Acta Scientiae Veterinariae, 2022. 50: 1885.

RESEARCH ARTICLE
Pub. 1885

ISSN 1679-9216

Cardiovascular System of Agouti (*Dasyprocta prymnolopha*)

Maria Michele Araújo de Sousa Cavalcante[1], Clarisse Maria Barbosa Fonseca[2], Andrezza Braga Soares Silva[1], Tarsia Giabardo Silva Mendonça[2], Sérgio Paulo Lima Guerra[3], Felipe José Costa Viana[4], Eunice Anita Moura Fortes[3], Maria Acelina Martins Carvalho[5] & Aírton Mendes Conde Junior[3]

ABSTRACT

***Background*:** The species *Dasyprocta prymnolopha* is a wild rodent with a geographic distribution that extends from Mexico to South America, including Brazil. Agouti has been the subject of morphophysiological research, but data on the cardiovascular system remains limited. Therefore, the objective was to describe the macroscopic and microscopic morphology, including the study of the cardiac and coronary system syntopy of the species *D. prymnolopha*.

***Materials, Methods & Results*:** Twelve *Dasyprocta primnolopha* adults were used, 6 males and 6 females. Topographic analysis of the heart was evaluated *in situ*, with subsequent measurement, anatomovascular description and macroscopic study of cardiac and coronary vascularization. A microscopic investigation and identification of structural cardiac aspects were also carried out in adult agoutis, the biological samples of the heart were submitted to histological techniques and stained with Hematoxylin and Eosin and Masson's Trichrome. The heart is located between the end of the 2nd and the beginning of the 5th intercostal space, with the apex reaching the 6th space. It presents the presence of 2 ligaments: phrenopericardium and sternopericardium. The right atrioventricular valve is composed of 2 cusps, the parietal and the septal, with variations within the same species for 3 cusps. Projections that interconnect the papillary muscles with each other were observed. In the left ventricle there are variations in the number of papillary muscles (range 2 to 4). In the region of the aortic valve, 5 ostia were observed in the left aortic sinus in all animals. The coronary circulation has a predominantly left distribution. Histologically, the heart consists of 3 main layers: endocardium, myocardium, and epicardium. The cusp valves of the atrioventricular openings are composed of endocardial folds that contain a central plate of dense connective tissue, and inserted in this cardiac musculature was observed the cardiac skeleton, with its fibrous ring consisting of collagen and elastic fibers that surrounds the atrioventricular opening.

***Discussion*:** Cardiac assessment in wild animals is challenging, as in-depth knowledge of the morphology of the cardiovascular system is required for the use of diagnostic tools. In this first anatomical study of the heart, this organ presents syntopy with those of other rodents, but the topography may vary in individuals of the same species, which may be related to the accentuated vertebral curve. The phrenopericardial and sternopericardial ligaments were observed in this research, although there are no reports in other species of *Dasyprocta* sp. The arrangement of the arteries has, as a particularity, the larger left atrium in relation to the heart/atrium size ratio when compared to other domestic species, covering the left coronary sinus until it reaches the left atrial surface. In the agouti, it was observed that the vascularization is left, with the left coronary artery giving rise to both the paraconal and subsinuous interventricular branch, a fact found in animals such as ruminants, dogs. In the histological observations of the present study, the heart was similar to that of other mammals. Our data reveal morphological characteristics similar to those of other mammals, but with very expressive characteristics that differ even within the species. It is important to generate new information to elucidate cardiac and coronary diagnostic analyses, which can be extended to different species.

Keywords: agouti, wild rodent, coronary arteries, cardiac, heart, histology, morphology.

DOI: 10.22456/1679-9216.122366

Received: 20 February 2022 | Accepted: 16 July 2022 | Published: 17 August 2022

[1]Doctoral Program in Animal Science (DPAS); [2]Doctoral Program in Technologies Applied to Animals of Regional Interest (PPGTAIR); [3]Department of Morphology (DMOR) & [4]Coordination of the Veterinary Medicine Course (CVMC), Federal University of Piauí (UFPI), Bom Jesus, PI, Brazil. [5]Department of Veterinary Morphophysiology (DVM) - UFPI, Teresina, PI. CORRESPONDENCE: C.M.B. Fonseca [clarissembfonseca@gmail.com]. PPGTAIR-UFPI. Campus Ministro Petronio Portella. CEP 64049-550 Teresina, PI, Brazil.

INTRODUCTION

The species *Dasyprocta prymnolopha* (Wagler, 1831) has been the subject of morphophysiological research, such as the study of blood cells [9], dental morphology [5], arterial supply of the penis and kidney [6,7]; which demonstrates the recent change in the focus on the use of agouti as an experimental animal, from management and reproduction studies to morphophysiological studies.

Studies on the cardiovascular system in wild animals are limited to the heart and some large vessels, with information available mostly to laboratory rodents, which have the distinct anatomy and physiology of domestic animals, with few reports of wild species [12,13,21]. With regard to the species agouti, only one study was carried out to determine the cardiac physiological aspects in clinically normal agoutis [32]. It is known that in addition to the anatomy and physiology of the heart, detailed knowledge of coronary artery branches is essential in the investigation and treatment of heart disease [35], since small wild mammals commonly have cardiovascular problems, however, clinical reports of diagnosis and treatment of these diseases are rare [21].

