Radiography Open

ISSN: 2387-3345 Vol 7, No 1 (2021) https://doi.org/10.7577/radopen.4490

Anatomical variations of posterior inferior cerebellar artery (PICA) on digital subtraction angiography (DSA)

Dileep Reddy Ayapaneni[1], Surekha Srikonda[2], Krishna Teja Nerella*[3], Latha P. Reddy[1].

[1]Department of Radio-diagnosis, Dr. D. Y. Patil Medical College, Hospital & Research Centre, Pimpri, Pune, Maharashtra, India

[2]Department of Radio-diagnosis, Maharaja Institute of Medical Sciences (MIMS), Nellimarla, Vizianagaram District, Andhra Pradesh, India

[3]Department of Interventional Radiology, Dr. D. Y. Patil Medical College, Hospital & Research Centre, Pimpri, Pune, Maharashtra, India

*Corresponding author e-mail address: krishna.teja666@gmail.com

Keywords: Anatomical variations, Posterior inferior cerebellar artery, Cerebral Digital Subtraction Angiography.

Abstract

Introduction: The posterior inferior cerebellar artery (PICA) often exhibits anatomical variations at the craniovertebral junction. Few studies investigated variations of the posterior inferior cerebellar artery, and the prevalence of other variations has not been reported. The study aimed to identify variations of the posterior inferior cerebral artery using cerebral Digital Subtraction Angiography (DSA).

Method: 50 patients underwent 64-slice cerebral Digital Subtraction Angiography. Four types of variations were observed.

Results: Out of a total of 50 patients, 23 (46%) were males and 27 (54%) females (all age groups). Our study has shown the utility of the 2 sequences - fluoroscopy and cine. All 2 sequences have their significance in evaluating anatomical variations in PICA. Only 20% of the 50 patients had all the posterior inferior cerebellar artery without anatomical variations. Anatomic variations commonly involve the distal segment of the vertebral artery (VA). Most of them are seen arising from the C1, C2, and both C1 and C2 origins. Anatomic variations involve arising from the C1 origin in 9 patients, C2 origin in 11 patients, C1 & C2 origin in 8 patients, and other variations observed in 12 patients.

Conclusion: Variations of the posterior inferior cerebellar artery can be easily evaluated by cerebral Digital Subtraction Angiography (CDSA). Recognizing and reporting them at cerebral CDSA may be clinically important. Surgeons should be mindful of this variation during operations.

Introduction

The posterior inferior cerebellar artery (PICA) is one of the three vessels which provide arterial supply to the cerebellum. PICA perfuses important neural structures, such as the lateral posterior area of the medulla oblongata, the inferior half of the anterior surface of the cerebellum, and the inferior half of the vermis. Occlusion of this vessel results in serious ischemic conditions, such as Wallenberg syndrome, cerebellar infarction, and acute tonsillar herniation (1). It is the most variable and tortuous cerebellar artery (2).

Posterior inferior cerebellar artery supplies into Posteroinferior cerebellar hemispheres (up to the great horizontal fissure), Cerebellar tonsils (85%), Biventral lobule (80%), and nucleus gracilis (85%), and Superior semilunar lobule (50%).

Owing to recent advances in CT technology it allows for better visualization of small vessels and has partially replaced digital subtraction angiography (DSA) (3).

There are few studies that investigated anatomical variations of the cerebellar arteries (4-5), and the prevalence of some variations on CTA has not been reported before (4). In the era of CTA, these variations should be reclassified for anatomical and systematic evaluation.

The purpose of this study was to identify the anatomical variations of PICA origin by cerebral Digital Subtraction Angiography (DSA).

Material and methods

Institutional Ethical Committee (IEC) clearance was obtained for this study protocol. Consent from the patient was obtained from all study participants. The duration of the study period was one year (January 2020 to December 2020) at the Department of Interventional Radiology. This cross-sectional observational study included fifty patients, who referred to our setup for Cerebral DSA. Patients of all age groups and either gender were included. Patients with recent episodes of stroke and patients who are disoriented and uncooperative were excluded from the study. This study was carried out using Phillies DSA machine. Both the vertebral arteries were assessed.

