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Original Article

Microsurgical anatomy of foramen caecum posterius (Vicq d'Azyr foramen): importance for vascular neurology and neurosurgery

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ABSTRACT

Of 15 fresh cadavers, we studied the pontomedullary junction regarding the arterial source and variations, in the called Vicq d'Azyr foramen. This small triangular depression at the lower boundary of the pons between the pyramids that marks the upper limit of the anterior median fissure of the medulla oblongata is the foramen caecum medullae oblongatae, or Vicq d`Azyr foramen. The results showed a basilar artery of diameter of 6.22 mm, 12.37 perforators to the mentioned area, mainly having their origin from basilar artery. The importance of studying this area is to better understand the neurovascular diseases of brain stem and serve as a guide for neurosurgeons operating in this vital area. © **Neuroanatomy. 2008; 7: 49–51.**

Key words [foramen of Vicq d'Azyr] [perforating arteries] [vertebrobasilar junction] [microvascular anatomy] [anterior spinal artery] [foramen magnum]

Introduction

The foramen of Vicq d'Azyr is a triangular-shaped area located rostral to the ventral median fissure of the medulla oblongata, situated in the midline on the base of the brain stem, at the pontomedullary junction [1]. Its importance relies on the fact that it is penetrated by small vessels from the vertebrobasilar axis that nourish vital pontine nuclei and tracts. We described the microvascular anatomy of the perforating vessels of the foramen of Vicq d'Azyr (FVA). Although this area is known to have a very high concentration of brainstem perforating vessels, its microvascular anatomy was rarely studied in detail in literature. The purpose of this study was to describe the microvasculature of this territory in detail and emphasize its importance to better understand the neurovascular diseases of brain stem [2,3,4] and serve as a guide for neurosurgeons performing operations in this vital area.

Material and Methods

The arteries at the vertebrobasilar junction and the perforating arteries of the foramen of Vicq d'Azyr were examined using a surgical microscope in 15 fresh cadaveric brain stems in the period from December 2002 to February 2003 (9 cases) and in October 2007 (6 cases), during a total time of 4 months. The methodology was kept in both periods and all dissections were performed by the main author in the SVO (Service of Investigation of Death Causes, Hospital das Clinicas University of Sao Paulo). All cases died of natural, non-neurological causes. Subjects with head injuries were excluded. Mean age was of 61.8 years, ranged from 58 to 72. All patients were white, 8 female and 7 male. The brains have been removed from skulls within 6 to 12 hours after death. The dissection was performed under magnification with surgical loupe 4x, (Design For Vision Ronkonkoma, New York, USA); with microsurgical instruments micro knife, 3 mm sharp dissector and forceps, as well a micro-scissors (Mizuho Medical Inc, Tokyo, Japan). The pictures for panoramic view were taken by means of photo camera, Dimage Z2, Konika Minolta (Tokyo, Japan), lens 1:2.8-3.7, 38 to 380 mm, 10x optical zoom, additional lens Bower (Tokyo Japan) 0.45x and for anatomical details a photo camera, Dimage X1, Konica Minolta, zoom lens 7.7-23.1 mm 1:3.5-3.8, additional lens Crystal Vision, 0.45X (Japan) were used.

Results

The total number of perforating branches to the region of the foramen caecum medullae oblongatae, was 191 in the total 15 brains, having an average of 12.73 perforators per brain, ranged from 4 to 28. They arose as distal branches from 62 main trunks, average of 4.1 per brain, ranged 2 to 6, originating mainly from the basilar artery in 13/15 (87%) and the left ventral spinal artery (VASA) only in 2/15 (13%); we have not found any originating from the vertebral arteries. The average outer diameters of the left and right vertebral arteries were 3.07 mm and 2.4 mm, 6.22 mm for the basilar artery (Figure 1), and 0.5 mm for the right and left ventral spinal arteries. The measure of inner diameter was accomplished trough millimetric ruler and two tips compass, analyzed under loupe magnification. The branching pattern and interesting anatomical variations of the main vessels of the vertebro-basilar junction are described in Table 1. Advanced atherosclerotic changes were found in 5 main trunks, all of those in the patients with advanced age; 62, 68, 68, 72, 71 year old respectively. The data about the specimens are summarized in Tables 1 and 2.

