

# Aorta Artery and Branches in Tucanuçu (*Ramphastostoco* – Muller, 1776)

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**Abstract**— *Tucanuçu* (*Ramphastostoco* – Muller, 1776) is the largest Tucano birds and possess remarkable characteristics, such long orange beak and black spot on end, its black plumage, an area of bare orange skin around the eyes and blue eyelids, being a symbol of avian diversity found in South American ecosystems, whose anatomy and systemic description are little studied, fundamental process to understand biological system of this animal. Thus, this work aimed to perform an anatomical description of aorta artery and respective branches in Tucanuçu through a comparative study, using 2 male and 2 female specimens. In this sense, the present work shows unprecedentedly discovered about this animal that vascular pattern shows similarities with other birds and Aorta being the main vessel that emerges from left ventricle base of the heart. The first branches of Aorta are three coronary arteries: Right, Left and Dorsal. Brachiocephalic Aa. and Cervicobrachial arises from cranial face of aortic arch and directed: Brachiocephalic a. which is left limbs, to head, neck and left thoracic member and Cervicobrachial to neck and right thoracic limb.

**Keywords**— *Circulatory System, Comparative Anatomy, Wild Animals and Birds.*

## I. INTRODUCTION

Tucanuçu (*Ramphastostoco* – Muller, 1776) is the largest Tucano birds [1] and possess remarkable characteristics, such long orange beak and black spot on end, its black plumage, an area of bare orange skin around the eyes and blue eyelids [2]. It is a bird Piciforme order and Ramphastidae family, found in all central part of Brazilian territory and some parts of Amazon, exhibiting abundance in Cerrado and Atlantic Forest [1,3,4]. Due unmistakable and unmistakable characteristics, Toucanos

birds are considered the symbol of avian diversity in South American continent. However, this species is threatened as victim of anthropic actions, including animal trafficking [5,6].

This bird stands out for its large size, reaching up to 66 cm in length and its beak, 23 cm, which, although large and disproportionate to the body, is light, representing only 5% of its body weight, which can weigh 540 grams [7]. They are large birds that occupy forest canopy and whose diet is substantially based on fleshy fruits [3,8,9], insects and arthropods, but also can loot nests of other birds and feed their eggs or puppies [10].

The presence of fruits in Tucanuçu diet, it has an important ecological function in dispersion of seeds, fundamental for regeneration of forests [11]. The planet presents complex pattern climates, which, in turn, play an important role in creating complex patterns of vegetation and types of community found, including Cerrado, which can be considered complex biome [12]. The Cerrado is the second largest Brazilian biome, consisting of a mosaic of plant formations ranging from open fields to dense forest formations [13,14]. It occupies about 20% of national territory, limiting itself almost all Brazilian biomes (except southern fields and coastal ecosystems), there are still regions of enclaves Cerrado in Amazon, Caatinga and Atlantic Rainforest caused changes in biodiversity [15].

Cardoso da Silva and Bates (2002) [16] suggest that bird distribution patterns follow same dynamics of flora diversification of Cerrado environments. The group of birds presents an expressive concentration of species in Cerrado, since practically half of species registered in Brazil can be found in this biome. Major revisions of

Cerrado avifauna indicate existence of 837 species in this area [17].

The aorta is the main arterial trunk of the body, beginning at the base of left ventricle and divided into *Ascending* and *Descending Part*, and presents many ramifications. In domestic birds, the first branches of *Ascending Part* are *Right Coronary* and *Left Coronary Aa.* that born cranially at aortic valve fixation. Each coronary artery branches in *Superficial* and *Deep Branches*, unlike mammals. The *Deep Branch* is larger than *Superficial* and travels through interventricular septum. The right coronary artery is larger than left. The following branches of Aorta are: *Right* and *Left Brachiocephalic Arteries*, very prominent, which originate *Right* and *Left Common Carotid Arteries* and *Right* and *Left Subclavian Arteries* [18].

Aorta Arch is the transition between *Ascending* and *Descending Parts* and extends dorsally and to the right and reaches the apex level of right lung doubles caudomedially continuing then as *Descending Part of Aorta* or simply *Descending Aorta*, which extends to tail region, when is called *Median Caudal Artery*. Each *Brachiocephalic Artery* is divided into *Common Carotid Artery*, *Axillary Artery* and *Pectoral Trunk*. The *Descending Aorta*, along its path through thorax and abdomen, emits several pairs of *Dorsal Arteries* which are named according to the segment of column in *Dorsal*, *Caudal*, *Sacral* and *Intercostal*. At the fifth costal level, descending aorta emits two large branches, *Celiac A.* and *Mesenteric cranial a.*, the two main abdominal visceral arteries, other visceral branches of descending aorta are *Renal Arteries* and *Mesenteric Caudal*. In the pelvic portion of birds, the substantial branches of aorta are *External* and *Sciatic Iliac Arteries* as the major branches of this portion of aorta and the main arteries for pelvic limb of birds [18].

