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External macroscopic anatomy of the *Bradypus variegatus* heart

[*Anatomia macroscópica externa do coração de Bradypus variegatus*]

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ABSTRACT

The sloth is known for its slow movements and arboreal habits. Most parts of its anatomy need yet to be unveiled, in order to understand the peculiarities that justify its behavior. In this sense, an investigation of the external characteristics of the heart of the three-toed sloth, *Bradypus variegatus*, was carried out to indicate the shape, the faces, the dimensions, the topography, and the coating of this organ. For this purpose, fifteen corpses destined for dissection and four healthy specimens were used to carry out thorax digital x-ray. Based on the obtained results, it was noticed that the heart of the species in question presents conical shape, situated obliquely in the mediastinum, is displaced to the left and has latero-lateral slight flattening. Among the animals, discrepancies were found in the organ skeletopy, which presents the tapered apex and the base, in which the large vessels can be observed, whose arrangements also proved to be variables. The heart presents faces (right and left), margins (cranial and caudal) and is surrounded by the pericardium, which gives off two ligaments, sternopericardial and phrenico pericardial. Its size is proportional to the age and length of the individual, with measurements, in general, slightly larger in males.

Keywords: Morphology, morphometry, topography, heart, *Bradypus variegatus*

RESUMO

O bicho-preguiça é conhecido por seus movimentos lentos e por seu hábito arborícola. Muito de sua anatomia precisa ainda ser desvendada, com o objetivo de se entender as peculiaridades que justificam seu comportamento. Nesse sentido, realizou-se uma investigação das características externas do coração da preguiça-de-três-dedos, Bradypus variegatus, *a fim de apontar a forma, as faces, as dimensões, a topografia e o revestimento desse órgão. Para tal, foram utilizados 15 cadáveres destinados à dissecação e quatro espécimes hígidos para realização de radiografia digital do tórax. Com base nos resultados obtidos, observou-se que o coração da espécie em questão apresenta formato cônico, situa-se obliquamente no mediastino médio, é deslocado para o antímero esquerdo e possui achatamento laterolateral. Foram constatadas, entre os animais, discrepâncias na esqueletopia do órgão, que apresenta um ápice afilado e uma base, na qual se podem observar os grandes vasos, cujos arranjos também se demonstraram variáveis. O coração apresenta faces (direita e esquerda), margens (cranial e caudal) e encontra-se envolvido pelo pericárdio, que emite dois ligamentos, esternopericárdico e frenicopericárdico. Seu tamanho é proporcional à idade e ao comprimento do indivíduo, com medidas, em geral, levemente maiores nos machos.*

Palavras-chave: morfologia, morfometria, topografia, coração, Bradypus variegatus

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INTRODUCTION

Sloths are mammals that are part of the Xenarthra superorder, as are anteaters and armadillos. They are distributed in the genera, *Bradypus*, which includes sloths with three toes on the thoracic limbs (bradypodids) and *Choloepus*, which includes animals with only two fingers on those limbs (megalonychids) (Gardner, 2005). Both *Bradypus* and *Choloepus* are slow and arboreal mammals with great peculiarities in their organic systems, which still lack detailed descriptions, especially with regard to fundamental systems for the functioning of the organism, such as the cardiovascular system (Gyton and Hall, 1997).

Bradypodids are present in almost all species in Brazil (Amorim, 2000), with emphasis on *Bradypus variegatus*, the common sloth, with a strong occurrence in the country northeast (Cabral, 2000). These animals have been a frequent target of accidents, electrocution being the most common one due to anthropic actions, which fragment and destroy habitats, bringing wild species closer to urban centers (Fuentes and Hockings, 2010; Xavier *et al.*, 2010; Pereira, 2015).

Bradypodids carry out important mutualistic interactions with moths, fungi, and green algae (Suutari *et al*., 2010; Pauli *et al.*, 2014). They also participate in the natural diet of cats, snakes, and large birds of prey. The impact on its population is consequently associated with the imbalance of these trophic relationships (Hayssen, 2010; Marchini *et al*., 2011; Zibetti and Lima, 2013; Tavares *et al.*, 2016).

To provide data that aid in the knowledge to be applied in the treatment of sick sloths or victims of injuries, as well as to favor the understanding of the behavior of these animals linked to their anatomical findings, a study of the *B. variegatus* heart was carried out, covering the morphology, morphometry and topography of the organ, as well as aspects of the basal and pericardial vessels.

