

Anatomical Study of the Grasscutter's Aorta (*Thryonomys swinderianus*, Temminck 1827)

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Abstract

Rationale and objective: The grasscutter's aorta, the largest artery in the body from which most other arteries originate, is an important anatomical model. The objective of the study is to describe the grasscutter's aorta and identify its main branches.

Materials and methods: This was a morphological, cross-sectional, descriptive study of the aortas of five adult grasscutters. Euthanasia was

performed under general anesthesia by exsanguination via the left ventricle following a thoraco-abdominal incision. Aortic dissections were carried out on fresh specimens after vascular injection of colored latex. The parameters analyzed included the origin, course, termination, dimensions, and major branches.

Results: The aorta originates at the base of the left ventricle and terminates at the entrance to the pelvic cavity, following an initial arch before continuing as a nearly midline thoracic and abdominal segment in a cranio-caudal direction. The main branches included two coronary arteries, two supra-aortic trunks, a constant celiac trunk, and either one or two mesenteric arteries. The average length of the aorta was 132.48 mm, with mean diameters of 1.61 mm, 1.46 mm, and 1.04 mm at the ascending aorta, the descending thoracic aorta, and the abdominal aorta, respectively.

Conclusion: The grasscutter's aorta qualitatively presents almost the same main branches as that of humans. Quantitatively, however, certain differences have been identified. Further studies with larger sample sizes are necessary to confirm these initial observations.

Keywords: Aorta, anatomy, grasscutter, Lomé-Togo

Introduction

The use of animal models for scientific research and clinical purposes is an established practice motivated by the anatomical similarities between humans and certain mammals. According to the American National Research Council Committee on Animal Models for Research and Aging, an animal model is a model that allows the study of reference data on biology or behaviour, or in which a spontaneous or induced pathological process can be studied. The latter has one or more aspects in common with an equivalent phenomenon in humans or other animal species (Barré-Sinoussi et al., 2015). Through these models, comparative anatomy has been studied, physiopathological mechanisms have been discovered, and new diagnostic or therapeutic methods have been developed. In African countries, animal models have always been imported from Western countries, posing problems of accessibility and financial cost. To overcome these difficulties, researchers in West Africa began focusing on the grasscutter with a view to making it the anatomic model par excellence. The resurgence of scientific interest in this potential model stirred interest in conducting several studies (Broalet et al., 2019, 2021; James et al., 2016). In one of the recent studies on this specimen, it has been shown the particularity of the coronary arteries has been shown, the first branches of the grasscutter's aorta (Sogan et al., 2025). Then, this study is carried out to complete existing findings on its vascular system, such

as the other main arterial branches and the dimensions of the aorta of this model.

Materials and methods

This is a morphological, cross-sectional, and descriptive study of the grasscutter's aorta and its main branches. The study considered five adult grasscutters from a domestic breeding farm.

Each grasscutter studied was kept in a fenestrated wooden crate; a cotton pad heavily soaked in halothane was placed next to the grasscutter in the crate. After anesthesia was induced, it was deepened by injecting ketamine at the base of its tail with a dose of 10 mg per kg. The animals were euthanized by exsanguination through the left ventricle following thoraco-abdominal opening under general anesthesia. Vascular washing using heparinized saline was performed through the trocar implanted in the left ventricle and evacuated from the right atrium by a gravitational system. A 10 ml injection of red-dyed latex was performed from the left ventricle trocar. The animal was preserved in a 10% formalin solution for seven days and then stored in a refrigerator for two days. Dissections were performed both before and after formalin injection. The parameters analyzed included the origin, course, termination, dimensions, and major branches. Diameters and lengths were measured using the biological image analysis platform Fiji (ImageJ-win64) (Schindelin et al., 2012). Aortic measurements were obtained according to the following procedures:

