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Original Articles

Intestine vascularization of sloth (*Bradypus variegatus* SCHINZ, 1825)

Vascularização do intestino do bicho-preguiça (*Bradypus variegatus* SCHINZ, 1825)

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A R T I C L E I N F O

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A B S T R A C T

Common sloth (*Bradypus variegatus*) is a mammal that belongs to the superorder Xenarthra, typical from neotropical regions, with geographic distribution from Honduras to northern Argentina. Our study aimed to describe the intestine blood supply of these Bradipodids in order to collaborate with the clinical-surgical for these animals. For that, ten animals, included four females and six males, were sampled from the collection of the Anatomy Division, Department of Animal Morphology and Physiology, Universidade Federal Rural de Pernambuco DMFA/UFRPE. Corpses received formalin, preserved in saline solution and subsequently dissected for description of the cranial (AMCr) and caudal (AMC) mesenteric arteries. Sixty percent of sloths presented AMCr and AMC, cwhile 30% of them had intestines (small and large) irrigation from the common mesenteric artery (AMCo), an arterial trunk from which AMCr and AMC originated. For 10% of the specimens, the entire intestine was vascularized only by AMCr. Along the AMCr branches, there were arched arrangements, with arches size reductionat the level of the small intestine. Therefore, *B. variegatus* presents anatomical variations regarding the irrigation of the intestine, which can be made from AMCr and AMC, from the AMCo arterial trunk or to a lower frequency exclusively through AMCr branches.

Palavras-chave:
Artérias mesentéricas
Aorta
Suprimento sanguíneo
Preguiça-comum
Xenarthras

R E S U M O

A preguiça-comum (*Bradypus variegatus)* é um mamífero pertencente à superordem Xenarthra, típica de regiões neotropicais, com distribuição geográfica de Honduras ao norte da Argentina. O estudo teve como objetivo descrever o suprimento sanguíneo do intestino destes Bradipodídeos, com o intuito de colaborar com a clínica-cirúrgica destes animais. Neste contexto, foram utilizados dez animais pertencentes ao acervo da Área de Anatomia do Departamento de Morfologia e Fisiologia Animal da Universidade Federal Rural de Pernambuco DMFA/UFRPE, sendo quatro fêmeas e seis machos. Os cadáveres foram formolizados e conservados em solução salina e, posteriormente, dissecados para a descrição das artérias mesentéricas cranial (AMCr) e caudal (AMC). Diante disto, observou-se que 60% das preguiças apresentaram AMCr e AMC. Enquanto que, em 30% delas, a irrigação dos intestinos (delgado e grosso) se deu a partir da artéria mesentérica comum (AMCo), um tronco arterial do qual se originaram AMCr e AMC. E em 10% dos espécimes, todo intestino foi vascularizado unicamente pela AMCr. Ao longo das ramificações de AMCr percebeu-se arranjos arqueados, com diminuição do tamanho dos arcos ao nível do intestino delgado. Portanto, *B. variegatus* apresenta variações anatômicas quanto a irrigação do intestino, podendo esta ser feita a partir de AMCr e AMC, do tronco arterial AMCo ou numa menor frequência através exclusivamente de ramos de AMCr.

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INTRODUCTION

Studying the intestinal vascularization model of *Bradypus variegatus* (common sloth) seeks to understand some body aspects, which may corroborate for understanding of its differentiated morphophysiology, since they havea slow metabolism, which may be related to the consumption of low-energy foods, whereas are authentic follicles, fed leaf, buds and soft branches Gilmore; Costa; Duarte (2001). These mammals have adaptive functions such as reduced absorption of toxic substances synthetizedby some plants part of their diet (PEREIRA JR, 2007).

Common sloth present large and complex stomach (MESQUITA et al., 2015), divided into three chambers: cardia, bottom, diverticulum, body, pre-pylorus I and II, which function is digestion supported bycellulose-digesterbacteria. Regarding the intestine, Fonseca Filho et al. (2018), reported that *B. variegatus* has long intestine, which corroborates König; Liebich (2016), who reported that herbivores intestine have greater length than carnivores. However, a study performed about sloth of the genus *Choloepus* reported that the large intestine is short and the cecum is absent, which may indicatea gastric fermentation (BRITTON, 1941; PINHEIRO, 2008).