Together, anatomical and systemic descriptions of any specie are fundamental for biological system knowledge and the importance in ecosystem. However, anatomy of aorta and its branches in Tucanuçu is little studied. Considering the importance of circulatory system for this animal anatomy, this study aimed investigate and describe the anatomy of Abdominal Aorta and its branches in Tucanuçu as a literary subsidy for different areas of knowledge and preservation programs.

## II. MATERIAL AND METHODS

The present paper is a descriptive anatomical study with two male and two female specimens of

Tucanuçu (*Ramphastos toco*), obtained from natural or accidental death on the roadsides of Brazilian Southeast of Goiás, under authorization of SISBIO n° 37072-2. Considering the descriptive approach of this work, statistical analysis is not necessary. All procedures were conducted in accordance with ethical principles and approved by the Institutional Ethics in Research Committee at the Federal University of Uberlândia (CEUA/UFU n° 067/12).

The study was made in the research laboratory of human and comparative anatomy of Federal University of Goiás – RC, as previously described by our group [19], where the arterial system was dissected and inject with Latex Artecola, colored with red pigment Wandalar, through the carotid artery. Subsequently was made a fixation with aqueous 10 % formaldehyde solution to conservation.

The preparation of anatomical pieces was performed under consecrated techniques in Macroscopic Anatomy and abdominal wall was laterally open to visceral exposure, then all abdominal part and digestive system secluded, exposing dorsal wall of abdomen. With an anatomical forceps, adipose tissue and other tissues were removed to expose abdominal aorta artery and its branches. A stereomicroscope MOTIC SMZ-168, with magnification of 10X was used to dissection procedure.

The Nikon® D7000 18-105 digital camera was used to photographic documentation and description nomenclature adopted is the standard of Nomina Anatomica Veterinaria (2012) [20], elaborated by the International Committee on Veterinary Gross Anatomical Nomenclature.

## III. RESULTS

Aorta is the main artery that leaves heart of Tucanuçu, it born at base of left ventricle and emits three coronary arteries: *Right*, *Left* and *Dorsal*. The first part of Aorta in Tucanuçu, *Ascending Aorta* is very short, it follows cranially, slightly inclined to the right and soon curves strongly to the right and dorsally, like *Aortic Arch*. The *Aortic Arch* emits *Brachiocephalic Aa.* to left and *Cervicobrachial* to the right. A *Brachiocephalic a.* is a prominent blood vessel that born from cranial faces of aortic arch and then branches into *Left Carotid a.* and *Left Subclavian a.*. A *Cervicobrachial a.* arises from aortic arch and provides branches to neck and right limb and from *Aortic Arch* in dorsal surface, born an artery for lungs, trachea, and esophagus (Figure 1).