1. Open the image in the Fiji ImageJ application, on which the dimensions of the arteries are to be measured
2. Setting the measurement scale (preferably in centimeters): use the straight-line tool in the application window to determine the centimeter equivalent of the pixels by drawing a one-centimeter line segment on the ruler (or another measuring tool) placed next to the structure to be measured before taking the photographs; by pressing the "M" key on the keyboard and the result displays in a small window
3. Update this scale by going to Analysis then "Set Scale" in the application; enter 1 in the "Known Distance" field and centimeters in "Distance Unit"; press the "M" key on the keyboard again, and the result appears in the same window as before.
4. Measure arterial lengths: select "freehand lining tool" then go to the image open in the application, position the cursor, and draw a line between the two points (start and end) of the section to be measured, press the "M" key and the result appears in the aforementioned results window

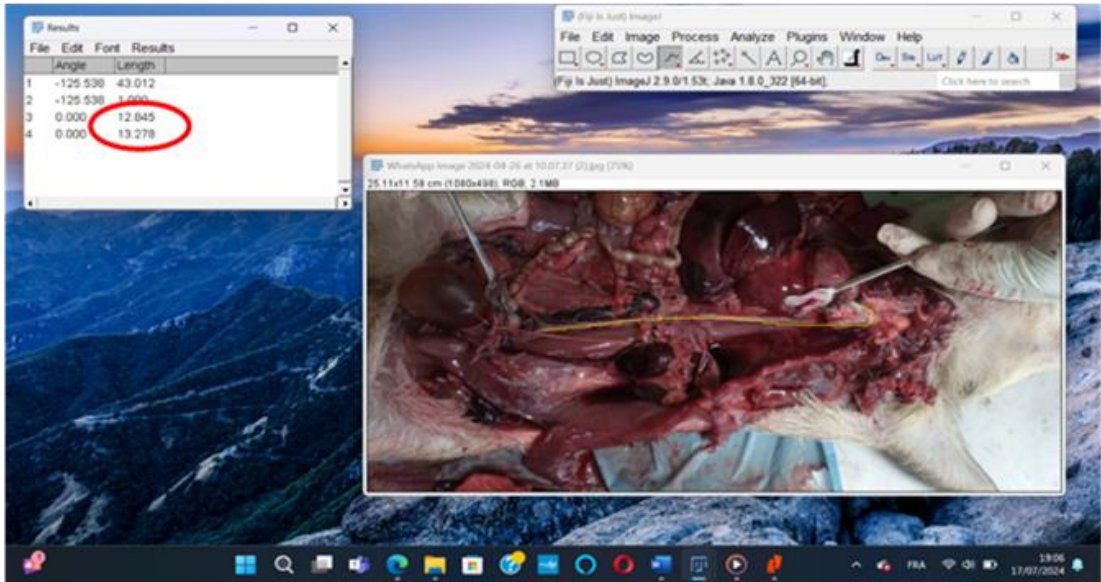


Figure 1: Illustration of aortic length measurement (yellow line) in centimeters on the screen, results highlighted in red circle (screenshot captured during measurement)