The opportunity for research carried out by the presence of these animals in a breeding ground allows the collection of valuable data for zoological medicine, since the literature is still incomplete on the biology and physiology of agouti [29]. In this sense, the present study seeks to define the morphology of the cardiac and coronary system the *Dasyprocta prymnolopha*.

MATERIALS AND METHODS

Animals

Twelve agoutis (*Dasyprocta prymnolopha*) from the Center for the Study and Preservation of Wild Animals - NEPAS (Certificate of Registration IBAMA / PI No. 02 / 08-618) of the Federal University of Piauí (UFPI) were used. The animals were divided into 2 groups, with 6 males and 6 adult females, received water *ad libitum* and appropriate feeding. All animals were wormed and submitted to anesthetic protocol [31].

After confirming the anesthetic plan, the animals were euthanized with an overdose of Thiopental Sodium®[1] intravenously until death was confirmed by cardiorespiratory arrest [8].

Cardiac measurement and surveying

Through the dissection, the topography of the heart was evaluated *in situ*, with posterior measurement and anatomovascular description, and all intercostal muscles were removed, leaving only the costal grid as reference for the cardiac positioning in the animal. All nomenclature adopted was based on Veterinary Anatomical Nomenclature [32].

Coronary classification

The same animals used for cardiac measurements were selected for macroscopic study of cardiac and coronary vascularization. The Neoprene 650 latex artery evidential technique was used with posterior fixation of the specimens in 10% formaldehyde [39].

In order to classify the distribution of the posterior ventricular branches of the coronary arteries, according to their superficial path, the posterior face of each ventricle was divided into 8 areas [33,34].

As a diagnostic tool, it is necessary to know the coronary distribution. Thus, Schlesinger's criteria [42] were classified according to 3 different types: A: right dominance, B: balanced type and C: left dominance.

Histological processing

For classical histological processing and paraffin inclusion, different regions were obtained from the longitudinal and transverse random sections of the hearts of 2 males and 2 females. Then, the blocks with the tissues were sectioned with a thickness of 5 μm and stained by the techniques of Hematoxylin-Eosin (HE) and Trichrome of Masson (TM) for light microscopy, under a Leica DM4000 microscope[2] by a digital photomicrographic system. All nomenclature adopted was based on Veterinary Histological Nomenclature [22].

RESULTS

Macroscopic anatomy

The heart of the *Dasyprocta prymnolopha* occupies most of the middle mediastinal space, with asymmetrical position is situated obliquely within the thoracic cavity. It is noted that the vertebral curve of this animal is accentuated, convex ventrally, in the cervical and cranial parts of the thoracic region, since the heart is located between the end of the 2nd and beginning of the 6th intercostal space, depending on the size of the animal, with the cranial margin beginning between the 2nd (n = 6) to the 4th (n = 2) intercostal space and the apex reaching as caudal as the 6th (n = 4) intercostal space.

In all agoutis studied, the heart was surrounded by the lung and covered by the pericardium (Figure 1 A). The pericardium attaches to the sternum bones by the sternopericardial ligaments (Figure 1 B) and attaches dorsally to the adventitial tunica of the great vessels, attaching to the diaphragm muscle by the frenopericardial ligament (Figure 2 B).

The heart presents a rough shape (Figure 2), matching the 3 dimensions x, y and z. It has 4 cavities, 2 atria and 2 ventricles (Figure 2 A), separated by the interatrial and interventricular septa respectively, and separated from each other by a surrounding coronary sulcus. When viewed from the atrial view, the heart is broad, short and blunt, because the midline sulcus is deep when it extends ventrally border, without reaching the apex (Figure 2).

The arrangement of the arteries at the base of the heart is formed by the pulmonary trunk, which originates from the right ventricle, and by the aortic arch originating from the left ventricle (Figure 2 A). Both vessels have a common coat of the serous pericardium. Shortly before branching the pulmonary trunk into the right and left pulmonary arteries it is connected to the descending aorta by a fibrous attachment, the arteriosus ligament, which is reminiscent of the ductus arteriosus from the fetus (Figure 2 A).

The auricles, also known as the auricular appendage, are distinctly different in size; the left one is distinguished by the larger size when compared to the right, covering a large part of the coronary sinus (Figure 2), besides having a series of grooves, which form grooves for the length of its border. In the atrial view (Figure 2 A) the right ventricle is slightly bulged, forming almost the entire cranial border of the heart but not reaching the apex, which is formed entirely by the left ventricle.

The left and right atria have smooth and rough walls respectively, both of which are thin. The wall of the right atrium is lined internally by a membrane, the endocardium, and this atrial cavity is crossed in several directions by muscular protrusions or pectinate muscles (Figure 3 B). Just as the right and left atria are traversed by the same muscle, giving irregular appearance (Figure 3 A).

The ventricles make up most of the heart, the left wall being thicker than the right. In the right ventricular cavity, a rough aspect that provides insertions to the intertwined branches of the chordae tendineae is more evident (Figure 4 A), not being clearly noticed in the left ventricle (Figure 4 B). In each ventricle 4 papillary muscles were observed, to which the chordae tendineae are attached (Figure 4). The thickness of the papillary muscles, which are thinner in the right ventricle, are also related to each other through projections of the musculature itself (Figure 4 A).

By communicating the atrium to the ventricle, the ventricular atrial ostia are covered by cusp-shaped membranes, in number 3 on the right (tricuspid) side and 2 on the left (bicuspid) side of the heart. The left cusp thicker than the one on the right side. These membranes are valves that are supported by chordae tendineae (Figure 4 A & B).

