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## Distribution of mesenteric cranial artery in the small intestine of *Procyon cancrivorus* (Cuvier, 1798) (Mammalia, Procyonidae)

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**ABSTRACT.** The mesenteric artery is a high caliber vessel dependent on the abdominal artery, right below the emergence of the vessels destined for the liver and stomach. The present study aimed to describe the behavior of the arterial vessel in the small intestine of the crab-eating raccoon (*Procyon cancrivorus*). The animals were collected on highways (roadkill). Cannulation of the abdominal aorta, perfusion with warmed water (40°C) and stained latex injection (Neoprene 450, Dupont do Brasil and Sulvinil stain, Glassuret S.A) were performed, followed by formaldehyde fixation (10%). The dissection and photographic documents (Sony Cyber-shot, 8.1 megapixels) made it possible to systemize the arteries and define the vascular patterns of the viscera. It was verified that the mesenteric cranial artery supports the entire jejunum and the mesenteric portion of the ileum. Next to the mesenteric border, it becomes an anastomosis forming vascular arches from where straight arteries leave, supplying the mesenteric portion and sometimes also the jejunal anti-mesenteric portion. The artery that irrigates the ileum comes up as a branch of the cranial mesenteric artery. Anatomic knowledge of the vascular pattern of the crab-eating raccoon (*Procyon cancrivorus*) is of fundamental importance for researches regarding the arterial distribution of the intestine considering anatomic variances.

**Key words:** *Procyon cancrivorus*, small intestine, cranial mesenteric artery.

**RESUMO.** Comportamento da artéria mesentérica cranial no intestino delgado de mão-pelada *Procyon cancrivorus* (Cuvier, 1798) (Mammalia, Procyonidae). A artéria mesentérica é um vaso de grande calibre dependente da artéria aorta abdominal, imediatamente abaixo da emergência dos vasos destinados ao fígado e estômago. O objetivo do presente estudo foi descrever o comportamento dos vasos arteriais do intestino delgado em mão-pelada (*Procyon cancrivorus*). Os animais são procedentes de coleta em rodovias (mortos por acidente). Realizou-se a canulação da aorta abdominal, perfusão com água aquecida (40°C) e injeção de látex corado (Neoprene 450, Dupont do Brasil e Sulvinil Corante, Glassuret S.A), seguido de fixação em formaldeído (10%). As dissecações e documentação fotográfica (Câmera Sony Cyber-shot, 8.1 megapixels) permitiram sistematizar as artérias e definir os padrões vasculares da víscera. Verificamos que a artéria mesentérica cranial supre todo o jejuno e a face mesentérica do íleo. Próximo à borda mesentérica, anastomosa-se formando as arcadas vasculares e desta partem as artérias retas, que suprem à face mesentérica e, às vezes, a face antimesentérica do jejuno. A artéria que irriga o íleo surge como último ramo da artéria mesentérica cranial. O conhecimento anatômico do padrão vascular de mão-pelada (*Procyon cancrivorus*) é de fundamental importância em pesquisas que se referem à distribuição arterial do intestino, levando-se em consideração as variações anatômicas.

**Palavras-chave:** *Procyon cancrivorus*, intestino delgado, artéria mesentérica cranial.

### Introduction

The crab-eating raccoon is a mammal of the Procyonidae family, of wide geographic distribution, occupying all national biomes, and one of the least studied Brazilian carnivores (MORATO et al., 2004). Its body length is variable – between 40.0 and 100.0 cm – and the long tail presents alternated

rings, 20.0 to 38.0 cm long. Fur color oscillates from dark to grizzled, being undoubtedly identified due to a black mask that goes from the eyes to the jaw line and the uppermost height of the hind limbs, as well as its peculiar tail (REIS et al., 2006). It is an animal of nocturnal habits, solitary, which lives near to mangroves, beaches, swamps and other water bodies,

and feeds on fish, insects, amphibians, fruits and crabs.

This study aimed to examine the particular aspects related to the distribution of the arterial branches in the small intestine. According to Morandini (1968), the mesenteric arteries are responsible for blood supply in the small and large intestine in reptiles, birds and mammals, and the digested nutrients are absorbed by the epithelium and transferred to circulation (HILDEBRAND, 1995).