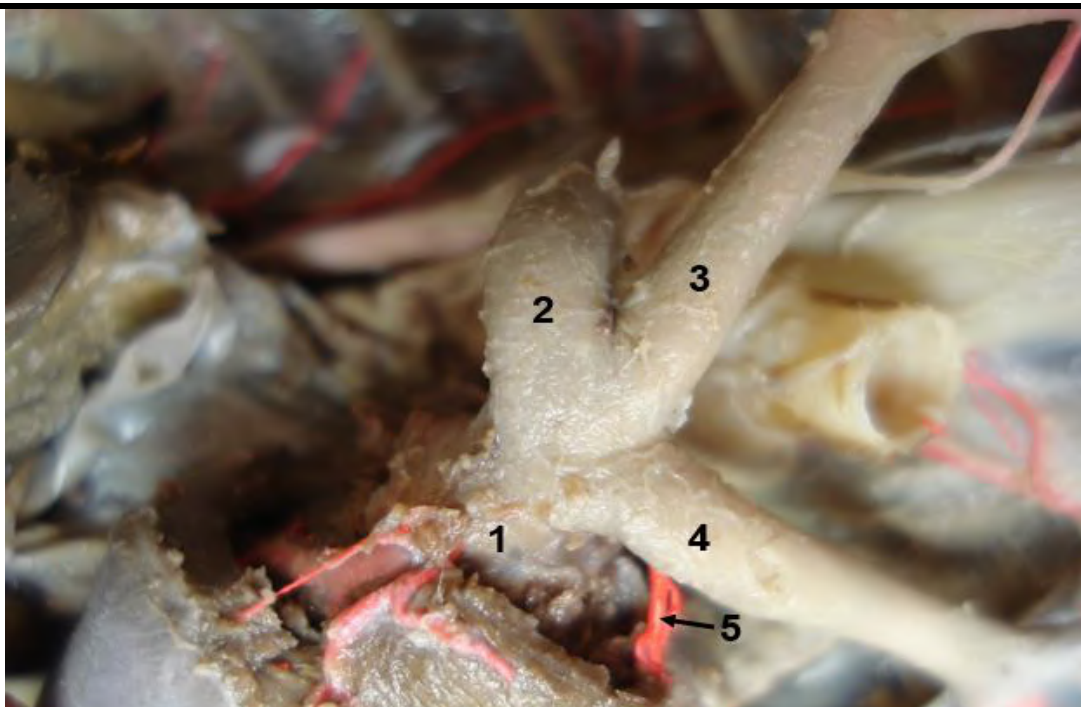


Fig.1: Ventral view of the thoracic cavity of the Tucanuçu: 1- Ascending Aorta, 2- Descending Aorta, 3- Cervicobrachial Artery, 4- Brachiocephalic Artery, 5- Pulmoesophageal Artery.

The descending aorta begins at cranial pole of right lung, curves medially to medial plane, when follows the ventral aspect of spine, crossing entire thorax, without providing collateral. The first major branch of descending aorta is a visceral artery, *Celiac A.*, and then, on ventral side, *Mesenteric Cranial A.* born, a large artery which

together *Celiac A.*, supplies nearly all abdominal viscera. Throughout *Abdominal Part* of Aorta, in the vicinity of *Celiac* and *Mesenteric Cranial A.*, several small arteries, as *Intercostals Aa.* intended for chest wall and abdominal wall. The next branches of Aorta are small *Renal Cranial Aa.*, intended for cranial lobes of kidney (Figure 2).