Imaging: Patient kept in supine position; Philips Digital Subtraction Angiography Machine was used to study Cerebral DSA. Ultravist® (iopromide) contrast agent was used (4 ml to 12 mL of

300 mg Iodineper mL). We assessed the anatomy and variations of the cerebellar arteries and classified the findings.

Results

Demographics: In our study, ten were of age group 30-44, 16 of age group 45-59, and twenty-four of age group above 60. A 15-year-old male was the youngest patient in the study and a 74-year-old female was the oldest patient in the study group. A total of fifty participants were evaluated, out of which there were 23(46%) males and 27(54%) females (all age groups).

Distribution of cases: Most variations observed to be arising from C1, C2, and both C1 & C2 origins. Segmental caliber variations in distal VA and its branches, LSA. It was observed that similar variations, but not identical set of anatomic variants of distal VA linked to another of their branches, the PSA, as a result of comparable segmental alterations within the caliber and connections.

Table 1

Incidence of the types of variations observed

Type	Incidence (%)
Normal	10 (20%)
C1 origin	9 (18%)
C2 origin	11 (22%)
C1 and C2 origin	8 (16%)
Others	12 (24%)

Case 1: C1 Origin of the PICA: A cerebral DSA test performed in 20 years female before the surgery of left frontal lobe neoplasm. One variation at C1 origin of the right PICA was observed (Fig. 1).

Case 2: A 15-year aged child underwent embolization of a nasopharyngeal angiofibroma. A proximal origin of the right PICA from both C1 & C2 roots was observed (Fig. 2).

Case 3: Cerebral DSA was observed in 44 years aged female before diagnosing transient ischemic attacks. Incidentally, the C2 origin of the right PICA was noted (Fig.3).

Case 4: A 44-year aged female was investigated for basal ganglia and subarachnoid hemorrhage. A C2 origin of the PICA was observed on the left side (Fig.4).

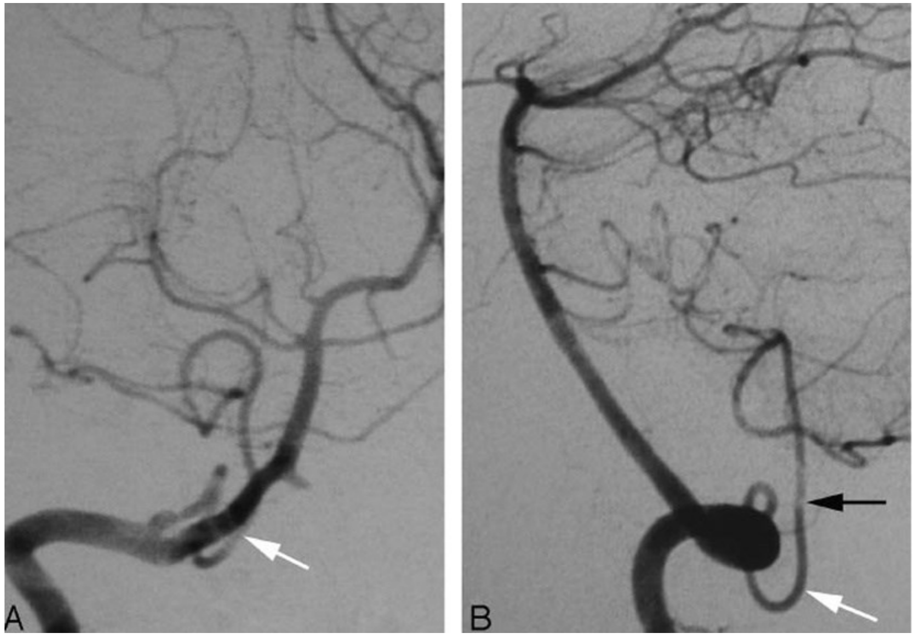

Figure 1. (A). DSA, anteroposterior view right VA, depicts a proximal origin of right PICA from the superior aspect of right VA. PICA trunk has a Z-shape with a normal course of PSA. The segment of VA proximal to the take-off of the PICA corresponds to the spinal branch of the ProA, which divides into anterior radicular branch distal VA, and a posterior radicular branch PSA. Ascending ramus of the PSA (arrow), normally establishes small anastomosis with PICA, is prominent and constitutes the actual origin of the vessel. **(B).** DSA, right VA, lateral view, depicts the dorsal position of proximal PICA in the foramen magnum region (black arrow), aligned with the ascending ramus of PSA (white arrow).

