SYSTEMATIZATION, DISTRIBUTION AND TERRITORY OF THE CAUDAL CEREBRAL ARTERY ON THE SURFACE OF THE BRAIN IN PAMPAS FOXES (Pseudalopex gymnocercus)

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ABSTRACT

In this study thirty pampas fox brains (Pseudalopex gymnocercus) were used, injected with red stained latex. The objectives were to systematize and describe the distribution and the vascularization territory of the caudal cerebral artery. This artery was originated from the caudal branch of the internal carotid artery, and through its course, the main axis emitted the rostral tectal artery, branches to the piriform lobe and caudal choroidal branch as collateral branches, and continuing, from where it emits the caudal medial hemispheric branches, as the caudal inter-hemispheric artery. The vascular territory of the caudal cerebral artery of the pampas fox was formed by the adjacent areas of this vessel route over the ventrolateral surface of the cerebral peduncle, caudal third of the piriform lobe, rostral colliculus, the rostral part of the caudal colliculus, the pineal body, the medular stria, the habenula, the dorsal surface of the thalamus, the medial and lateral geniculate bodies, the hippocampus, the parahippocampal gyrus, the choroid plexus of the third and lateral ventricles, the splenium of corpus callosum, the caudal third of the medial surface of the cerebral hemisphere and the limiting edge of the convex face of the cerebral hemisphere within its caudal pole.

Key words: Anatomy, Brain, Arteries, Canidae, Foxes

INTRODUCTION

The search for the functional understanding of the nervous system lead to an increasing number of publications and morphologic studies about encephalic arterial vascularization. Different methods and several animal species are being used in the anatomic study of the vessels that provide essential nutrients to the nervous tissue in order to keep its normal activities. The classic works of Tandler [16] mentioning the comparison anatomy and the history about the head arteries devel opment, and De Vriese [7], about the filogenetic and ontogenetic studies, which classified the various animal groups according to the kind of encephalic irrigation, showed a huge variety of vascular models associated with the filogenetic development of the brain. With this purpose, this work approaches the caudal cerebral artery of the pampas fox (Pseudalopex gymnocercus), a wild canine found in Argentina, Uruguay, Bolivia and in open fields of the Southern region of Brazil. Depedrini and Campos [6] carried out the systematic brain base arteries study of pampas foxes. However, due to no information available about the caudal cerebral artery distribution in this species, even in the classic bibliography, nor in specialized publications, the results were compared to authors that were dedicated to studying the canids, especially the Canis familiaris, due to its taxonomic proximity. So we used information from

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De La Torre et al. [5], Wiland [15], Nanda [14], Gillilan [10], Evans [8], Alcântara and Prada [2], Alcântara et al. [1] and Kapoor et al. [12]. Trying to understand the filogenetic development of this artery, the standard model of this vessel occurrence with some of the species located under the pampas fox in the zoological scale was discussed and so, information from some authors that researched the brain filogenetics morphology [3] and the encephalic vascularization in turtles [4,9] and in opossum [13] was used. Besides, this work aims at the systematization, distribution and arterial vascularization territories of the caudal cerebral artery on the brain surface of the pampas fox.

MATERIAL AND METHODS

In this work thirty brains of pampas foxes (P. gymnocercus), 17 males and 13 females, young and adults, from Uruguaiana, Rio Grande do Sul, Brazil, under consent and authorization of the Brazilian Institute of Environment (IBAMA) were used. The specimens were sacrificed using an association of mebezonium iodide, embutramine and tetracaine hydrochloride (0.3 mg/kg, intrapulmonary; T-61 Intervet). After that, the thorax was opened and the subclavian arteries were clamped. The common carotid arteries were canulated and the arterial system was cleaned by flushing it with cold saline solution and heparin (10,000 IU; Heparin, Cristália). The arterial system was injected with latex (Cola 603; Bertoncini) stained in red with a specific pigment (Suvinil color agent; Basf). Then the neck was sectioned in the trunk insertion, followed by total skin removal and the opening of a bone window in the skullcap. Samples remained immersed in 20% formaldehyde for at least seven days for fixation. The brains were removed from the cranium, the duramater was removed and the arteries were dissected. The cerebral hemispheres were separated from the brain stem by an oblique section at the thalamus. The material was analyzed with magnifying glasses (LTS - 5X increase and Stemi SV8 – Zeiss), and to compose the results schematic sketches of the arteries were elaborated in dorsal, right/left medial views of the cerebral hemispheres and a dorsal view of the brain stem. Photographic data of all samples were recorded in order to document results. Nomina Anatomica Veterinaria [11] was used to describe the cerebral arteries and their ramifications, and due to the inexistence of some arteries nomenclature, some terms were added and suggested, based on literature and according to authors' criteria. Percentage estimate was applied for statistical analysis.

RESULTS

The caudal cerebral artery in the pampas fox normally appeared as a single vessel and as a collateral branch from the caudal branch of the internal carotid artery (caudal communicating artery) (Fig. 1). The main axis of the caudal cerebral artery, just after where it originates, emitted a rostral tectal artery and then it continued, projecting itself dorsolaterally surrounding the cerebral peduncle to the cerebral transverse fissure (Figs. 1 and 2). Before reaching the medial geniculate body, it emitted collateral branches to the piriform lobe, a caudal choroidal branch to the dorsal surface of the thalamus and to the choroid plexus of the third ventricle, and caudal medial hemispheric branches to the tentorial part of the medial surface of the cerebral hemisphere. Its main axis, the caudal inter-hemispheric artery, arched upon the parahippocampal gyrus, ascending and ramifying on the medial cerebral hemisphere surface (Fig. 2). Its terminal branch surrounded the splenium of the corpus callosum until it reached the caudal pole of the cerebral hemisphere.