Concave semilunar valves, 3 in number, were observed at the aorta and pulmonary trunk outlets (Figure 5). Note the presence of coronary artery ostia on both sides of the aortic semilunar valve, but on the left side it has 5 different entries to reach the coronary artery, registered in all animals in this study (Figure 5 A)

Coronary arteries

The vessels covered by adipose tissue were observed, mainly in the region of the coronary sulcus (atrioventricular). It may be noted that the supplying arteries of the heart arise in the left and right aortic sinuses and occupy the atrioventricular and interventricular coronary grooves (Figure 6 A).

The left coronary artery originates in the left aortic sinus, its path lies between the pulmonary trunk and below the left atrium, it is divided into a paraconal interventricular branch (Figure 6 A) and a circumflex branch (Figure 6 B). Like, the same left circumflex branch emits intermediate branches (Figure 6 B). The paraconal interventricular branch accompanies the paraconal interventricular sulcus towards the apex of the heart, irrigating the left cardiac wall and a large part of the interventricular septum (Figure 6 A & B). The circumflex branch accompanies the coronary sulcus towards the caudal face of the heart, where it emits long intermediate branches still on the left border, almost reaching its apex (Figure 6 C). Upon reaching the caudal face (atrial view) of the heart, the left coronary artery divides into lateral, intermediate and medial branches, and then forms the subsurface interventricular branch which is in the subsurface interventricular groove (Figure 6 C).

The right coronary artery originates in the right aortic sinus, which passes between the pulmonary trunk and the right atrium (Figure 6A'). It follows a circumflex path on the right side of the coronary sulcus, issuing long interim branches at the right cardiac border (Figure 6B'), following toward the origin of the subsinuous interventricular branch, not even forming the same, but emits small caudal intermediate branches (Figure 6 C'). In both interventricular (paraconal and subsinuous) branches, septal branches of distinct sizes and positions run through the ventricle (Figure 6 A' & C').

Microscopy analysis

The inner layer, the endocardium, is continuous with the inner tunic of the large blood vessels entering and leaving the heart; the intermediate, the pericardium, muscular and thicker layer, the myocardium; and the outermost layer called the epicardium (Figure 7). The endocardium completely lines the ventricles and atria and covers the heart valves and related structures, such as the papillary muscle (Figure 7 A & B). It is noted that the endocardium consists of 3 layers: endothelium, subendothelial and subendocardial. The first is the innermost layer, the endothelium, followed by the subendothelial composed of dense connective tissue with elastic fibers and collagen. The subendocardial layer consists of loosely distributed elastic and collagen fibers (Figure 7 A & B). Endocardial morphology did not differ between atria and ventricles. The myocardium, the richly vascularized stromal intermediate layer, is the thickest in the heart, which is composed of striated cardiac muscle bundles, a capillary network, and cardiac skeleton (Figure 7). The epicardium lines the myocardium externally, and is composed of mesothelial cells. Under the epicardium is a loose connective tissue layer (Figure 7 C & D), which also forms protective sheaths around the blood vessels and nerves (Figure 8).

The aorta presented as an elastic artery having three basic layers: intimate tunic, medium tunic and adventitial tunic (Figure 8 A & B). The intimate tunic formed by the endothelium that lines the organ internally. This endothelium rests on the basement membrane in contact with the surrounding fibroelastic connective tissue (Figure 8 A & B). The middle tunic consists of several smooth muscle layers in a helical arrangement interspersed with a varying number of elastic fibers and collagen fibers (Figure 8 B). Although macroscopy showed a dilation in the aortic bulb region, there was no increase in diameter of the bulbous muscle tunic towards the descending aorta. The external or adventitial tunic is made up of dense fibroelastic connective tissue, with a predominance of elastic and collagen fibers (Figure 8 A & B). This tunic also contains vasa vasorum (vessel vessels), an outer portion of the middle tunic that contains small blood and lymphatic vessels (Figure 8 C).

The cusp valves of the atrioventricular openings are composed of endocardial folds that contain a central plate of dense connective tissue, and inserted in this cardiac musculature was observed the cardiac skeleton, with its fibrous ring consisting of collagen and elastic fibers that surrounds the atrioventricular opening (Figure 9). Note also the presence of the fibrous triangle, a small area of connective tissue, predominantly composed of hyaline tissue (Figure 9 A & B).