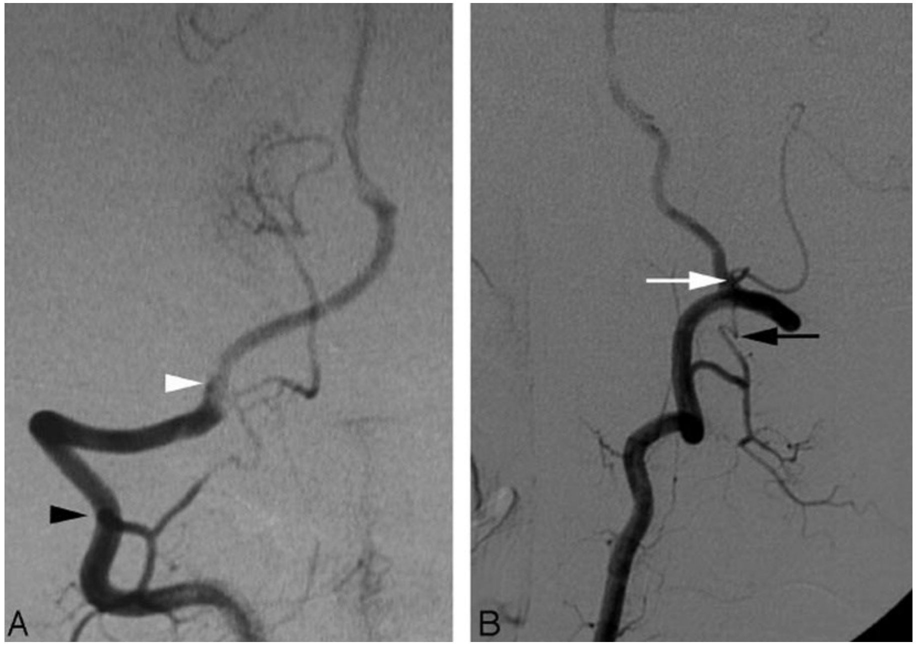

Figure 2. (A). Anteroposterior view, DSA, right VA, depicts the double origin of right PICA from right LSA through C1 (white arrowhead) & C2 (black arrowhead) roots. **(B).** Lateral view, DSA, right VA, depicts ascending course of proximal PICA (white arrow) aligned with LSA (black arrow). The proximal PICA has a more anterior position in the region of the foramen magnum.