MATERIAL AND METHODS

Fifteen corpses and four healthy specimens of sloths of the *B. variegatus* species were used for dissection and digital radiography, respectively. The research was duly registered in the National System for the Management of Genetic Heritage and Associated Traditional Knowledge (SinGen), under No. A21069D, and was carried out with the authorization of the Ethics Committee in the Use of Animals of the Federal Rural University of Pernambuco (Ceua/ UFRPE), No. 50/2018. It also had the release of the Wild Animal Screening Center of the State Environment Agency (Cetas/CPRH), No. 02/2017, and the Biodiversity Authorization and Information System of the Chico Mendes Institute (SisBio/ICMBio), No. 46665/10. All steps were properly photo documented and the determinations of the International Committee on Veterinary Gross Anatomical Nomenclature, Nomina Anatômica Veterinária, 2017, were used for naming purposes.

The dissection was performed in the Anatomy Area of the Department of Animal Morphology and Physiology of the Federal Rural University of Pernambuco (DMFA/UFRPE). For the description of cardiac structures, fifteen cadavers were used, five adult males, nine adult females and one young, fixed in 20% formaldehyde and preserved in 30% saline solution tanks, which belong to the Anatomy Area collection. The copies were received from Cetas/CPRH, after natural death. The animals received a midsagittal incision in the thorax, with subsequent folding of the skin, muscles, and ribs, to observe the heart *in situ* and determine the peculiarities of the shape, faces, topography and the main arteries and veins present at the base of the organ, pointing out their respective skeletopies. The pericardium was also identified.

Subsequently, the heart was removed from the cavity and dissected to identify its external structures and carry out measurements such as the dorsoventral length and the distance between the coronary sulcus and the apex. The width and perimeter were also analyzed, being measured, respectively, at the level of the middle portion of the organ and at the height of the coronary sulcus. For these measurements, a steel caliper (150mm/0.02mm) was used and, exclusively to verify the perimeter, the heart was surrounded with a pre-washed zero line, which was then measured with a ruler. For proportion analysis purposes, the body length of the corpses was obtained with a measuring tape, which is the distance between the spaces, occipitoatlantal and sacrococcygeal. The morphometric data obtained were based on the work of Silva *et al*. (2016).

In four healthy animals, one adult female, two young and one young male, living in semi-captivity, kept by the Instituto Preguiça de Garganta Marrom, at the Recife Zoo, located in the Dois Irmãos State Park, Recife-PE, digital chest radiography exams were performed to obtain topographic and biometric data of the heart. The animals were hugged to the plate, held by a handler, properly protected with a lead vest and collar. The portable radiography device used was the Image Serv, with direct conversion and a resolution of 7.86 Mpixel. The software has the complete DICOM 3.0 package. The projections were laterolateral and dorsoventral. The exams took place in the animals' enclosure, at the zoo, to avoid the stress of transport.

RESULTS

From the analysis of the data gathered from the research, it was found that *B. variegatus* sloths have a rigid chest, flattened in the laterolateral direction and slightly in the dorsoventral direction, with a diameter that visibly increases caudally. The heart is located in the middle mediastinum, with its apex displaced towards the left antimere. This organ is conical in shape, with laterolateral flattening, and is positioned obliquely to the sternum, with the right lateral skull base facing the dorsum and the tapered apex left lateral tail facing the womb (Fig. 1). The radiographic findings showed that bradipodids have the heart displaced in the caudal direction, when compared to dogs and cats.

