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Original Research Article

Anatomical Study of the Coronary Arteries of the Grasscutter (*Thryonomys swinderianus, TEMMINCK 1827*)

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ABSTRACT

Background: The grasscutter is an animal model increasingly used in fundamental research in Africa. **Aim:** To describe the anatomy of the coronary arteries of the grasscutter.

Methods: This was a preliminary, experimental, cross-sectional and descriptive study involving four grasscutters, aged four months and older each. An injection of non-fractionated heparin was given to the grasscutters before the beginning of the experiment. A dissection and an extraction of the heart from the thoracic cavity were performed after killing animal under general anaesthesia. A washing of the coronary arteries was performed before the injection of latex with red dye on the left and unstained latex in the right coronary. After latex injection, the coronary arteries were described by direct observation of the fresh specimens.

Results: The two coronary arteries arise at the base of the aorta in anterior left and right positions respectively. The left coronary artery terminates in two branches, the circumflex artery and the ventral interventricular artery; the left marginal artery arises from the ventral interventricular artery. The right coronary artery, from its origin, gives a branch for the sinu-atrial node, an infundibular branch and the right marginal artery. It then passes into the right atrioventricular sulcus to terminate at the dorsal surface of the heart, giving rise to the dorsal interventricular artery.

Conclusion: The distinctive features of coronary artery anatomy described in this preliminary study will be useful in the carrying out of a model of ischaemia in a myocardial territory for fundamental research.

KEY WORDS: Coronary Arteries, Grasscutter, Anatomy, Lomé, Togo.

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INTRODUCTION

The greater grasscutter (Thryonomys swinderianus, TEMMINCK 1827) or cane rat is a rodent of the grassy savannah, clearings and deforested areas in process of domestication in Africa. Its breeding in close captivity (or cane rat farming) is increasingly developing in West and Central Africa for reasons of both food speculation and wildlife resource management, but also for socio-cultural reasons [1-3]. The popularisation of cane rat farming is also motivated by the renewed scientific interest in the aforesaid rodent. A lot of researches focus on this animal in the West African sub-region, the cane rat being increasingly used as an animal model. As a matter of fact, in Côte d'Ivoire, Broalet and others studied the anatomy of the encephalon, the vascularisation of the brain stem and the vertebra-basilar system of the cane rat [4-6]; in Togo, James and others shed light on its carotid system [7]. In Senegal, the distinctive feature of the cane rat's digestive system was revealed at the end of a study in 2008 [8]. To our knowledge, no detailed study has been done on the cane rat's coronary arteries to date. We therefore initiated this work with a view to contributing to the discovery of the anatomical structures of this rodent, in this case its coronary arteries.

METHODS

It was a preliminary, experimental, cross- sectional and descriptive study from March to October 2024, i.e. over seven months. The study took place in the human anatomy laboratory at the University of Lomé. It focused on four grasscutters, all from domestic breeding and aged four months and over. An injection of 2500 IU of non-fractionated heparin was made at the base of the grasscutters' tail before the start of the experiment in order to prevent blood coagulation. General anaesthesia was performed on each grasscutter, using halothane and the ketamine at a dose of 02 ml per 05 Kg at the base of the tail. Under general anaesthesia a ventral thoracoabdo- minal flap was performed exposing the heart. Final killing was implemented rapidly by exanguination by puncture the ascending aorta after opening the pericardium. We then proceeded to the dissection and extraction of the heart from the thoracic cavity. Once the heart had been extracted, we performed the following procedures in succession:

- Washing of the right and left cavities of the heart with 0.9% NaCl solution with added heparin 5000 IU per 0.5 liter via the superior vena cava and the aorta.

- Identification of the orifices of the coronary arteries at the base of the stump of the ascending aorta with the naked eye.

- Catheterisation of the coronary arteries and washing with heparinised 0.9% NaCl solution.

- Injection of 10% formaldehyde solution into the coronary arteries for pre-fixation.

