CONTRIBUTION TO THE ARTERIAL BLOOD CIRCLE OF THE BRAIN IN EGYPTIAN BALADI GOAT (CAPRA HIRCUS)

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SUMMARY

The course and variability of arterial circle was researched in eight Egyptian baladi goat of both sex (four male and four female), of different age and weighing about 20-30 kg. It was observed that the brain receives its blood supply through two sources, the internal carotid artery, the basilar artery, in addition to a little contribution by the vertebral artery. The features characteristic of this species includes the internal carotid artery which receives its blood from the maxillary artery. The internal carotid artery leaves the rostral epidural rete mirabile and perforates the dura mater to leave the cavernous sinus. It bifurcates into the rostral.cerebral artery and the caudal communicating artery.
The rostral cerebral artery forms the anterior part of arterial circle of the brain
The caudal communicating arteries form the posterior part of the arterial circle of the brain.

Key words: goat, brain, arteries

INTRODUCTION

Although many years have passed Arteries supplying the brain with blood have attracted the attention since a long time, both in human and animals. The research is still open both for scientific and practical investigation. An extensive coverage includes the papers whose authors investigate the arteries of cerebral base in ruminants.

The first studies covering of arterial circle of the brain in goats were published by (Hoffman; (1900), de Vriese (1905) and Getty (1975). In addition to the arteries of the cerebral base in cattle were described by (Chomiak,and Welento 1967), in sheep by (Jabłoński,and Wiland 1973) in Cervidae, by (Godynicki and Wiland (1970, 1971), Godynicki (1972). The course and variability of the cerebral base arteries in cattle fetuses were also described by (Brudnicki, and Gielecki (1996). the aim of the present work was to provide a helpful diagnostic aid and may well become more popular as experience accumulates so, the present work investigates the arterial circle of the brain in goat, as an indication of the exacting task required for clinicians.

MATERIALS AND METHODS

The research investigated eight egyptian baladi goats of both sexes (four male and four female), of different age and weighing about 20-30 kg. The arteries of the head in the animals researched were filled with gum milk latex colored with carmine stain via both left and right common carotid arteries and then the preparations were being preserved with 10% formalin solution for two weeks. Then muscles were being removed and the brain was prepared, the course and variability of arteries were investigated and a digital-camera photographic made.

RESULTS

The arterial supply of the brain is delivered mainly through two arterial structures, the arterial circle of the brain and the basilar artery.

The arterial circle of the brain (circus arteriosus cerebri) is located on the ventral surface of the anterior two third of the brain stem. The source of the arterial blood to the circle include the internal carotid artery (fig. 1-1) and the basilar artery (fig. 1-10) Concerning the internal carotid artery ; it was observed that , it is constructed of two portions , the first two third was obliterated , while the remaining part , intracranial section, is constructed mainly from internal maxillary artery (channel 3), The internal carotid artery forms in the cerebral base – two main arterial circles of the brain. The arterial circle of the brain in goat takes the form of the (8) digit shape or it takes the form of the 'heart'. The internal carotid artery leaves the rostral epidural rete mirabile and perforates the dura mater to leave the cavernous sinus. It bifurcates into the rostral cerebral artery (fig. 1-2) and the caudal communicating artery (fig.1-3).

The arterial circles (arteriae cerebri):

A-The rostral cerebral artery: it forms the anterior part of arterial circle of the brain initially it takes a wide curve towards the piriform lobe and descended as rostral choroid artery (fig. 1-4) which showed variability in the manner of its origin where in four cases ,it was provided from the rostral cerebral artery while in one case it was originated at the bifurcation of the internal carotid artery into rostral cerebral and caudal communicating arteries and in one case it was originated from the caudal communicating branch in some cases. At the level of optic chiasma, the rostral cerebral artery gives rise to the middle cerebral artery (fig. 1.-5); the most powerful branch of the arterial circle of the brain. This vessel takes a considerable curve and goes towards the lateral fissure where it divided up into cortical branches it was double in one case. The rostral cerebral artery passed towards the longitudinal cerebral fissure. Before reaching it, it proceeds along the medial olfactory tract towards olfactory bulbs; here it gives rise to a thin rostral communicating artery (fig. 1-6) which joins a similar vessel on other side; thus closing up the arterial circle of the brain rostrally in most cases under investigation. The rostral cerebral artery gives off during its course the marginal artery which divide up on the medial surface of the hemispheres into two cortical branches also descending

onto the dorsal surface of the hemispheres and continue as the artery of corpus callosum, finally the rostral cerebral artery bifurcated into two branches internal ophthalmic artery and internal ethmoidal artery.

