VIA MEDICA

ORIGINAL ARTICLE

Folia Morphol.
Vol. 64, No. 3, pp. 194–198

ISSN 0015–5659
www.fm.viamedica.pl

The choroid plexus of the fourth ventricle and its arteries

Mansoor Sharifi[1], Maciej Ciołkowski[1], Paweł Krajewski[2], Bogdan Ciszek[1]

[1]*Department of Anatomy, Center of Biostructure, Medical University of Warsaw, Poland*
[2]*Department of Forensic Medicine, Medical University of Warsaw, Poland*

[Received 14 March 2005; Revised 5 June 2005; Accepted 20 June 2005]

The choroid plexus of the fourth ventricle consists of two symmetrical parts located in the roof of the ventricle and protruding through its openings, the foramina of Luschka and Magendie. The arteries supplying the choroid plexus of the fourth ventricle are difficult to approach because of their deep location within the cerebellopontine angles and the cerebellomedullary fissure. They originate from multiple sites on the cerebellar arteries, and pass near the vital structures of the pons and medulla. The increasing use of the operating microscope and endoscopy during operations in the posterior cranial fossa has created a need for better understanding of the microsurgical anatomy of the plexus and its arteries.

The arteries of 15 human brain-stems with cerebelli were injected with coloured gelatine and fixed in 10% formaldehyde solution. The specimens were studied under an operating microscope.

The choroids plexus on each side of the midline was divided into four segments, the medial and lateral horizontal segments and the rostral and caudal sagittal segments, in order to facilitate the description of their blood supply. The anterior inferior cerebellar artery (AICA), the posterior inferior cerebellar artery (PICA) and the superior cerebellar artery (SCA) were the main supplying vessels. AICA supplied the portion of the plexus in the cerebellopontine angles and the adjacent part of the lateral recess of the fourth ventricle through the foramina of Luschka. PICA supplied most of the choroid plexus in the roof and the median opening of the fourth ventricle.

Key words: foramen of Luschka, foramen of Magendie, anterior inferior cerebellar artery, posterior inferior cerebellar artery

INTRODUCTION

The choroid plexus of the posterior fossa is composed of two inverted L-shaped fringes that arise on the ventricular surface of the *tela choroidea* of the fourth ventricle and are located on each side of the midline [3, 7]. The paired sagittal (longitudinal) limbs bordering the median plane are referred to as the medial segments. The horizontal (transverse) limbs that originate from the rostral ends of the medial segments are the lateral segments. The entire structure presents the form of a letter T, the vertical limb of which, however, is double [3, 7] (Fig. 1).

The medial segments are located in the roof near the midline and the lateral segments extend through the lateral recesses and the foramina of Luschka into the cerebellopontine angles. Each medial segment

Address for correspondence: Mansoor Sharifi, Department of Anatomy, Center of Biostructure, Medical University of Warsaw, ul. Chałubińskiego 5, 02–004 Warszawa, Poland, tel/fax: +48 22 629 52 83, e-mail: mansoorir@yahoo.com

