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A SYSTEMATIC STUDY OF THE BRAIN BASE ARTERIES AND THEIR BLOOD SUPPLY SOURCES IN THE CHINCHILLA (*Chinchilla lanigera* – MOLINA 1782)

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ABSTRACT

The origin of the blood supply to the brain and arteries of the ventral surface of the brain was studied in 31 adult chinchillas (*Chinchilla lanigera*). The arterial system was filled with latex 603 via the brachioencephalic trunk and the left subclavian artery, both of which arose from the aortic arch in most cases. The right and left internal carotid arteries (100% and 93.3%, respectively) did not contribute to the brain supply. The vertebral arteries were present in all cases and formed the basilar artery (96.7%) that gave off the ventral spinal artery caudally in all cases. The caudal cerebellar artery was single (80%) or double (20%) on the right, and single (70%) or double (30%) on the left. The rostral cerebellar artery was present as a caudal vessel on the right (73.3%) and on the left (70%), and as a rostral vessel in all cases. The rostral tectal artery was single in all cases. The caudal cerebral artery was single (53.3%), double (36.7%) or triple (10%) on the right, and single (46.7%), double (46.7%) or triple (6.7%) on the left. The hypophyseal artery was present in all cases. The internal ophthalmic artery was present only on the right (26.7%), or only on the left (23.3%). The middle cerebral artery was single in all cases on both sides. The rostral cerebral artery was present as a well-developed (96.7%) or vestigial (3.3%) vessel in both antimeres, gave off lateral arteries to the olfactory bulb and the median rostral inter-hemispheric artery, and ended as the internal ethmoidal artery. The cerebral arterial circle was open (70%) or closed (30%) rostrally, and closed caudally in all cases. The brain was supplied almost exclusively by the vertebral-basilar system.

Key words: Brain vascularization, cerebral arteries, chinchilla, rodent

INTRODUCTION

The blood supply sources to the brain vary among animal species [8-20], possibly as an adaptation to different feeding habits. This adaptation probably involved excessive growth of the tympanic bulla and the movement of the mandibullary condyles, with consequent compression of the internal carotid artery. This series of events could partially account for the switch from a carotid blood source to a vertebral-basilar blood source in some rodent species, and the appearance of the rete mirabile in the cerebral blood supply sources of the Artiodactyla [20].

There have been very few studies of the brain blood supply in wild and exotic species. The classic studies by Tandler [20] and De Vriese [8] provided important contributions to the phylogeny and ontogeny of the cerebral arteries. Subsequent studies have investigated the blood supply of the chicken [6], dog [1], opossum [14], pampas fox [7], wild boar [15] and capybara [16]. Several studies have also examined the cerebral blood supply of chinchillas (*Chinchilla lanigera*) [9,11,17].

In this work, we describe the standard organization and variations of the brain base arteries and their blood supply sources in the chinchilla (*Chinchilla lanigera*). This information should be useful for subsequent morphological studies on the vascularization of the central nervous system.

MATERIAL AND METHODS

Thirty-one adult chinchillas (*Chinchilla lanigera)* (17 females and 14 males, weighing 350-800 g) were obtained from breeders in Santa Maria and Viamão in the state of Rio Grande do Sul, Brazil.

Prior to sacrificing, 31 chinchillas recevied heparin (5000 IU/animal, i.p.; Liquemine-Roche) followed 30 min later by an overdose of sodium thiopental (at 2.5%, 50 mg/kg, i.p.; Cristália, Itapira, SP, Brazil). The

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thoracic cavity was opened, the apex of the heart was cut, and the brachiocephalic trunk and left subclavian artery were cannulated via the left ventricle and aorta. The arterial system (30 animals) was washed with cold 0.9% saline solution (100 ml/animal) and filled with red (Sulvinil) latex 603 (Bertoncini). The specimens were subsequently immersed for 1 h in running water to allow latex polymerization, and the trunk was then sectioned at the first lumbar vertebra. The skin was removed, a window was opened in the cranium, and the parts were fixed in 20% formaldehyde for seven days, after which the brain was removed along with a segment of the cervical spinal cord. The main and collateral branches of the aortic arch were dissected to allow description of the vessels that supplied blood to the brain.

One chinchilla (the 31st animal) was injected with acrylic dental resin (Clássico Ltda, São Paulo, SP, Brazil) to produce a vascular frame and allow complementary observations. The frame was obtained after the specimens had been immersed in water for six months. Schematic drawings of the ventral view of the brain base arteries of all specimens were prepared with the aid of a magnifying glass (Stemi SV8 Zeiss), and the vessels were named according to the Nomina Anatomica Verterinaria [10], with some designations based on our criteria and the relevant literature. Some specimens were photographed (Sony DSC F717) to illustrate the vessel arrangements.

RESULTS

The main vessels supplying blood to the chinchilla brain were the vertebral arteries, which were branches of the subclavian arteries, with a single case in which the left internal carotid artery was the sole source of the blood supply (Figs. 1 and 2). In 93.3% of the cases, the aortic arch gave off the brachiocephalic trunk and the left subclavian artery as sequential collateral branches, whereas in 6.7% of the cases, it gave off branches as the brachiocephalic trunk, the left common carotid artery, and the left subclavian artery. The right and left common carotid arteries divided into an internal carotid artery at the loop of the hypoglossal nerve, and continued as the external carotid artery in all preparations (Fig. 3).

As with the brain base arteries, the internal carotid artery, after originating in the common carotid artery, was projected dorsally and ran medially around the large tympanic bulla, sending its terminal branches to the right of the foramen lacerum in 100% of the cases and to the left in 93.3%. Consequently, this vessel did not contribute to the brain blood supply. In 6.7% of the cases, the left internal carotid artery did not follow its usual path towards the hypophysis, but rather reached the ventral face of the rhombencephalon at the midline of the middle third of the medulla oblongata, thereby contributing to the brain blood supply (Figs. 2 and 4).

The vertebral artery projected from the subclavian artery and entered the transverse foramen at the sixth cervical vertebra. After passing the transverse foramen of the atlas, this vessel penetrated the alar and lateral vertebral foramen towards the vertebral channel (Fig. 3). Its terminal branch anastomosed with its contralateral homolog on the ventral face of the medulla oblongata to form a thick basilar artery in 96.7% of the cases (Figs. 5 and 6). In 3.3% of the specimens, the left and right vertebral arteries did not participate in the irrigation of the encephalon. This irrigation was provided exclusively by the left carotid artery since their very thin branches cooperated only to form the ventral spinal artery (Fig. 2).