Bradipodids population has been suffering from environmental changes promoted by anthropic actions. Considering that are essential tree-dependents by needing to move among trees for feeding, and go down to groundmainly to defecate. Thus, the non-adaptation of sloths living on the ground makes these eutheria, of slow movements, become more susceptible to predators (GILMORE; COSTA; DUARTE, 2001). This condition has contributed to reduce specimens, and currently, the genus already has representatives on the endangered species red list acording to the International Union Conservation of Nature IUCN (2019). Brazil has almost all representatives of three-toed sloth, excepted for pygmy three-toed sloth (*Bradypus pygmaeus*).

Through the importance to know the anatomical aspects of sloths and in order to contribute for treatment of sick or injured animal, our work aimed to describe the origin and distribution of the cranial (AMCr) and caudal (AMC) mesenteric arteries of common sloth, which is a valuable information for veterinarians and biologists for knowledge and medical clinic of this species.

MATERIAL AND METHODS

To perform this research, ten sloths of the species *B. variegatus* were sampled, four females and six males. Corpses were donated after natural deathby Dois Irmãos Zoo and Wild Animal Screening Center CETAS-Tangará. Then, they were sent to the collection of Anatomy Division, Department of Animal Morphology and Physiology, Universidade Federal Rural de Pernambuco DMFA/UFRPE. Corpses were fixed by perfusion with formaldehyde 20% and storaged in tanks with saline solution 30%. Dissection occurred from a median sagittal incision in the abdomen, followed by skin and muscle foldered, in order to observe and descript the mesenteric arteries. Steps were photo-recorded to better understand the results. Data analysis considered the origin, frequency and arrangement of the mesenteric arteries branches. The project was approved according the protocol nº 027/2018 of the Animal Use Ethics Committee CEUA/UFRPE and SISBIO nº46665-3.

RESULTS

The intestinal vascularization of common sloth had variation conform origin of AMCr and AMC (Table 1). In 60% of the animals sampled, AMCr originated from the right side of the abdominal aorta, caudally to the celiac trunk, and vascularized the entire small intestine and a large part of the large intestine (cecum and circles). Whereas for these animals, AMC emerged ventrally from the abdominal aorta, cranially to renal arteries, irrigating the rectum and distal extremity of colon (Fig. 1).

However, for 30% of the analyzed sloths, the small intestine and most of the large intestine (cecum and colon) were vascularized from an arterial trunk, the common mesenteric artery (AMCo) that originated a common trunk with celiac artery, located on the right side of the abdominal aorta, the celiac-mesenteric trunk. The common mesenteric artery was divided into AMCr and AMC, and these had the same irrigation areas previous described (Fig. 1).

For 10% of the specimens, however, AMC was not evidenced, in which AMCr is responsible for the branches emission in order to vascularize the entire intestine.

Regarded the mesenteric arteries angioarchitecture, AMCr branches presented arched form in 100% of the specimens, and the arches caliber gradually decreased along the small intestine. From the arches, there was also distribution of straight branch that nourished the intestinal loops (Fig. 2). On the other hand, AMC demonstrated a straightpath adhering in the rectum.

Table 1 – Intestine Vascularization Characteristics of Sloth *Bradypus variegatus*.

Arteries that Vascularize the Intestine	Frequency (%)	Vessel Origin regards the Abdominal Aorta
Cranial* and Caudal▲ Mesenteric Artery	60	Right Side (Cranial Mesenteric) Ventral (Caudal Mesenteric)
Commom▪ Mesenteric Artery	30	Right Side
Cranial* Mesenteric Artery	10	Right Side

*Emerges caudally from the abdominal aorta to celiac artery
▲Emerges cranially from the abdominal aorta torenal arteries
▪Emerges from the abdominal aortain a commom trunk with the celiac artery

Figure 1 – Intestinal vascularization origin of sloth *Bradypus variegatus*. A- Mesenteric arteries originated from the common mesenteric artery (AMCo). B- Cranial (AMCr) and caudal (AMC) mesenteric arteries originated directly from the abdominal aorta (aa). C- AMC absent. Celiac-mesenteric trunk (TCM), celiac artery (AC), left renal artery (ARE), rectum (RT), right antimere (d) and left antimere (e).