B-The caudal communicating arteries (fig. 1-3): it is concerned as the caudal continuation of the internal carotid artery which curved around the mamillary body and then run medially from the oculomotor nerve to join at the level of prepontian sulcus to transform into the basilar artery. In its course, the caudal communicating artery gradually gives rise the caudal cerebral artery (fig. 1-7), caudal choroidal artery (fig. 1-8) as well as the rostral cerebellar artery (fig. 1-9). Medially the caudal communicating artery bifurcates into short arterioles descending deep into the midbrain.

The basilar artery (fig. 1-10) starts at the posterior part of the interpedunculate fissure, it was run caudally over the pons, to reach the medial fissure of the medulla oblongata. The diameter of the basilar artery gradually decreases caudally. In its final part it gives rise to thin vertebral arteries (fig. 1-14) as well as the ventral spinal artery (fig. 1-15). In its anterior part, the basilar artery ramifies into numerous branches- Pontine branches (fig. 1-13); beyond the level of the abducent nerve from the basilar artery gives caudal cerebellar arteries (fig. 1-11). This is spread over the caudal and dorsal surface of the cerebellum. The Caudal cerebellar arteries give rise to labyrinthian arteries (fig. 1-12) and medullary branches (fig. 1-13).

In goat the arteries of the cerebral base show a variability both in its course as well as in its pattern of descend of respective vessels. The rostral cerebellar artery, the final branch of the caudal communicating artery; in goat there was observed a considerable variability of their descend. In one case individual there was noted a vessel descend asymmetry where it was branched out by double branches –from caudal communicating branches on the left side (fig3a) while in another case it was represented by double branches one from the caudal communicating branch and one from the origin of the basilar artery from the connection of the two communicating branches on the left side (fig3b). While on the right side the rostral cerebellar artery was descend also by double branch but one branch from the caudal communicating branch and one branch from the initial section of the basilar artery (fig3a and 3b).

In one case there was observed a vascular button-hole formation where the left and the right caudal communicating arteries joined the basilar artery (Fig.4).

DISCUSSION

The main vessels forming the arterial circle of the brain in goat are internal carotid arteries whose supracranial section, after birth, atrophies Daniel et al. (1953), Getty (1975) and Layunta and Roldan (1982) in goat. The intracranial section of internal carotid artery is reconstructed mainly from the

rostral epidural rete mirabile which supplies the arterial circle (channel 3 according to king 1976) the basilar artery (channel 2 according to king 1976) carries blood from the arterial circle the direction of blood in the basilar artery is caudal so, no vertebral blood reaches the cerebral hemispheres. A similar pattern of arteries is found in all the ruminants researched so far, including cattle, as reported by Chomiak, Welento (1967), Brudnicki, Gielecki (1996), roe-deer and in red deer - Godynicki, Wiland (1970, 1971), sheep by Jabłoński, Wiland (1973) ,Getty (1975), king (1976) and Qian et al (1999) in sheep and bison ,Muglia,Longo and Paterniti (1982) in sheep and goat and Węgrzyn et al. (1983) in bison.

The function of the rete mirabile is to regulate the flow of arterial blood towards the cerebrum as well as the thermal regulation of the brain preventing it from overheating; the arterial system of the cerebrum in ruminants, including goat, is equipped with a safety system as reported by (. Draehmpaehl D. 1988) in goat.

In goat it is characteristic that the arterial circle of the brain is a well-developed anterior section of the circle made up of rostral cerebral arteries. The vessels took a form of a considerable curve forming a 'heart'. Or (8) digit shape as reported by Brudnicki (2000) in goat.

The middle cerebral artery, like in other mammals, remains the strongest branch of the rostral cerebral artery. A wide curve described by the artery where it descends from the parent vessel is also found in other ruminants. According to Brudnicki (2000). The curves of arterial vessels decrease a negative effect of blood beats on the delicate cerebral tissue. Cases of double middle cerebral arteries were reported as a vascular variant in different animal species by Wiland, Brudnicki (1984) and (Siekmann et al 2000) in swine, Jabłonski et al. (1989), Skoczylas, Wiland (1999),and Kapoor, Kak and Singh (2003) in ruminant..

