

RESEARCH/ARAŞTIRMA

Anatomical Variations of the Anterior Inferior Cerebellar Artery and Their Surgical Significance: A Combined Radiologic and Cadaveric Study

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ABSTRACT

Objective: To delineate the anatomical spectrum, frequency, and neurosurgical relevance of anterior inferior cerebellar artery (AICA) variations through combined radiological and microsurgical cadaveric analysis, and to explore potential associations between AICA anomalies and posterior circulation aneurysms.

Material and Methods: Computed tomography angiography (CTA) scans of 400 patients (212 males, 188 females; mean age 55.9 years) were retrospectively reviewed for AICA anomalies, aneurysms, and other vascular variations. Cadaveric dissections of two formalin-fixed adult heads (four sides) were performed through retrosigmoid and far-lateral approaches under microscope magnification, with attention to cranial nerve relationships and labyrinthine artery origin.

Results: AICA variations were identified in 26 patients (6.5%), totaling 27 variant arteries. The most common anomaly was AICA-PICA common trunk (2.5%), followed by early bifurcation (1.5%) and duplication (1.0%). Hypoplasia (0.75%), double origin (0.5%), aplasia (0.25%), and fenestration (0.25%) were less frequent. Posterior circulation aneurysms were present in 17 patients (4.25%); 11.5% of patients with AICA variations harbored aneurysms versus 3.7% without variations, suggesting a potential anatomical predisposition to aneurysm formation. Cadaveric dissection confirmed AICA origin from the basilar artery, looping around the CN VII–VIII complex, and consistent relationship with the labyrinthine artery and flocculus.

Conclusion: AICA variations occur in ~6.5% of individuals, most commonly as an AICA-PICA common trunk or early bifurcation, and show a higher association with posterior circulation aneurysms. Accurate preoperative identification and understanding of microsurgical anatomy are essential, as these variants increase surgical complexity and potential complications in skull base and vascular procedures.

Keywords: Anterior inferior cerebellar artery, cerebellopontine angle, microsurgical anatomy, vascular variations.

Anterior Inferior Serebellar Arterin Anatomik Varyasyonları ve Cerrahi Önemi: Kombine Radyolojik ve Kadavra Çalışması

ÖZET

Amaç: Anterior inferior serebellar arter (AICA) varyasyonlarının anatomik spektrumunu, sıklığını ve nöroşirürjikal önemini; radyolojik ve mikrocerrahi kadavra analizinin birlikte kullanılmasıyla ortaya koymak ve AICA anomalileri ile posterior dolaşım anevrizmaları arasındaki olası ilişkileri araştırmak.

Gereç ve Yöntem: 400 hastaya ait bilgisayarlı tomografi anjiyografi (CTA) görüntüleri (212 erkek, 188 kadın; ortalama yaş 55,9 yıl) AICA anomalileri, anevrizmalar ve diğer vasküler varyasyonlar açısından retrospektif olarak incelendi. İki adet formalinle fikse edilmiş erişkin kafa kadavrasında (dört taraf) retrosigmoid ve far-lateral yaklaşımlar kullanılarak mikroskop büyütmesi altında diseksiyonlar gerçekleştirildi ve kranial sinir ilişkileri ile labirentin arterinin kökeni özellikle değerlendirildi.

Bulgular: AICA varyasyonları 26 hastada (%6,5) saptandı ve toplam 27 varyant arter tespit edildi. En sık görülen anomali AICA-PICA ortak trunku (%2,5) olup, bunu erken bifurkasyon (%1,5) ve duplikasyon (%1,0) izledi. Hipoplazi (%0,75), çift köken (%0,5), aplazi (%0,25) ve fenestrasyon (%0,25) daha nadir görüldü. Posterior dolaşım anevrizmaları 17 hastada (%4,25) mevcuttu; AICA varyasyonu bulunan hastaların %11,5'inde anevrizma saptanırken, varyasyonu olmayanlarda bu oran %3,7 idi ve bu durum anevrizma oluşumu açısından olası bir anatomik yatkınlığı düşündürmektedir. Kadavra diseksiyonları, AICA'nın baziler arterden köken aldığını, CN VII–VIII kompleksinin etrafında bir halka oluşturduğunu ve labirentin arter ile flokkulus ile olan ilişkisini doğruladı.