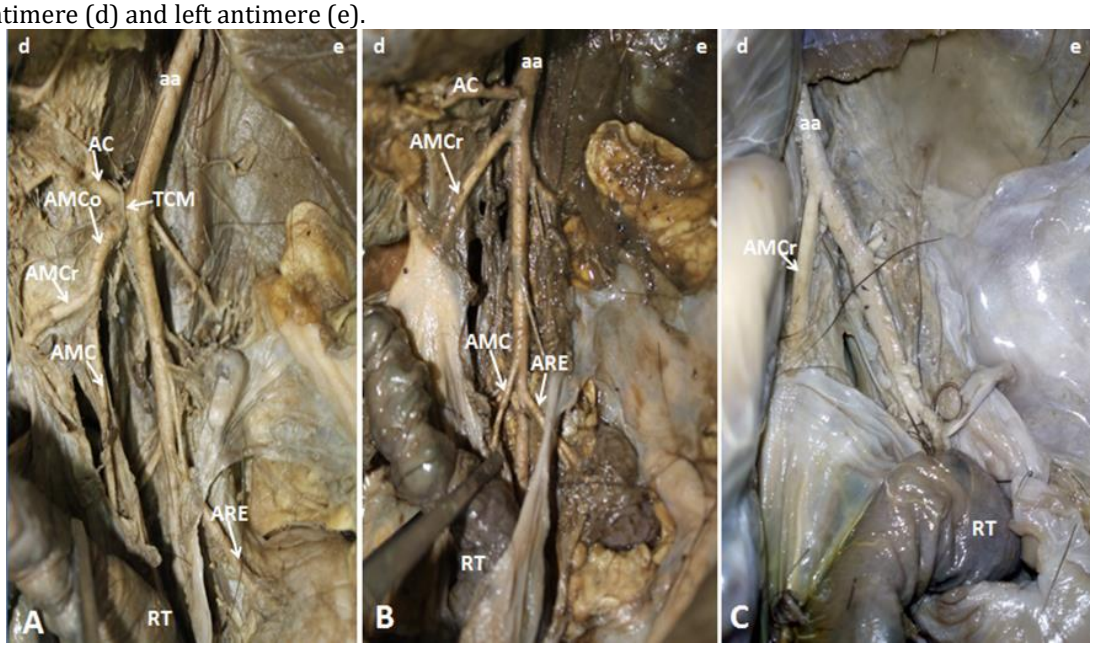
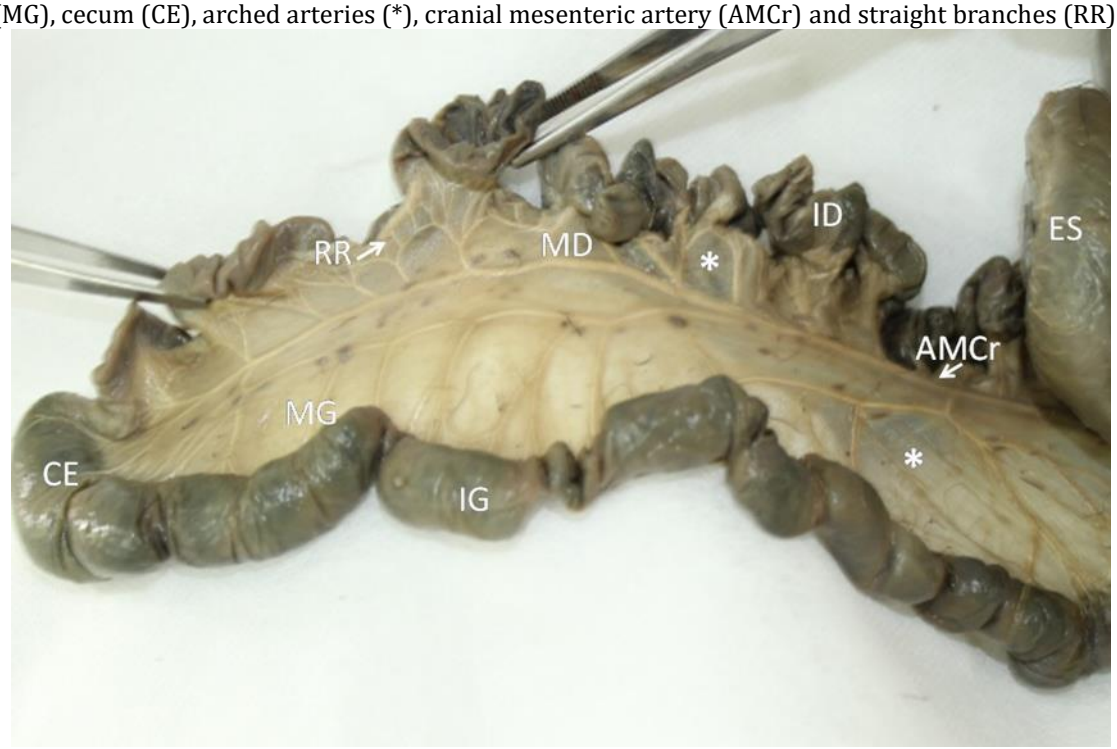