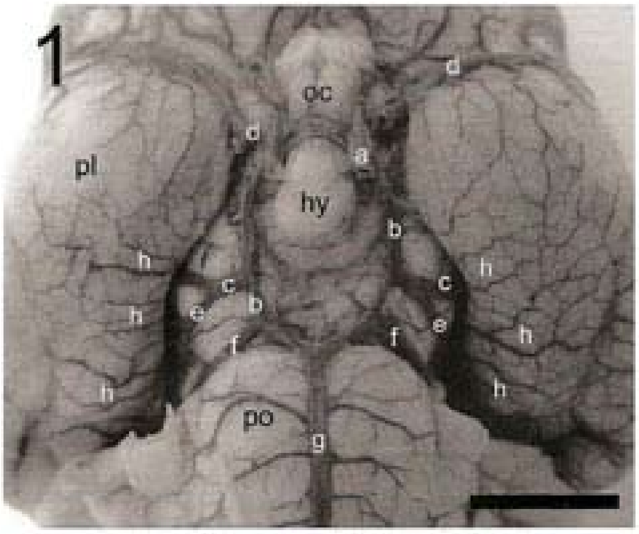

Figure 1. Ventral view (detail) of the brain base in pampas foxes. a - internal carotid artery, b - caudal branch of the internal carotid artery, c - caudal cerebral artery, d - middle cerebral artery, e - tectal rostral artery, f - rostral cerebellar artery, g - basilar artery, h - branches of the caudal cerebral artery to the piriform lobe, oc - optic chiasma, pl - piriform lobe, hy – hypophysis, po - pons, cp - cerebral peduncle. Bar = 8 mm.

In 86.7% of the cases, the right caudal cerebral artery was a single vessel (Fig. 2), whereas, in 13.3% of the cases, it was double. In these cases of duplicity, the following variations were observed: in 3 samples the most caudal vessel, always of smaller caliber, corresponded to its first collateral branch, the rostral tectal artery; in 1 case the caudal cerebral artery was duplicated (Fig. 3), the branch of the middle cerebral artery being the most rostral vessel, where the rostral choroidal artery commonly originates. It was a well developed vessel and it penetrated in the cerebral transverse fissure to form almost all the caudal cerebral artery territory vascularization, emitting a small branch to the piriform lobe, the rostral choroidal artery, the caudal inter-hemispheric artery with its caudal medial hemispheric branches. The most caudal component, and with a smaller caliber, originated from the caudal branch of the internal carotid artery, like the pattern; nevertheless its branches were only the rostral tectal artery, a branch to the piriform lobe, a caudal choroidal branch and a small caudal medial hemispheric branch. In 100% of the brains, the left caudal cerebral artery was a single vessel.