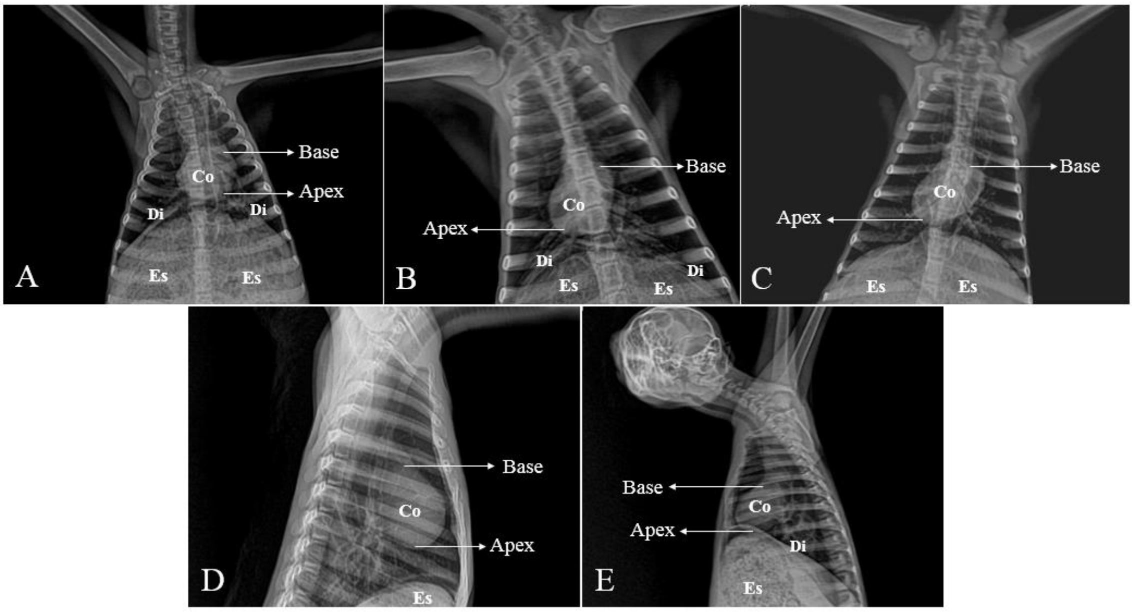

Figure 1. Images of digital chest radiographs of young *Bradypus variegatus* sloths (A, C, and E) and adults (B and D), indicating the heart base and apex, evidencing the skeletopy variation of the heart and the displacement of the organ to the left antimere. A, B and C- Dorsoventral projection (A- Heart positioned between the 4th and 6th intercostal space. B- Heart positioned between the 5th and 7th intercostal space. C- Heart positioned between the 5th and 8th intercostal space). D and L- Laterolateral projection (D- Heart positioned between the 5th and 7th intercostal space. E- Heart positioned between the 5th and 8th intercostal space). Heart (Co), diaphragm (Di), stomach (Es).

Variation in the cardiac skeletopy of the studied specimens was observed, both in the dissected animals and in the radiographed live individuals. It was observed that, in cadavers, the base of the heart was located in the 4th intercostal space in ≅11% (1) of adult females, in young females and in 20% (1) of males. In the 5th space, in ≅89% (8) of the adult females and 80% (4) of the males. Regarding the apex, it was found to be located in the 5th intercostal space in 20% (1) of males. In the 6th space, in ≅44% (4) of adult females and 60% (3) of males. At the 7th intercostal space level, in 56% (5) of adult females, in young females, and in 20% (1) of males. In the radiographed specimens, it turned out that the cardiac silhouette was found in the laterolateral projection, from the 5th to the 7th intercostal space in the male and adult female, while in the young ones, the organ was located from the 5th to the 8th space. In the dorsoventral projection, the male heart was between the 4th and the 6th space, while in two of the females, one young and one adult, the organ was located between the 5th and 7th space. In the remaining young female, the heart was visualized between the 5th and 8th space (Fig. 1.).

The vessels at the base of the heart were identified in the dissected animals, with the pulmonary trunk positioned ventrally to the ascending aorta, while the pulmonary veins and arteries were found dorsally to the ventral, cranial and caudal veins. The aorta artery, after emerging from the heart, curves to the left, forming the aortic arch, which, in all dissected specimens, emitted three branches, the brachiocephalic trunk (which gave rise to the right common carotid artery and the artery right subclavian artery), the left common carotid artery and the left subclavian artery. The arch continues caudally to the descending aorta. The pulmonary trunk, in turn, bifurcates into the two pulmonary arteries, right and left, while the cranial vena cava receives, immediately before entering the heart, the azygos vein, found in the right antimere of the thorax (Fig. 2 and Fig. 3).

In the analyzed specimens, sloths were found to have two pulmonary veins, one right and one left (Fig. 2). These, as well as the pulmonary arteries, have discrepancies in their angioarchitecture before entering and after emerging, respectively, in the pulmonary hilum in both antimeres. In this context, it was noticed that the right pulmonary artery bifurcates into two branches in ≅67% (6) of adult females, in the young female and in 40% (2) of males and presented three branches in ≅33% (3) of adult females and 60% (3) of males. The left pulmonary artery bifurcated in young females in 56% (5) of adults and 80% (4) of males and tripled in ≅44% (4) of adult females and 20% (1) of males.

