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ANATOMY OF THE CAUDAL CEREBRAL ARTERY ON THE SURFACE OF CAPYBARA (*Hydrochoerus hydrochaeris*) BRAIN

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ABSTRACT

In this study, we examined the distribution of the caudal cerebral artery on the surface of the capybara brain and determined the territory irrigated by this vessel. A total of 68 brain hemispheres from female and male capybaras (*Hydrochoerus hydrochaeris*) were injected with Latex 603 or Latex Frasca, stained with red and blue pigments, and fixed in 20% formalin. The caudal cerebral artery arose from the terminal branch of the basilar artery rostrally to the root of the oculomotor nerve. Immediately after its emergence, the caudal cerebral artery gave off the rostral tectal artery in 27.9% of the specimens and then crossed the cerebral peduncles dorsally to the geniculate bodies and to the pulvinar to give off small perforating branches towards these structures. During its course over the surface of the hippocampal gyrus, the caudal cerebral artery gave off small hippocampal branches dorsally, the caudal choroidal artery rostrally, and a variable number of cortical branches caudally. The terminal branches of the caudal cerebral artery crossed the splenium of the corpus callosum and were distributed on the caudo-medial surface of the brain hemisphere. The territorial limits of the caudal cerebral artery included the thalamus, the rostral colliculum, part of the caudal colliculum, the caudal face of the pyriform lobe, the tentorial surface, the retrosplenic portion of the medial surface, and a narrow area of the dorso-lateral face of the brain hemisphere, along the margins of the dorsal longitudinal and transverse fissures of the brain.

Key words: Brain vascularization, capybara, encephalic arteries, *Hydrochoerus*, rodents

INTRODUCTION

The capybara (*Hydrochoerus hydrochaeris*), a South American mammal, belonging to the family Hydrochaeridae, is the largest known rodent and can reach a length of 1.30 m, a height of 65 cm, and a weight of 55 kg. The capybara is an alternative food source for humans, because of the high nutritional value, excellent texture, and pleasant flavor of its meat, in addition to the low cost of production. Some of the biological characteristics of capybaras that favor domestication include its easy reproduction in captivity, its special family structure, its high reproductive capacity and rapid growth.

Despite the increasing interest in breeding capybaras for commercial purposes, the number of studies on the anatomy of this species is still very small. An understanding of the encephalic irrigation is extremely important, because of its close association with the development of the central nervous system.

In a previous study [7], we found that the cerebral circulation of the capybara originated only from the vertebro-basilar system. Such an arrangement has been reported only in guinea pigs [6], since in other species the blood supply to the caudal cerebral artery is provided by the vertebro-basilar and carotid systems [1, 3-6]. In the present study, we examined the arterial vascularization of the encephalon in capybaras and mapped the distribution of the caudal cerebral artery to determine the territory irrigated by this vessel. This analysis was done by vascular replenishing and anatomical dissection of the main branches of this artery to identify their origin, branches and course.

MATERIAL AND METHODS

Sixty-eight cerebral hemispheres of *H. hydrochaeris* were obtained from commercial slaughterhouses (Lider and Nova Bassano), in the state of Rio Grande do Sul, Brazil. The animals were electrically stunned and immediately bled. The head was separated from the rest of the body by sectioning the cranial cervical region, with care being taken to preserve the first cervical vertebra. After collection, the specimens were transported to the laboratory of veterinary anatomy where the common carotid arteries were cannulated and 20 ml of anti-coagulant solution

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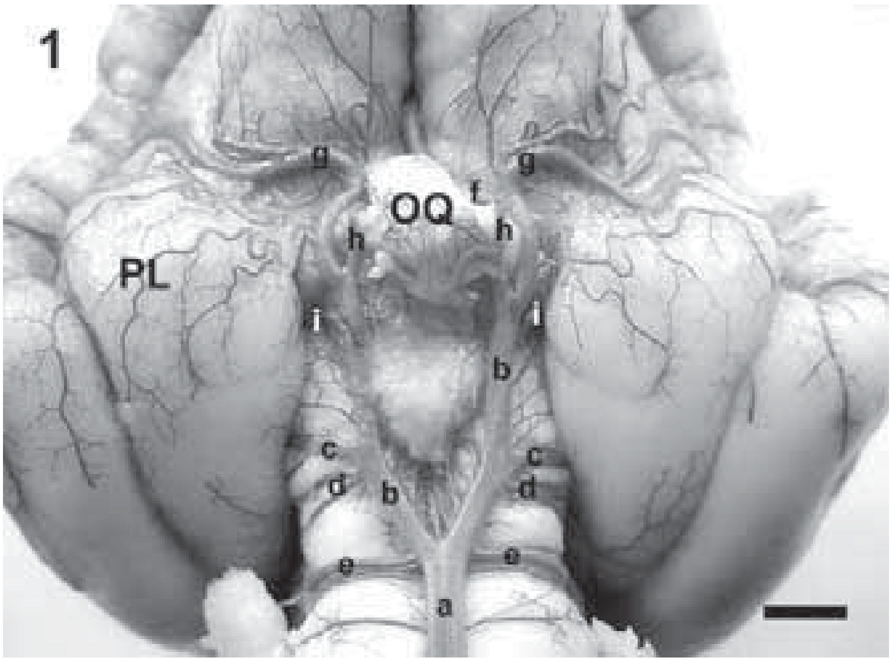