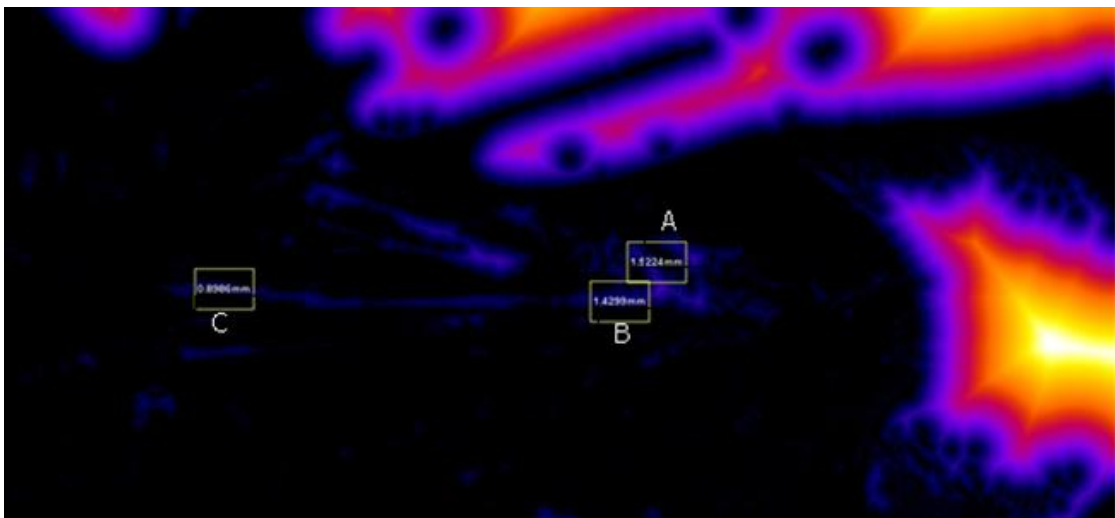


Figure 2: Illustration of aortic diameter measurements (screenshot captured during measurements); A: Ascending aorta; B: Thoracic descending aorta; C: Abdominal aorta

Figures 1 and 2 show the results displayed on the computer screen after completing the various steps for measuring length and diameter.

These dimensions were taken from the fresh aorta before injections and formalin fixation. For greater accuracy in identifying the true origin of the aorta and the major vessels at the base of the heart, additional dissection was performed on a fresh, non-formalin-fixed grasscutter. This specimen was not included in the aortic measurements.

Results

Origin: The aorta arises at the base of the heart, at the level of the left ventricle, posterior and to the right of the origin of the pulmonary trunk (figures 3 and 4).