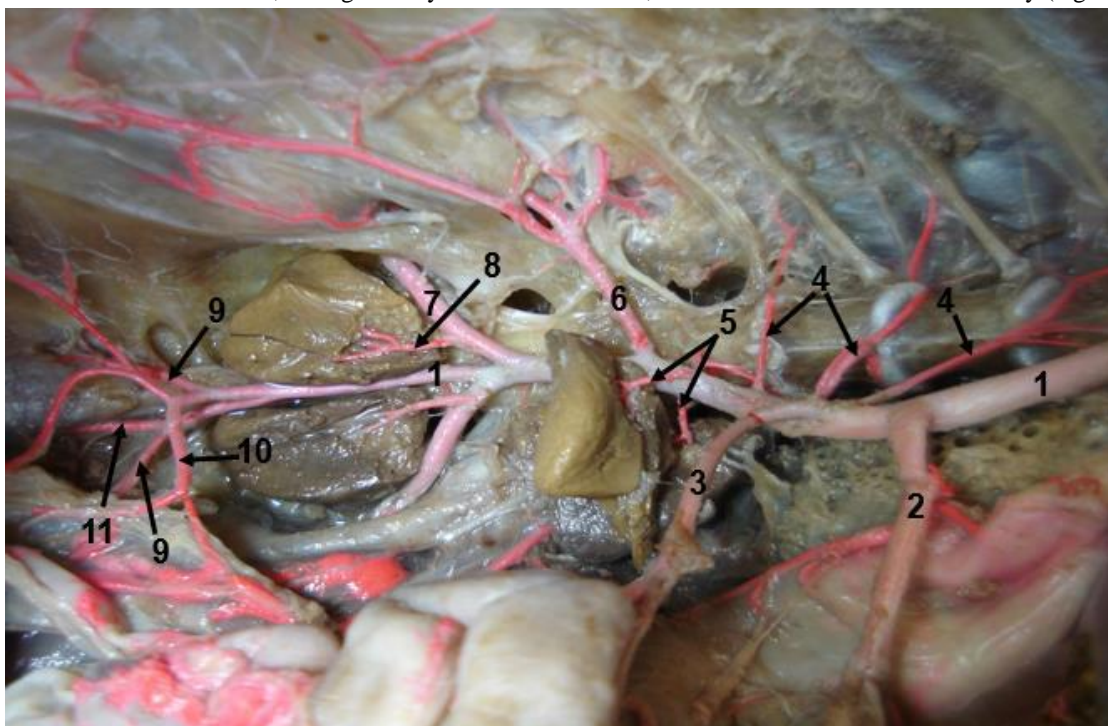


Fig.2: Ventral view of the thoracoabdominal cavity of the Tucanuçu: 1- Descending aorta, 2- Celiac artery, 3- Cranial Mesenteric Artery, 4- Intercostal Arteries, 5- Cranial Renal Arteries, 6- External Iliac Artery, 7- Sciatic Artery, 8- Caudal Renal Arteries, 9- Internal Iliac Artery, 10- Caudal Mesenteric Artery, 11- Medium Caudal Artery.



Then, on each side, a large *External Iliac A.*, which dorsally crosses renal lobe in lateral direction, but does not provide any branches before reaching abdominopelvic wall. Thereafter, a large *Sciatica A.* appears on each side, as penultimate branch of aorta, which is destined for pelvic limb. Both *Sciatic Arteries* cross laterally caudal lobe of the kidney and path emits a branch for renal lobe, then follows freely until Ileum-

Sciatic foramen, where leaves pelvis. Aorta follows caudally, now much smaller in caliber, on ventral surface of synsacrum and divides into *Internal Iliacs Aa.* and *Medial Caudal*. *Internal Iliac* provides branches to intrapelvic structures and medial flow goes to *uropygium*. A large *Caudal Mesenteric Artery* arises from *Internal Iliac* and suppresses intra-pelvic viscera and caudal part of intestine (Figure 3).

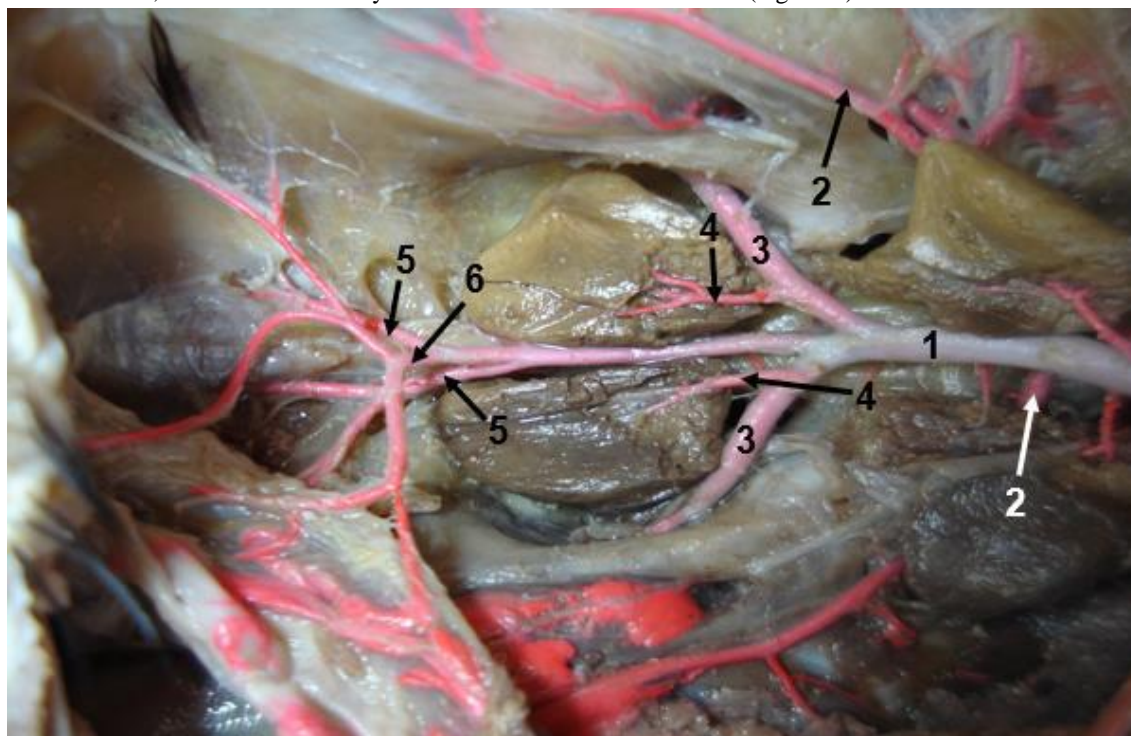


Fig.3: Ventral view of the thoracoabdominal cavity of Tucanucu: 1 - Descending Aorta, 2- External Iliac Artery, 3 - Ischiatic Artery, 4 - Caudal Renal Artery, 5 - Internal Iliac Artery, 6 - Caudal Mesenteric Artery.