Regarding the pulmonary veins, it was identified that, in the right antimere, the vessel is formed by the anastomosis of two branches in ≅44% (4) of adult females; of three branches in young females, ≅33% (3) of adults and 60% (3) of males. It is formed by four branches in 40% (2) of males and continues as a single vessel to the base of the heart in ≅ 22% (2) of adult females. The left pulmonary vein is formed from the confluence of two branches in ≅33% (3) of adult and young females. This same vein is formed by the junction of three branches in ≅44% (4) of adult females and 80% (4) of males and through four branches in ≅11% (1) of adult females. The left pulmonary vein can also emerge from the lung as a single vessel, as recorded in ≅11% (1) of adult females. In 20% (1) of the males, a peculiar arrangement of the branches was noticed when forming the left pulmonary vein: two branches converge to form a single vessel, which bifurcates and anastomoses again, constituting the referred vein.

The aorta artery and the pulmonary trunk, as well as the vena cava and pulmonary veins, leave and arrive, respectively, in the heart with a skeletopy corresponding to the base of the organ. The pulmonary trunk, in particular, showed differences between specimens regarding the position of its bifurcation, originating the pulmonary arteries at the level of the 4th intercostal space in young females, ≅11% (1) of adults and 20% (1) of males. In ≅67% (6) of adult females and 60% (3) of males, the trunk bifurcation occurred at the level of the 5th intercostal space, while in ≅22% (2) of adult females and 20% (1) of males occurred at the height of the 6th space. The ligamentum arteriosum was visualized in all the dissected animals, showing location similar to the origin of the pulmonary arteries (Fig. 3).

