronary Blood Vessel</td>
</tr>
<tr>
<td>Interventricular Artery or Descending Posterior</td>
<td>Subsinusal Interventricular Artery (SIA)</td>
<td>Blood Vessel Originating From Either Coronary Artery</td>
</tr>
<tr>
<td>CircumflexArtery</td>
<td>CircumflexArtery or Left Circumflex Artery (Accx)</td>
<td>Left Coronary Artery Blood Vessel</td>
</tr>
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According to the nomenclature previously mentioned in Table 1; the RCA, SIA, PIA, and ACx angiogenically produce branches which extend and introduce the myocardium of the ventricles because of the greater thickness that they have in comparison to the Atria. In this way, the anterior face of the left ventricle is irrigated by...
diagonal branches (DB) of the (PIA). The lateral faces of the left and right ventricles are irrigated by right marginal branches (RMB) pertaining to the RCA and the left marginal branches (LMB) corresponding to the ACx respectively; the inferior side of the left ventricle by lateral posterior branches (LPB) can be described in a variant way by the intermedius ramus (IR), when the left coronary artery (LCA) divides and locates itself in the PIA and ACx, becoming a primary diagonal branch (DB)\(^1\). In anthropogenic terms, the model of human coronary dominance has been based upon the findings of various authors\(^1,2,13\), recognizing the work of Dr. Schlesinger\(^14\) who established the reference towards right coronary dominancy when the RCA, after originating the posterior inter ventricular portion (inter ventricular subsinusal portion in animals) it extends to below the coronary sinus and produces the lateral posterior branches (LBP) and finalizes as the posterior inter ventricular portion; the concept of co dominance or balanced circulation is applied when the lateral posterior branches originate from the ACx and the RCA and finishes as a posterior inter ventricular portion\(^13,14\). The purpose of the present study is to value the anatomical characteristics such as origin, ramification, caliber and dominance of the coronary porcine arteries and to them compare them to those of human coronary arteries in order to determine their similarities, and in this manner conclude if the most common pig heart is a valid model that can be extrapolated for dissection and anatomic study in human medical programs.

2. Materials and Methods

A descriptive study was conducted where an injection corrosion technique was applied with the purpose of verifying coronary dominance and the cardiac vascularity distribution pattern, using 30 specimens of porcine hearts of the PIG breed destined for sacrifice, provided by the company FrigoTimaná, Tuluá, Cauca Valley.

Management and Conservation and the Specimen

The hearts were initially washed with a commercial chemical substance meant for corpse preservation composed of formaldehyde and aldehyde ketones with the purpose of eliminating blood waste and clots of atrial and ventricular cavities and large blood vessels. The next step was the dissection of the pulmonary artery and aorta. They were sectioned transversally on top of the root at semilunar valve depth. The right and left coronary sinuses were identified and the right and left coronary arteries were cannalized, using a number #6 Nelaton probe, through which a self-curing acrylic solution along with its respective dissolvent was manually injected while being mixed with red paint within a 1- minute interval and the plunger of a 20ml needle in order to observe repletion and coloration in the lumen of the RCA, right margins, PIA, LCA, RD, ACx, left margins, lateral posterior branches, and RI if it is present.

The points of origin of the RCA, LCA, SIA and posterior lateral branches were classified as normal and varying; the amount RD, RMI and LPB were quantified. Coronary dominancy was determined according to Schlesinger standards\(^13\). Measures of central tendency and dispersion were also calculated to determine the points of origin of the RCA, LCA, PIA, and ACx.

3. Results

In accordance to the 100% of the sample used, the arteries demonstrated a normal anatomical origin, meaning the RCA found in the ostium in the right aortic cavity. The LCA found in the ostium from the left aortic cavity, the PIA and ACx of the LCA. The RI was found in 12% of hearts (Figures A and B). The average vascular diameter was greater in the LCA with 6.0mm and the smallest was the ACx with 5.02 mm.

The average longitude of the LCA was 9.14mm, with a range of 5.16 and 13.25, a standard deviation of 2.98 and a variance of 9.14mm. It was observed that many secondary ramifications followed from the RCA and LCA, generating a very dense vascular pattern inside the myocardium, a positive aspect which generates good collateral irrigation and myocardial micro circulation.
Restrictions of legal character using descriptive studies and hearts age become complicated and difficult because of recently, in Colombia direct studies by human cadaver coronary angiographs cardio resonance, angiotomography like direct dissection and a diagnostic imaging methods like been widely conducted in humans using diverse techniques Descriptive anatomical studies coronary arteries in pigs are similar to those anatomical pattern of origin, distribution and ramification of scarce nevertheless, those that do exist conclude that the identical. Reports about porc morphological expression as a cardiac level is nearly anatomy reference in comparison to humans because it's medical experimentation and surgery. It also serves as an anatomy reference in comparison to humans because it's morphological expression as a cardiac level is nearly identical. Reports about porcine coronary circulation is scarce nevertheless, those that do exist conclude that the anatomical pattern of origin, distribution and ramification of coronary arteries in pigs are similar to those of humans. Descriptive anatomical studies of coronary arteries have been widely conducted in humans using diverse techniques like direct dissection and a diagnostic imaging methods like cardio resonance, angiotomography with multi-detectors and coronary angiographs Recently, in Colombia direct studies by human cadaver hearts age become complicated and difficult because of restrictions of legal character using descriptive studies and case reports based on imaging studies which are part of the users clinical history. Many experimental bio models like the laboratory rat, the albino rat and the guinea pig among others used in bio medical investigation have demonstrated analogies with those conducted in humans. The pig as an experimental bio model has been used for a little less than two decades, in laparoscopic surgery simulation, endoscopic simulation and traumatology, it has also been used in cardiac transplant with genetic bio model modification in other mammals like the baboon because of its dimensions and morphological characteristics which are very similar.

4. Discussion

In the past years, the pig has been used as a model for bio medical experimentation and surgery. It also serves as an anatomy reference in comparison to humans because it’s morphological expression as a cardiac level is nearly identical. Reports about porcine coronary circulation is scarce nevertheless, those that do exist conclude that the anatomical pattern of origin, distribution and ramification of coronary arteries in pigs are similar to those of humans. Descriptive anatomical studies of coronary arteries have been widely conducted in humans using diverse techniques like direct dissection and a diagnostic imaging methods like cardio resonance, angiotomography with multi-detectors and coronary angiographs. Recently, in Colombia direct studies by human cadaver hearts age become complicated and difficult because of restrictions of legal character using descriptive studies and case reports based on imaging studies which are part of the users clinical history. Many experimental bio models like the laboratory rat, the albino rat and the guinea pig among others used in bio medical investigation have demonstrated analogies with those conducted in humans. The pig as an experimental bio model has been used for a little less than two decades, in laparoscopic surgery simulation, endoscopic simulation and traumatology, it has also been used in cardiac transplant with genetic bio model modification in other mammals like the baboon because of its dimensions and morphological characteristics which are very similar.

5. Conclusions

The porcine coronary arteries like human arteries are very similar in relation to the anatomical origin, ramification pattern, and dimensions and dominance. This contributes to the pig being a highly compatible experimentation animal with human coronary morphology. The pigs most common coronary dominancy system is right followed by the left and a balanced circulation or co dominancy, which are also the conclusions drawn by reports of descriptive studies conducted in human coronary arteries. When the ramus intermedius is found, it resembles the first left marginal branch and not like the first diagonal branch which is how it usually been expressed in anatomy texts and in the findings of descriptive studies.
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