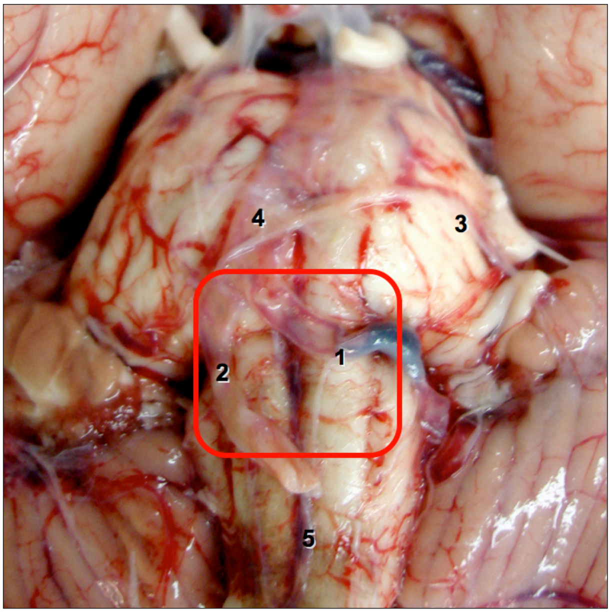

Figure 1. Anatomical specimen shows the basilar artery, and the both vertebral arteries (Case 9). The red square shows the analyzed area. Color version of figure is available online. *(**1:** left vertebral artery; **2:** right vertebral artery; **3:** right anterior inferior cerebellar artery; **4:** basilar artery; **5:** anterior spinal artery)*

Discussion

Vicq d'Azyr foramen was described by the French anatomist Felix d'Azyr (1748-1794) in the 18th century. This is a small triangular depression at the lower boundary of the pons between the pyramids, marking the upper border of the anterior median fissure of the medulla oblongata; also called foramen caecum medullae oblongatae [1].

These anatomical data are important for those wishing to study the pathophysiology of vascular insults to this area caused by atheromas, thrombi, and emboli; to plan vertebrobasilar aneurysm surgery, surgery for vertebrobasilar insufficiency; as well as to study foramen magnum neoplasms [1–5]. In our patients these changes were observed in 13 brains, with severe pattern in 5.

The vascular anatomy of the infratentorial compartment is highly variable. These variations should be taken into consideration to avoid damages during vascular or tumor surgery. In contrast, the entering locations of perforating vessels remain constant, referring to these zones as key areas when planning or doing surgical procedures in this region.

Our results were similar to found by Mercado et al, 2004. However, the number of branches coming from vertebral artery and VASA were lower in our study [6].

Santos-Franco et al. found one anterior-ventral spinal artery at each side in 30 of the brain stems (60%) [7]. The

Table 1. Summarized data about the consecutive specimens obtained from fresh cadavers.

Number	Age	Gender	Arterial anomaly	Branches	Main trunks	Atherosclerotic changes	Cause of death
1	58	M	No	4	2	0	Renal complication of Lupus
2	58	M	No	16	6	++	Coma by Diabetes
3	62	F	No	14	2	+++	Heart attack
4	59	M	No	5	3	+	Indetermined
5	58	M	No	15	5	+	Asthma
6	59	F	AICA/PICA	12	5	+	Cardiac Failure
7	59	F	No	18	4	++	Colon cancer
8	68	F	NO	14	6	+++	Breast cancer
9	68	F	NO	28	3	+++	Heart attack
10	59	F	Vertebral ectasia	13	3		Heart attack
11	71	M	No	5	4	+++	Lung cancer
12	57	F	No	17	6	+	Melanoma
13	65	F	No	15	4	0	Breast cancer
14	72	M	Basilar trunk ectasia	10	4	+++	Mesenteric ischemia
15	54	M	No	5	5	+	Cardiac failure

(M: male; F: female; AICA: anterior inferior cerebellar artery; PICA: posterior inferior cerebellar artery; 0: no changes; +: minimal changes; ++: moderate changes; +++: severe changes)

Table 2. Diameters of the main arteries in posterior circulation.