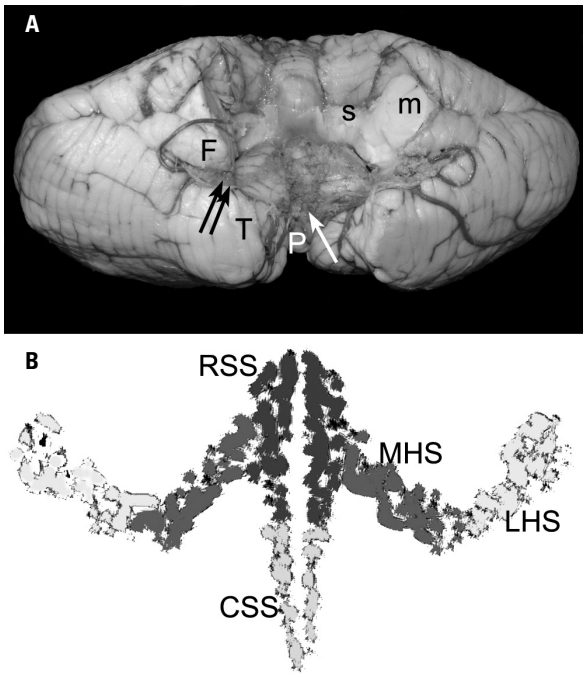

Figure 1. Anterior view of the roof of the fourth ventricle with the choroid plexus after removal of the floor of the ventricle (**A**). Two lateral ends protrude through the foramina of Luschka and the caudal median end protrudes through the foramen of Magendie. Schematic picture of the choroid plexus of the fourth ventricle with its segments (**B**). T — tonsil, F — flocculus, P — pyramid, m — middle cerebellar peduncle, s — superior cerebellar peduncle, single arrow — foramen of Magendie, double arrow — foramen of Luschka, LHS, MHS — lateral and medial horizontal segments, RSS, CSS — rostral and caudal sagittal segments.

is subdivided into a rostral and a caudal part. The rostral parts are widest at their junction with the lateral segments, extend from the level of the nodule anterior to the tonsils to the level of the foramen of Magendie and are parallel to the rhomboid fossa. The caudal parts are located between the tonsils and climb on the vermis to the level of the pyramid bordering the foramen of Magendie. The rostral and caudal ends of the medial segments are often fused [3, 7].

The lateral segments form a horizontally (transversely) oriented fringe that is attached to the rostral part of the medial segments and extends through the lateral recesses into the cerebellopontine angles [3, 7]. Each lateral segment is subdivided into medial and lateral parts. The medial part forms a narrow fringe that is continuous with the rostral part of the medial segment and is attached to the *tela choroidea* covering the lateral recess caudal to the cerebellar peduncles. The lateral part is continuous with the medial part at the lateral margin of the cerebellar peduncles and protrudes through the foramen of Luschka into the cerebellopontine angle below the flocculus (Fig. 1).

The choroid plexus is supplied by small branches arising from AICA and PICA, and, rarely, SCA. The arteries supplying the choroid plexus in the posterior fossa are smaller than those supplying the choroid plexus in the lateral or third ventricles [4, 3]. In this study the arteries supplying each part of the choroid plexus were counted with regard to their origin. It is worth mentioning that very few authors to date have focused on the number and origin of the choroidal arteries in the manner presented here.

MATERIAL AND METHODS

The study was based on 15 human cerebella, making a total of 30 cerebellar hemispheres or cerebellopontine angles. The specimens were collected fresh during autopsies and injected with coloured gelatine to facilitate observation and then fixed in 10% formaldehyde solution. The fixed specimens were dissected and examined under a surgical microscope.

RESULTS

A count of the branches from the main trunks of AICA, PICA and SCA revealed that the majority of branches originated from PICA.

To facilitate the observations we divided the entire choroids plexus into four segments instead of the sagittal and horizontal parts of the lateral and medial segments described, as mentioned earlier, by previous authors. The four segments are as follows: the lateral horizontal segment, the medial horizontal segment, the rostral sagittal segment and the caudal sagittal segment.

The blood supply to each of the segments was described separately.

1. The lateral horizontal segment (LHS), which protrudes through the foramen of Luschka, was principally supplied by the AICA (Fig. 2A). However, PICA, basilar artery and vertebral artery also give out branches (Fig. 2B, Table 1).

2. The medial horizontal segment (MHS), located within the fourth ventricle, was mostly supplied by the PICA (Fig. 3). In a few cases it was supplied by a contralateral PICA, AICA and hypoplastic PICA (Table 2).

3. The rostral sagittal segment (RSS), also located within the fourth ventricle, was supplied in most cases by PICA (Fig. 3), together with other branches from AICA and a hypoplastic and contralateral PICA (Table 3).