The mesenteric artery is an unique vessel that comes out of the aorta artery a little caudal to the origin of the celiac artery, as Ede (1965), Schwarze and Schroder (1970), Nickel et al. (1977) and Getty (1981) observe, without making reference to the strain of these animals. This vessel is responsible for irrigating the largest part of small intestine (SISSON; GROSSMAN, 1959).

Nayar et al. (1983), while observing by arteriography the anatomy of the abdominal viscera and the lombar region in caprines, carnivores, swine and rabbits, report that the cranial mesenteric artery, in these species, is originated from the following branches: middle colic artery, the most developed branch, which anastomoses with the left gastroepiploic artery; ileocolic artery, where, in goats and rabbits, it is the first released branch; cranial duodenal pancreatic artery; and several jejunal arteries anastomose themselves, originating arches. The caudal mesenteric artery is a low caliber vessel and is divided into cranial and caudal branches.

Studies performed by Júnior et al. (2002), demonstrating the origin and distribution of the mesenteric artery in dogs, reported that the cranial mesenteric artery was originated in the ventral portion of the descending abdominal aorta in all preparations (100%) and released the left adrenal branches and the right pancreatic ones, as well as the caudal pancreaticoduodenal arteries and the middle and left colic, as well as also the ileocolic artery. The caudal mesenteric artery emerged from the ventral portion of the descending abdominal aorta and near to its end releases the cranial rectal arteries and left colic.

The arterial supply in small intestine of the crab-eating raccoon is originated from the cranial mesenteric artery. Therefore, the aim of this study was to describe the behavior of the arterial vessels in the small intestine of the crab-eating raccoon (*Procyon cancrivorus*), from the irrigation of the cranial mesenteric artery.

## Material and methods

In the development of the study, five animals were used, collected from highways (roadkill), obeying the criteria set by the Committee of

Institutional Ethics and as well as existing law (Law 1153/95), in 2008. The animals were taken to the Human and Compared Anatomy Laboratory of the Federal University of Goiás State - Jataí Campus.

An opening in the abdominal cavity was performed for identification, isolation and cannulation of the abdominal aorta, warm-water perfusion (40°C) and stained latex injection (Neoprene 450, Dupont do Brasil and Sulvinil Stain, Glassuret S.A), followed by formaldehyde fixation (10%).

The block containing the viscera was taken out from the interior of the abdominal cavity and dissected, allowing the systematization of the arteries to define the vascular pattern of the viscera and to document it with a camera (Camera Sony Cyber-shot, 8.1 megapixels).

## Results and discussion

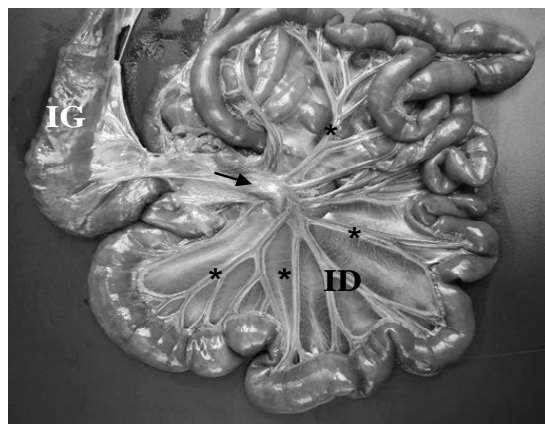
Through dissection of the intestine of five animals (*P. cancrivorus*), the presence of the mesenteric artery and its distribution in small and large intestine (Figure 1) was observed. As Ede (1965), Schwarze and Schroder (1970), Nickel et al. (1977) and Getty (1981) report, the cranial mesenteric artery is a single vessel that comes out from the aorta artery, and the same was observed in carnivore mammals. This vessel is responsible for irrigating most of the small intestine (SISSON; GROSSMAN, 1959). As Morandini (1968) described, the mesenteric arteries are vessels responsible for supplying blood to the small and large intestine of reptiles, birds and mammals, where digested nutrients are absorbed by the epithelium and taken to circulation (HILDEBRAND, 1995).