The ventral spinal artery was present as a thin vessel derived from a terminal branch of the left vertebral artery in 76.7% of the cases or of the right vertebral artery in 10% of the cases; in 13.3%, this vessel was formed by the anastomosis of branches of the right and left vertebral arteries (Figs. 5 and 6).

The basilar artery was formed by the anastomosis of the terminal branches of the right and left vertebral arteries, immediately inside the foramen magnum, in 96.7% of the specimens. This artery was present as a thick, rectilinear vessel that rostrally ran on the ventral midline of the rhombencephalon up to the rostral groove of the pons, where it divided into two terminal branches (Figs. 5 and 6). However, in 3.3% of the cases, the basilar artery was formed by the left internal carotid artery and projected rostrally to form the brain blood supply from the ventral middle third of the rhombencephalon (Fig. 2). At this point, the basilar artery gave off a thin caudal vessel that anastomosed with the very thin terminal branches of the vertebral arteries.

At the trapezoid body in the ventral middle third of the rhombencephalon, the basilar artery gave off a caudal cerebellar artery at each antimere (Figs. 5 and 6); these caudal cerebellar arteries ran laterodorsally until they reached the choroid plexus of the fourth ventricle. The right caudal cerebellar artery was present as a single or double vessel in 80% and 20% of the cases, respectively; the corresponding frequencies for the left caudal cerebral artery were 70% and 30%, respectively.

The rostral cerebellar artery was a thin vessel located caudally that normally originated from the basilar artery, very close to where it divided into its terminal branches (Figs. 5 and 6). This vessel laterally ran inside the rostral groove of the pons to reach the middle cerebellar peduncle, the base of the flocculus and the paraflocculus. On the right, the rostral cerebellar artery occurred as a collateral branch of the basilar artery in 66.7% of the specimens, was absent in 26.7%, and was present as a ramification of the right terminal branch of the basilar artery in 6.6% of the cases. On the left, the rostral cerebellar artery was present as a collateral branch of the basilar artery in 63.3% of the specimens, was absent in 30%, and was present as a ramification of the left terminal branch of the basilar artery in 6.7% of the cases.

The basilar artery bisected into its two terminal branches at or near the rostral groove of the pons inside the interpeduncular fossa (Figs. 5 and 6), with its branches running laterally at approximately 90^o; this vessel gave rise to the tectal and caudal cerebral arteries. After giving off the caudal cerebral artery, the terminal branches of the basilar artery ran rectilinear and parallel or slightly divergent courses until reaching the optic chiasm. At the mid-third of this course, they gave off a hypophyseal artery and, in some cases, an internal ophthalmic artery, as collateral branches (Figs. 5 and 6). At the brain lateral fossa, the terminal branch of the basilar artery was usually divided into the middle cerebral artery – its last collateral branch – and the rostral cerebral artery – its terminal branch –, which ran rostromedially. In most of the cases (96.7%), this vessel was symmetrical on the right and on the left, but in 3.3% of the cases, the terminal branch of the basilar artery followed a more lateral course, sometimes on the right and sometimes on the left, continuing as the middle cerebral artery but with no terminal branch, i.e., it did not form the rostral cerebral artery.

The first collateral branch given off by the terminal branches of the basilar artery was the rostral cerebellar artery, the most rostral vessel (Figs. 5 and 6). This vessel ran laterodorsally around the cerebral peduncle, rostrally to the groove of the pons, and branched at the caudal colliculi and at the rostral,

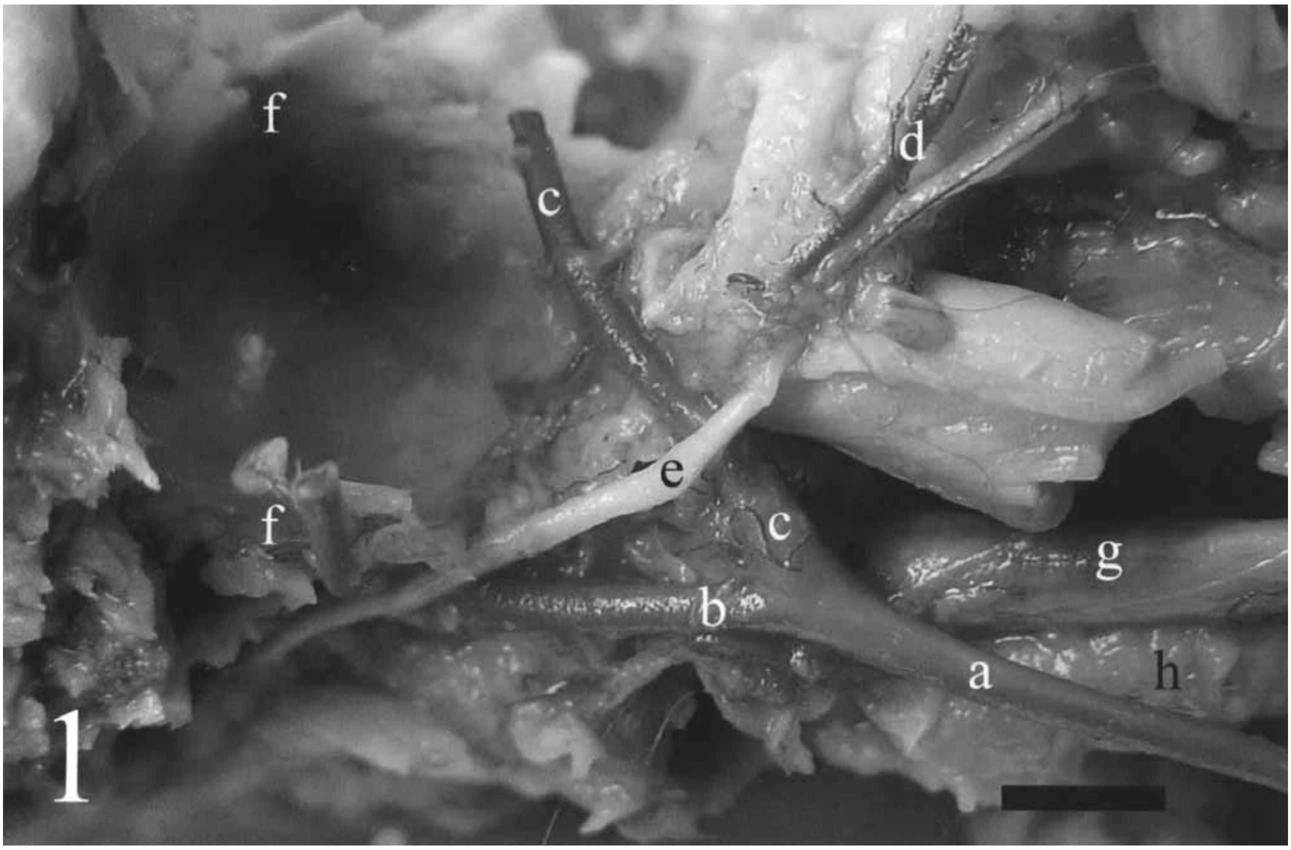

Figure 1. Left lateral view of the base of the cranium showing the well-developed left internal carotid artery: **a** – left common carotid artery, **b** – left external carotid artery, **c** – left internal carotid artery, **d** – occipital artery, **e** – loop of the hypoglossal nerve, **f** –medial wall of the open tympanic bulla, **g** – esophagus, **h** – trachea. Bar = 3.5 mm.