4. The caudal sagittal segment (CSS) was chiefly supplied by PICA (Fig. 3, 4) and less frequently by AICA and a hypoplastic and contralateral PICA (Table 4).

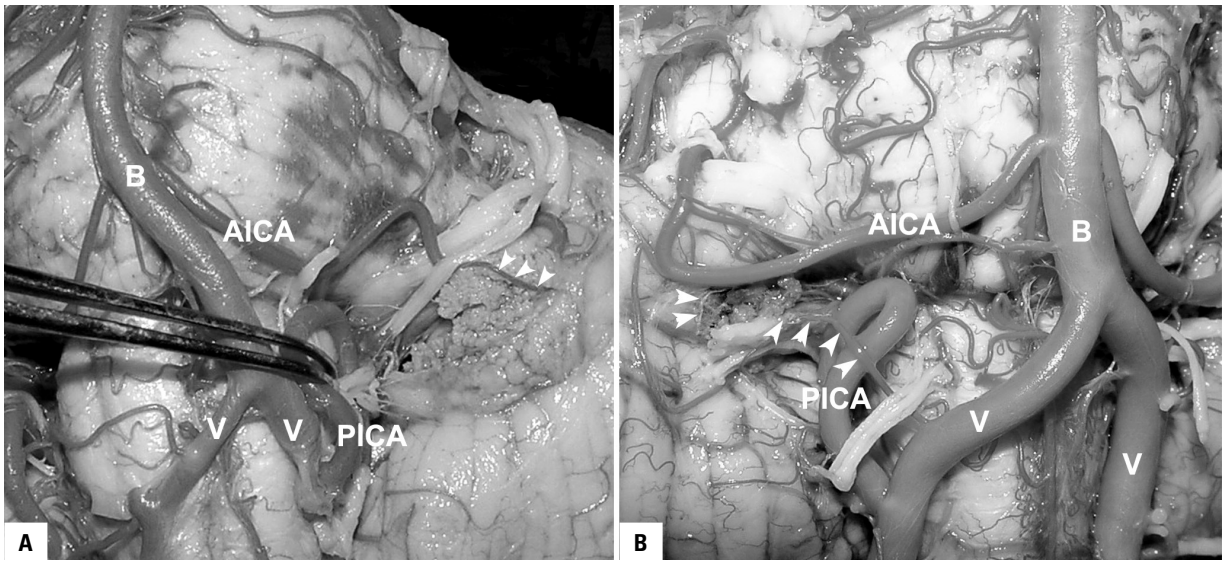

Figure 2. The lateral horizontal segment of the choroid plexus in the cerebellopontine angle is usually supplied by the anterior inferior cerebellar artery (AICA) (**A**). This segment may also receive branches (arrowheads) of the posterior inferior cerebellar artery (PICA) or direct branches from the basilar — B and vertebral — V arteries (**B**).

Table 1. Lateral horizontal segment (LHS) of the plexus in the region of the foramen of Luschka

Artery of origin	Number of choroidal branches to the left LHS	Number of choroidal branches to the right LHS
Anterior inferior cerebellar artery	99 in 13 cases	91 in 11 cases
Posterior inferior cerebellar artery	11 in 1 case	8 in 1 case
Superior cerebellar artery	–	–
Basilar artery	7 in 1 case	–
Vertebral artery	–	8 in 2 cases

Table 2. Medial horizontal segment (MHS) within the fourth ventricle

Artery of origin	Number of choroidal branches to the left MHS	Number of choroidal branches to the right MHS
Posterior inferior cerebellar artery	65 in 15 cases	63 in 15 cases
Hypoplastic posterior inferior cerebellar artery	1 in 1 case	–
Contralateral posterior inferior cerebellar artery	5 in 1 case	–
Anterior inferior cerebellar artery	4 in 1 case	–
Contralateral anterior inferior cerebellar artery	–	1 in 1 case