Researching the course and variability of cerebral base arteries in goat, we can conclude that the variability observed in this species was much limited, as compared with those reported in other ruminant species. The rostral cerebral arteries united in the medial fissure creating a short trunk of arteries of the corpus callosum. Only in some cases there were observed rostral communicating arteries a similar, to that observed in cattle, the connection of rostral cerebral arteries was observed in bison, Wegrzyn et al. (1983) in bison and Brudnicki (2000) in goat. The greatest variability was observed in the pattern of descend of rostral choroid arteries. In other ruminant species, usually it descends from the rostral cerebral artery. In one case there was also observed a vascular button-hole formation where the left and the right caudal communicating arteries joined to the basilar artery similar observation was denoted by Brudnicki (2000) in goat.

The basilar artery, similarly to its course in other ruminant species, it was run caudally showing a decrease in diameter. The course of the vessel was regular. Its greatest branch is the caudal cerebellar artery; it was descending on the surface of the pons and medulla oblongata, the basilar artery gave rise to very numerous branches. Vertebral arteries, similarly to other ruminants, were not well developed, which suggests that their contribution to cerebral blood-supply remains inconsiderable; a similar conclusion was drawn by Fazzari (1929), Getty (1975) in ruminant and Frackowiak and Godynicki (2003) in cat. Our research showed that the pattern of arteries of the cerebral base in goat was similar to other ruminants. The variability of the vascular area researched observed in that species, is somewhat limited as compared with the variability noted in cattle.

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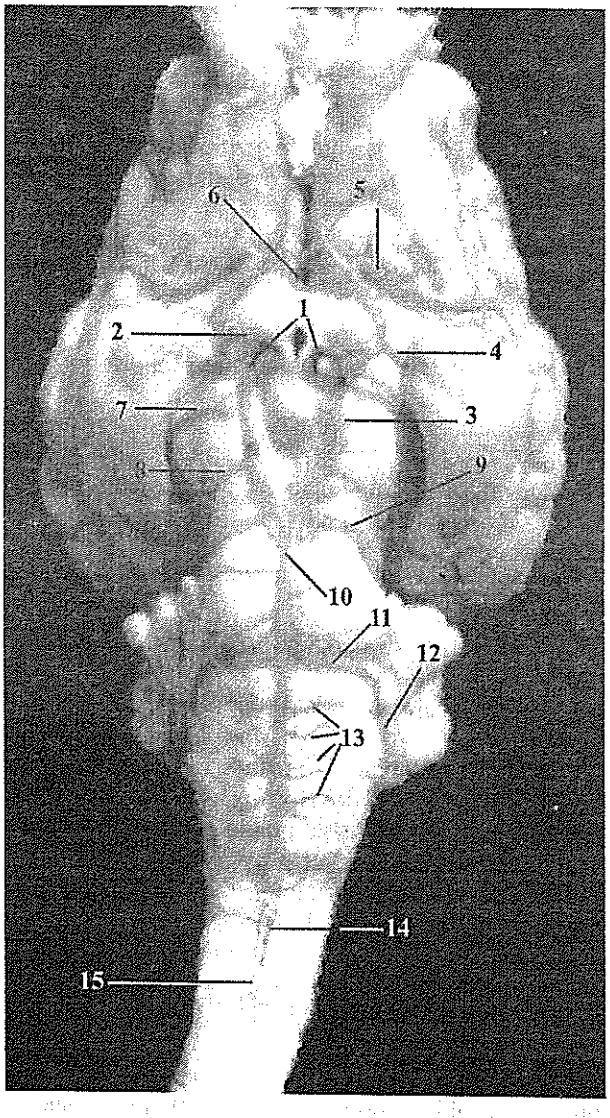

Fig. 1. The arterial circle of the brain in goat. 1 - Internal carotid artery, 2 - Rostral cerebral artery, 3 - Caudal communicating artery, 4 - Rostral choroid artery, 5 - middle cerebral artery, 6 – Rostral communicating cerebral artery, 7 - Caudal cerebral artery, 8 - Caudal choroid ramus, 9 - Rostral cerebellar artery, 10 - Basilar artery, 11 - Caudal cerebellar artery, 12 - Labyrinthian artery, 13 - Pontine and medulla oblongata branches, 14 - Vertebral artery, 15 - Ventral spinal artery