middle, and caudal lobules of the cerebellum. The rostral cerebellar artery occurred as a collateral branch of the terminal branch of the basilar artery in 90% of the cases on the right, and in 83.3% on the left, whereas it was a direct collateral branch of the basilar artery on the right in 10% of the specimens and on the left in 16.7%.

The tectal rostral artery was a thin vessel that originated laterally from the terminal branch of the basilar artery, between the rostral cerebellar artery and the caudal cerebral artery (Figs. 5 and 6). This artery ran around the cerebral peduncle to reach the mesencephalon at the rostral colliculi and was present as a single vessel in both antimeres in all cases.

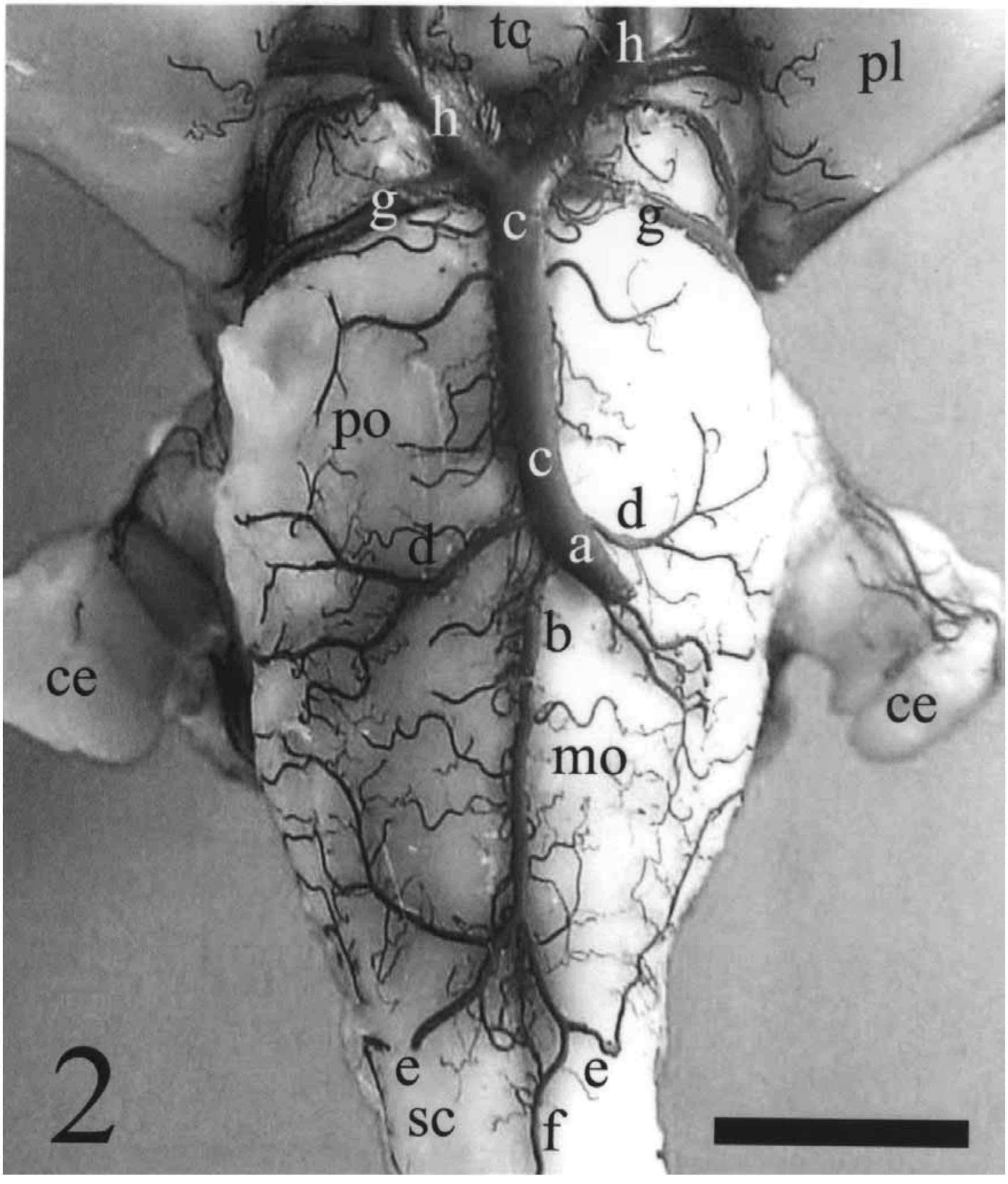

Figure 2. Detail of the ventral view of the brain showing the left internal carotid artery that irrigates the entire brain base: **a** – left internal carotid artery, **b** – caudal branch of **a**, **c** – basilar artery, **d** – caudal cerebellar artery, **e** – vertebral artery, **f** –ventral spinal artery, **g** – rostral cerebellar artery, **h** – terminal branches of the basilar artery, **tc** – tuber cinereum, **pl** – pyriform lobe, **po** – pons, **ce** – cerebellum, **mo** – medulla oblongata, **sc** – spinal cord. Bar = 4 mm.