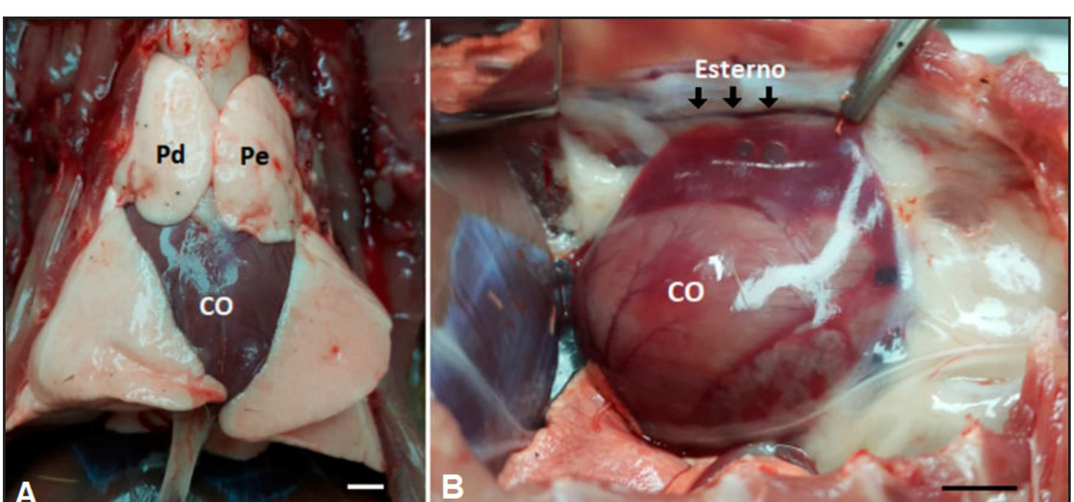

Figure 1. Photograph of the heart of *Dasyprocta prymnolopha in situ*. A- Heart involved by the right and left lung lobes. B- Thoracic cavity in transverse section - Heart and sternopericardial ligaments (arrows). Heart: CO; Left lung lobe: Pd; Right lung lobes: Pe. [Bar= 3 cm].

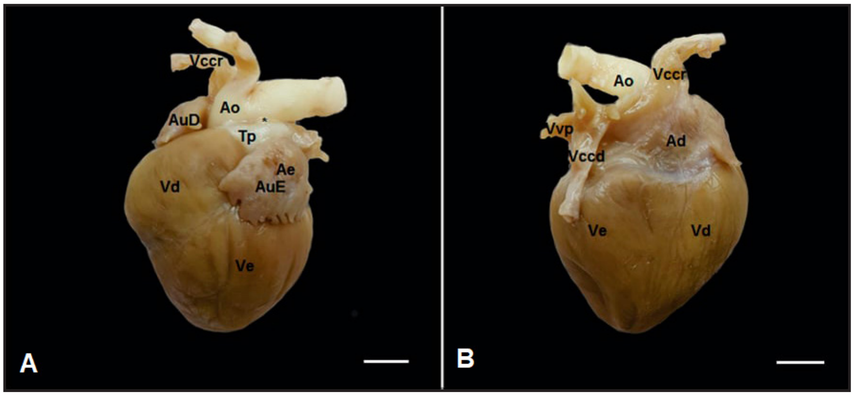

Figure 2. Macroscopic photography of the heart of *Dasyprocta prymnolopha*. A- View of auricular face and B- View of atrial face. The 4 cardiac chambers are evidenced: Right ventricle, Left ventricle, right atrium and left atrium. The main vessels of the base of the heart: Aorta, Lung trunk, Cranial vena cava, Caudal cava vein and Lung veins. Appendices: Left and right auricle (AuE & AuD). And arterial ligament (*). Aorta: Ao; Caudal cava vein: Vccd; Cranial vena cava: Vcrcr; left atrium: Ae; Left auricle: AuE; Left ventricle: Ve; Lung trunk: Tp; Lung veins: Vvp; right atrium: Ad; Right auricle: AuD; Right ventricle: Vd. [Bar= 1 cm].

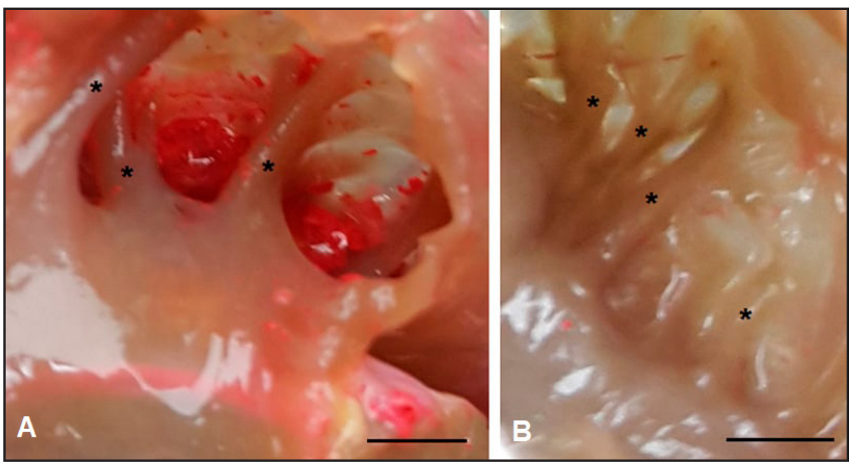

Figure 3. Photograph of the macroscopic internal aspect of the atrium of the heart of *Dasyprocta prymnolopha*. A- Macroscopic aspect of the right atrium with presence of the pectiniform muscles (*). B- Internal walls of the left atrium with presence of the pectiniform muscles (*). [Bar= 5 mm].