Sonuç: AICA varyasyonları bireylerin yaklaşık %6,5'inde görülmekte olup, en sık AICA-PICA ortak trunkusu veya erken bifurkasyon şeklinde izlenmekte ve posterior dolaşım anevrizmaları ile daha yüksek birliktelik göstermektedir. Bu varyantların varlığı, kafa tabanı ve vasküler cerrahi girişimlerde cerrahi karmaşıklığı ve olası komplikasyonları artırabileceğinden, ameliyat öncesi doğru tanımlanması ve mikrocerrahi anatomisinin iyi anlaşılması büyük önem taşımaktadır.

Anahtar Kelimeler: Anterior inferior serebellar arter, serebellopontin açısı, mikrocerrahi anatomi, vasküler varyasyonlar.

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The article has not been presented at any scientific event.

1. Introduction

The anterior inferior cerebellar artery (AICA) is one of the three main cerebellar arteries, responsible for supplying the anterior-inferior cerebellum, the lateral pons, and the internal auditory structures (1–4). The origin of the basilar artery (BA) is typically located in the lower pontine region, from which it courses through the cerebellopontine angle (CPA), thereby giving rise to the labyrinthine artery (1,5–7). The artery then loops around the cranial nerve (CN) VII–VIII complex en route to the cerebellum (1,6,8). AICA plays a crucial role in neurovascular anatomy. Its occlusion has been demonstrated to result in the manifestation of symptoms consistent with lateral pontine syndrome, including hearing loss and facial weakness (9). AICA loops frequently play a crucial role in neurovascular compression syndromes, such as hemifacial spasm and tinnitus (10,11). These anatomical structures are often encountered during surgical procedures for vestibular schwannomas and brainstem lesions (12,13). A comprehensive understanding of the microsurgical anatomy of the AICA is of great importance in neurosurgical practice.

Anatomical variations of the AICA are comparatively underreported in comparison to those of anterior circulation arteries. Classical microsurgical studies have documented that AICA's origin and territory can vary considerably, often in reciprocal balance with the posterior inferior cerebellar artery (PICA). For instance, a dominant AICA may coincide with a diminutive PICA (an AICA-PICA common trunk variant), whereas a hypoplastic AICA is often accompanied by an enlarged PICA supplying the inferolateral cerebellum (14,15). It has been reported that other anomalies include the presence of duplicate AICAs (two independent AICA branches on one side) and AICAs that originate as two rootlets (double origin) from BA (10,14,15). Such variants are not merely anatomical curiosities; they have the capacity to impact hemodynamics and thus possess clinical relevance. Emerging clinical observations suggest a correlation between cerebellar artery variants and aneurysm formation or other vascular pathologies (16,17).

Despite these implications, there have been few large-scale studies focusing on AICA variations (18). The majority of literature pertaining to AICA anomalies consists of isolated case reports or small case series, frequently within the context of specific pathologies (15,18). In order to guide neurosurgical practice, it is necessary to develop a comprehensive understanding of the frequency with which AICA variants occur, the forms they take, and the ways in which they correlate with clinical issues. In this study, an integrated analysis of AICA anatomy and variations is presented, combining radiological data from 400 patients with cadaveric dissection findings. The objective of this study is to delineate the incidence and spectrum of AICA anomalies, including aplasia/hypoplasia, duplication, common origin with PICA, fenestration, double origin, and early bifurcation, and to evaluate the association of these variants with aneurysm formation in the posterior circulation. Furthermore, we highlight the microsurgical anatomy of the AICA segments and discuss how each variant could influence surgical strategy. The objective of this study is to establish parallels with embryological development and hemodynamic factors in order to elucidate the aetiology of these variations and their significance for clinicians managing cerebrovascular and skull base pathologies.

2. Material and Method

2.1. Research Type and Sample of the Research

This study was designed as a retrospective radiologic and anatomical observational study. The radiological component consisted of a retrospective evaluation of computed tomography angiography (CTA) images from 400 patients who underwent vascular imaging of the posterior circulation. The images were analyzed to determine anatomical variations of the AICA and the presence of posterior circulation aneurysms. To complement the radiologic findings and provide anatomical validation, cadaveric dissections were performed on two formalin-fixed adult heads (four sides) using retrosigmoid and far-lateral approaches under microscopic magnification.