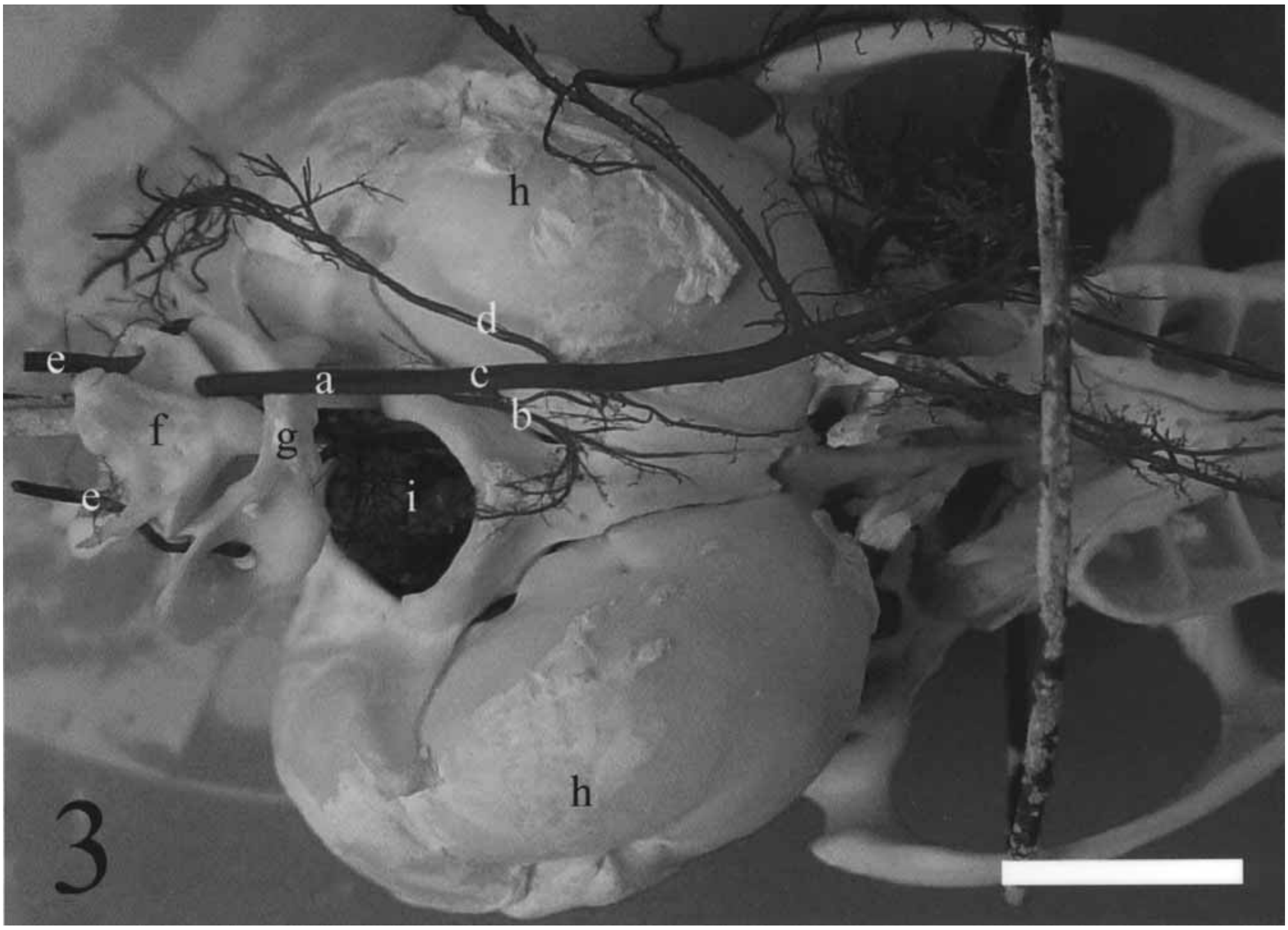

Figure 3. Ventral view of the vascular mold of a chinchilla cranium showing an incompletely developed right internal carotid artery: **a** – right common carotid artery, **b** –internal carotid artery, **c** – external carotid artery, **d** – occipital artery, **e** – vertebral artery, **f** – axis, **g** – atlas, **h** – tympanic bulla, **i** – foramen magnum. Bar = 6 mm.

The caudal cerebral artery was usually a single, thick vessel derived from the right and the left terminal branches of the basilar artery (Figs. 5 and 6). The caudal cerebral artery ran laterodorsally around the cerebral peduncle to reach the brain transversal fissure, and gave off branches to the thalamus, striae medullaris, pineal body, and the tentorial and medial faces of the brain hemisphere. The caudal cerebral artery reached only the caudal third of the medial face of the brain hemisphere. On the right, this artery was as a single vessel in 53.3% of the specimens, double in 36.7%, and triple in 10%; the corresponding frequencies for the left side were 46.7%, 46.7% and 6.6%, respectively.

The hypophyseal artery was present as a thin vessel that originated medially from the right and left terminal branches of the basilar artery at level of the tuber cinereum (Figs. 5 and 6). Its branches distributed on the latter and reached the hypophysis. The right and left hypophyseal arteries arose from the right and left terminal branches of the basilar artery, respectively, in 86.6% of the specimens, from the internal ophthalmic artery in 6.7%, and from several small branches originating from the anastomosis of the right or left terminal branch of the basilar artery with the artery that followed the fifth pair of cranial nerves in 6.7%.

The internal ophthalmic artery was infrequent, originating from the terminal branch of the basilar artery and extending from the tuber cinerium up to the optic chiasm. This vessel ran rostrally, and left the cranial cavity along with the optic nerve and ran parallel to this nerve until it reached the orbital cavity. The internal ophthalmic artery was present on the right in 26.7% of the cases and on the left in 23.3%.

The middle cerebral artery was a collateral branch of the terminal branch of the basilar artery