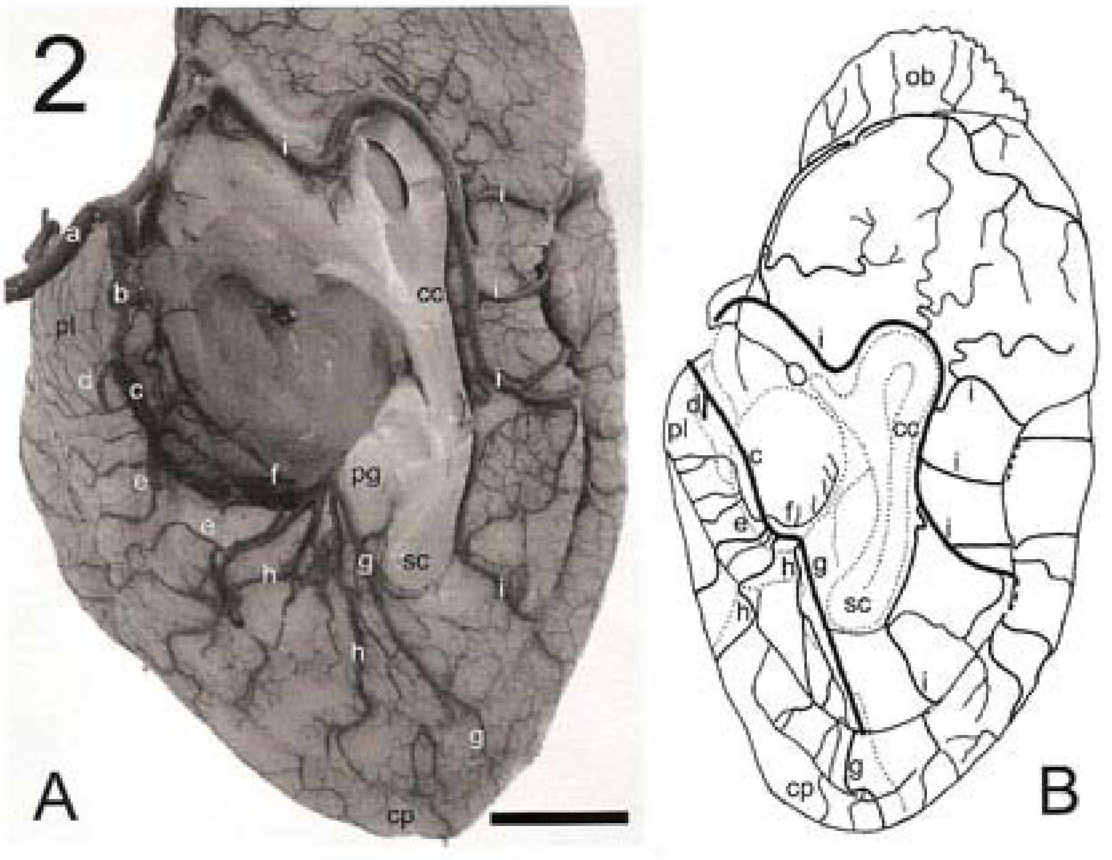

Figure 2. Medial view of the right cerebral hemisphere in the pampas fox showing pattern distribution of the caudal cerebral artery. A - detail, B - schematic draw, a - internal carotid artery, b - caudal branch of the internal carotid artery, c - caudal cerebral artery, d - rostral tectal artery, e - branch to the piriform lobe, f -caudal choroidal artery, g - caudal inter-hemispheric artery, h - caudal medial hemispheric branch, i - branch of the rostral cerebral artery,ob - olfactory bulb, pl -piriform lobe, cc - corpus callosum, sc - splenium of the corpus callosum, pg - parahippocampal gyrus, cp - caudal pole. Bar = 7 mm.

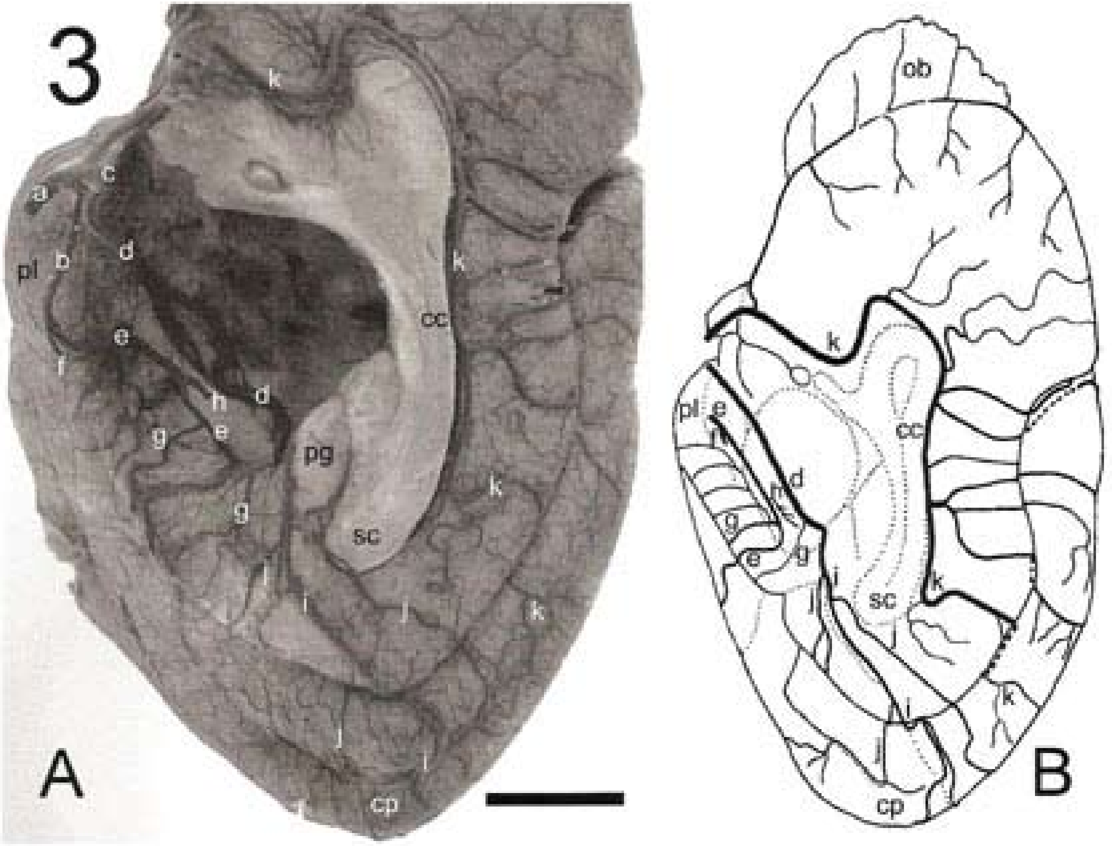

Figure 3. Medial view of the right cerebral hemisphere in pampas foxes showing double caudal cerebral artery. A - detail, B - schematic draw, a - internal carotid artery, b - caudal branch of the internal carotid artery, c - middle cerebral artery, d - caudal cerebral artery (rostral vessel), e - caudal cerebral artery (caudal vessel), f - rostral tectal artery, g - branch to the piriform lobe, h - caudal choroidal branch, i - caudal inter-hemispheric artery, j - caudal medial hemispheric branch, k - branch of the rostral cerebral artery, ob - olfactory bulb, pl- piriform lobe, cc - corpus callosum, sc - splenium of the corpus callosum, pg - parahippocampal gyrus, cp - caudal pole. Bar = 8 mm.

Through the main axis course, the caudal cerebral artery normally emitted, as collateral branches, the rostral tectal artery, branches to the piriform lobe, the caudal choroidal branch, continuing as the caudal inter-hemispheric artery (Fig. 2). The rostral tectal artery often appeared as a single vessel, originated as the first collateral branch of the caudal cerebral artery, still in the brain stem. Surrounded laterodorsally the cerebral peduncle going to the medial geniculate body, where it emitted branches, which their terminal branches ramified intensely, forming a network, making an anastomosis with its contra-lateral ends and with caudal tectal artery branches, emitted by the rostral cerebellar artery, forming a plexus that irrigated the mesencephalic tectum (Figs. 2 and 4). The rostral tectal artery also emitted thin branches that reached the pineal body, the medular stria, the habenula and the adjacent thalamic areas (Fig. 4). In 96.7% of the brains, the right rostral tectal artery was single, varying in its origin: in 26 samples it was a branch of the right caudal cerebral artery; in 2 cases it was emitted from the caudal branch of the right internal carotid artery; in 1 sample it was a collateral branch of the double caudal cerebral artery previously mentioned. In 3.3% of the cases, the right rostral tectal artery was double, where the most rostral vessel presented a higher caliber and originated from the right caudal cerebral artery. And the most caudal vessel, of smaller calibre, was originated from the caudal branch of the right internal carotid artery. In 100% of the specimens, the left rostral tectal artery was a single vessel originated from the left caudal cerebral artery.