Figure 1. Ventral view of the brain base arteries of *Hydrochoerus hydrochaeris* without the hypophysis. **a** – basilar artery, **b** – terminal branch of the basilar artery, **c** – caudal cerebral artery,–**d** – rostral tectal artery, **e** – rostral cerebellar artery, **f** – rostral cerebral artery, **g** – middle cerebral artery, **h** – internal ophthalmic artery, **i** – rostral choroidal artery, **OQ** – optic chiasma, **PL** – piriform lobe. Bar = 5 mm.

(ACD-AFU, Alex Istar – Indústria Farmacêutica Ltda) was injected. The vascular system was subsequently washed with saline solution and then filled with colored latex 603 (Latex 603, Bertoncini, São Paulo, SP). The specimens were placed under running water for approximately 1 h to allow solidification of the injected material. The head skin was removed, a window was opened in the skull, and the heads were immersed in 20% formaldehyde for at least 7 days. After this period, the encephala were removed along with the dura mater, that was then removed. The region of interest was dissected by removing the thalamus and the brain stem. A dissection magnifying lens (Model II 20 – Ramsor) was used to observe the encephalon arteries.

To map the vascular territory, the encephalon was removed from formaldehyde-fixed specimens and the basilar artery was cannulated, with the cannula being introduced until the emergence of the caudal cerebral artery. The ophthalmic artery was then clamped and the vascular territory was replenished by injecting stained Frasca Latex (Frasca's latex injection medium – Polysciences, Inc.). At this point the terminal branches of the basilar artery were clamped and the cannula was removed, washed and introduced again in order to fill the rest of the arterial system with different pigments. The specimen was again immersed in formalin for 7 days and the caudal cerebral artery then dissected in order to map its territory.

Schematic drawings and photographs of all specimens were used to document the results. Whenever possible, the vessels were designated according to the Veterinary Nomina Anatomica [2].

RESULTS

The caudal cerebral artery arose from the terminal branch of the basilar artery rostrally to the root of the oculomotor nerve, and ran in a dorso-lateral direction around the cerebral peduncle. The vessel then proceeded beneath the covering of the caudal part of the pyriform lobe, the parahippocampal gyrus, and the caudo-ventral portion of the brain hemispheres, and gave off branches to the caudal third of the medial face of the brain hemisphere. The caudal cerebral artery was present as a single vessel in all of the specimens examined (Fig. 1).

Immediately after its emergence, the caudal cerebral artery gave off the first collateral vessel – the rostral tectal artery – in 19 hemispheres (27.9%); in ten of these cases, this vessel was double and in nine it was single. In the remaining cases (n = 49, 72.1%), the rostral tectal artery derived directly from the terminal branch of the basilar artery (Fig. 1). The rostral tectal artery was distributed on the mesencephalon tectus, and included the rostral colliculum and part of the caudal colliculum. As it reached the parahippocampal gyrus, the caudal cerebral artery gave off the hippocampal branches dorsally, which immediately penetrated under the cover of the alveus, and a series of thin branches ventrally towards the thalamus.