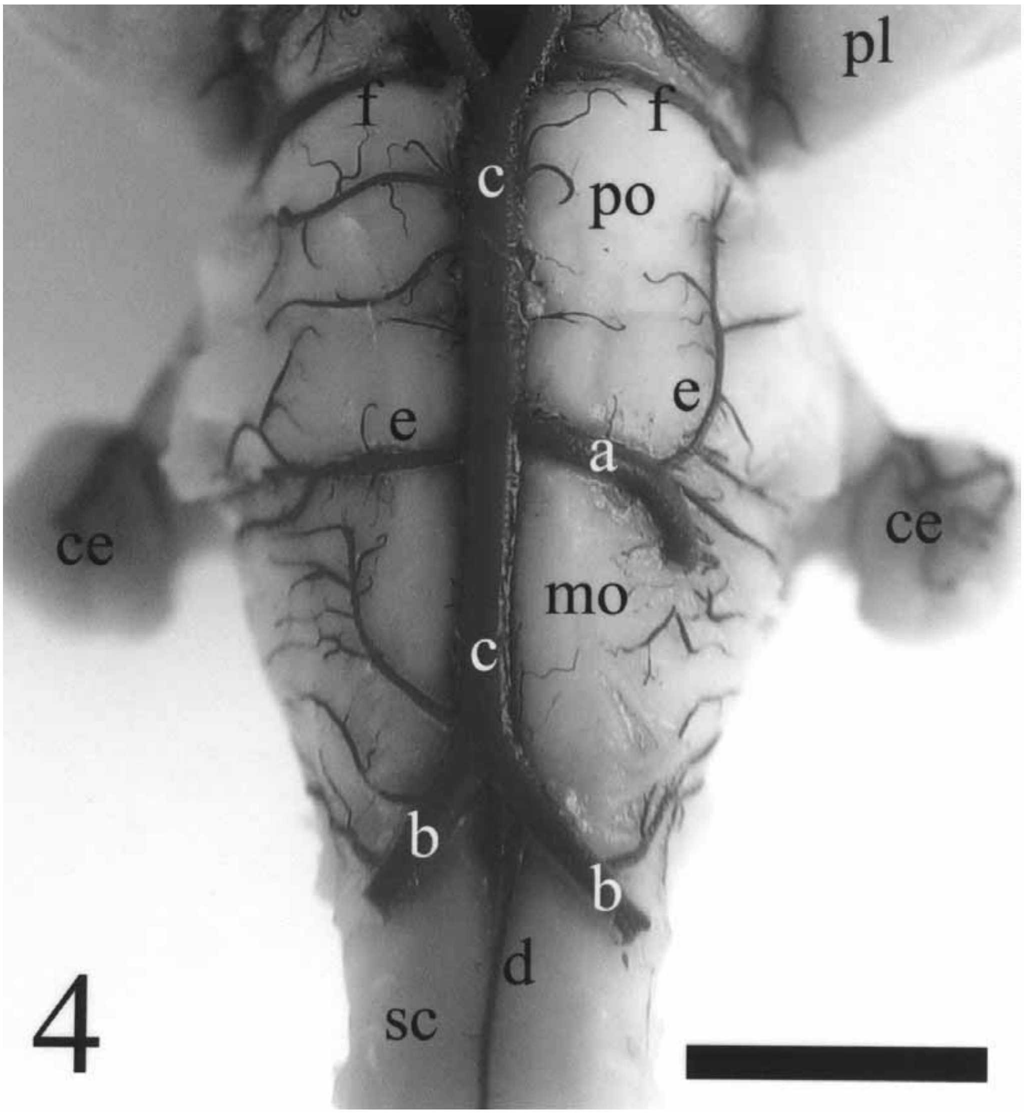

Figure 4. Detail of the ventral view of the brain showing the development of the left internal carotid artery that contributes to the encephalic irrigation: **a** – left internal carotid artery, **b** – vertebral artery, **c** – basilar artery, **d** – ventral spinal artery, **e** – caudal cerebellar artery, **f** – rostral cerebellar artery, **pl** – pyriform lobe, **po** – pons, **mo** – medulla oblongata, **ce** – cerebellum, **sc** – spinal cord. Bar = 5 mm.

that ran laterally at the optic chiasm into the lateral cerebral fossa (Figs. 5 and 6). During its course within the lateral cerebral fossa, this vessel ran rostrally to the pyriform lobe and gave off several collateral branches to these structures, with its main trunk subsequently branching at the convex face of the cerebral hemisphere. This vessel was present in both antimeres in 100% of the specimens.

The rostral cerebral artery was the terminal branch of the left and right terminal branches of the basilar artery and projected rostromedially from the middle cerebral artery (Figs. 5 and 6). This vessel was present in both antimeres in 96.7% of the cases, but was absent in 3.3% of the specimens; in one case, this vessel occurred on the right, while in another it occurred on the left, with the persistence of a fine vestigial vessel.

The rostral median inter-hemispheric artery was a single vessel, typically present as a collateral branch of the rostral cerebral artery, in a single antimere (Figs. 5 and 6). This vessel penetrated the ventral cerebral longitudinal fissure, was projected dorsally, coursed around the knee of the corpus callosum, and gave off a series of hemispheric