Case	Left VA (mm)	Right VA (mm)	Basilar (mm)	Left SA (mm)	Right SA (mm)
1	3.1	2.0	5.0	0.4	0.5
2	3.0	2.2	4.8	0.5	0.5
3	3.6	2.8	3.9	0.4	0.6
4	3.5	2.1	4.4	0.4	0.4
5	3.6	2.0	4.5	0.5	0.4
6	3.0	2.2	5.2	0.5	0.5
7	3.2	3.5	5.5	0.6	0.6
8	3.6	3.0	10	0.4	0.6
9	2.5	3.0	4.4	0.3	0.6
10	2.8	2.0	4.1	Not visible	0.5
11	3.5	2.0	4.8	0.5	0.5
12	3.6	2.3	4.5	0.6	0.4
13	2.4	2.2	5.8	0.6	0.6
14	2.0	2.0	20	Not visible	Not visible
15	2.7	1.8	6.4	0.5	0.4
Median ± Δ	3.07± 0.41	2.34 ± 0.29	6.22 ±2.38	0.5 (13 cases) ±0,07	0.507 (14 cases) ±0,06

(VA: vertebral artery; SA: spinal artery; Δ: deviation)

anterior spinal artery (ASA) was a direct branch emerging from the left vertebral artery (VA) in 15 (30%), from the right VA in 4 (8%), and from the basilar artery (BA) in one brain stem (2%). The previously described "typical pattern" of the junction of the ventral spinal arteries (AVS) from both sides was observed only in 9 brain stems (18%). The anterior communicating spinal artery (ACoSA) was observed in 15 brain stems (30%). Also multiple ACoS arteries were described in one brain stem. Both, the AVS and the ASA were observed to send long circumferential branches that supplied irrigation to the olive in 42 (84%) brain stems. Their study gave important information for a better understanding of the clinical picture of ischemic lesions of the brain stem, such as the medial medullary syndrome, and highlighted the remarkable role of the AVS and ASA as anatomical landmarks during the surgical approaches to lesions involving the ventral aspect of the medulla and the foramen magnum. Only in 1 case we were not able to find right and left spinal arteries with origin from vertebral artery.

Mahmod et al. found in dissected 20 brain stems, a total number of 287 perforators, with an average (± standard deviation) of 14.35 ± 1.24 perforators per brain (range 7 to 28) [1]. Their origin was as follows: right vertebral artery in 52 perforators (18.11%); left vertebral artery in 35 (12.19%); basilar artery below the anterior inferior cerebellar artery (AICA) in 139 (48.43%); basilar artery above the AICA in 46 (16.02%); AICA in 10 (3.48%); and anterior spinal artery in five (1.74%). Most of the perforators arose as sub-branches of larger trunks; their average outer diameter was 0.16 ± 0.006 mm while that of trunks was 0.35 ± 0.02 mm. We found an anterior inferior cerebellar artery and posterior inferior cerebellar artery common trunk (AICA/PICA) as anatomical variation.

Mercado et al. found that a total number of perforating branches was 286 in the 21 brains, an average of 13.6 perforators per brain, ranged 7 to 22 [6]. They arose as distal branches of 73 main trunks, average of 3.5 per brain, range 2 to 5, originating mainly from the basilar artery in 41 (56.1 %), the left ventral spinal artery in 12 (16.4%), and the left vertebral artery in 8 cases (11%). The average outer diameters of the left and right vertebral arteries were 3.2 mm and 2.9 mm, 4.1 mm for the basilar artery, and 0.6 mm for the right and left ventral spinal arteries. The results are similar to ours, and they did not identify the absence of left or right spinal arteries.

In many tumors placed in foramen magnum, mainly in its anterior portion, the encasement of these perforators may explain post-operative complications as brain stem ischemia as well as surgical bed hematomas. The number of perforators in the region of posterior foramen caecum justifies a digital subtraction angiography for the pre-operative period. Therefore the brain stem monitoring evocated potential has its employ justified in anatomical and physiological reasons, mainly any vascular lesion or neoplasia placed in this area [8–10].

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