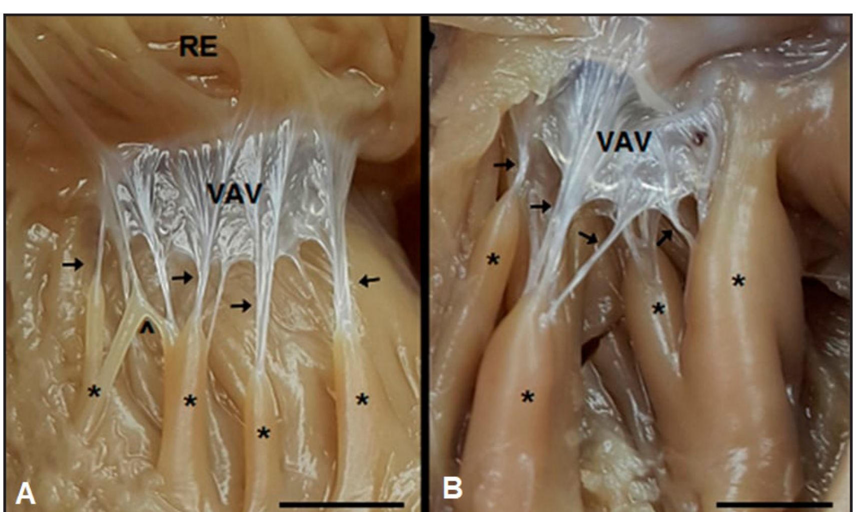

Figure 4. Photograph of the internal macroscopic aspect of the ventricles of the heart of *Dasyprocta prymnolopha*. A- Sagittal section of the heart showing internal view of the right ventricle. Muscular projection (^) that interconnects the papillary muscles (*). B- Internal view of the left ventricle. Note the papillary muscles (*), the chordae tendineae (arrow), atrioventricular valves and intertwined branches. Atrioventricular valves: VAV; Intertwined branches: ER. [Bar= 5 mm].

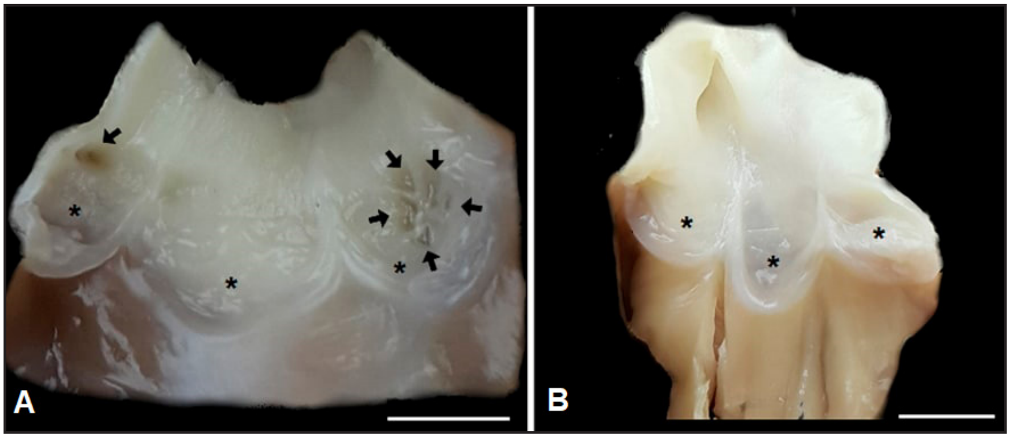

Figure 5. Photograph of the semilunar valves. A- Valves (*) constituting the semilunar aortic valve, with the presence of the ostia of the coronary arteries (arrow). B- Valves (*) that constitute the pulmonary lunate valve. [Bar= 5 mm].