About the origin of the cranial mesenteric artery, it was observed that it always comes out from descending abdominal aorta artery, near and in the caudal portion of the celiac artery. The branches of the cranial mesenteric artery (colic, ileal, cecal, jejunal and ileocolic) referred in this study, were previously demonstrated by Júnior et al. (2002), as can be observed in Figure 2.

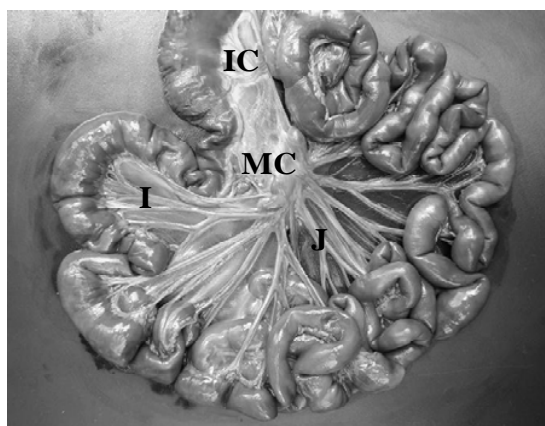
Considering the irrigation of the cranial mesenteric artery, it was found in the citation of Ede (1965) that this vessel distributes itself in the mesentery. Schwarze and Schroder (1970), Sisson and Grossman (1975) reported that the largest portion of the small intestine was irrigated by this vessel. Baumel et al. (1979) consider that the cranial mesenteric artery when is up to end releases branches to the ileum, which is in accordance with our findings.

Cardoso et al. (2002) report that in its path, the cranial mesenteric artery originates an arch near to the mesenteric margin of the jejunum and ileum, and

from this arch vessels leave to this segment of the small intestine obeying irregular gaps and, approximately, in right angles.



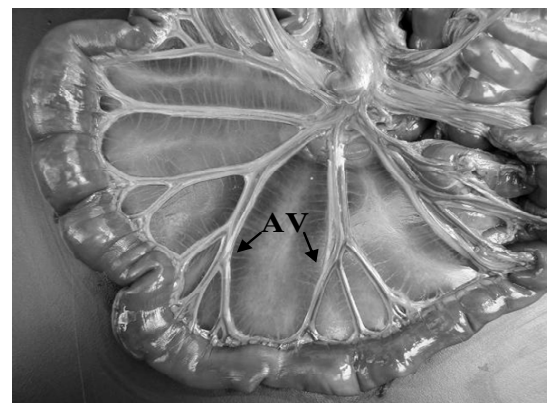
**Figure 1.** Photograph demonstrating the small intestine (ID) and part of the large intestine (IG) of crab-eating raccoon (*Procyon cancrivorus*) and the mesenteric cranial artery (arrow) and its ramifications (\*).



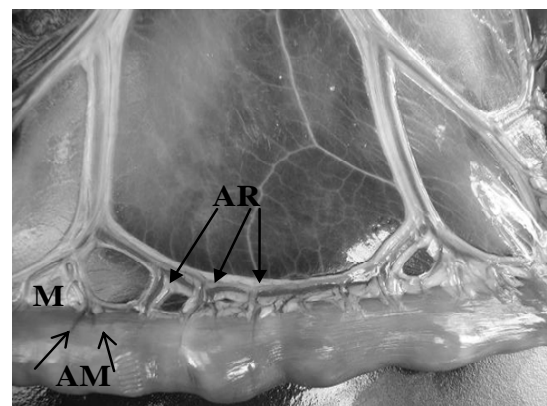
**Figure 2.** Photograph demonstrating the arterial distribution of the small and large intestine of crab-eating raccoon (*Procyon cancrivorus*). Mesenteric cranial artery (MC), jejunal arteries (j), ileal arteries (i) and ileocolic artery (IC).

On the jejunal arteries, Cardoso et al. (2002) report that they go through the mesentery to the corresponding intestinal segments, originating anastomotic arches from where several small vessels leave to the intestinal wall, which was evidenced in all analyzed cases either irrigating the mesenteric margin or the antimesenteric one (Figures 3 and 4).