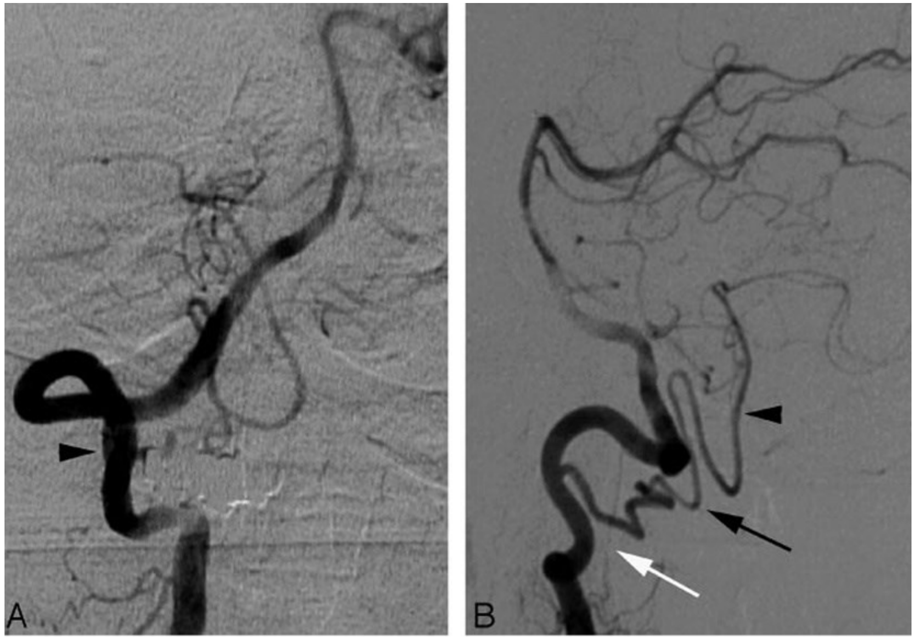

Figure 3. (A). Anteroposterior view, DSA, right VA, depicts C2 origin of right PICA (black arrowhead, partially masked by teeth subtraction artifacts). **(B).** Lateral view, DSA, right VA, depicts the posterior position of PICA at foramen magnum (black arrowhead). The PICA is a cranial continuation of the posterior spinal axis (black arrow), fed by the segmental C2 branch (white arrow).

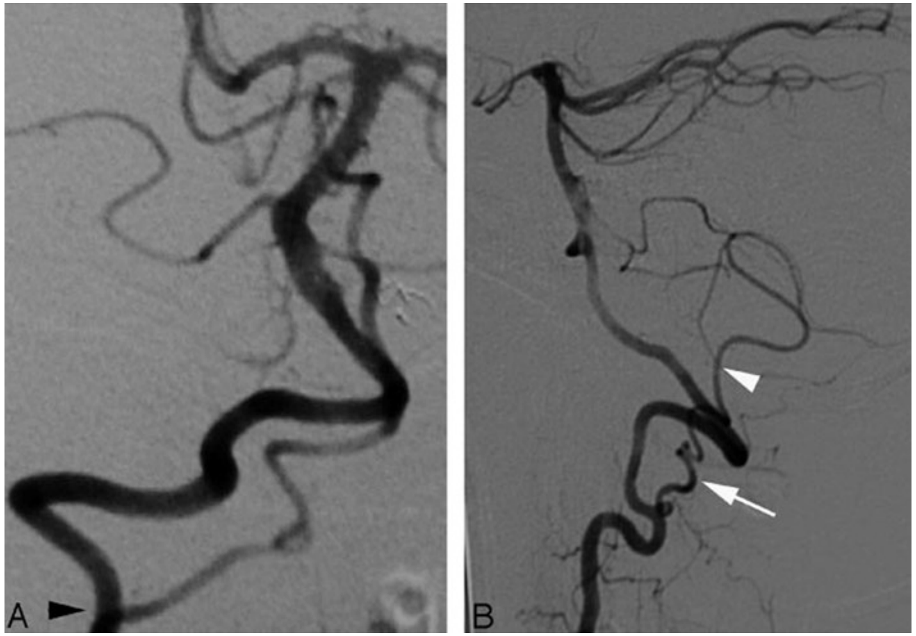

Figure 4. (A). Anteroposterior view, DSA, left VA, depicts proximal (C2) origin of the left PICA (black arrowhead). **(B).** Lateral view, DSA, left VA, depicts left PICA (white arrowhead) is the cranial continuation of the LSA (white arrow). The PICA crosses the foramen magnum in a more anterior position consistent with LSA rather than PSA.