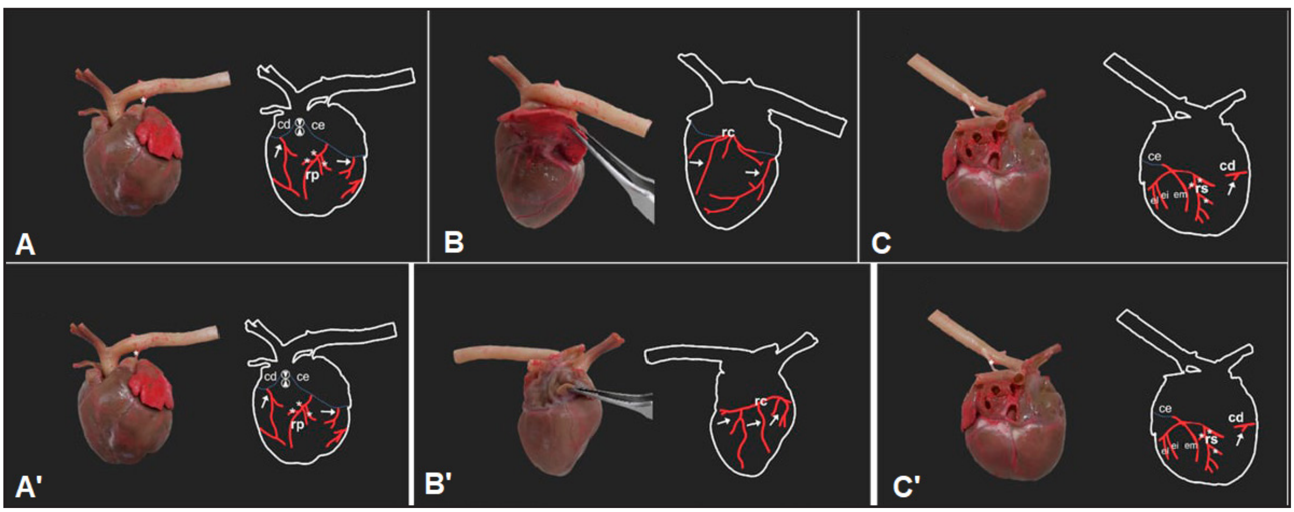

Figure 6. Photograph and schematic of the coronary distribution of *Dasyprocta prymnolopha*. Next to each image a scheme of the corresponding coronary distribution, following the sequence from A to C, the heart rotates about its own axis in the left direction and following the sequence from A' to C', the heart rotates about its own axis in the right direction. A- Note the auricular face of the heart, the right and left coronary artery branches, the paraconal interventricular branch, septal branches (*) and intermediate branches (arrow). B- Continuing the left coronary artery, it follows the circumflex branch emitting intermediate branches (arrows). C- On the atrial surface, the left coronary prolongation ends with lateral intermediate and medial branches with the presence of the subsinuous interventricular branch (rs) and its septal branches (*). A'- Note the auricular face of the heart, the right and left coronary artery branches, the paraconal interventricular branch, septal branches (*) and intermediate branches (arrow). B'- Continuing the left coronary artery, it follows the circumflex branch emitting intermediate branches (arrows). C'- On the atrial surface, right coronary prolongation ends with the emission of a small intermediate branch (arrow). cd: right coronary artery branches; ce: left coronary artery branches; ei: intermediate branch; el: lateral branch; em: medial branch; rc: circumflex branch; rp: paraconal interventricular branch; rs: subsinous interventricular branch.

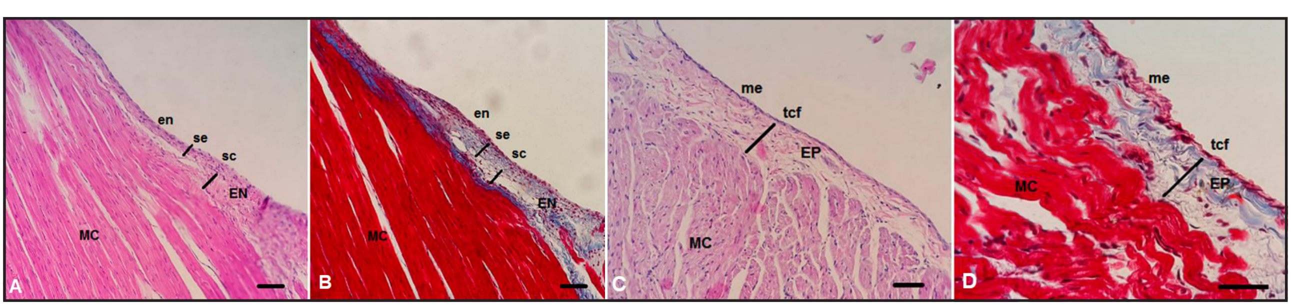

Figure 7. Photomicrograph of cardiac tissue of *Dasyprocta prymnolopha*. A & B- Two tunics of the heart are observed: Endocardium and Myocardium. The endocardium consists of 3 layers: endothelium, subendothelial and subendocardial. C & D- Two cardiac tunics are noted: Epicardium and Myocardium. The epicardium is formed by 2 layers: mesothelial and loose connective tissue. Hematoxylin-Eosin (A & C) and Masson's Trichrome (B & D). Endocardium: EN; Endothelium: en; Epicardium: EP; Myocardium: MC; loose conective tissue; tcf; mesothelial; me; subendocardial: sc; subendothelial: se. [Bar= 50 μm].

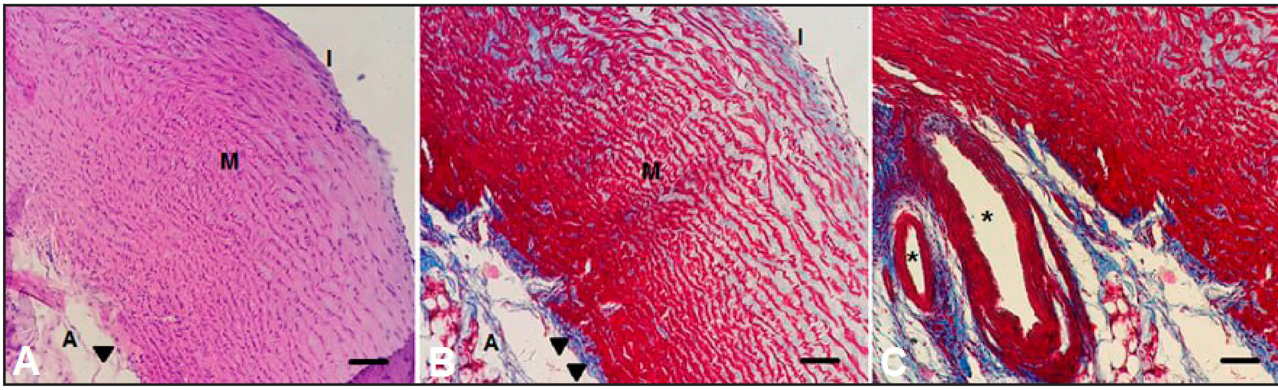

Figure 8. Photomicrograph of cardiac tissue of *Dasyprocta prymnolopha*. A & B- Overview of cross-sectional aorta tunics: intimate, medium and adventitial. Highlighting the outer elastic blade (arrowhead). C- The presence of vasa vasorum is observed in the adventitial tunic, supported by the elastic lamina (*). Hematoxylin-Eosin (A) and Masson's Trichrome (B & C). Adventitial (A); Intimate: I; Medium: M. [Bar= 50 μm].