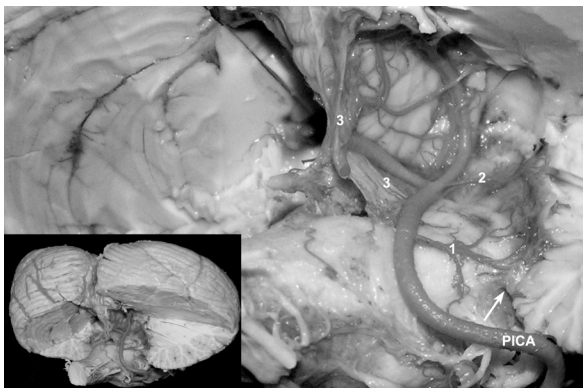

Figure 3. The cerebellomedullary fissure exposed after partial resection of the cerebellar hemisphere. The right PICA is supplying the medial horizontal segment (1) as well as the rostral (2) and caudal (3) sagittal segments of the plexus with numerous branches.

DISCUSSION

Our classification of the choroid plexus into four segments, two horizontal (lateral and medial) and two sagittal (rostral and caudal), corresponds in general to the lateral floccular, lateral peduncular, medial nodular and medial tonsillar segments distinguished by Fujii et al. [3] and reproduced in other publications after them. Our nomenclature is more practically oriented with regard to the known variability of the choroid plexus of the fourth ventricle and appears more logical and easy to comprehend.

Our findings on the blood supply of the different segments of the plexus are similar to the results presented by Fujii et al. in their paper [3]. We found

Table 3. Rostral sagittal segment (RSS) within the fourth ventricle

Artery of origin	Number of choroidal branches to the left RSS	Number of choroidal branches to the right RSS
Posterior inferior cerebellar artery	47 in 15 cases	80 in 15 cases
Hypoplastic posterior inferior cerebellar artery	11 in 2 cases	–
Contralateral posterior inferior cerebellar artery	5 in 1 case	–
Anterior inferior cerebellar artery	3 in 1 case	–
Contralateral anterior inferior cerebellar artery	–	–

Table 4 Caudal sagittal segment (CSS) within the foramen of Megendie

Artery of origin	Number of choroidal branches to the left CSS	Number of choroidal branches to the right CSS
Posterior inferior cerebellar artery	66 in 15 cases	60 in 15 cases
Hypoplastic posterior inferior cerebellar artery	3 in 1 case	–
Contralateral posterior inferior cerebellar artery	4 in 2 cases	–
Anterior inferior cerebellar artery	1 in 1 case	–
Contralateral anterior inferior cerebellar artery	–	–

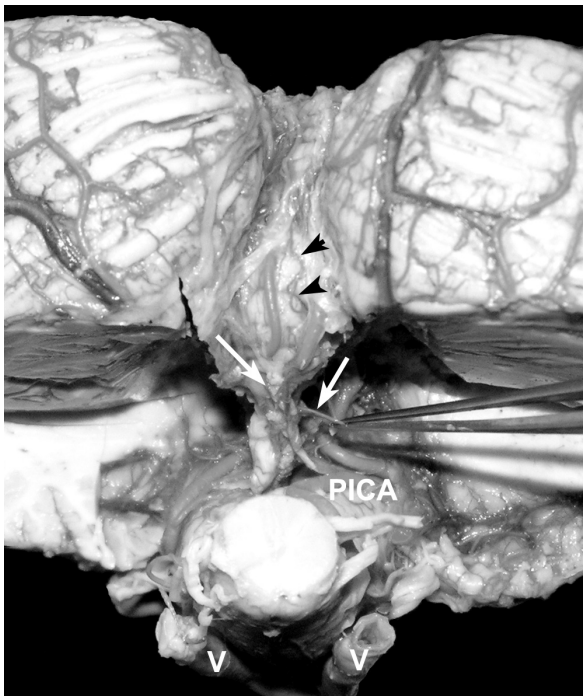

Figure 4. Median aperture of the fourth ventricle. Parallel caudal segments of the plexus may receive branches from both sides (arrow), not only from PICA, but also from the terminal branches of SCA (arrowheads).

that AICA most commonly supplied the lateral horizontal segment and PICA supplied most of the other segments. From a practical point of view, it is worth noticing that the contralateral AICA or PICA sometimes supplied segments of the choroid plexus. This finding was also confirmed in our study. In our material it was also noticed that the basilar artery in one case and the vertebral artery in two cases gave choroidal branches to the lateral horizontal segments.