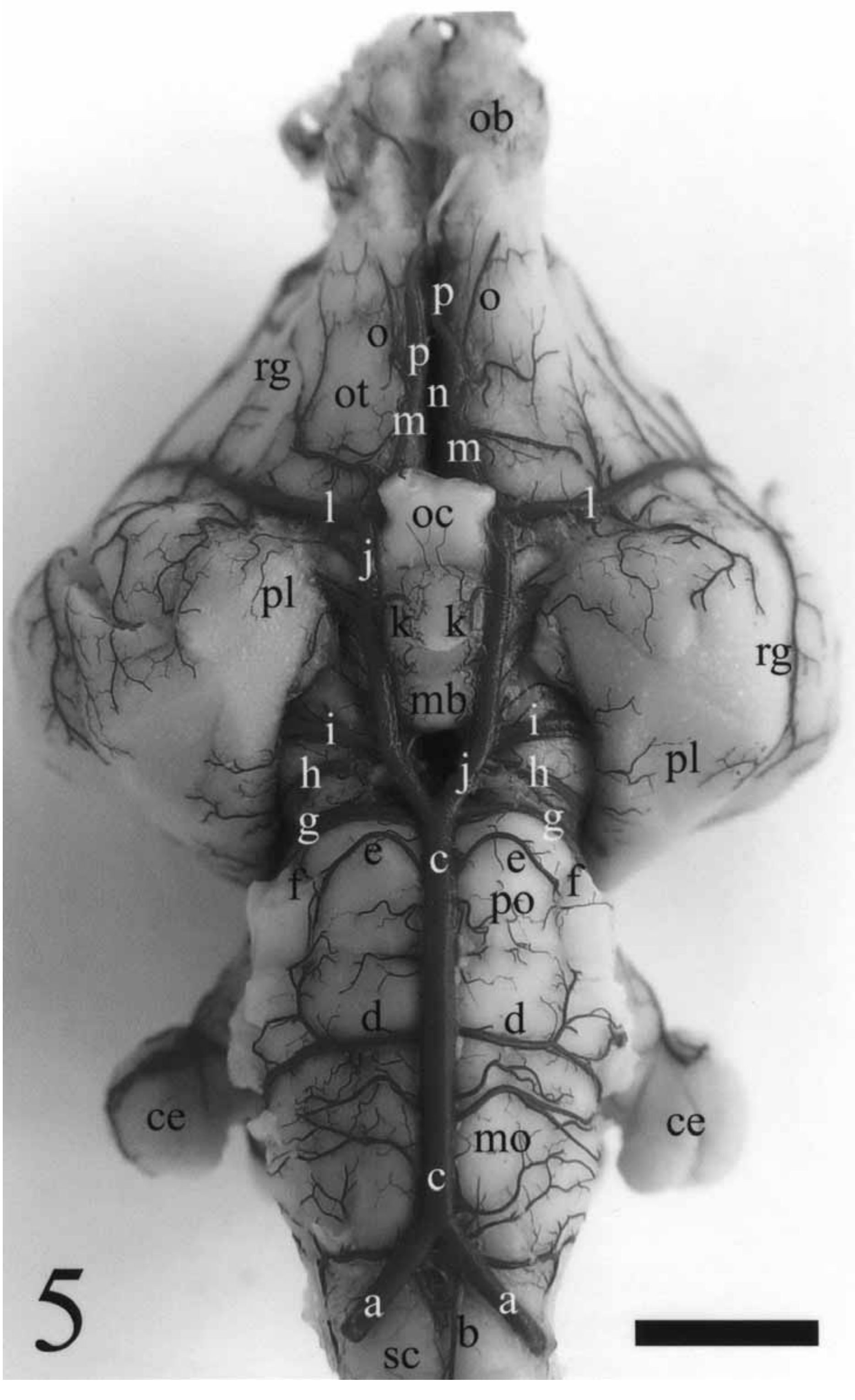

Figure 5. Ventral view of the brain base arteries: **a** – vertebral artery, **b** –ventral spinal artery, **c** – basilar artery, **d** – caudal cerebellar artery, **e** – trigeminal artery, **f** – rostral cerebellar artery (caudal vessel), **g** – rostral cerebellar artery (rostral vessel), **h** – tectal artery, **i** – caudal cerebral artery, **j** – terminal branches of the basilar artery, **k** – hypophyseal artery, **l** – middle cerebral artery, **m** – rostral cerebral artery, **n** – rostral median inter-hemispheric artery, **o** – lateral artery of the olfactory bulb, **p** – internal ethmoidal artery, **ob** – olfactory bulb, **rg** – rhinal groove, **ot** – olfactory trigonous, **pl** – pyriform lobe, **oc** – optic chiasm, **mb** – mamillary body, **po** – pons, **mo** – medulla oblongata, **ce** – cerebellum, **sc** – spinal cord. Bar = 4.7 mm.

branches towards the medial faces of both cerebral hemispheres, eventually reaching the two rostral thirds of these faces. The terminal branches of the rostral median inter-hemispheric artery anastomosed with the terminal branches of the right and left caudal cerebral arteries at the splenius of the corpus callosum. In 50% of the specimens, this artery derived from the left rostral cerebral artery, and from the right rostral cerebral artery in 20%, with the arterial cerebral circle remaining open rostrally. In 23.3% of the specimens, the rostral median inter-hemispheric artery was formed by the union of the right and left branches of the rostral cerebral artery, while in 6.7%, the rostral median inter-hemispheric artery was formed by a branch of the rostral cerebral artery that received a fine anastomosis of the medial artery of the olfactory bulb of the opposite antimere and resulted in closure of the cerebral arterial circle rostrally in both cases.

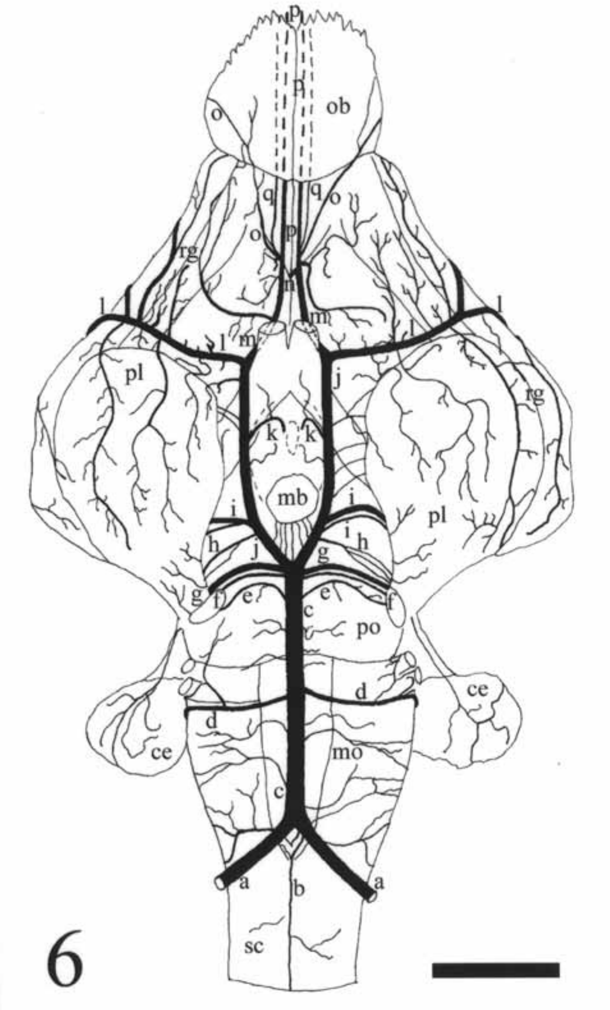

Figure 6. Schematic drawing showing the standard distribution of the brain base arteries in a ventral view of *Chinchilla lanigera*: **a** – vertebral artery, **b** –ventral spinal artery, **c** – basilar artery, **d** – caudal cerebellar artery, **e** – trigeminal artery, **f** – rostral cerebellar artery (caudal vessel), **g** – rostral cerebellar artery (rostral vessel)**, h** – tectal artery, **i** – caudal cerebral artery, **j** – terminal branches of the basilar artery, **k** – hypophyseal artery, **l** – middle cerebral artery, **m** – rostral cerebral artery, **n** – rostral median inter-hemispheric artery, **o** – lateral artery of the olfactory bulb, **p** – internal ethmoidal artery, **q** – medial artery of the olfactory bulb, **ob** – olfactory bulb, **rg** – rhinal groove, **pl** – pyriform lobe, **oc** – optic chiasm, **mb** – mamillary body, **po** – pons, **mo** – medulla oblongata, **ce** – cerebellum, **sc** – spinal cord. Bar = 4.7 mm.