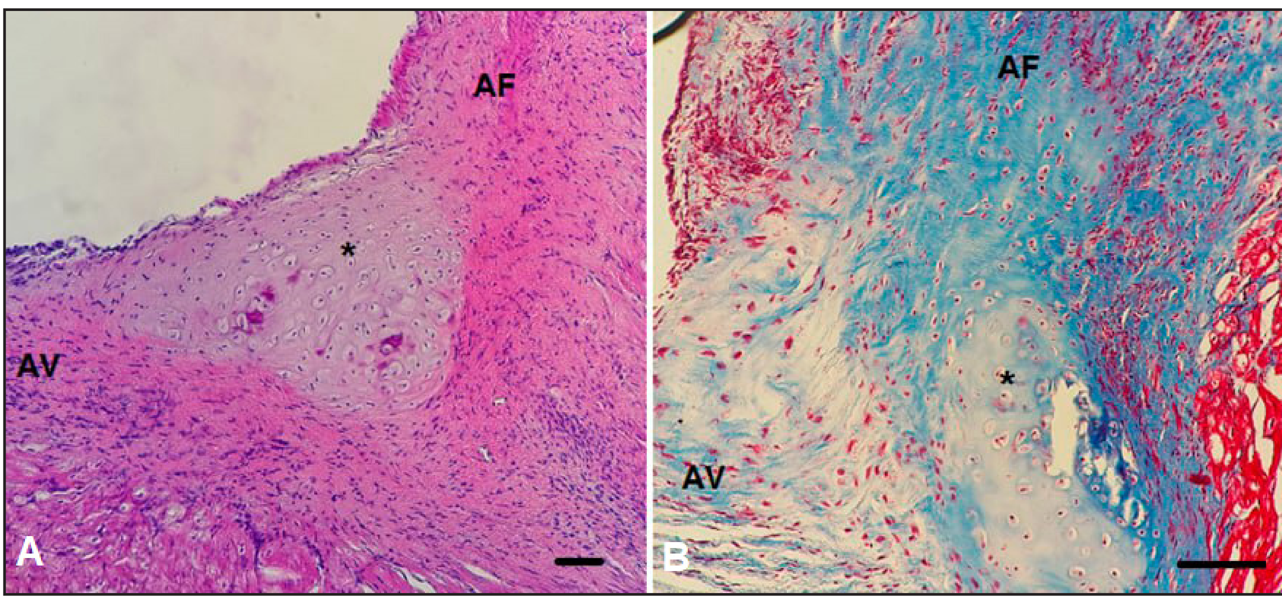

Figure 9. A & B- Photomicrograph of cardiac tissue of *Dasyprocta prymnolopha*. The cardiac skeleton near the right atrioventricular valve, consisting of the fibrous ring and the fibrous triangle (*) of hyaline cartilage (stained in blue) is observed. Hematoxylin-Eosin (A) and Masson's Trichrome (B). Atrioventricular valve: AV; Fibrous ring: AF. [Bar= 50 μm].

DISCUSSION

The cardiovascular assessment of small mammals wild may be challenging. Current diagnostic modalities used in cardiology can be adapted to wildlife as long as its cardiac anatomy and physiology are well known. In the literature, there are only cardiological studies related to radiographic and echocardiographic parameters that contribute to a greater understanding of cardiac morphology in *Dasyprocta primnolopha* specie [12,13,31]. Thus, this study is the first research anatomicroscopy of the heart of the *D. prymnolopha*.

The topography of the agouti heart (*D. prymnolopha*) differs when related to the size of the animal studied, as the variation in cardiac positioning can also be related to the sharp vertebral curve that the animal presents, similar to that of felines [17]. In the present study, the agouti cardiac topography was investigated, determining its position from the 2nd intercostal space, in contradiction to previous studies [12], in which the cardiac positioning was noted starting from the 4th intercostal space.

In the macroscopic analysis *D. prymnolopha* heart corresponds to the descriptions made for other animals [2,47]. The heart shape differs when compared to that of the groundhog rodent (*Marmota monax*) [2] and *Procyon cancrivorus* [38] which has a cone-shaped heart [21], while in the agouti is broad, short and blunt like those of swine [17]. Internally the heart is divided into 4 cavities, 2 atria and 2 ventricles, as reported in terrestrial mammals and externally it is completely surrounded by the pericardium [24,38,47].

The frenopericardial and sternopericardial ligaments observed in this research were also found in the most diverse species [19,36]. There are no reports of these ligaments in other *Dasyprocta* species to date in the literature. In domestic terrestrial mammals, the frenopericardium is the only ligament found in carnivores, ie species that have the most oblique cardiac axis because this ligament imposes a strict restriction on the mobility of the heart, and the sternopericardium in swine, horses and ruminants [17].

The arrangement of the arteries at the base of the heart of the animals studied has varied peculiarities when compared to domestic species. The aorta in the agouti is similar in its course and relationships to the equine and bovine aorta because it does not have such a sharp arch [17,24]. The left subclavian artery and brachiocephalic trunk arise separately from the aortic arch as in swine [17]. Possibly the right angulation of the aortic artery in agoutis occurs due to the localization of the heart within the mediastinal space. During diastolic and systolic movements, aortic movement is limited to nearby adjacent structures such as the trachea.

As a particularity of the *D. prymnolopha* specie, the left auricle is larger in size relative to the heart to auricle size ratio when compared to other domestic species, covering the left coronary sinus until it reaches the left atrial surface. In this sense, it resembles only the swine species, since in horses, ruminants and carnivores the left auricle does not appear on the atrial surface of their hearts [17,24].