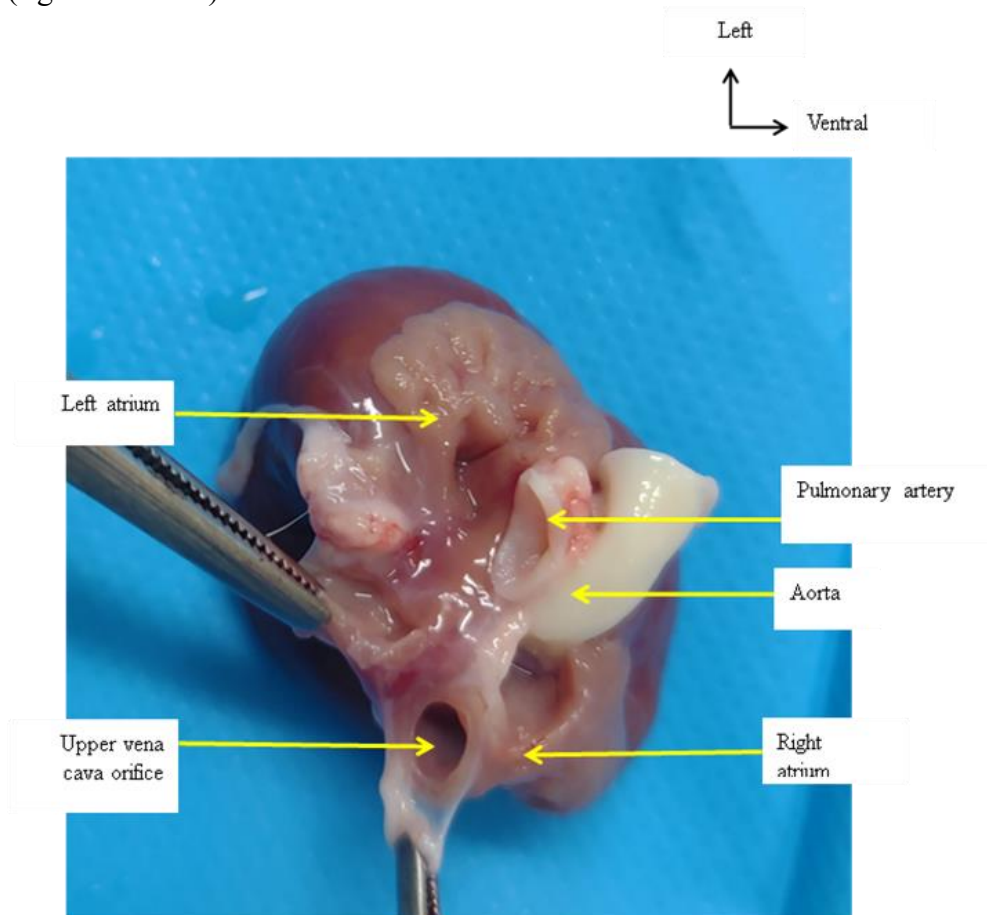


Figure 3: Showing the large vessels at the base of the Grasscutter heart

Overall course: From its origin, the aorta courses cranially and medially, forming an arch with a caudal and right concavity. It then courses caudally, crosses the diaphragm to the left of the esophageal orifice, and then becomes abdominal. Consequently, it is divided into two segments: a thoracic segment and an abdominal segment (Figure 5).

- *The thoracic segment:* after forming the arch, it courses transversely and caudally in a left paramedian position toward the aortic orifice of the diaphragm. It is deviated slightly to the right at about one centimeter from this orifice.

- *The abdominal segment:* From the aortic orifice of the diaphragmatic artery, it runs transversely toward the pelvic cavity to the left of the caudal vena cava.

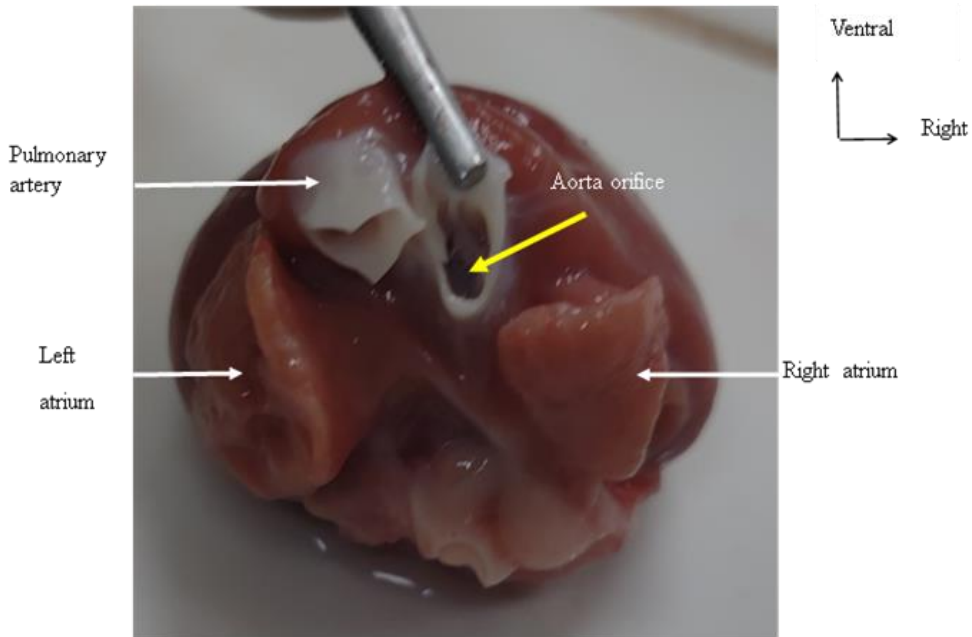


Figure 4: Aorta orifice (yellow arrow)