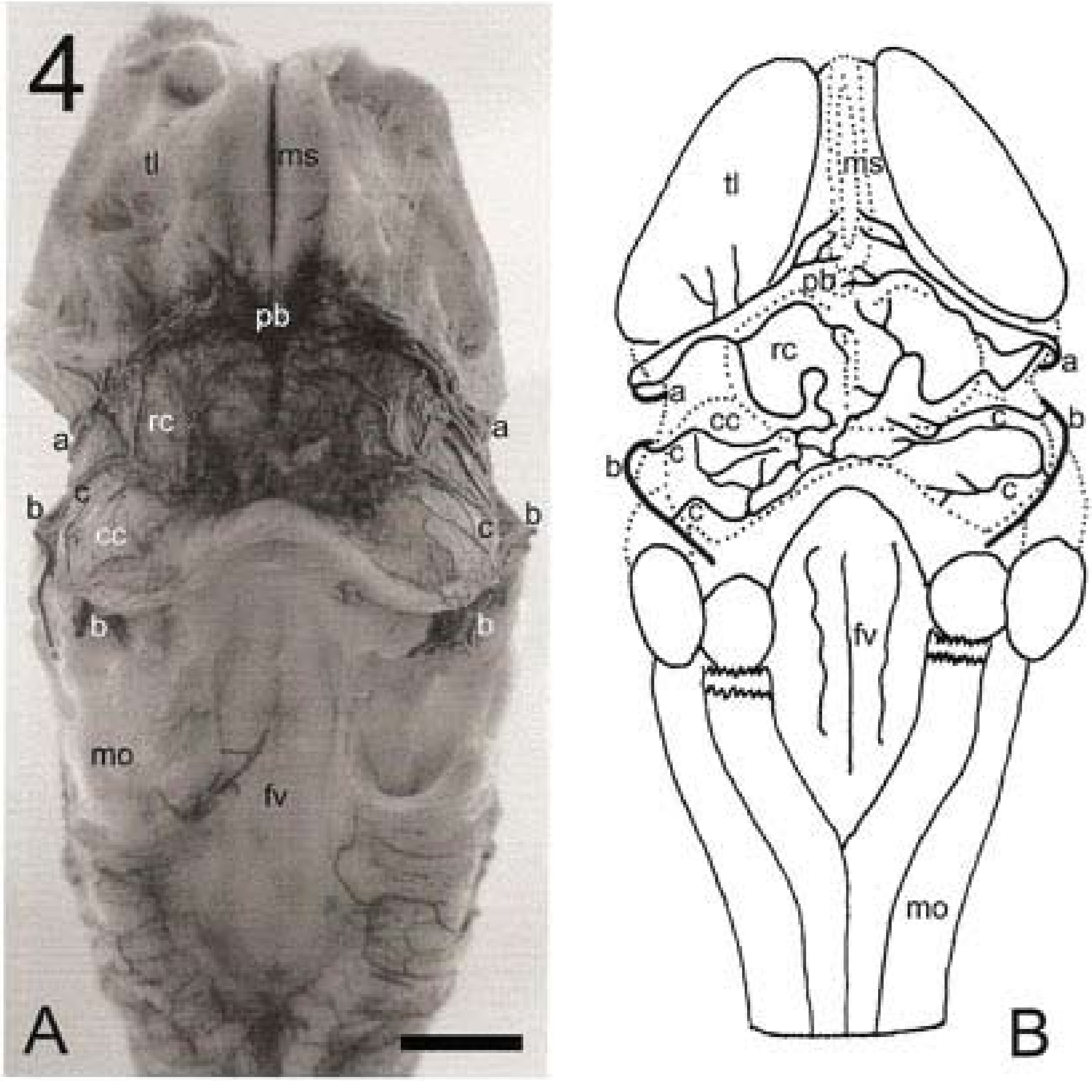

Figure 4. Dorsal view of the brain stem in pampas foxes. A – detail, B - schematic draw, a - rostral tectal artery, b - rostral cerebellar artery, c - caudal tectal artery, tl - thalamus, rc - rostral colliculus, cc - caudal colliculus, pb - pineal body, ms - medular stria, mo -medulla oblongata, fv - fourth ventricle floor. Bar = 5 mm.