Fig. 2. Double middle cerebral artery – 5

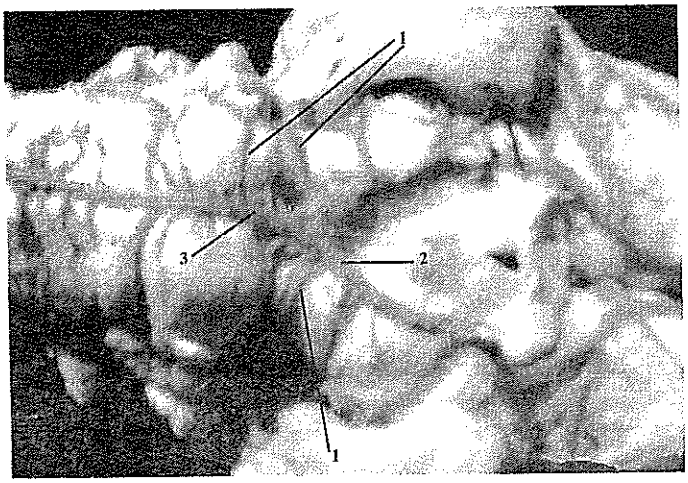

Fig. 3a. Double rostral cerebellar artery (1) –from caudal communicating branches (2) on the left side and one branch from the caudal communicating branch and one from the basilar artery (3) on the right side.

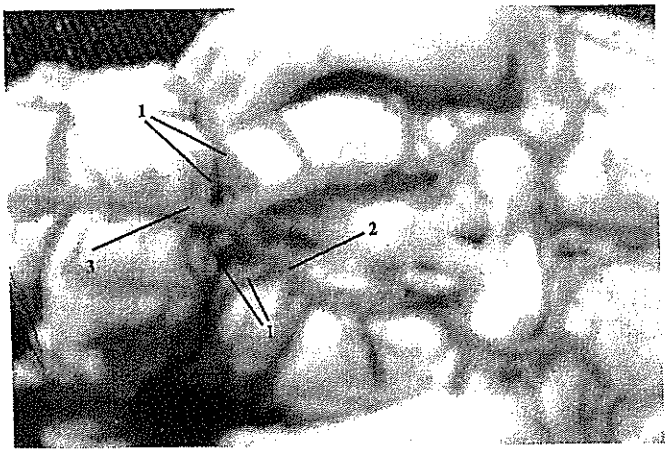

Fig. 3b. Double rostral cerebellar artery (1) – one from caudal communicating branches (2) and one from the union of the two communicating branches to form the basilar artery(3) on the left side and one branch from the caudal communicating branch and one from the basilar artery on the right side.

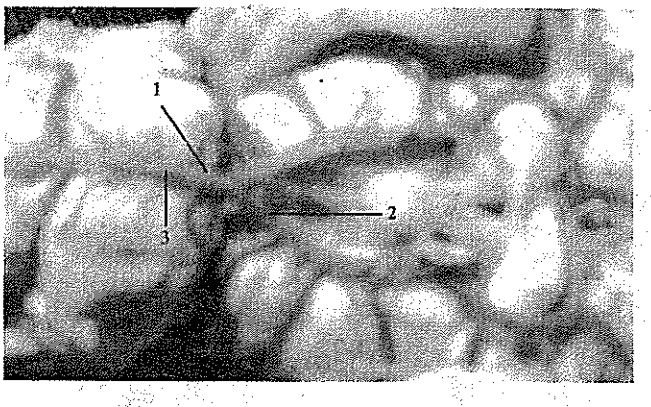

Fig. 4. Vascular button-hole formation (1) between the connection of caudal communicating artery- (2) and basilar artery – (3)

الملخص العربى

دراسة دورة الشرايين المخيه فى مخ الماعز البلدى

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استخدمت فى هذه الدراسه ثمانيه من الماعز البلدى أربعه من الاناث وأربعه من الذكور تزن ما بين 20-30 كيلو جراما.

وقد اشتملت الدراسه على تشريح الشرايين الموصله الى قاعدة وساق المخ

وتبين الاتى:

الشرايين المغذيه للمخ تبدأ من الشريان السباتى الداخلى الذى ينقسم بدوره بعد ان يخترق الام الجافيه الى الشريان المخى الامامى والاوسط ثم الشريان المخى المتلاقى مع مثيله على الجانب الاخر من المخ ويظهر خلال تلاقى تفرعات الشريان المخى على الجانبين دورة الشرايين المخيه والتي تكون بشكل القلب.

قامت الدراسه ايضا بمقارنة النتائج فى جميع الحالات محل الدراسه وتبين مجموعه من الاختلافات فى تفرعات الشرايين المخيه.