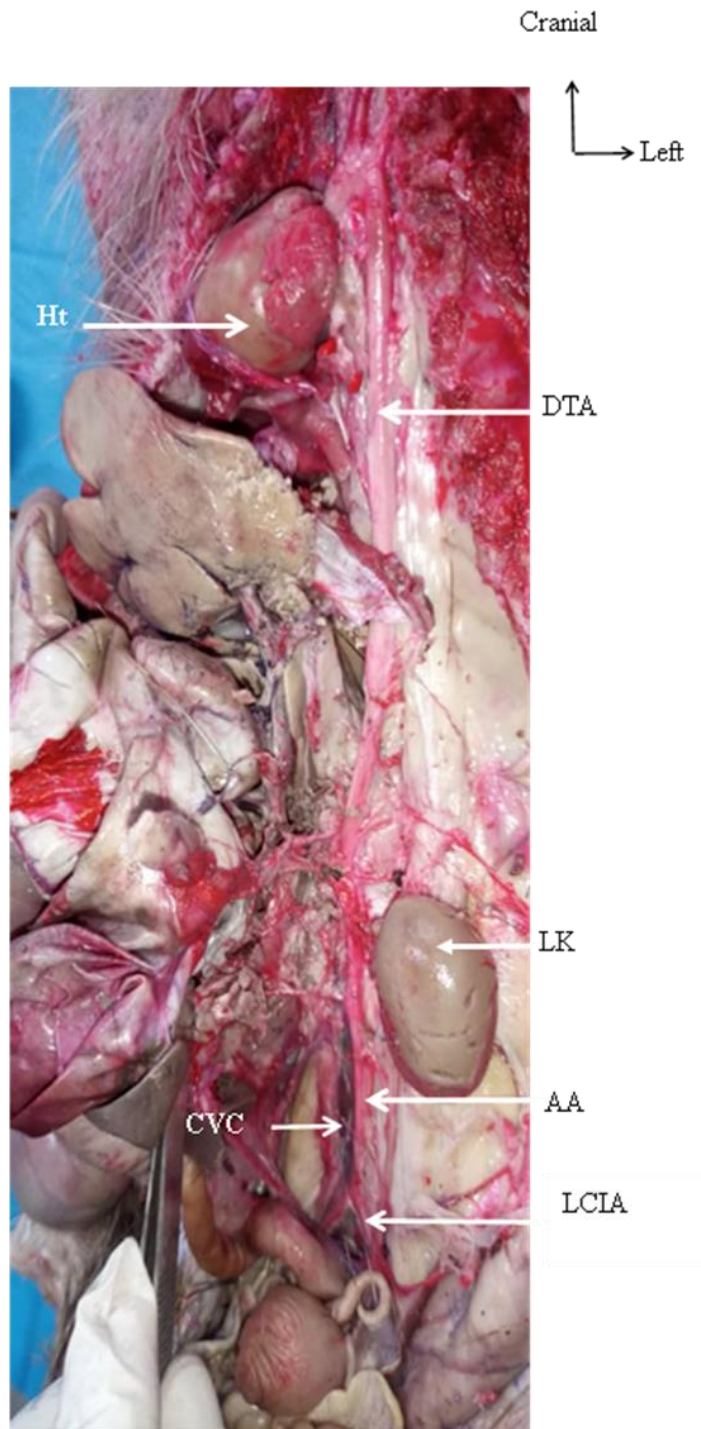
Ending: It arises at the entrance to the pelvic cavity by bifurcation anteriorly and to the left of the origin of the caudal vena cava (figure 5).

Main terminal branches: They are represented by two iliac arteries (left common iliac and right common iliac). The right iliac artery passes anterior to the initial portion of the inferior vena cava (figure 5).

Main side branches:

- At the level of the thoracic aorta, the branches are represented by the two coronary arteries (left and right) arising at the base of the aorta, as described in the article on the coronary arteries (Sogan et al., 2025); two supra-aortic trunks: the common carotid trunk and the left subclavian artery, heading toward the cephalic extremities and forelimbs.
- *At the level of the abdominal aorta*, the following main branches are noted (figure 6): a celiac trunk; a single mesenteric artery was present in two out of five cases. In three out of five cases, we observed a large cranial mesenteric artery and a smaller caliber caudal mesenteric artery. Other branches observed on the abdominal aorta were two renal arteries (left and right); two genital arteries (right and left); lumbar and caudal phrenic arteries.