2.2. Data Collection

Radiological data were retrospectively obtained from CTA images of 400 patients (mean age 55.9 years, range 7–90; 47% female) (Table 1, Figure 1).

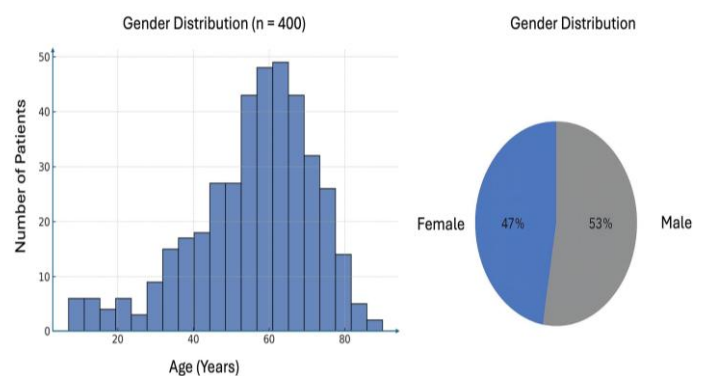


Figure 1. Demographic characteristics of the study.

All scans provided high-resolution visualization of the vertebrobasilar system and were reviewed using multiplanar and three-dimensional reconstructions. The AICA was evaluated for anatomical variations including aplasia, hypoplasia, duplication, early bifurcation, fenestration, double origin, and common trunk with the PICA. In the present study, AICA hypoplasia was defined as a vessel diameter of less than 0.8 mm at its origin from the basilar artery, in accordance with previously published radiological criteria (18). In addition, posterior circulation aneurysms involving the PICA, AICA, superior cerebellar artery (SCA), basilar artery, or vertebral artery were recorded with respect to their presence, number, and location. All imaging analyses were performed using a dedicated workstation (Keydata, Izmir, Turkey) and were confirmed by consensus with a senior neuroradiologist.

Table 1. Demographic characteristics of the study population.

Variable	n	%
Total patients	400	
Female	188	47
Male	212	53
Minimum age	7.0	
Maximum age	90.0	
Mean age	55.9	

2.3. Implementation of the Research

2.3.1. Statistical Analysis

Radiological measurements were performed using measurement tools integrated into the imaging system (Probel Software, Izmir, Turkey). Descriptive statistics were calculated, including minimum, maximum, mean, and standard deviation values. Categorical variables were expressed as frequencies and percentages. Statistical analyses were conducted using SPSS (SPSS Inc., Chicago, IL, USA).

2.3.2. Cadaveric Dissection

Cadaveric dissections were performed on two formalin-fixed adult heads (four sides) to validate the radiological findings and provide a three-dimensional understanding of AICA anatomy. The retrosigmoid and far-lateral approaches were used to expose the AICA from its basilar origin to its distal cerebellar branches. Under microscopic magnification ($\times 6$ – $\times 40$), sequential dissection was performed to demonstrate the anterior pontine, lateral pontine, flocculopeduncular (meatal), and cortical segments of the AICA and their relationships with the cranial nerves (CN V–X) and PICA. Each stage of the dissection was documented using high-resolution photographs and compared with CTA findings to confirm anatomical correlations.

2.4. Ethical Aspects of the Research

The study was approved by the Izmir City Hospital Ethics Committee (decision number 2025/261, date 04/06/2025). This study was conducted in accordance with the Declaration of Helsinki.

3. Results

3.1. Radiologic Findings

In the study of 400 patients, 26 patients (6.5%) exhibited an AICA variation on at least one side, with a total of 27 variant arteries being identified. Table 2 provides a synopsis of the identified variations in terms of their type and frequency.

Table 2. Frequency of AICA variations.