Rostrally, along the posterior face of the hippocampal formation, the caudal cerebral artery emitted, a series of short, thin, rack-like branches that frequently anastomosed to form networks. The caudal cerebral artery also gave off the caudal choroidal artery, which was present as a single vessel in 85.3% of the cases (Fig. 2) and as a double vessel in 13.2% of the cases; this vessel was absent in 1.5% of the specimens. When present, the caudal choroidal artery anastomosed with the rostral choroidal artery and contributed to the formation of the choroidal plexus

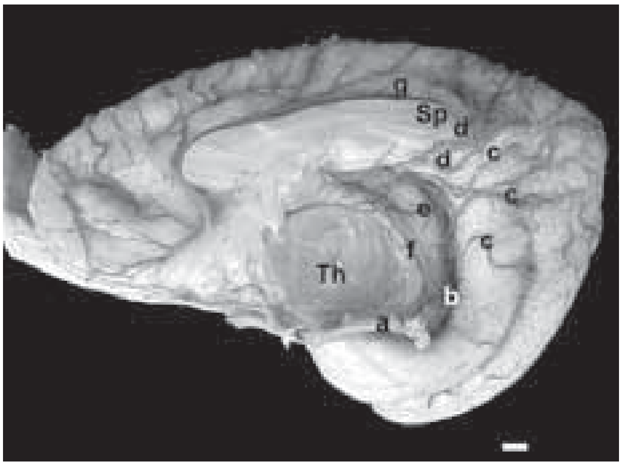

Figure 2. Left medial view of the brain of *Hydrochoerus hydrochaeris* showing the distribution of the caudal cerebral and the rostral choroidal arteries. **a** – terminal branch of the basilar artery, **b** – caudal cerebral artery, **c** – cortical branches of b, **d** – terminal branches of b, **e** – caudal choroidal artery, **f** – rostral choroidal artery, **Sp** – splenium of corpus callosum, **Th** – thalamus. Bar = 10 mm.

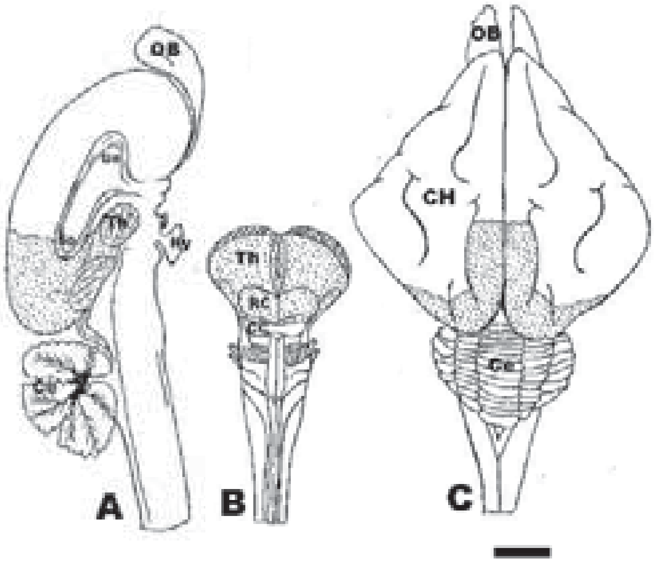

Figure 3. Schematic representation showing the territory of the caudal cerebral artery on the surface of the brain in *Hydrochoerus hydrochaeris*. The stippled area corresponds to the distribution of the branches of the caudal cerebral artery. **A** – medial view of the brain, **B** – dorsal view of the brain stem, **C** – dorsal view of the brain, **CC** – caudal colliculus, **Ce** – cerebellum, **CH** – cerebral hemisphere, **Ge** – genu of the corpus callosum, **Hy** – hypophysis, **OB** – olfactory bulb, **RC** - rostral colliculus, **Sp** – splenium of the corpus callosum, **Th** – thalamus. Bar = 10 mm.

of the third and the lateral ventricles.

As it continued its course, the caudal cerebral artery gave off a variable number of cortical branches (3 - 11 branches, average of six) caudally (Fig. 2). These cortical branches were distributed on the caudal face of the pyriform lobe and on the tentorial surface of the brain hemisphere, where they anastomosed with the cortical branches of the middle cerebral artery. After the sequence of cortical branches, the terminal branch of the caudal cerebral artery reached the retrosplenic portion of the medial surface of the brain hemisphere, where it gave off a rostral anastomotic branch to the corpus callosum artery – the terminal branch of the rostral cerebral artery – and then proceeded dorsally until it reached the dorso-lateral surface at the level of the marginal sulcus (Fig. 2).

The territorial boundaries of the caudal cerebral artery included the thalamus, the rostral colliculum, part of the caudal colliculum, the caudal face of the pyriform lobe, the tentorial face, the retrosplenic portion of the medial face, and a narrow area of the dorso-lateral surface of the brain hemispheres, along the margins of the longitudinal and transverse fissures of the brain (Fig. 3).