Figure 5: Overview of the aorta from origin to termination



Ht: heart; DTA: descending thoracic aorta; LK: left kidney;
AA: abdominal aorta; LCIA: left common iliac artery; CVC: caudal vena cava

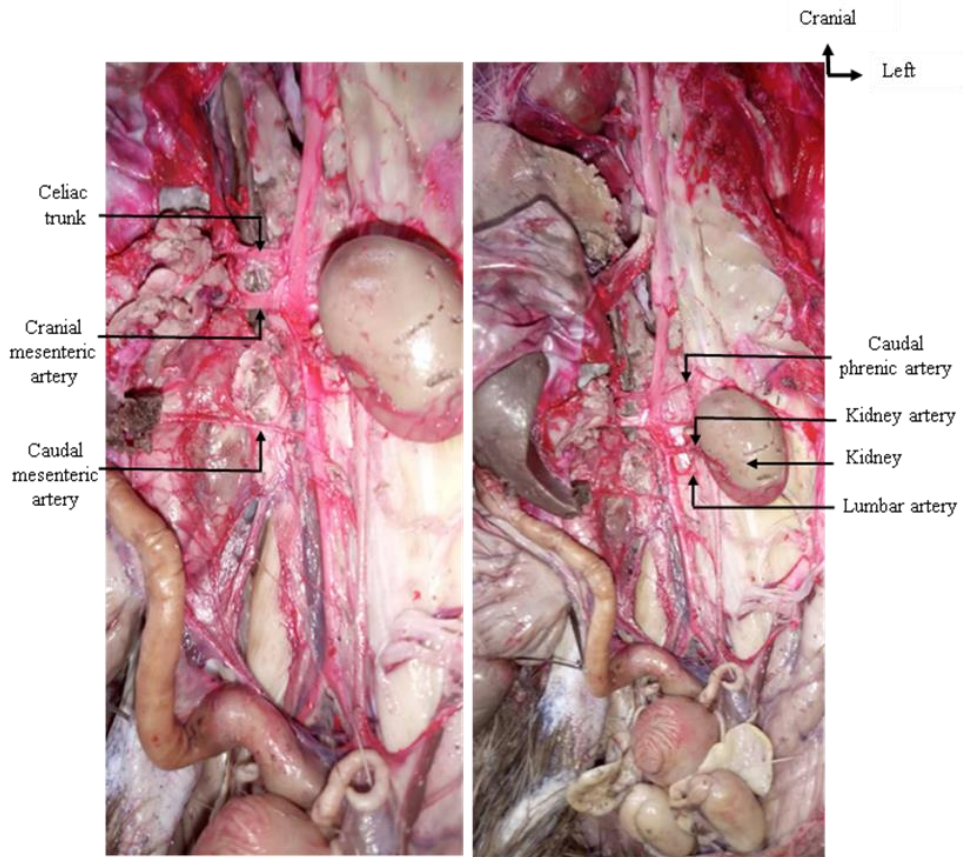


Figure 6: Abdominal branches of the aorta

Dimensions

The mean aortic length was 132.48 mm and the mean diameters were 1.61 mm; 1.46 mm and 1.04 mm at the ascending aorta, the thoracic aorta and the abdominal aorta, respectively (tables I and II).

Table 1: Grasscutter's characteristics and aorta length

	Age (mounth)	Weight(kilograms)	Aorta length (millimeter)
Grasscutter 1	12	3,7	128,4
Grasscutter 2	15	4,7	132,7
Grasscutter 3	10	4,1	130,6
Grasscutter 4	18	5,2	140,5
Grasscutter 5	14	4,0	130,2
Mean ± SD	13,80 ± 3,03	4,34 ± 0,61	132,48 ± 4,73

Table 2: Grasscutter aorta segment diameters

	Ascending thoracic aorta (in millimeter)	Descending thoracic aorta (in millimeter)	Abdominal aorta (in millimeter)
Grasscutter 1	1,52	1,42	0,89
Grasscutter 2	1,45	1,39	1,02
Grasscutter 3	1,61	1,48	1,16
Grasscutter 4	1,85	1,55	1,05
Grasscutter 5	1,58	1,48	1,10
Mean ± SD	1,61 ± 0,15	1,46 ± 0,06	1,04 ± 0,09

Discussions

Anatomical studies of the vascular system have traditionally relied on vascular injection techniques. Even though these methods are increasingly being replaced by new imaging technologies and Artificial Intelligence, they still hold their place in basic research. Using this anatomical technique, we were able to obtain results on the grasscutter's aorta even though the very fine branches could not be properly objectified for a good description. The small sample size is the limitation of this study. However, as a preliminary study, it has given us insights into the characteristics of the grasscutter's aorta. Further studies with larger sample sizes are necessary to confirm these initial observations.