The caudal cerebral artery, ascending the lateral surface of the cerebral peduncle, emitted thin branches that were distributed ventrally in the third most caudal part of the piriform lobe (Fig. 1 and 2). On the right, the frequency of the emitted branches, to supply the piriform lobe, was the following: 1 in 40%; 2 in 30%; 3 in 16.7%, 4 in 10%; and 5 branches in 3.3%. On the left side, the frequency of the emitted branches, to supply the piriform lobe, was the following: 2 in 30%; 1 in 26.7%; 3 in 20%; 4 in 16.7%; and 5 branches in 6.7%. The caudal cerebral artery then emitted rostrally a caudal choroidal branch that ascended dorsomedially along the fimbria of the hippocampus ventrally, reaching the lateral geniculate body, the medular stria and the choroid plexus of the third and lateral ventricles (Fig. 2). The caudal choroidal branch emitted uncounted little branches to the adjacent areas on its course. At least one of these branches anastomosed with the rostral choroidal artery. The right caudal choroidal branch was present as a single vessel in 100% of the samples. In one of these cases, where there was duplicity of the right caudal cerebral artery, the right caudal choroidal branch originated from the most caudal vessel (Fig. 3). On the left, the caudal choroidal branch was present, as a single vessel, in 100% of the cases. The main axis of the caudal cerebral artery continued as caudal inter-hemispheric artery, its terminal branch, at the point where it started emitting the collateral branches to supply the tentorial part of the medial surface of the cerebral hemisphere. Its terminal axis advanced towards the caudal pole of the cerebral hemisphere (Fig. 2). Through its course, the caudal inter-hemispheric artery emitted a variable number of collateral branches, the caudal medial hemispheric branches, to the tentorial part of the medial surface of the cerebral hemisphere (Fig. 2). On the right side, the frequency of the emitted branches was the following: 2 in 43.3%; 3 in 26.7%; 4 in 16.7%; 1 in 10%; and 5 branches in 3.3%. On the left side, the frequency of branches was: 3 in 46.7%; 2 in 23.3%; 4 in 23.3%; 1 in 3.3% and 5 branches in 3.3%. From its main axis, the caudal cerebral artery also emitted 1-3 caudal medial hemispheric branches to the non-tentorial part of the medial surface of the cerebral hemisphere (Fig. 2). Its terminal ramifications anastomosed with the terminal branches of the middle and rostral cerebral arteries. On the right, the frequency of the emitted branches was the following: 2 in 40%; 1 in 36.7%; 3 in 3.3%; and this branch was inexistent in 20%. On the left, these branches appeared in the following frequency: 2 in 46.7%; 1 in 40%; 3 in 3.3%; and in 10% this branch was not present. The terminal ramifications of the caudal cerebral artery anastomosed with the terminal ramifications of the rostral and middle cerebral and rostral cerebellar arteries. The anastomoses with the rostral cerebral artery were located in: the medial surface of the cerebral hemisphere, next to the splenium of the corpus callosum; in the convex face of the cerebral hemisphere, near the caudal pole, over the marginal gyrus. Anastomoses between the terminal ramifications of the caudal cerebral artery and the terminal ramifications of the middle cerebral artery in: the convex face of the cerebral hemisphere, near the caudal pole, on the surface of the marginal, ectomarginal and ectosylvian gyri in its most caudal portions were also observed: in the caudal third of the piriform lobe; and also the caudal choroidal branch of the caudal cerebral artery anastomosed on the dorsal surface of the thalamus with the rostral choroidal artery, middle cerebral artery collateral branch. The terminal ramifications of the rostral tectal artery, on the dorsal surface of the mesencephalic tectum, anastomosed with the terminal ramifications of the caudal tectal artery, branch of the rostral cerebellar artery (Fig. 4). The terminal ramifications of the rostral tectal artery anastomosed with their counter lateral homologues, on the dorsal surface of the mesencephalic tectum. The territory of the caudal cerebral artery in the pampas fox (P. gymnocercus) (Fig. 5) covered the adjacent areas on its course over the ventrolateral surface of the cerebral peduncle, the caudal third of the piriform lobe, the rostral colliculus, the rostral part of the caudal colliculus, the pineal body, the medular stria, the habenula, the dorsal thalamus surface, the medial and lateral geniculate bodies, the hippocampus, the parahippocampal gyrus, the choroid plexus of the third and lateral ventricles, the splenium of the corpus callosum, the caudal third of the medial surface of the cerebral hemisphere and the limiting edge of the convex face of the cerebral hemisphere in its caudal pole.

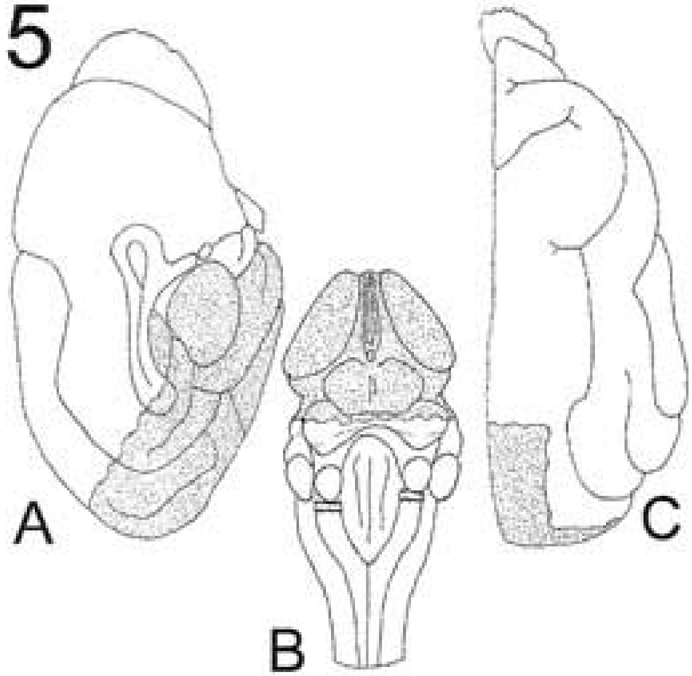

Figure 5. Schematic representation showing the territory of the caudal cerebral artery on the surface of the brain in pampas fox. The stippled area corresponds to the distribution of the branches of the caudal cerebral artery. A - medial view of the left cerebral hemisphere, B - dorsal view of the brain stem, C - dorsal view of the right cerebral hemisphere.