The lateral artery of the olfactory bulb arose from the left and right rostral cerebral arteries, close to the origin of the rostral median inter-hemispheric artery (Figs. 5 and 6). This vessel projected laterorostrally to supply the ventral and lateral faces of the olfactory bulb. The right lateral artery of the olfactory bulb was present in 76.6% of the samples, and had also orignated alone; this same vessel originated from a common trunk with the right medial artery of the olfactory bulb in 23.3% of the cases. The left lateral artery of the olfactory bulb was present in 73.3% of the specimens and also orignated alone, whereas in 26.7% of the cases it derived from the common trunk with the left medial artery of the olfactory bulb.

The medial artery of the olfactory bulb was typically a single vessel given off as a collateral branch of the rostral cerebral artery of the same antimere (Fig. 6). This artery projected rostrally inside the cerebral longitudinal fissure and irrigated the medial and dorsal faces of the olfactory bulb. The right medial artery of the olfactory bulb was an individual vessel in 76.7% of the specimens, and in 23.3%, it was derived from a common trunk with the right lateral artery of the olfactory bulb. On the left, the medial artery was a single vessel in 73.3% of the cases and in 26.7%, it originated from a common trunk with the left lateral artery of the olfactory bulb.

The internal ethmoidal artery was a thick vessel seen as the terminal branch of the rostral cerebral artery (Figs. 5 and 6). The internal ethmoidal artery, after coursing through the lamina cribosa, gave off branches in the ethmoidal labyrinth. On the right, this vessel was present in 90% of the samples as a terminal branch of the right rostral cerebral artery, whereas in 10% it was present as a branch of the left internal ethmoidal artery. On the left, the internal ethmoidal artery was a terminal branch of the left rostral cerebral artery in 93.3% of the specimens, and a branch of the right internal ethmoidal artery in 6.7%.

The cerebral arterial circle of the chinchilla was supplied by the vertebral-basilar system in 93.4% of the studied brains, whereas in 3.3% it was irrigated exclusively by the left internal carotid artery, or by the vertebral-basilar system with a significant contribution from the left internal carotid artery in another 3.3%. The cerebral arterial circle was closed caudally in all specimens but was open rostrally in 70% of the cases.

DISCUSSION

In most chinchillas (93.3%), the aortic arch gives rise to two major vessels, the brachiocephalic trunk and the left subclavian artery [2], a finding similar to that reported by Kabak and Haziroglu [12] for guinea-pigs. In the remaining 6.7% of chinchillas, the aortic arch gives rise to a third vessel, the left common carotid artery [2], as also seen in other rodents [18,19].

Tandler [20] described the internal carotid artery as a primitive vessel that was under constant development in several mammals. This artery occurs as a fine fibrous chord in some species but is absent in others. In rodents, the internal carotid artery is well-developed in *Pedetes caffer* and *Mus rattus*, but is completely obliterated in *Cavia cobaya* and *Sciurus* [8]. According to Tandler [20], in *Sciurus vulgaris* and *Arctomys marmota*, only the proximal segment of the internal carotid artery is developed, i.e., up to the promontory of the tympanic bulla, where it undergoes involution, as also seen in chinchillas. However, Bugge [4] stated that the internal carotid arteries were absent in *C. lanigera*, *Myocastor coypu, Octodon degus, Thryonomys swinderianus, Bathyergus suillus, Cryptomys natalensis* and *Heterocephalus glaber*. This observation differed from our findings in two cases since the left internal carotid artery remained well developed and contributed to or gave rise to the cerebral blood supply, albeit atypically.

According to Jablonski and Brudnicki [11] and Roskosz *et al.* [17], the internal carotid arteries of chinchillas run on the surface of the cerebral base towards the optic nerve, anastomosing with the left and right terminal branches of the basilar artery, and dividing these branches into two segments. In most of the specimens examined in the present study, the hypophyseal artery originated at the same site as described above and irrigated the hypophysis and the tuber cinereum. In two cases, there was an anastomosis involving the artery that followed the fifth pair of cranial nerves and which joined the terminal branch of the basilar artery in both antimeres. This anastomosis may be a vestige of the primitive internal carotid artery, but clearly involved a complete transformation.

In her description of ontogenesis in the rabbit, De Vriese [8] stated that the internal carotid artery always occured on the lateral faces of the hypophysis and divided into rostral and caudal branches. After several embryonic stages, the vertebral arteries started to develop and form their terminal branches by incorporating the caudal branch of the internal carotid artery. The internal carotid artery regressed and its rostral terminal branches were also incorporated into the terminal branch of the basilar artery. In rabbits, the transformation that occurs during ontogenesis stops before this last stage, i.e., the brain is supplied by the carotid and vertebral-basilar systems, whereas in chinchillas, there is complete regression of the intracranial segment of the internal carotid artery. As a result, the caudal and rostral branches of the primitive internal carotid artery are incorporated into the terminal branches of the basilar artery, with no apparent vestige. In the two cases in which the internal carotid artery was persistent on the left antimere, the intracranial segment also regressed completely in its course up to the hypophysis whereas the developed portion anastomosed directly with the basilar artery or formed the entire cerebral vascularization. These cases represent important anatomical variations that may reflect a degree of instability in the cerebral vasculature of chinchillas.

The cerebral vasculature of chinchillas was very similar to that of capybaras [16], except that in the latter species the rostral branch of the persistent internal carotid artery was incorporated into the terminal branch of the basilar artery. Nevertheless, the course of the latter vessel remained very sinuous and formed an arch that gave off the middle and rostral cerebral arteries, whereas in chinchillas, the course remained entirely straight after the incorporation and gave off a same branches. As a result, the site of arrival of the primitive internal carotid artery in the terminal branches of the basilar artery was unobservable since the former artery had regressed completely.

De Vriese [8] reported that in some mammals the internal carotid arteries almost no longer participated in the composition of the cerebral arterial circle, which was formed mainly by the vertebral arteries. This type of irrigation occurs in a large number of rodents, and in some chiropterans, lemurids, and edentates. In *C. lanigera* [4,5], the internal carotid arteries are absent and the brain is supplied by the vertebral arteries [11,17]. According to Reckziegel *et al.* [16], the brain of *H. hydrochaeris* is supplied by the vertebral arteries and the blood supply of the brain depends exclusively on the vertebral basilar system. However, there is an anastomosis between the maxillary artery and the internal ophthalmic artery in both antimeres. In chinchillas, the vertebral arteries showed the same arrangement as that described in other rodents, although in one specimen, the caliber of the vertebral arteries was very thin; these arteries did not participate in the cerebral irrigation but formed the ventral spinal artery.