We found in this study two coronary arteries, as in humans, rats, and rabbits, at the base of the grasscutter's aorta. We observe no anatomical variations among the five grasscutters used for this study. However, in humans, variations are not uncommon, including the absence of the left coronary artery or the bifurcation of the right artery at birth (Francois et al., 2020; Demirkol et al., 2013; Afassinou et al., 2025).

Apart from the coronary arteries, the main branches of the thoracic aorta were represented by two supra-aortic trunks: a bi-carotid trunk and a left subclavian artery. This anatomical defining feature has already been highlighted by James and others in their studies (James et al., 2016). Compared to other laboratory specimens, namely the rabbit, in 94% of cases, the left common carotid arises from the bifurcation of the brachio-cephalic trunk as in the grasscutter, but in 4% of cases, it comes directly from the aortic arch, thus bringing the supra-aortic trunks to three in these cases (Ding et al., 2016). In mice, the existence of the three supra-aortic trunks was demonstrated by Sawada and others (Sawada et al., 2019). In humans, in normal (modal) anatomy, three trunks arise from the aortic arch. However, anatomical variations are not uncommon. Thus, in 24% of cases, authors report the presence of only two supra-aortic trunks: a common trunk giving rise to the brachiocephalic trunk and the left common carotid artery, followed by a second trunk corresponding to the left subclavian artery, as observed in the

grasscutter (Aboulhoda et al., 2019). In such cases, this configuration is referred to as a bovine aortic arch variation in humans.

On the abdominal segment of the aorta, the arteries going to the digestive system vary from two to three. In other words, we have noted a constant celiac trunk associated either with a single mesenteric artery or with two mesenteric arteries.

The celiac trunk is also constant in the rat and the rabbit, just like in humans, where it is for the organs of the supra-mesocolic level of the abdomen. The cranial mesenteric artery originates just below the celiac trunk, usually in grasscutters, rats, rabbits and humans. However, this origin can be either in common with the right renal artery, or at the same level or below it in rats (Vdoviaková et al., 2016). In humans, it forms a common trunk with the celiac trunk, constituting the mesenterico-celiac trunk, a rare case reported in the literature (Çiçekcibaşı et al., 2005).

The caudal mesenteric artery was inconstant in this study. When it existed, it participated in the vascularization of the distal colon. It was absent in two out of five cases. It is constant in rats and is reserved for the left colon (left colic artery) and the rectum (cranial rectal artery), just like in humans. Unlike what is observed in humans, it arises from the ventral surface of the aorta, higher up and far from the terminal bifurcation of the aorta in the grasscutter.

Similar to humans, the two genital arteries arise directly from the abdominal aorta in a high position, forward and laterally, very close to the renal arteries. The same arrangement has been found in the rabbit with a right genital artery arising slightly higher than the left (Kigata et al., 2020). This again demonstrates the existence of anatomical similarities between humans, the grasscutter, and the rabbit regarding the mode of emergence of the genital arteries.

The other branches found in this study were the caudal lumbar and phrenic arteries. We do not focus on these parietal arteries, nor on their namesakes in the thoracic segment, because the latex used here did not allow the study of these very fine vessels.

Conclusion

The largest artery in the body, the grasscutter's aorta, exhibits almost the same main branches as in humans from a qualitative perspective. Quantitatively, however, certain differences have been identified. Further studies with larger sample sizes are necessary to confirm these initial observations. Looking for the upcoming studies, these first results represent specific features that must be taken into account when conducting experiments on the grasscutter's aorta for clinical purposes.

Conflict of Interest: The authors reported no conflict of interest.

Data Availability: All data are included in the content of the paper.

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Declaration for Animal Studies: This study was approved by the relevant Animal Ethics Committee of the Faculty of Health Sciences at the University of Lomé (Togo) under approval number 417/2026/CE-FSS/19/01. All applicable international, national, and institutional guidelines for the care and use of animals were followed.

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