#### IV. DISCUSSION

Spite the ecological concern situation, Tucanuçu (*Ramphastoco* – Muller, 1776) is one of the main birds found in “Centro de Triagem de Animais Silvestres – CETAS – Catalão” and other Wildlife Rehabilitation Centers, and a large part of animals destined to these organizations originate in traffic and many of them are dies [21].

Considering the results obtained in this work, was observed that Ascending Aorta of Tucanuçu is very short and follows cranially, slightly inclined to the right and soon curves strongly to the right and dorsally, constituting Aorta Arch, in agreement with descriptions in domestic birds [18,22,26] and domestic pigeon (*Columba livia*) [27]. Neto (2013) [28], describes, in pigeons, the branches of *Aorta A.*, and portrays *Celiac A.*, as the first major branch of descending aorta, in agreement with Getty in Sisson & Grossman (2008) [18] and Schwarze&Schröder (1970) [2], in domestic Gallus and Mutuns of gender Crax and Mitu to Gonçalves *et al.* [29].

The *Brachiocephalic Aa.* and *Cervicobrachial* are two prominent blood vessels found in Tucanuçu that arise from cranial face of aortic arch and go to head, neck and thoracic limbs, in accordance with descriptions of Getty in Sisson & Grossman (2008) [18] and Schwarze&Schröder (1970) [23] in Domestic Rooster. In Tucanuçu, the *Brachiocephalic a.* is a left branch, of *Aortic Arch*, which divides into *Common Carotida*, *Subclavian A.* and *Cervical Ascending A.*, while *Cervicobrachial a.* is a right branch, which emits a large *Cervical A.* and remains laterally as *Subclavia A.*. From *Aortic Arch*, in Tucanuçu, an artery for lungs, trachea, and esophagus born from dorsal surface in accordance with descriptions of Getty in Sisson & Grossman (2008) [18] and Schwarze&Schröder (1970) in domestic Gallus [22].

According to Getty in Sisson & Grossman (2008) [18] and Schwarze&Schröder (1970) [22], in domestic Gallus, the *Descending Aorta*, along its path through thorax and abdomen, emits numerous pairs of *Dorsal Arteries* are named according to the segment of

column in *Dorsal Intercostals*, *Sinsacral* and *Caudal*, but in Tucanuçu also arises several arteries, the *Intercostals Aa.* intended for thoracic wall and abdominal wall, without constituting itself in numerous branches.

*Celiac A.* and *Mesenteric Cranial A.*, the two main abdominal visceral arteries, other visceral branches of descending aorta are renal arteries and caudal mesenteric [18]. The findings in Tucanuçu are consistent with descriptions of Getty in Sisson & Grossman (2008) [18], Schwarze & Schröder (1970) [22], Baumel (1981) [23], Baumelet *et al.* (1993) [24] and Dyce *et al.* (2004) [25] in Domestic Gallus and Geeverghese *et al.* (2012) [26] in Domestic pigeon (*Columba livia*).

In Tucanuçu, the next major branches of descending aorta are External Iliac a., Ischiatic and Internal Iliac, in agreement with citations in domestic Gallus by Getty in Sisson & Grossman (2008) [18], Schwarze & Schröder (1970) [22], Nickel *et al.*, (1977) [27], Baumel (1981) [23], Baumelet *et al.* (1993) [24] and Dyce *et al.* (2004) [25] and in Domestic pigeon (*Columba livia*) to Geeverghese *et al.* (2012) [26].

## V. CONCLUSION

The present study shows unprecedentedly relates about aorta artery and respective branches in Tucanuçu (*Ramphastostoco*), showing that the first major branch of descending Aorta is an odd visceral artery, *Celiac a.* and then, on ventral face, *Mesenteric Cranial a.*, the largest visceral branch of descending aorta, which together with *Celiac A.* supplies almost all of abdominal viscera. In Tucanuçu, *Renal Cranial Aa.* arises from aorta, but averages and flows are from *Ischiatic a.* Also, several small branches are found destined to structures abdominal cavity, such as: gonads, adrenals and other tissues. Thus, this work shows great similarity with others birds and particularities about this specie, contributing to anatomical description and understanding of an important blood vessel in Tucanuçu biological system.

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