AICA variations	n	%
Common origin with PICA	10	2.5
Early bifurcation	6	1.5
Duplication	4	1.0
Hypoplasia	3	0.75
Double origin	2	0.5
Fenestration	1	0.25
Aplasia	1	0.25
Total AICA variations	27 (26 patients)	6.5

The most prevalent variant was identified as a common trunk of AICA and PICA, which was observed in 10 cases (2.5% of the study). In such cases, the AICA did not arise independently from the BA; instead, a single arterial branch originating from the basilar (or distal vertebral) artery gave rise to both the PICA and AICA, typically bifurcating towards the territories of each. Representative three-dimensional CTA reconstructions

demonstrating two cases of AICA-PICA common trunk variation are presented in Figure 2.

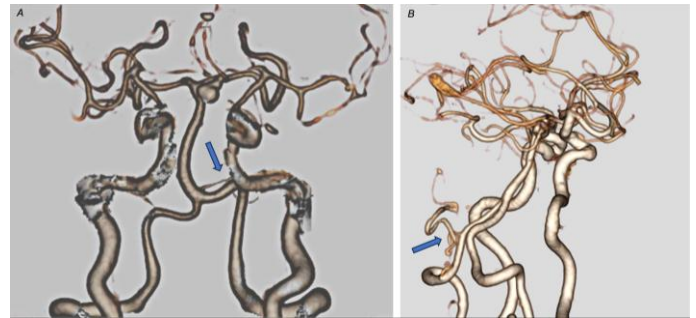


Figure 2. Representative three-dimensional CTA reconstructions demonstrating left-sided AICA-PICA common trunk variations (A, B). AICA = anterior inferior cerebellar artery, CTA = Computed tomography angiography, PICA = posterior inferior cerebellar artery.

The subsequent most prevalent anomalies were identified as early bifurcation of AICA in six cases (1.5%) and duplication of AICA in four cases (1.0%). Early bifurcation signifies that the AICA divides into its cerebellar branches shortly after its origin, which can result in the appearance of two separate arteries on imaging, mimicking a duplication. In contrast, true duplication occurs when two distinct AICA vessels originate separately from the BA on the same side. Hypoplasia of the AICA was observed in 3 cases (0.75%). In two cases (0.5%), the phenomenon of double origin of AICA (two proximate origin stems fusing into one artery) was observed. A single case of each of AICA aplasia (0.25%) and AICA fenestration (0.25%) were detected. In the case of aplasia, no AICA was visualised on CTA, and the ipsilateral PICA was enlarged, consistent with PICA supplying the AICA territory; in the fenestration case, the AICA had a characteristic "split channel" appearance on CTA, with two arterial channels rejoining distal to the split. Bilateral AICA variations were rare, with bilateral involvement seen in only one patient; this patient was characterized by early bifurcation on one side and a common origin (AICA-PICA) on the other. In the remaining 25 patients, the variation was unilateral and the opposite AICA was normal. The common anatomical variations of the AICA identified in the present series are schematically illustrated in Figure 3.

Duplicated AICAs were observed to be two discrete arteries coursing in the CPA cistern: frequently, one followed the conventional path towards the internal auditory meatus (IAM), while the other ran slightly inferiorly; both supplied the anterior inferior cerebellum. In such cases, the AICA was threadlike in shape and was observed to barely reach the cerebellum. The single fenestrated AICA manifested as a loop or double channel on CTA, suggesting the presence of an embryonic channel that did not successfully fuse. No instances of an AICA originating directly from the vertebral artery (beyond the common trunk cases) or from the carotid circulation were identified. All AICAs in the present series arose from the BA in some form.

The following conclusions were drawn regarding the aneurysm: A total of 17 patients (4.25% of 400) were found to have one or more posterior circulation aneurysms on imaging. The distribution of cases included aneurysms of the PICA (5 cases), BA trunk or tip (4 cases), vertebral artery including the vertebrobasilar junction (2 cases), AICA (1 case), PCA (2 cases), and multi-vessel combinations (3 cases with dual aneurysms, such as concurrent BA + PICA aneurysms) (Table 3). Among patients with AICA variations (n = 26), 3 patients (11.5%) had aneurysms in the posterior circulation, whereas among those

without AICA variation ($n = 374$) only 14 patients (3.7%) had posterior circulation aneurysms. Due to the small number of aneurysm cases in the variation subgroup, statistical comparisons were interpreted descriptively and no definitive inferential conclusions were drawn. Conversely, out of the 17 patients with posterior circulation aneurysms, 6 patients (35%) were found to harbor an AICA variation, a proportion notably higher than the 6.5% baseline variation rate in the overall population.