- Rinsing with 0.09% heparinised saline solution.

- Injection of a 35.04 g/mol ammonia solution into the coronary arteries to ensure good impregnation of the dyes.

- Rinsing of the coronary arteries with 0.09% heparinised saline solution.

- Injection into the left coronary artery of neoprene latex mixed instantly with red dye beforehand.

- Injection into the right coronary artery of diluted neoprene latex unmixed with red dye to highlight the right coronary artery and its branches, which appear white to distinguish them from the left coronary artery.

After the injections, we proceeded to the description of the coronary arteries by direct observation. The description focused on the origin, the course, the main branches and the termination of each coronary artery. The terminology adopted is that of the new anatomical nomenclature.

RESULTS

Left coronary artery: Its origin is at the base of the ascending aorta in a forward and left position (figure 1). From this origin the artery is hidden by the right ventricle and the pulmonary artery. It emerges forward between the right ventricle and the left atrium then ends by dividing into two branches, left and

right (figure 2). The left terminal branch or circumflex artery goes around the upper left part of the heart between the atrium and the left ventricle then bends downward and descends to the dorsal surface of the left ventricle. It gives several collateral branches to the ventricles (figure 3). The right terminal branch or the ventral interventricular artery goes along the entire interventricular sulcus towards the apex of the heart. In the proximal part of the sulcus, the ventral interventricular artery gives on its left flank a large artery which goes along the left edge of the heart: it is the left marginal artery (figure 4). From the left marginal artery depart the diagonal arteries.

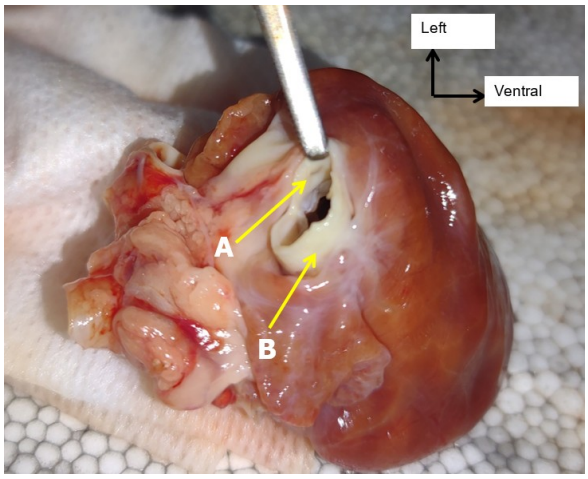

Fig. 1: showing the origin or ostium of the left coronary artery at the base of the aorta.
Legend: A= ostium of the left coronary artery; B= ascending aorta

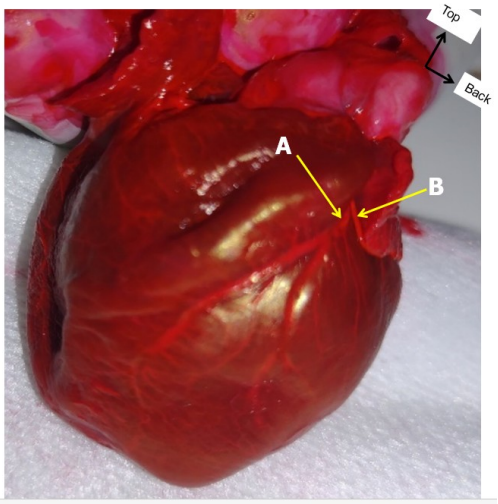

Fig. 2: showing the terminal branches of the left coronary artery
Legend: A= ventral interventricular artery; B= circumflex artery

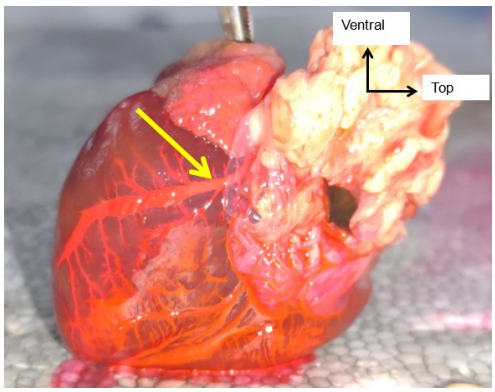

Fig. 3: showing the course of the circumflex artery on the dorsal surface of the heart (yellow arrow)