DISCUSSION

On the systematic study of the brain base arteries in the pampas fox, Depedrini and Campos [6] concluded that the blood supply to the brain in this species came from two sources: the main source, constituted by the internal carotid arteries, forming the carotid system, and a supplementary one formed by the vertebral-basilar system. They described that in their two terminal branches, the internal carotids bifurcate into the rostral and caudal branches [2,7,10,16], and that the caudal branch, thinner than the short rostral branch, emits the caudal cerebral artery as a collateral branch. In her description of the blood supply of the dog's brain, Nanda [14] related that the internal carotid artery ended as it divided into 3 main branches, namely, the caudal communicating artery and the rostral and middle cerebral arteries. This trifurcation of the internal carotid artery had been observed by Alcântara and Prada [2] in only 10% on the left and in 13.3% on the right, in 30 dogs. Contradictory opinions occurred about the origin of the caudal cerebral artery in dogs, when Gillilan [10], Alcântara and Prada [2] and Alcântara et al. [1] explained that the caudal branch of the internal carotid artery formed the caudal cerebral artery when joining with the basilar artery. However, according to Nanda [14], the caudal cerebral artery originated from the junction of the caudal communicating artery with the mesencephalic artery, and this last one represented the mesencephalic segment of the caudal communicating artery. To Kapoor et al. [12], the basilar artery bifurcated into two caudal cerebral arteries, which connected with the internal carotid arteries, on both sides, by the fine posterior communicating arteries. Therefore, De La Torre et al. [5] and Wiland [15] considered that the caudal cerebral artery originated from the caudal communicating branch of the internal carotid artery. According to Tandler [16], both branches of the internal carotid arteries united in a basilar artery, after originating the caudal cerebral artery. Those deviations could be elucidated by De Vriese's [7] filogenetic point of view, which stated that the caudal cerebral artery was, in its primitive stage, a collateral branch of the caudal terminal branch of the internal carotid artery. In a more recent stage, it was and formed the anastomotic limit between the caudal branch of the internal carotid artery and the division branch of the basilar artery. Later, it was the terminal portion of the division branch of this last quoted artery and, in an even more recent stage, the caudal cerebral artery was a collateral of the basilar artery terminal division branch. Morphologically, the caudal cerebral artery belonged to the carotid group and, only the secondary vascular modification sequence made it belong to the vertebral dominium. In the pampas fox, the caudal cerebral artery was a collateral branch of the internal carotid artery's caudal branch [6].

Although infrequent, an important variation observed in the pampas fox was the appearance of the caudal cerebral artery duplicity. In dogs, only Gillilan [10] described that occasionally one or two usual branches of the caudal cerebral artery originated directly from the caudal division of the caudal internal carotid artery as in primitive mammals.

Nanda [14] made a detailed report that the caudal choroidal branch had been originated caudally to the caudal cerebral artery, just after where it begins, describing that this vessel followed a dorsal direction on the cerebral peduncle and reached the caudal part of the lateral geniculate bodies and pulvinar, rostrally to the rostral colliculus and its brachium. This branch divided into three or four fine branches that joined, with similar branches from the opposite side and terminal branches of the branch to the rostral mesencephalic tectum, forming a network in the vicinity of the pineal body. One or two terminal branches of the caudal choroidal branches continued rostrally on the thalamus and contributed to supplying the third ventricle choroid plexus, pineal body and associated structures. The caudal choroidal branch mentioned by the author was described in the pampas fox as a vessel emitted from the main trunk of the caudal cerebral artery, after the origin of the branches to the piriform lobe, which did not cooperate with the mesencephalic tectum vascularization, as observed in dogs. In pampas foxes it was considered more pertinent to denominate the rostral tectal artery as the first collateral branch emitted by the caudal cerebral artery since its ramifications distributed mainly in the rostral colliculi and in the most rostral part of the caudal colliculi.

Wiland [15], in 68 dogs, showed that before penetrating underneath the piriform lobe, the caudal cerebral artery separated into two branches, and that in 17.5% of the males and in 21.4% of the females this artery did not divide on one side. Although the distribution is not mentioned, according to its localization, it is supposed that the author was referring to the rostral tectal artery verified in pampas foxes.

Alcântara et al. [1] adopted the caudal cerebral artery division criteria in two segments, the basal (mesencephalic) and the hemispheric segments. They explained that the basal segment had a 0.5 cm average length, and continued in the cerebral peduncle lateral face direction surrounding them to ascend vertically on the medial face of the corresponding cerebral hemisphere. They also quoted that the basal segment emitted an artery that continued caudally to the corresponding cerebral peduncle lateral face to be distributed to all caudal and rostral colliculi surface, but they did not denominate them. In pampas foxes, the vessel emitted by the caudal cerebral artery that followed that course was the rostral tectal artery, although its pattern distribution did not reach the caudal part of the caudal colliculus.

Only Nanda [14] made a brief citation about the collateral branches to the piriform lobe, while relating that during its course, the caudal cerebral artery, in dogs, emitted several cortical branches that were distributed to the caudal and caudomedial parts of the cerebral hemisphere, including the caudal part of the piriform lobe.

According to De La Torre et al. [5] the caudal cerebral artery surrounded the cerebral peduncle, arching medially on the dorsal aspect of the brain stem, forming almost a complete circle, surrounding the most caudal part of the thalamus and the lateral geniculate body, and then it went directly caudally to the ventral surface of the occipital lobe, near the median line to irrigate the medial aspect and the pole of this lobe [1,10]. In pampas foxes, the continuance of the main axis of the caudal cerebral artery was denominated caudal inter-hemispheric artery, and the cortical branches were designated as caudal medial hemispheric branches. With regard to the frequency of the emitted branches to the cerebral hemisphere cortex, Nanda [14] mentioned only that the number and the origin point of the cortical branches were variable. Alcântara et al. [1] concluded that from 6 to 9 branches were emitted by the hemispheric segment of the caudal cerebral artery, and that they supplied the caudal and medial surface and part of the dorsal surface of the occipital lobe, and also the medial surface of the parietal lobe. As the systematization criteria adopted by the authors was different to the one used in the pampas fox study, it was not possible to compare these data.