DISCUSSION

As shown here, the caudal cerebral artery arose from the terminal branch of the basilar artery, rostrally to the emergence of the oculomotor nerve [7], and was present as a single vessel in all cases. Immediately after its emergence, the caudal cerebral artery gave off the rostral tectal artery as the first collateral branch in 27.9% of the hemispheres, while this branch arose directly from the terminal branch of the basilar artery in the remaining cases. As reported elsewhere [7], the caudal cerebral artery is present as single, double or triple vessel. When the caudal cerebral artery was present as a double or triple vessel, the rostral vessel was the caudal cerebral artery itself, whereas the second and third vessels, which arose caudally, proceeded towards the mesencephalon tectus and corresponded to the rostral tectal artery. In these cases, the latter vessel arose directly from the terminal branch of the basilar artery.

According to Nilges [6], the caudal cerebral artery in the guinea pig originates from the terminal branches of the basilar artery, whereas in the rabbit, the terminal branch of the basilar artery continues as the caudal cerebral artery, after anastomosing with a branch of the caudal communicating artery. The tectal artery may derive either from the caudal cerebral artery or from the terminal branch of the basilar artery. In the dog, the caudal cerebral artery is a branch of the caudal communicating artery, which emits the tectal artery as the first collateral branch. Nanda [5] stated that the caudal cerebral artery in the dog originated from the caudal communicating artery and immediately gave off the caudal choroidal branch, which in turn provided branches to the mesencephalon tectus. In ruminants and horses, the caudal cerebral artery originated from the caudal communicating artery, and the branches towards the mesencephalon tectus in the horse were derived from caudal choroidal branches. In the dog [1], the caudal cerebral artery originates at the junction between the caudal branch of the internal carotid artery and the terminal branch of the basilar artery and immediately bifurcates into a basal segment and a hemispheric segment. The basal segment ramifies and is distributed over the entire surface of the mesencephalon tectus.

After reaching the parahippocampal gyrus, the caudal cerebral artery gave off the hippocampal branches dorsally. At the same level, the caudal cerebral artery also emitted a series of short, thin branches rostrally, as well as the caudal choroidal artery. The latter anastomosed with the rostral choroidal artery and contributed to the formation of the choroidal plexus of the third and lateral ventricles. This behavior of the caudal cerebral artery as it reaches the parahippocampal gyrus is similar to the findings of Nanda [3-5] for horses, ruminants and dogs. According to Nilges [6], the caudal cerebral artery in guinea pigs, dogs, rabbits, cats and monkeys proceeds along the posterior border of the hippocampal formation, giving off a series of rake-shaped branches to the hippocampal region. At the temporal extremity of the hippocampal formation, branches of the rostral choroidal artery anastomose with the hippocampal branches. The rake-like arrangement of the arteries emerging from the caudal cerebral artery and their course relative to the hippocampus is similar to that found in the capybara, although the presence of the caudal choroidal artery as a branch of the caudal cerebral artery in this region was not seen by Nilges [6], nor was its anastomosis with the rostral choroidal artery. According to Alcântara [1], the hemispheric segment of the caudal cerebral artery in dogs followed a sinuous course towards the dorsal surface of the thalamus. This artery emitted its terminal branches upon reaching the splenium of the corpus callosum. No other branches were mentioned by Alcântara [1].

During its course along the parahippocampal gyrus, the caudal cerebral artery gave off a variable number of cortical branches caudally, that were distributed on the caudal face of the pyriform lobe and on the tentorial face of the brain hemisphere. In its terminal course, the caudal cerebral artery reached the retrosplenic portion of the medial face of the brain hemisphere. The cortical and terminal branches described for dogs, horses and ruminants by Nanda [4] and those reported by Nilges [6] in guinea pigs, rabbits, cats, and dogs were similar to our findings in the capybara. The latter author observed that, in addition to the terminal branches in the end portion of this artery in rabbits and dogs, there was another branch that contributed for the formation of the choroidal plexus of the third ventricle. In the cat, however, the terminal branches anastomosed with the rostral choroidal artery. As shown by Alcântara [1], the caudal cerebral artery gave off cortical branches along its course on the dorsal surface of the thalamus and its terminal branches, as it circled the splenium of the corpus callosum.

As shown by various authors [1,3-6] the territory irrigated by the caudal cerebral artery is constant in all species, although there are some variations in the branches emitted by this artery. In relation to blood supply, we have shown that in the capybara the cerebral circulation originates only from the vertebro-basilar system, which gives rise to all of the arteries that irrigate the encephalon. A similar arrangement has been found only in guinea pigs. In other species, the blood supply to the caudal cerebral artery is provided by the vertebro-basilar and carotid systems.

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