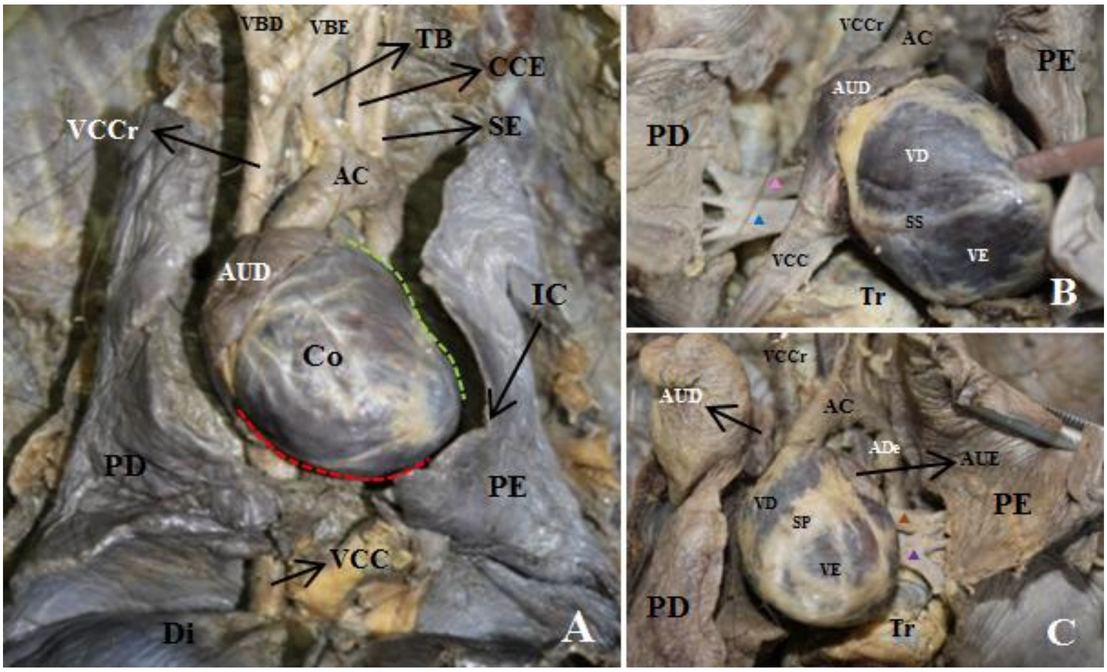

Figure 2. Photomacrographs of the external morphology of the heart of adult sloths *Bradypus variegatus*. A - Positioning of the heart amid other thoracic structures. B - View of the right cardiac face. C - View of the left cardiac face. Heart (Co), right ventricle (VD), left ventricle (VE), subsinuous groove (SS), paraconal groove (SP), cranial heart margin (-----), caudal cardiac margin (-----), right atrium (AUD), left atrium (AUE), aoptic arc (AC), brachiocephalic trunk (TB), left common carotid artery (CCE), left subclavian artery (SE), descending aorta (ADe), right brachiocephalic vein (VBD), left brachiocephalic vein (VBE), cranial vena cava (VCCr), caudal vena cava (VCC), right pulmonary artery (▲) left pulmonary artery (▲) right pulmonary vein (▲), left pulmonary vein (▲), right lung (PD), left lung (PE), cardiac notch (IC), diaphragm (Di), trachea (Tr).

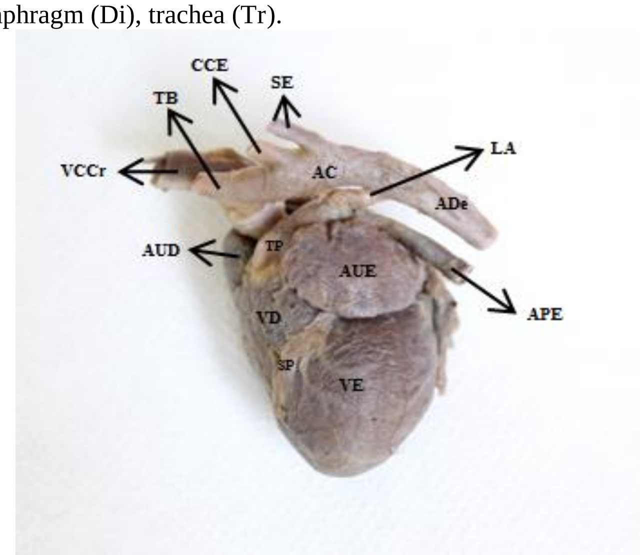

Figure 3. Photomacrography of the left face of the heart of adult sloth *Bradypus variegatus*, indicating the presence of the ligamentum arteriosum. Right ventricle (VD), left ventricle (VE), paraconal groove (SP), right atrium (AUD), left atrium (AUE), pulmonary trunk (TP), left pulmonary artery (APE), arterial ligament (LA), aortic arch (AC), brachiocephalic trunk (TB), left common carotid artery (CCE), left subclavian artery (SE), descending aorta (ADe), cranial vena cava (VCCr).

The pulmonary arteries and veins pass through the hilum of the lung in different positions among the studied animals. In the left antimere, the entry and exit of these vessels at the level of the 5th intercostal space was described in ≅11% (1) of adult females. In the 6th space, in young females, ≅11% (1) of adults and 40% (2) of males. In the 7th space, in ≅11% (1) of adult females. In the interval between the 4th and 5th space, in 20% (1) of the males. From 5th to 6th, in ≅44% (4) of adult females and 40% (2) of males. From the 6th to the 7th, in ≅22% (2) of the adult females. In the right antimere, the vessels are related to the hilum at the level of the 5th intercostal space in ≅11% (1) of adult females. On the 6th, in ≅44% (4) of adult females and 60% (3) of males. In the intervals from the 5th to the 6th space, in ≅22% (2) of the adult females. From 6th to 7th, in young females, ≅22% (2) of adults and 40% (2) of males.

Through the morphometric data obtained from cadavers, it was observed that the dimensions of the heart are proportional to the age and length of the animal, being greater in adults than in young ones. Between sexes, however, means were seen slightly higher in males, except for organ width. The numbers corresponding to the measurements performed on the dissected specimens are detailed in Table 1. In the radiographs of the live specimens, it was found that the cardiac silhouette was slightly larger in the adult female (5.94mm) than in the young ones (5.9mm and 5 .65mm). However, these values were lower than those measured for the young male (6.48mm).