Since the encephalon irrigation distribution, such as in any other anatomic structure, is closely associated with its development level and with the consequent morphology presented by the central nervous system of each species, it was considered pertinent to try to clarify how the evolution of the encephalic arterial vascularization followed up the brain development. So, the acquired results in pampas foxes were compared to the species located below in the zoological scale, such as reptiles (turtles) and marsupials (opossum).

According to Beccari's [3] references about the turtle's brain morphology, they described that this species had a huge olfactory bulb, and being a macrosmatic animal, it had a big area that corresponded to the paleopallium cortical area, not being defined as a cortical area but a primordial one. This area extended along the entire ventral surface and in the lateral part of the convex face of the cerebral hemisphere. So, the archipallium had appeared for the first time on the zoological scale as a complete and developed cortex. This animal presented on the dorsal surface of the hemisphere, between the most medial hippocampus and the most lateral piriform pre-cortex (olfactory), a small stripe of dorsal pallium, that was the precursor of the neopallium, because the neopallium would be defined as from the monotreme mammals. The cerebral hemispheres were so much less developed that they dorsally revealed the diencephalon and all the mesencephalic tectum (optic lobe). Regarding the cerebral's arterial vascularization in turtles, Burda [4] quoted that the cerebral carotid arteries bifurcated into rostral and caudal branches [7], and called them rostral and caudal encephalic arteries; the caudal branch followed caudally and emitted the caudal cerebral artery and the mesencephalic artery [9]. According to Burda [4], the caudal cerebral artery emitted branches to the caudal pole of the cerebral hemisphere and branches to the epiphysis and to the choroid plexus of the third ventricle. The mesencephalic artery reached the caudodorsal boundary of the midbrain and bifurcated into rostral and caudal branches, the rostral branch joined with its counterpart to form the epiphyseal artery that, after it had emitted branches to this brain's region and to the choroid plexus of the third ventricle, ended at the epiphysis. The caudal branch of the mesencephalic artery distributed vessels over the dorsal region of the cerebellum [9].

Studying the brain morphology of the opossum, Beccari [3] classified this species' encephalon as macrosmatic, without corpus callosum, which presented a huge olfactory bulb with a short and thick peduncle and wide olfactory tracts, which distributed its fibers over a large area of paleopallium, corresponding to the olfactory trigone surface, cerebral lateral fossa and piriform lobe. All this wide area corresponded to the cerebral hemisphere base, extended to the lateral face where it was limited by the lateral rhinal sulcus. Its archipallium (rostral, dorsal and caudal hippocampus) was well developed, extending to the medial face of the cerebral hemisphere, from the septal area up to the hippocampal comissure, where the dorsal hippocampus ended and the caudal hippocampus started, which projected to the cerebral hemisphere's interior, forming the caudal portion of the lateral ventricle's floor. The only important hemispheric comissures were the hippocampal and the cerebral rostral comissures, because due to the little neopallium development, the corpus callosum has not appeared yet. To the author, the neopallium area was not extensive and limited between the lateral rhinal and hippocampal sulcus, on the convex and medial faces of the cerebral hemisphere, and due to having no sulcus or cisures, nor giry, this species was considered lissencephalic. According to Lindemann and Campos [13], in quoting the brain vascularization in the opossum, the caudal cerebral artery originated from the caudal communicating artery in the middle third of the cerebral peduncles. It maintained its course laterodorsally surrounding the cerebral peduncles to immerse in the transverse fissure. Its main axis surrounded all the peduncle, going to the mesencephalic tectum, where it projected rostromedially, passing between the rostral colliculi and the caudolateral portion of the thalamus. Near the rostral tubercle of the thalamus, its terminal branch advanced dorsally to reach the caudal portion of the medial surface of the cerebral hemisphere, where it anastomosed with the tentorial branch, forming the caudal inter-hemispheric artery. In its course, the caudal cerebral artery emitted two main collateral branches, the tentorial hemispheric branch and the rostral tectal artery, respectively.

Concerning the brain morphology in carnivorous, Beccari [3], classified this animal group as macrosmatics, being in an intermediary position between the inferior mammals and the simians, since they present a massive olfactory center, a wide and frilled neopallium, and the corpus callosum, being this last one not so massive when compared to the primates, as a result, the rostral and dorsal archipallium (hippocampus) were atrophied. The mesencephalon was completely covered by the cerebral hemispheres, which enlarged caudally.