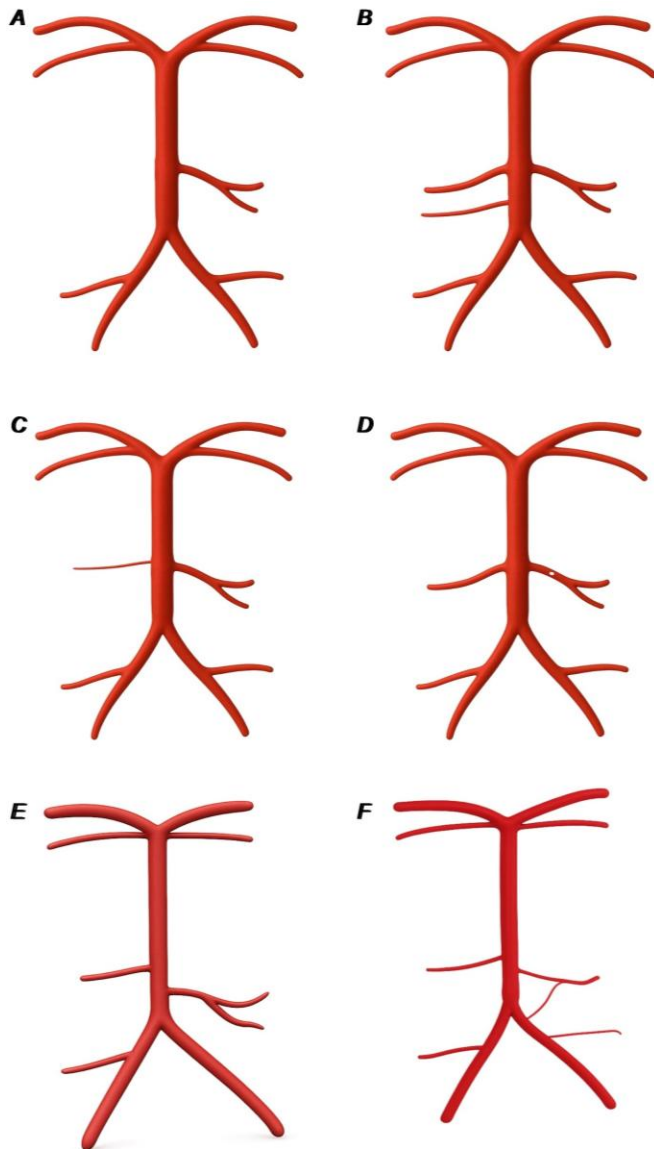


Figure 3. Common AICA variations are illustrated: aplasia of AICA (A), duplicated AICA (B), hypoplasia of AICA (C), fenestrated AICA (D), common origin with PICA (E), double origin of AICA (F). AICA = anterior inferior cerebellar artery, PICA = posterior inferior cerebellar artery.

These findings may suggest a possible non-random co-occurrence of AICA developmental anomalies and aneurysm formation. In the subset of patients with both an AICA variation and an aneurysm, the aneurysm locations were predominantly PICA and BA. PICA aneurysms, which constituted the most prevalent posterior circulation aneurysms overall (approximately 30% of all posterior circulation aneurysms in this series), were observed in multiple AICA variation cases, including one patient with a common AICA-PICA trunk who developed a PICA aneurysm at the trunk bifurcation. Furthermore, BA aneurysms, accounting for approximately 24% of all posterior circulation

aneurysms, were observed in the variation group, often in conjunction with BA fenestration or dolichoectasia.

Table 3. Aneurysms in posterior circulation.

Artery	n	%
PICA	5	29.41 %
BA	4	23.53 %
AICA	1	5.88 %
Vertebro-basilar junction	2	11.76 %
PCA	2	11.76 %
Multiple segments	3	17.65 %

3.2. Cadaveric Dissection Findings

The examination of a cadaveric specimen of the posterior fossa provided direct anatomical validation of radiological observations and yielded further insights into the microsurgical anatomy of the AICA. In all four dissected sides, a well-formed AICA was identified, arising from the BA at the pontomedullary junction, just below the origin of the SCA. No cadaver specimen demonstrated a complete absence of AICA. The absence of conspicuous arterial duplications or fenestrations in this limited cadaver sample is not unexpected, given the rarity of such variants.