Table 1. Heart dimensions and body length of dissected *Bradypus variegatus* sloths

Morphometric Variables	Average±Standard Deviation (cm)		
	Young Female	Adult Female	Adult Males
Dorsoventral Length of the Heart	3.08*	3.44±0.60	3.59±0.43
Distance between the Coronary Sulcus and the Heart Apex	1.84*	2.60±0.42	2.65±0.46
Width of the heart	2.28*	2.60±0.42	2.57±0.15
Cardiac Perimeter	7.10*	8.65±0.98	8.70±0.68
Body Length	30.00*	45.40±4.67	46.20±4.49

*Indicates that there is no standard deviation because it is a single measured specimen.

The heart of bradypodids has a sparse lining of adipose tissue and makes ventral syntopy with the lungs, sternum, and costal cartilages. Dorsally, it is related to the thoracic aorta, pulmonary trunk, esophagus, bronchi, caudal vena cava, trachea, pulmonary veins, and arteries. Laterally, in the right antimere, it meets the right lung. In the left antimere, with the corresponding lung, which is compressed by the heart, resulting in the cardiac notch. Cranially, it faces the cranial vena cava, lungs, ascending aorta, and aortic arch. Caudally, it rests on the diaphragm, so that the contraction of this muscle helps to expel blood from the heart. It was possible to identify in the organ, the right (atrial) and left (auricular) faces and the cranial and caudal margins. The coronary sulcus between atria and ventricles was observed, and among the latter, the presence of subsinuous and paraconal sulci was observed, the first being right-handed and the second sinister (Fig. 2). In the subsinuous sulcus, the subsinuous interventricular branch was found, originating from the circumflex branch of the right coronary artery, while in the paraconal sulcus, the paraconal interventricular branch that emerged from the left coronary artery was observed. The heart is surrounded by the pericardium, with two ligaments being seen in sloths, the sterno pericardium and the phrenic pericardium (Fig. 4).

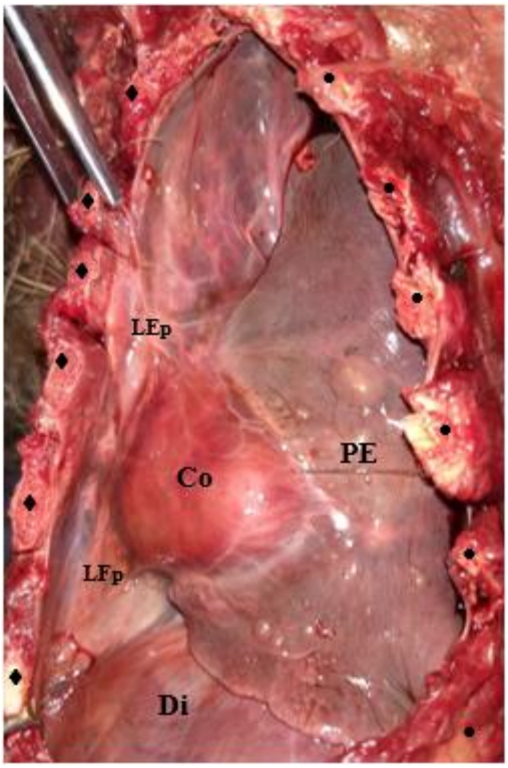

Figure 4. Photomacrography of the left antimere of the open thorax of the adult sloth *Bradypus variegatus*, showing the sternopericardial and phrenico pericardial ligaments. Heart (Co), left lung (PE), costal cartilage (♦), rib (•), sternopericardial ligament (LEp), phrenico pericardial ligament (LFp), diaphragm (Di).

DISCUSSION

Bradypodids have the heart in shape and location, in general, similar to other terrestrial mammals, that is, the organ is conical and located in the middle mediastinum (Cruvinel *et al*., 2008; Ávila *et al.*, 2010; Dyce *et al.*, 2010; Pinheiro *et al*., 2014; Pereira *et al*., 2016). However, on a more detailed observation, it can be stated that the heart differs, at its extremity, among the representatives of the class in question, with the apex being tapered in sloths and rounded in the dog (*Canis lupus familiaris*) (Carvalho *et al.*, 2002) and in the anteater (*Tamandua tetradactyla*) (Pinheiro *et al.*, 2014). Among reptiles, however, such as the green turtle (*Chelonia mydas*), the heart is pyramidal (Braz *et al.,* 2013). In sloths, the organ has a laterolateral flattening, typical of quadrupeds, even in these xenarthrans having the chest slightly compressed dorsoventrally (Dyce *et al.*, 2010). This characteristic implies Davis (1964) statements, which associate the shape of the heart with the shape of the thorax, and not with the varied habits of the species. In aquatic mammals, the organ is broad and flat, which is an adaptation to life in water that offers a lower risk of deformity due to hydrostatic pressure. It is even possible to describe the presence of a bifid apex in representatives of the Phocidae family (Rowlatt, 1990; Drabek and Bums, 2002).