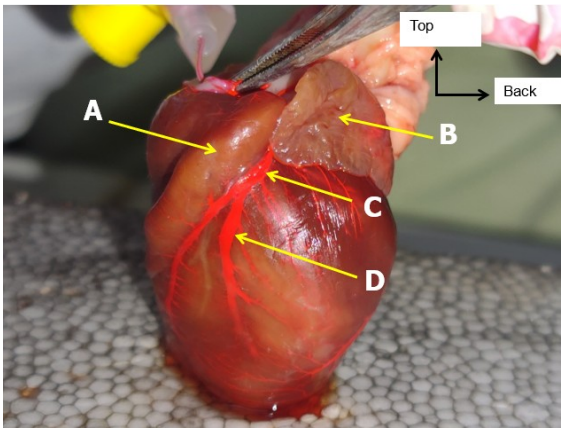

Fig. 4: showing the terminal branches of the left coronary artery
Legend: A= right ventricle; B= left atrium;
C= interventricular artery; D= left marginal artery

Right coronary artery: It arises forward and to the right at the base of the ascending aorta (Figure 5). It descends on the right between the right atrium and right ventricle, skirting the right edge of the heart. Very early on, just at the level of its origin, the right coronary artery gives rise to several branches (Figure 6):

- on its right edge, an artery in the direction of the superior vena cava: this is the equivalent of the artery of the sinu-atrial node.

- on its left edge, two arteries: a branch towards the base of the pulmonary artery trunk, the right infundibular artery; a branch going along the right edge of the heart; it is the right marginal artery. From this marginal artery, descending branches leave towards the right ventricle.

Then, along the rest of its course, there is an atrial artery on its right edge and a terminal branch on the dorsal surface of the heart which descends into the proximal part of the interventricular sulcus, the dorsal interventricular artery (Figure 7).

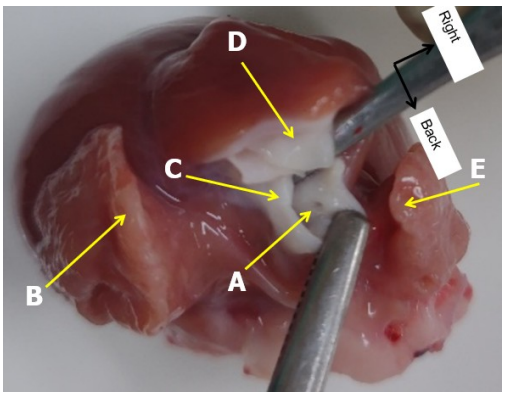

Fig. 5: showing the origin or ostium of the right coronary artery at the base of the aorta
Legend: A= ostium of the right coronary artery; B= left atrium; C= ascending aorta; D= pulmonary artery; E= right atrium

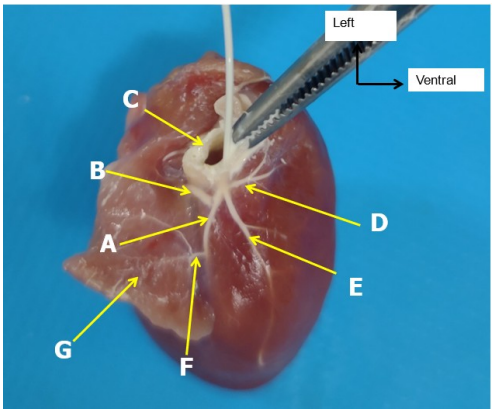

Fig. 6: showing the branches of the right coronary artery
Legend: A= right coronary artery; B= artery of the sinu-atrial node; C= ascending aorta; D= infundibular artery; E= right marginal artery; F= atrial artery; G= right atrium