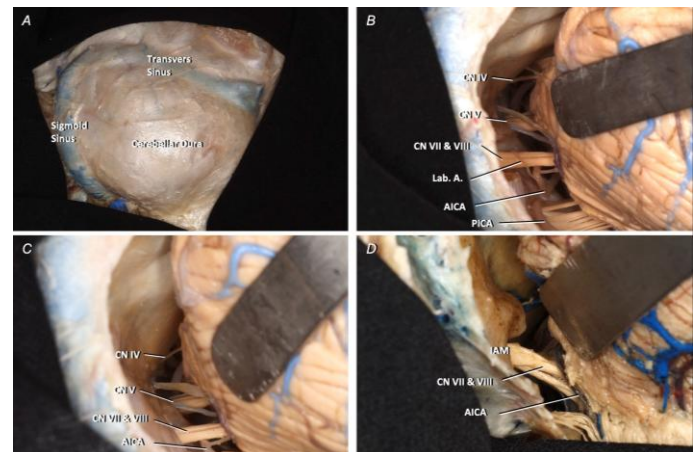


Figure 4. The retrosigmoid approach was performed on a cadaver head in the three-quarter prone position. The CPA, sigmoid sinus, and transverse sinus were exposed via lateral suboccipital craniotomy (A). Following dural retraction, a working corridor toward the IAM was created with mild cerebellar retraction. The labyrinthine artery was visualized originating from the AICA close to the IAM, entering alongside the CN VII–VIII complex (B). Microsurgical dissection under $\times 6\text{--}\times 40$ magnification exposed the cisternal segment of CN V–VIII, the flocculus, and the meatal loop of the AICA. The AICA coursed laterally along the pontine surface, passing beneath CN VI and looping superiorly around the CN VII–VIII complex (C, D). AICA = anterior inferior cerebellar artery, CN = cranial nerve, CPA = cerebellopontine angle, IAM = internal auditory meatus, Lab. A. = Labyrinthine artery, PICA = posterior inferior cerebellar artery.

The dissections were performed through two retrosigmoid and two far-lateral (transcondylar) approaches (Figures 4, 5). In the retrosigmoid approach, a lateral suboccipital craniotomy was performed to expose the CPA (Figure 4A). Following the dural opening and gentle retraction of the cerebellum allowed the CN VII–VIII complex, IAM and the AICA's meatal loop to be visualised (Figure 4B–D). In the far-lateral approach, partial condylar drilling and exposure of the cerebellomedullary cistern provided access to the vertebral artery, PICA, and lower cranial nerves (IX–X) (Figure 5A). From the AICA's primary origin, it was observed to progress laterally and slightly posteriorly along the pons, thereby

passing beneath CN VI (Figure 5B). As it approached the IAM, it exhibited an upward looping movement around the CN VII–VIII complex (Figure 5C, D).