Like the paca *(Agouti paca*), the sloth has an obliquely positioned heart, facing the left antimere. In rodents, the organ is positioned from the 1st to the 5th intercostal space (Ávila *et al.*, 2010). For ruminants, it is from the 2nd to the 5th, and, in horses, it is found from the 2nd to the 6th space, and there may be variations according to the heart size in the breeds (Dyce *et al.*, 2010). In carnivores such as dogs, it has been described to extend from the 3rd rib to the 6th intercostal space (Dyce *et al.*, 2010). In the cat (*Felis catus*), however, it is from the 3rd and 4th ribs to the 6th or 7th (Dyce *et al.*, 2010), while in the southern fur seal (*Arctocephalus australis*) (Guimarães, 2009) and in the capuchin monkey (*Sapajus apella*) (Furtado *et al.*, 2017) it is from 3rd to 7th. In pigs, it was observed to be from the 2nd to the 5th rib (Dyce *et al.*, 2010). In the group of xenarthrans, the anteater (Pinheiro *et al.*, 2014) and the giant anteater (*Myrmecophaga tridactyla*) (Cruvinel *et al.*, 2008), have the heart disposed from the 3rd to the 5th intercostal space. In the common sloth, it is located more caudally, with specimens in which the base of the organ was identified at the level of the 5th and the apex at the height of the 8th intercostal space. This characteristic seems to be related to the fact that the thoracic diameter is small at the shoulder girdle level, in order to favor a greater range of motion in the thoracic limbs, from the joint between the humerus and the scapula. In these slow animals, the different skeletopies of the heart and great vessels are possibly associated with discrepancies in the number of thoracic vertebrae of the bradypodidae, which may present from 14 to 15 vertebrae, in which ribs that extend through the abdominal cavity articulate, providing fixation for the stomach, preventing it from turning against the thorax when sloths assume postures contrary to gravity, which could hamper respiratory and cardiac mechanisms, given the significant weight of the stomach (Freitas, 2018). According to Dyce *et al.*

(2010), it is important to evaluate the cardiac topography of the species, as its variation may result in the need to apply different methods to perform and interpret the results of the clinical examination.

The outflow of the great vessels in the region of the common sloth cardiac base differed from that observed in the marsh caiman (*Caiman yacare*) (Alves *et al*., 2016), which has a duplicity of the aorta artery. And it was similar to that described for the raccoon (*Procyon cancrivorus*) (Pereira *et al.*, 2016). However, this carnivore has the brachiocephalic trunk and the left subclavian artery emerging from the aortic arch. This conformation is different from that analyzed in the bradipodids used in this study, in which the aortic arch originates the right brachiocephalic trunk, the left common carotid artery, the left subclavian artery and continues with the descending aorta. Although all dissected specimens demonstrated such an arterial arrangement, variations were described by Albuquerque *et al.* (2018). The authors reported specimens in which the right brachiocephalic trunk and the left common carotid artery and the left subclavian artery originated from the arch, resembling that seen in the raccoon (Pereira *et al*., 2016). They also identified, in one of the animals, a bibrachiocephalic trunk. In the Ocelot (*Leopardus pardalis*), the aortic arch gives rise to the brachiocephalic trunk (from which the left common carotid and a common trunk to the right subclavian artery and right common carotid artery) and the left subclavian artery emerge (Martins *et al*., 2010). These sloth's aortic arch branches arrangements, so varied, must be linked to the evolutionary processes that gave rise to arboreal species. However, further studies are needed.

Differences in the aortic arch ramifications were also observed in the dog, in which, in the absence of the brachiocephalic trunk, there is the emergence of a bicarotid trunk, the left and right subclavian artery, or there is the emergence of two trunks, one bicarotid and the other bisubclavian (Oliveira *et al.*, 2001; Filadelpho *et al.*, 2006). The absence of the brachiocephalic trunk was also noticed in ostrich (*Struthio camelus*) (Soares *et al.*, 2010) and turkey (*Meleagres* spp.) (Dyce *et al.*, 2010), with these birds having brachiocephalic arteries not originating from a trunk. Between the aorta and the pulmonary trunk, in sloth, the arterial ligament was seen, which was also observed in the studies by Guimarães (2009) in young and adult southern fur seals.