Discussion

The PICA is generally originated from the intradural (V4) segment of the vertebral artery; hence, the surgeon should pay careful attention after dural opening. But the course of PICA shows the most variation among the cerebellar arteries. (6) Rhoton reported on extradurally originate PICAs from the V3 segment. (7)

The current study results demonstrate that the prevalence of anatomical variations in cerebellar arteries was high. 20 % of the patients had complete anatomy without any variations. In a study by Yeliz Pekcevik and Ridvan Pekcevik, 11.7% of patients had complete anatomy without any variations. (8)

Most anatomic variations are seen arising from the C1, C2 & both C1 and C2 origins. The double origin of the PICA is potentially observed on the left side (9); but also reported on the right side. (10) We found a 2:1 ratio right-sided preponderance (Fig. 2). The double origin of PICA is associated with the fenestration. (11)

Conclusion

Our study results show the prevalence of anatomical variations within the cerebellar arteries was observed as high. In acute cerebral vascular accidents or pathologies in vertebrobasilar circulation are the candidate for interventional or microsurgical treatment, the unfamiliarity with the common variations in vertebrobasilar circulation results in misinterpretation causes and leads to wrong management. DSA angiographies allow the detailed evaluation of the supply of the brainstem, cerebellum, and cerebral parts. Performing the anatomical analysis of cerebral DSA may help to accurate interpretation. Reporting these variations was clinically important.

Conflict of interest

The authors have no conflict of interest to disclose.

References

1. Isaji T, Yasuda M, Kawaguchi R, Aoyama M, Niwa A, Nakura T, Matsuo N, Takayasu M. Posterior inferior cerebellar artery with an extradural origin from the V3 segment: higher incidence on the nondominant vertebral artery. *Journal of Neurosurgery: Spine* 2018;28(2):154-9. https://doi.org/10.3171/2017.5.SPINE161286
2. Songur A, Gonul Y, Ozen OA, Kucuker H, Uzun I, Bas O, Toktas M. Variations in the intracranial vertebrobasilar system. *Surg Radiol Anat* 2008;30(3):257-264 https://doi.org/10.1007/s00276-008-0309-6
3. Jayaraman MV, Mayo-Smith WW, Tung GA, Haas RA, Rogg JM, Mehta NR, Doberstein CE. Detection of intracranial aneurysms: multi-detector row CT angiography compared with DSA. *Radiology* 2004;230(2):510-518. https://doi.org/10.1148/radiol.2302021465

4. Siclari F, Burger IM, Fasel JH, Gailloud P. Developmental anatomy of the distal vertebral artery in relationship to variants of the posterior and lateral spinal arterial systems. *AJNR Am J Neuroradiol* 2007;28(6):1185-1190. https://doi.org/10.3174/ajnr.A0498
5. Uchino A, Saito N, Okada Y, Kozawa E, Nishi N, Mizukoshi W, Inoue K, Nakajima R, Takahashi M. Fenestrations of the intracranial vertebrobasilar system diagnosed by MR angiography. *Neuroradiology* 2012;54(5):445-450. https://doi.org/10.1007/s00234-011-0903-x
6. Macchi V, Porzionato A, Guidolin D, Parenti A, De Caro R: Morphogenesis of the posterior inferior cerebellar artery with three-dimensional reconstruction of the late embryonic vertebrobasilar system. *Surg Radiol Anat* 2005;27(1):56-60. https://doi.org/10.1007/s00276-004-0303-6
7. Rhoton AL Jr. Cranial Anatomy and Surgical Approaches. Hagerstown, MD: Lippincott Williams & Wilkins, 2003, pp 601.
8. Pekcevik Y, Pekcevik R. Variations of the cerebellar arteries at CT angiography. *Surgical and Radiologic Anatomy* 2014;36(5):455-61. https://doi.org/10.1007/s00276-013-1208-z
9. Lesley WS, Rajab MH, Case RS. Double origin of the posterior inferior cerebellar artery: association with intracranial aneurysm on catheter angiography. *AJR Am J Roentgenol* 2007;189(4):893-897. https://doi.org/10.2214/AJR.07.2453
10. Lesley WS, Dalsania HJ. Double origin of the posterior inferior cerebellar artery. *AJNR Am J Neuroradiol* 2004;25(3):425-427.
11. Cho YD, Han MH, Lee JY. Double origin of the posterior inferior cerebellar artery with juxta-proximal fenestration of caudal component. *Surg Radiol Anat* 2011;33(3):271-273. https://doi.org/10.1007/s00276-010-0747-9