On examining the morphology and the arterial vascularization of the turtle and the opossum, located low on the zoological scale, it is noticeable that in reptiles the small cerebral hemisphere did not cover the thalamus and the mesencephalon, and the cerebellum was hardly developed. The neopallium was not yet developed and just a small longitudinal central stripe of the cerebral hemisphere was formed of dorsal pallium, the predecessor of the neopallium. The lateral and ventral parts to its dorsal pallium corresponded to the paleopallium while the medial part, and the medial face of the cerebral hemisphere was the hippocampus or the archipallium. The caudal cerebral artery supplied the caudal pole of the cerebral hemisphere and the caudal third of the medial surface. The exposed diencephalon and the optic lobe were irrigated, as the cerebellum, by the mesencephalic artery, collateral branch of the cerebral carotid artery caudal branch. Examining the opossum encephalon, a marsupial mammal, the cerebral hemisphere has already developed a neopallium, which occupied all the dorsal part of the convex surface of the small cerebral hemisphere. The paleopallium was dislocated laterally and ventrally while the rostral, caudal and dorsal hippocampus occupied almost all the medial surface of the cerebral hemisphere. The caudal cerebral artery began to irrigate the caudal pole of the cerebral hemisphere, the caudal third of the medial face, including the tentorial part, the diencephalon, the tela choroidea and the choroid plexus of the lateral and third ventricles. A collateral branch that originated from the caudal cerebral artery on its base, the rostral tectal artery, supplied the rostral colliculi and the rostral part of the caudal colliculi, corresponding to the mesencephalic artery that was incorporated to the caudal cerebral artery territory. In the opossum, this branch cooperated with the bloody supply to the tela choroidea and the choroid plexus of the third ventricles through fine branches. The mesencephalic artery incorporation by the caudal cerebral artery probably occurred due to the growth of the cerebral hemisphere that superimposed the mesencephalic tectum partially in the opossum and totally in the.

With the cerebellum development and the acquisition of lateral cerebellar hemispheres in mammals, the cerebellar arteries differentiated, specially the rostral cerebellar artery that started supplying the cerebellum and the mesencephalic tectum caudal part, with its branch, the caudal tectal artery. Observing the encephalon anatomy of the dog or the pampas fox, the appearance of the corpus callosum, not present in the opossum has been observed, and in the carnivorous it interconnected the well-developed frilled neopallium of these animals. There was an atrophy in the medial surface of the cerebral hemisphere of the dorsal and rostral hippocampus with the neopallium folded into the medial face. The lateral rhinal sulcus was present in the ventral face and the paleopallium was in circumscription. The caudal cerebral artery kept its territory visually identical, supplying the caudal pole, the caudal third of the medial surface of the cerebral hemisphere, the thalamus and through its rostral tectal branch it supplied the mesencephalic tectum, except the caudal part of the caudal colliculus and cerebellum.

Observing the filogenesis of the artery which supplied the mesencephalic tectum, the mesencephalic artery of the inferior vertebrate animals, it was understood that this artery changed into a collateral branch of the caudal cerebral artery in canids, and being the mesencephalic tectum its main irrigation territory, we suggest calling it rostral tectal artery. The caudal choroidal branch in pampas fox was a collateral branch of the caudal cerebral artery, which did not directly supply the mesencephalic tectum but the choroid plexus of the third and lateral ventricles. It is supposed that the referred literature had made a mistake when calling the first collateral branch of the caudal cerebral artery a caudal choroidal branch.

ACKNOWLEDGMENTS

The authors thank the Brazilian Institute for the Environment (IBAMA) for allowing the capture of the specimens. This work was supported by grants from CNPq.

REFERENCES

1. Alcântara MA, Almeida IC, Michalski FZ (2000) A artéria cerebral caudal em cães (Canis familiaris, Linnaeus, 1758) SRD – estudo da anatomia de seus

segmentos e distribuição. Tuiuti: Cienc.Cult. **21**, 57-69.

2. Alcântara MA, Prada ILS (1996) Artérias da base do encéfalo de cães (Canis familiaris, Linnaeus, 1758). I. estudo anatômico de suas origens e comportamento. Braz. J. Vet. Res. Anim. Sci. **33**, 67-71.
3. Beccari N (1943) Neurologia comparata - Anatomo-funzionale dei Vertebrati, Compreso I'Uomo. Sansoni Edizioni Scientifiche: Firenze.
4. Burda D (1965) Development of intracranial arterial patterns in turtles. J. Morph. **116**, 171-188.
5. De La Torre E, Mitchell OC, Netsky MG (1962) Anatomic and angiographic study of the vertebral-basilar arterial system in the dog. Am. J. Anat. **110**, 187-197.
6. Depedrini JS, Campos R (2003) A systematic study of the brain base arteries in the pampas fox (Dusicyon gymnocercus). Braz. J. Morphol. Sci. **20**, 181-188.
7. De Vriese B, (1905) Sur la signification morphologique des artères cérébrales. Arch. Biol. **21**, 357-457.
8. Evans HE (1993) The heart and the arteries. In: Miller's anatomy of the dog. p. 586-681. W. B. Saunders Company: Philadelphia.
9. 9.Frizzo MES, Campos R, Severino AG, Achaval M (1994) The vasculature of the subfornical organ of the turtle Chrysemys dorbigni. It. J. Anat. Embryol. **99**, 109-121.
10. Gillilan LA (1976) Extra- and intra-cranial blood supply to brains of dog and cat. Am. J. Anat. **146**, 237-254.
11. International Committee on Veterinary Gross Anatomical Nomenclature (2005) Nomina Anatomica Veterinaria. 5th edn. World Association on Veterinary Anatomist: Hannover.
12. Kapoor K, Kak VK, Singh B (2003) Morphology and comparative anatomy of circulus arteriosus cerebri in mammals. Anat. Histol. Embryol. **23**, 347-355.
13. Lindemann T, Campos R (2002) Anatomy of the caudal cerebral artery on the surface of opossum brain (Didelphis albiventris). Braz. J. Morphol. Sci. **19**, 67-72.
14. Nanda, BS (1975) Blood supply to the brain. In: The Anatomy of the Domestic Animals. Vol.2. (Getty R, ed). p. 1594-1651. W. B. Saunders Company: Philadelphia.
15. Wiland C (1973) Variation of the basal arteries of the brain in dogs. Folia Morph (Warsz). **32**, 63-70.
16. Tandler J (1898) Zur vergleichenden anatomie der Kopfarterien bei den Mammalia. Denksch. Akad. Wissen. **67**, 677-784.