In the present study, the existence of two pulmonary veins in *B. variegatus*, one right and one left, was described, contesting what was analyzed in the raccoon, which has four veins entering the left atrium. When treating the right atrium, these mammals have the similarity of this cardiac chamber receiving blood drained by the vena cava, cranial and caudal veins, having a first confluence of the azygos vein before its entry into the atrium (Pereira *et al.*, 2016). In paca, however, Ávila *et al.* (2010) identified two cranial vena cavas, one right and one left, in addition to the caudal vena cava. In this rodent, an azygos vein flows into the right vena cava, which collects blood from the left vena cava before reaching the right atrium. According to Pinheiro *et al.* (2014), in collared anteaters, the caudal vena cava and pulmonary veins were present in this arrival chamber, which diverges considerably from that described for other mammals (Ávila *et al.*, 2010; Pereira *et al.*, 2016).

Sloths have their hearts surrounded by their lungs, as do the anteater (Pinheiro *et al.*, 2014) and the giant anteater (Cruvinel *et al.*, 2008). In these hairys, a similarity was found in the existence of sulci, subsinuous and paraconal on the cardiac surfaces, right and left, respectively. In terms of the fat covering of the heart, *B. variegatus* resembles capuchin monkeys (Furtado *et al.*, 2017), whose tissue is scarce and differs from ostriches (Soares *et al.*, 2010), in which the coverage is thick.

In general, eutherians have the heart surrounded by the pericardium, which emits extensions that connect to structures adjacent to the organ. Sloths have two ligaments, the sternopericardial and the phrenico pericardial, which attach to the sternum and diaphragm, respectively. In non-human animals, these ligaments are common, so that the sternopericardial, present in horses, limits cardiac displacement, and the phrenico pericardium, in carnivores, gives them greater freedom of movement at the apex of the heart (Ávila *et al.*, 2010; Dyce *et al.*, 2010; König and Liebich, 2020). In the case of humans, there is also a third ligament, the vertebro pericardial ligament (Di Dio, 2004).

From the morphometric analysis of the *B. variegatus* heart, it was found that the size of the organ was directly proportional to the age and length of the animal, regardless of sex, which was also found by Guimarães (2009) in the fur seal southern. When comparing the data obtained from sloths with those obtained from other mammals, it was observed that the heart of these xenarthrans maintains dimensions similar to that of the paca, the second largest Brazilian rodent, whose craniocaudal measurement is 3.58cm±0.39 and laterolateral of 2.66cm±0.47 (Ávila *et al.*, 2010). It is smaller than the measurement made in anteaters, in which the organ was 6cm long and 3cm wide (Pinheiro *et al.*, 2014). These hairys, however, tend to have a larger body size than the common sloth (Wetzel, 1985; Cubas *et al.*, 2007; Pinheiro *et al.*, 2014). In this one, the cardiac extension did not show great variation between specimens, as seen in horses, in which the thoroughbreds have an organ larger than those of traction (Dyce *et al.*, 2010).

In sloths, the heart occupies a significant volume of the thorax, showing no functional discrepancies when correlating with the dimensions of these animals. What does not happen with pigs, whose organ is considerably small, which has been associated with the predisposition of these mammals, the sudden death syndrome (Dyce *et al.*, 2010). We can also mention the ostriches (Soares *et al.*, 2010), whose heart is large, and this considerable volume is because these birds are large and are runners.

CONCLUSION

The *B. variegatus* shows a heart with general characteristics compatible with other quadrupeds, even with a slight dorsoventral flattening of the thorax. The conical-shaped organ, with dimensions proportional to the age and size of the animal, has topographic variations that are accompanied by large vessels and their vascular arrangements. The heart is positioned obliquely in the middle mediastinum, displaced to the left and has the sides, right and left, and the margins, cranial and caudal. In addition, it is covered by the pericardium, which has the sternopericardial and phrenico pericardial ligaments and occupies a large area of the chest, being mostly involved by the lungs.

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