The basilar artery, designated as the basilar trunk by Lazorthes *et al.* [13], is a thick vessel [8,13,16,17,20] formed by the anastomosis of the vertebral arteries [8,11,16,17,19]. In agreement with the findings of Roskosz *et al.* [17] for chinchillas, we also observed that this artery was the thickest of all cerebral vessels.

According to Roskosz *et al.* [17], the superior caudal cerebellar arteries emerge along the course of the basilar artery in the medulla oblongata and pons. In the present study, the vessels that contributed to the vascularization of the cerebellum and choroid plexus of the fourth ventricle were identified and designated as caudal and rostral cerebellar arteries, respectively. Hence, the caudal cerebellar artery corresponded to the superior caudal cerebellar artery of Roskosz *et al.* [17]. In both antimeres, this artery was typically present as a single vessel given off by the basilar artery at the trapezoid body. In capybaras, the caudal cerebellar artery emerges in the initial third of the basilar artery, projects laterally, and irrigates the most laterocaudal part of the lateral cerebellar hemispheres and the caudal portion of the cerebellar vermis [16].

Reckziegel *et al.* [16] reported that in capybaras the basilar artery divided in its terminal branches and gave off the rostral cerebellar artery at the bifurcation, followed immediately by the caudal cerebral artery at the emergence of the oculomotor nerve. In chinchillas, the caudal communicating arteries in each antimere first give off the rostral cerebellar artery and then the caudal cerebral artery [17].

Jablonski and Brudnicki [11] and Roskosz *et al.* [17] stated that in chinchillas the posterior communicating branches first gave off the rostral cerebellar arteries and then the caudal cerebral arteries. As shown here, the caudal cerebral arteries were always collateral branches of the left and right terminal branches of the basilar artery, with the most caudal vessel being designated as the rostral tectal artery. The designation of this vessel as the caudal cerebral artery is not erroneous since, depending on the species studied, the region supplied by this vessel is part of the territorial domain of the caudal cerebral artery. In capybaras, the caudal cerebral artery is given off by the terminal branches of the basilar artery, projects laterally into the cerebral transverse fissure, and disseminates on the mesencephalon and on the caudal pole of the brain hemispheres [16].

Tandler [20] stated that the internal ophthalmic artery in *Viverra* and *Cavia* was a poorly well-developed vessel that, in marmots, communicated with the maxillary artery; this anastomosis was also reported in capybaras [16]. In the present study, the internal ophtalmic artery was an inconstant vessel with no anastomosis.

After passing the rostral extremity of the optic nerve, the rostral cerebral artery in chinchillas gives off the middle cerebral artery and courses laterally in front of the rostral margin of the pyriform lobe before dividing on the lateral surface of the brain hemisphere [11,17]. Reckziegel *et al.* [16] stated that the middle cerebral artery emerged as a collateral branch of the terminal branches of the basilar artery in the optic tract and then crossed the lateral fossa to spread out on the convex face of the brain hemisphere. This artery may occur as a double vessel or as an anastomosis “in island”. In chinchillas, the origin and distribution of the middle cerebral artery is similar to that of capybaras, but was a single vessel in both antimeres in all of the specimens examined here.

Jablonski and Brudnicki [11] and Roskosz *et al.* [17] stated that the rostral cerebral artery ran rostrally in the medial olfactory tract towards the cerebral longitudinal fissure and showed different degrees of development. In capybaras, this artery derived medially from the bifurcation of the terminal branch of the basilar artery and was absent in a few cases [16], as also occurred in some of the chinchillas examined here.

Tandler [20] reported that in *Mus rattus* and beavers the rostral median inter-hemispheric artery was a single median trunk that originated from the anastomosis of the rostral cerebral arteries. However, De Vriese [8] stated that in all of the mammals examined (monotremes, marsupials, edentates, perissodactyls, artiodactyls, several rodents, insectivores, chiropterans, pinnipedes, lemurids, and monkeys) this vessel also originated at the anastomosis between the rostral cerebral arteries but was considered to be a single median artery. In mice (*Mus musculus*) [13] and in some chinchillas, both rostral cerebral arteries anastomose close to the cerebral longitudinal fissure before irrigating each hemisphere. The designation of this vessel as the rostral median inter-hemispheric artery rather than as the corpus callosum artery is suggested here because primitive mammals such as monotremes and marsupials do not have this structure; when present, the main region that is irrigated is the medial face of the brain hemisphere, with the part supplying the corpus callosum being relatively smaller [3]. The term "median" was added to this designation since the vessel runs in the cerebral longitudinal fissure and is normally present as a pair rather than as a single vessel, such as occurs in most chinchillas.

In chinchillas, the rostral cerebral artery is more developed on one side and, before reaching the olfactory bulb, bisects into the corpus callosum artery and internal ethmoidal artery [11,17], with the first of these vessels penetrating the cerebral longitudinal fissure and then dividing on the medial face of the hemisphere.

After the emergence of the olfactory artery, the rostral cerebral artery in rats gives off the lateral orbitofrontal artery, which supplies the olfactory tubercle, the ventral surface of the olfactory bulb and the rostral face of the nucleus accumbens [19]. Based on the territorial description of this artery, we conclude that this vessel is the lateral artery of the olfactory bulb described in chinchillas. Scremin [19] stated that the olfactory artery runs parallel to the external edge of the optic chiasm, continues on the olfactory bulb, and finally splits into 2-4 terminal branches that run through the cribiform plate of the ethmoid bone to supply the nasal cavity. This description of the olfactory artery is consistent with the internal ethmoidal artery reported in chinchillas.

De Vriese [8] classified the arterial cerebral circle as type I, in which the brain is supplied exclusively by the internal carotid arteries, i.e., by the carotid system, type II, in which the carotid and vertebral-basilar systems contribute, symmetrically or asymmetrically, to the brain blood supply, and type III, in which only the vertebral-basilar system supplies blood to the brain. In most rodents, the vertebral cerebral arterial system overlaps the carotid system. In most of the chinchillas examined here, the arterial cerebral circle was classified as type III, i.e., only the vertebral-basilar system contributed to the brain blood supply.

According to Reckziegel *et al.* [16], the cerebral arterial circle of capybaras is supplied by a single source, the vertebral-basilar system. In this species, this system is closed caudally in all specimens and rostrally in 90%; in the remaining 10%, the system remains open because of the lack of one of the rostral cerebral arteries. In chinchillas, the cerebral arterial circle was also closed caudally in all cases, but was open rostrally in 70% of the specimens.

In conclusion, the results of this study show that in chinchilla the blood supply source to the brain is normally made by the vertebral-basilar system.

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