Figure 2 –Intestinal loops and angioarchitecture of cranial mesenteric artery (AMCr) of sloth *Bradypus variegatus*. Identified the stomach (ES), large intestine (IG), small intestine (ID), mesentery boundto jejune and ileum (MD), mesocolon (MG), cecum (CE), arched arteries (*), cranial mesenteric artery (AMCr) and straight branches (RR).



DISCUSSION

Intestinal vascularization of common sloth occurred predominantly from the AMCr and AMC mesenteric arteries, originated separately at the abdominal aorta, as observed for domestic animals according to König; Liebich (2016). However, two other arrangements were observed, one of them was characterized by the arterial trunk presence (AMCo), which divided and originated in AMCr and AMC, and the another arrangement, less frequent, in which AMC was not identified, thus the entire intestine presented vascularization by AMCr.

Variations were also reported by Ferreira et al. (2001) in fetuses of Saanen goats (*Capra hircus*), which presented AMCr origin in the ventral face of the abdominal aorta, caudally to the celiac artery for 93.33% of the specimens. While in 6.66% of fetuses, the celiac artery originated from a common trunk. For buffaloes (*Bubalus bubalis*), 90.33% of the animals sampled, the mesenteric and celiac artery originated independently, and for 9.66% of cases these arteries originated from a common trunk, originated from the ventral face of thethoracic aorta Machado et al. (2000).

Amadori et al. (2013) reported that forveado-catingueiro (*Mazama gouazoubira*), AMCr emerged from the abdominal aorta, caudal to the celiac artery. Also related by Oliveira et al. (2015), in which eighteen of the cavy (*Galea spixii*) sampled had the same arrangement identified for deer. Xavier-Silva et al. (2013) in their research with domestic catobserved that fifteen of the dissected animals had the caudal AMCr origin on the celiac artery. The Bradipodids analyzed in our work had the origin of caudal AMCr on the celiac artery, for most animals sampled, which corroborates with data previous mentioned.

Xenarthas, such as the collared sloth (*Bradypus torquatus*), dissected by Ferreira, et al. (2013) demonstrated the absence of AMC, as also observed for 10% of common sloths sampled in our study, for both species AMCr branches irrigate the entire intestine. Although, forgiant anteater (*Myrmecophaga tridactyla*), Souza et al. (2010) described that the intestines have irrigation provided by AMCr and AMC, which was also described by Getty (1986) when studying domestic animals such as pigs and dogs, which also occur commonly for *B. variegatus*, however, the animals previous mentioned have their vessels emerged ventrally from the aorta artery, which differs from the common sloth that has AMCr emerging from the right side and abdominal aortic ventral AMC, which may be associated with the peculiarities of this animal, such as countless variations in its vessels.

Based on the model of AMCr branches arched of the studied species, Souza et al. (2010) and Ferreira et al. (2013) also reported in their research that *B. torquartus* and *M. tridactyla*, respectively, presented the arterial arches with straight branches, responsible for nourishing the large and small intestines, facilitating blood flow and contributing to reduce a vascular failure.

CONCLUSIONS

It was concluded that the intestine of *B. variegatus* is vascularized by the mesenteric, cranial and caudal arteries, originated directly from the aortic artery or arterial trunk, the amco. It can be noticed, a less frequent arrangement with the unique presence of AMCr that irrigates the entire intestine. For this artery, arched architecture was observed for its branches, from which straight vessels left for the intestinal arches. The arched profile decreased the arches hierarchy along the small intestine. The caudal mesenteric artery, when present, demonstrated a straight path, insertedon the rectum.

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