The choroidal arteries may supply tumours, arteriorvenous malformations and aneurysms arising in and adjacent to the choroid plexus and ventricles [1–3, 9, 10]. Fortunately, the choroidal branches and the arteries from which they arise course around, rather than through, vital neural structures such as the medulla and pons and may be exposed by operative approaches that are compatible with good surgical results [3]. The choroidal vessels enter the plexus from outside, in other words from the cerebellomedullary fissure or through the foramina of the ventricle, which may sometimes be serviceable topographical landmarks during tumour resection. The operative approaches to lesions in the choroid plexus should be so designed that both ends of the pathological segment and its attachment to the *tela choroidea* are isolated, as the blood supply is from both ends of the plexal segment [3]. The choroidal arteries are also angiographical landmarks for the recognition and localisation of tumours in the posterior fossa. The choroidal branches of PICA serve as markers of the area of the fastigium of the fourth ventricle and are displaced by a tumour growing within the fourth ventricle [3, 6, 11].

The choroidal arteries frequently enlarge as tumours near the fourth ventricle derive their blood supply from them. The enlargement of the choroidal arteries is greatest with meningiomas, papillomas of the choroid plexus and intraventricular ependymomas [2–4]. Arteriorvenous malformations and aneurysms of the choroidal arteries in the posterior fossa are uncommon and, when present, more commonly involve the proximal trunks of PICA, AICA, and SCA [3, 5, 8].

REFERENCES

1. Alexander E Jr, Davis CH Jr, Pikula L (1966) Aneurysm of the posterior inferior cerebellar artery filling the fourth ventricle. Case report. J Neurosurg, 24: 99–106.
2. Chaffee B, Donaghy RMP (1963) Meningioma of the fourth ventricle. J Neurosurg, 20: 520–522.
3. Fujii K, Lenkey C, Rhoton AL Jr (1980) Microsurgical anatomy of the choroidal arteries: fourth ventricle and the cerebellopontine angles. J Neurosurg, 52: 504–524.
4. Huang YP, Wolf BS (1970) Angiographic features of brain stem tumors and differential diagnosis from fourth ventricle tumors. Am J Roentgenol, 110: 1–30.
5. Locksley HB (1966) Report on the cooperative study of intracranial aneurysms and subarachnoid hemorrhage. J Neurosurg, 25: 219–239.
6. Megret M (1973) A landmark for the choroidal arteries of the fourth ventricle — Branches of the posterior inferior cerebellar artery. Neuroradiol, 5: 85–90.
7. Rhoton AL Jr (2000) Cerebellum and fourth ventricle. Neurosurg, 47 (Suppl): S7–S27.
8. Rothman SLG, Azar-Kia B, Kier El (1973) The angiography of posterior inferior cerebellar artery aneurysms. Neuroradiol, 6: 1–7.
9. Rovit RL, Schechter MM, Chodroff P (1970) Choroid plexus papillomas: observations on radiographic diagnosis. AJR, 110: 608–617.
10. Takashi M, Okudera T, Fukui M (1972) The choroidal and nodular branches of the posterior inferior cerebellar artery. Their value in diagnosis of medulloblastomas. Radiology, 103: 347–351.
11. Thomson J, Harwood-Nash DC, Fitz CR (1973) The neuroradiology of childhood choroid plexus neoplasms. AJR, 118: 116–133.