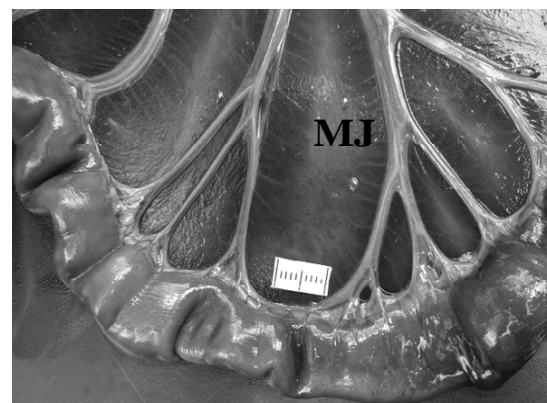
The peritoneum tends to release a fan-shaped formation, which holds the jejunum and ileum to the posterior abdominal wall, and is composed of two layers, having a sufficient extension to allow considerable mobility to this portion of small intestine; this formation is the mesentery, which will receive the prefixes of the organ where it is attending as the case of the mesojejunum, demonstrated in Figure 5.



**Figure 3.** Photograph demonstrating the jejunal arteries forming vascular arcs (AV) next to the mesenteric edge of the small intestine of the crab-eating raccoon (*Procyon cancrivorus*).



**Figure 4.** Photograph demonstrating right angles (AR) of arteries originating from the vascular arcs inserting itself, in part, the mesenteric edge (M and arrows) and in part, the anti-mesenteric edge (AM and arrows) of the jejunum of the crab-eating raccoon (*Procyon cancrivorus*).



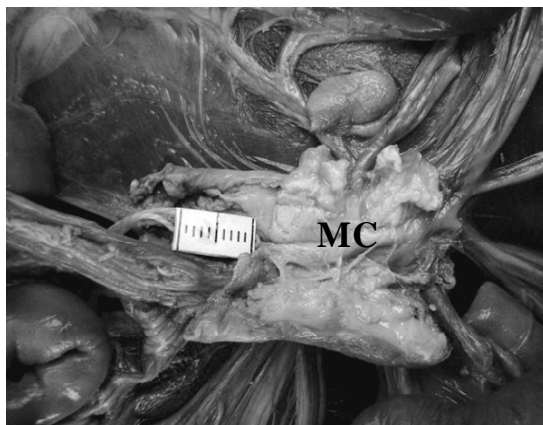
**Figure 5.** Photograph demonstrating mesojejunum (MJ) and the size of the vascular arcs of the jejunal arteries of the small intestine of the crab-eating raccoon (*Procyon cancrivorus*).

In all analyzed animals, a cranial mesenteric ganglion (Figure 6) could be observed near the origin of the cranial mesenteric artery (Figure 7), as described by Grossman and Sisson (1986). Dyce

et al. (1997) observed that in carnivores the most preeminent lymph nodes were located near the mesentery root, corroborating to our findings (Figure 6); next to it, there was a single lymph node near the cranial mesenteric ganglia of this animal.



**Figure 6.** Photograph demonstrating the presence of a mesenteric cranial ganglion (G) and node (L), and respective sizes, next to the origin of the mesenteric cranial artery of the small intestine to crab-eating raccoon (*Procyon cancrivorus*).



**Figure 7.** Photograph demonstrating the section of the mesenteric cranial ganglion and the emergence of the mesenteric cranial artery (MC) and its respective ramifications in the small intestine crab-eating raccoon (*Procyon cancrivorus*).

## Conclusion

The small intestine of the crab-eating raccoon (*Procyon cancrivorus*) is irrigated in its largest part by the cranial mesenteric artery. This artery always comes out from the descending abdominal aorta and originates a common trunk that supplies the whole jejunum and the ileal mesenteric portion. It branches off into colic, ileal, cecal, jejunal and ileocolic.

The jejunal arteries anastomize themselves near the mesenteric margin, originating vascular arches from where straight arteries leave, responsible for

the nutrition of the mesenteric portion and, sometimes, the jejunal antimesenteric portion.

The artery responsible for the ileal irrigation comes out as the last branch of the cranial mesenteric artery. Near the origin of the cranial mesenteric artery there is a cranial mesenteric ganglion and lymph nodes that are on top, in the mesentery root.

This anatomic knowledge of the vascular patten of the crab-eating raccoon (*Procyon cancrivorus*) has a fundamental importance in research on the arterial distribution of the intestine.

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