In the right atrium of the agouti heart there is a cranial vena cava and a caudal vein, similar to domestic animals [17,24], unlike that observed in animals such as paca and rats, which have 2 cranial venae cava (left and right) and 1 caudal [22,39]. The atrial musculature is thin, reaching translucent connotations, has a smooth cavity in the left atrium and becomes irregular by a series of muscle ridges (pectinate muscles) in the right atrium. This is due to the fact that the formation of most of the left atrial wall is smooth because it results from the incorporation of the primitive pulmonary vein [40], as well as domestic animals [24].

In the right ventricle, which constitutes the right cranial part of the ventricular mass, it can be observed that the right atrioventricular ostium is supported by the right atrioventricular valve, which consists basically of 3 cusps, and may have variations within the species itself 2 cusps, parietal and the septal, which also occurs with papillary muscles, ranging from 3 to 4, resembling carnivores [11,17], with minor peculiarities such as the presence of projections that interconnect the papillary muscles each other. In the left ventricle there are also variations in the amount of papillary muscles, which may vary from 2 to 4, differing from domestic animals and terrestrial and aquatic wild mammals [17,19,39].

The presence of the semilunar valves did not differ from those found in other domestic mammal species [24], but there was a striking difference found in the aortic valve region, which was the presence of 5 ostia in the left aortic sinus, contrasting with the usually occurs, only 1 on each side (right and left) [17]. Accessory coronary ostia have no clinical relevance, and therefore their existence is generally considered to be a mere variant of the normal coronary artery pattern [14]. It is assumed that this number of elevated ostia would favor the blood supply of cardiac muscles in agoutis.

The agouti have 2 coronary arteries, left and right, a fact that has also been observed in other animals such as deer [28], capybara [44], dogs [4] and rabbits [10].

Once the left coronary artery is present, it divides into paraconal interventricular branch and circumflex branch [1,14,16,30,44]. In the heart of the agouti the intermediate branch was evidenced originating from the circumflex branch of the left and right coronary artery [16,23,44].

There are numerous researchers have studied the distribution of coronary arteries [4,10,28,41,44,46,47] but their behavior in agoutis has not yet been reported in detail. In the agouti, it was observed that all the specimens analyzed presented characterized vascularization of the left type, with the left coronary artery giving rise to both the paraconal and subsinuous interventricular branch, a fact found in animals such as ruminants, dogs, 50% of cats, capybaras and rabbits [3,4,10,44]. Unlike animals such as horses, swine, 50% of cats and deer had right-sided vascularization [3,28,46].

In histological observations of the present study, the heart was similar to that of other mammals, consisting of 3 main layers: the endocardium, myocardium and epicardium, distinct peculiarities within the epicardial and endocardial layer itself [43].

The walls of arteries and veins are arranged in concentric layers, their composition and thickness vary with the size and type of vessel [41]. In present study, the aortic wall was analyzed, in histological sections they presented as an elastic artery consisting of 3 layers: intimate tunic, medium tunic and adventitial tunic. The intimate tunic proved to be a thin layer adhered to the arterial musculature. As with the presence of an external elastic limiting lamina [37,43,45].

The main functional element of the organ is the cardiac or myocardial muscle, whose composition consists of cardiac muscle fibers arranged in 2 layers and most of these fibers are inserted into the cardiac skeleton [25]. The cardiac skeleton is formed by the union of fibrous structures, but the constitution of the fibrous triangle is distributed differently in animal species.

The first stage of cardiac cartilage development in mammals occurs before birth, as detected by the detection of cartilage in rodent embryos as a laboratory rat [15]. This characteristic differs from large ruminants, in which ossification of the cardiac skeleton develops with age [25]. The description of the presence of cardiac cartilage in the aortic and pulmonary valves was given later involving Syrian hamsters (*Mesocricetus auratus*) [26,27].

CONCLUSION

This study establishes the first reference on the anatomomicroscopy of the heart of the species *Dasyprocta prymnolopha* a wild rodent well adapted to captivity, as well as its vascularization, generating important unpublished information for the elucidation of the cardiac and coronary diagnostic analysis and may be extended to different species. In summary, the heart is located between the end of the 2nd and the beginning of the 5th intercostal space with the apex reaching the 6th space maintained in the cardiothoracic position by the frenopericardial and sternopericardial ligaments. The right atrioventricular valve (tricuspid) consists of 3 cusps with variations within the same species for 2 cusps, the parietal and the septal. In the left ventricle there are variations in the number of papillary muscles, alternating from 2 to 4 muscles. The aortic valve region showed 5 ostia in the left aortic sinus. The coronary circulation has a predominantly left distribution. Histologically, the heart has 3 main layers: endocardium, myocardium and epicardium. The cardiac structure presents a skeleton with a fibrous triangle consisting of hyaline cartilage.

MANUFACTURERS

[1]Cristália Indústria Farmacêutica. São Paulo, SP, Brazil.

[2]Leica Microsystems. Weltzlar, Germany.

***Funding*.** This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

***Acknowledgements*.** The authors would like to thank the Federal University of Piauí (UFPI)bfor the structural support for making this research feasible.

***Ethical approval*.** The research was approved by the Ethics Committee on the Use of Animals of the Federal University of Piauí (UFPI) with nº 151/16, as well as the use of wild animals also requires the authorization from the Chico Mendes Institute for Biodiversity (SISBIO-ICMBio) with no. 50946-1.

***Declaration of interest*.** The authors report no conflicts of interest. The authors alone are responsible for the content and writing of paper.

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