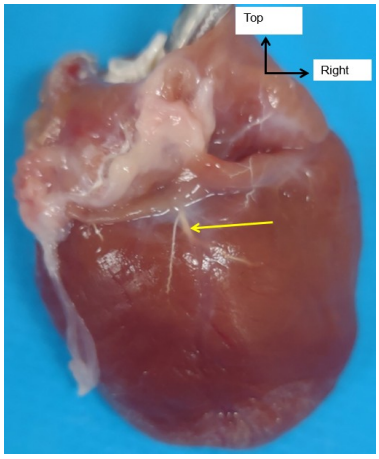

Fig. 7: dorsal view of the heart showing the dorsal interventricular artery (yellow arrow)

DISCUSSION

This is a first study on the description of the coronary arteries of the grasscutter. The study of the vessels uses basic anatomical techniques: vascular injection of latex coloured or not, dissection or corrosion.

Even though these methods are increasingly replaced by new imaging technologies and artificial intelligence, they still have their place in fundamental research [9].

The use of formaldehyde solution in injection or immersion ensures rigidity and a good subsequent study of the vessels. In this study, after dissection of the heart and injection into the coronary arteries, we proceeded to their description immediately. A subsequent study with injection - corrosion or injection - dissection under a microscope will allow us to determine the exhaustive distribution of all the branches of the coronary arteries. But in the meanwhile, this first description just after vascular injection allowed us to identify some particularities specific to the coronary arteries of the grasscutter.

The left coronary artery, from its origin to its termination, appears hidden and ends in two branches: a circumflex artery and a ventral interventricular artery, as in humans, with one difference [10]. As a matter of fact, the left marginal artery of the grasscuter comes from the trunk of the ventral interventricular artery and not from the circumflex. In the rabbit, the left coronary artery terminates in three branches: a proximal left atrial artery, the circumflex and the ventral interventricular. Unlike the grasscutter, the rabbit's left marginal artery arises from its circumflex artery [11]. In rats, and according to the results of studies by Dong-Choon and others, the trunk of the left coronary artery does not divide; it goes along the left edge of the heart from its emergence between the left atrium and the trunk of the pulmonary artery to the apex of the heart. However, during its course, it gives rise to diagonal ventricular branches, generally six in number; three for each ventricle [12]. In the Swiss albino mouse, the left coronary artery runs in the ventral interventricular sulcus and gives branches on its left and right flanks; the circumflex artery arises at the top of its left flank towards the left ventricle away from the left coronary sulcus [13]. The mouse left coronary artery often shows anatomical variations concerning its origin and course, running along the left edge of the heart to its apex. Along its course,

it gives rise to four major branches from which branches for the left heart are formed [14].

According to our observations, the right coronary artery of the grasscutter gives its main collateral branches so early that we could believe that the artery was subdivided into its terminal branches from its origin. The early origin of the infundibular arteries and that of the sinu-atrial node is comparable to the positioning in humans; however, in humans the right marginal branch does not arise so close to the origin of the right coronary [10]. In the rabbit, this right marginal branch arises at the very level of the right edge of the heart, and the right coronary artery terminates at the dorsal surface of the right ventricle in two branches: a distal right ventricular artery and a distal right atrial artery [11]. .

In the mouse, the right coronary artery divides after a short course into two main branches: a branch vascularising the right ventricle and a short septal branch for the interventricular septum [14].

CONCLUSION

This preliminary study, which highlighted the difference between the mode of termination and subdivision of the right and left coronary arteries of the grasscutter compared to those of humans and other animals, will be useful in the carrying out of a model of ischaemia in a myocardial territory by ligature or obliteration of a coronary trunk or its branches in fundamental research.

Author Contributions

All the authors/co-authors equally contributed for the manuscript right from conception of the study plan to the final drafting for the publication.

Conflicts of Interests: None

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