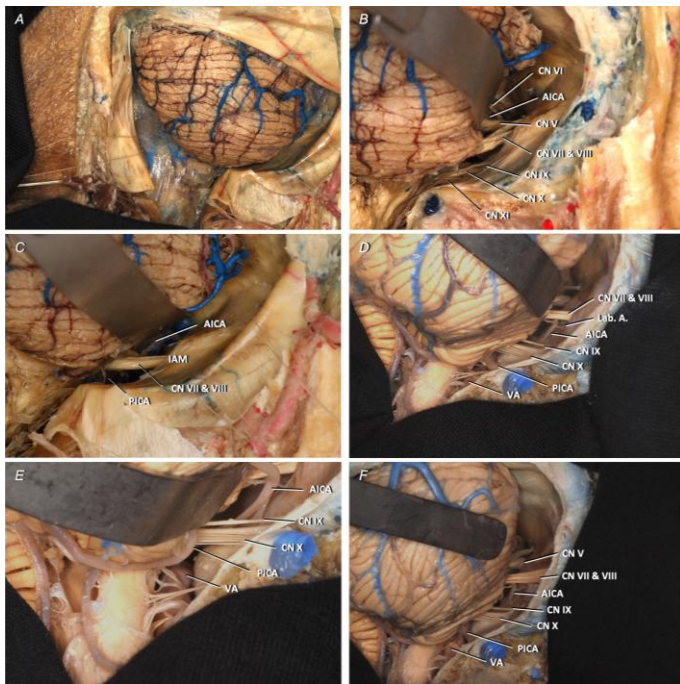


Figure 5. Far-lateral (transcondylar) dissections provided a caudocranial perspective on the vertebrobasilar junction and cerebellomedullary cistern. Exposure of the vertebral artery and lower CNs (CN IX–XI) allowed identification of the PICA and its typical course below the CN IX–XI rootlets (**A, B**). Progressive cerebellar retraction exposed the meatal loop of the AICA as it arched toward the IAM, closely associated with the CN VII–VIII complex (**C**). The labyrinthine artery originated from the AICA near the IAM and entered the IAM together with the CN VII–VIII complex (**D**). Distal dissection demonstrated the relationship between the AICA and lower CNs in the cerebellomedullary cistern, and the VA transitioning into the BA (**E**). Final exposure showed the AICA loop lying superior to the PICA, traveling toward the cerebellopontine angle and highlighting critical vascular–neural relationships encountered during posterior fossa approaches (**F**). AICA = anterior inferior cerebellar artery, BA = basilar artery, CN = cranial nerve, IAM = internal auditory meatus, Lab. A. = Labyrinthine artery, PICA = posterior inferior cerebellar artery, VA = vertebral artery.

In all specimens, the labyrinthine artery arose from the AICA near this meatal loop and entered the IAM with the CN VII–VIII, thus confirming AICA as the primary arterial supply to the inner ear (Figures 4B, C; 5D–F). In our cadaver specimens, no cases were observed where the labyrinthine branch originated directly from the BA.

The AICA meatal loop was located very close to the CN VIII at the IAM, suggesting a potential pathway for vascular compression syndromes such as hemifacial spasm or tinnitus (Figures 4, 5). The flocculus invariably covers the AICA, thus serving as a reliable intraoperative landmark. Elevation of the flocculus during surgery enables exposure of the AICA loop during CPA surgery (Figures 4, 5). In the far-lateral dissections, the AICA origin was positioned superior and rostral to the CN IX–X rootlets, while the PICA coursed behind and below these nerves (Figure 5C–F). This spatial organisation underscores the importance of differentiating the AICA and PICA during foramen magnum or lateral brainstem approaches.

4. Discussion

The presence of variations in the AICA can be attributed to the embryological development of the posterior circulation (15,19). The vertebrobasilar system originates from paired longitudinal neural arteries, which are connected by transverse anastomotic

channels (20). During normal development, selective enlargement of certain transverse vessels forms the principal cerebellar arteries—the PICA, AICA, and SCA—while others regress (2,21). The hemodynamic dominance of a given segment is a critical factor in determining its persistence. Typically, one transverse channel at the pontine level develops into the AICA, and one at the medullary level develops into the PICA (22). Variations emerge when atypical persistence or regression occurs among these channels.

A duplicated AICA is indicative of the persistence of two adjacent transverse segments, both of which retain BA connections and share the cerebellar territory normally supplied by a single vessel (15,23). In a similar manner, a double-origin AICA signifies the absence of fusion between two embryonic rootlets, which is analogous to the occurrence of arterial fenestrations in the basilar trunk (14). The single AICA fenestration in our series is indicative of incomplete longitudinal fusion within the basilar plexus, resulting in a double-barreled arterial segment (10). The AICA-PICA common trunk is a model for the dynamic developmental balance of cerebellar arteries (10,15). This variant is presumably caused by the AICA territory expanding caudally during development, thereby incorporating the inferior cerebellar region that is typically served by the PICA (10,15). Conversely, AICA hypoplasia or aplasia represents PICA dominance, where an enlarged PICA assumes the anteroinferior cerebellar territory (9,24).

Embryological and hemodynamic factors may contribute to the possible relationship between AICA variants and posterior circulation aneurysms described in previous studies (25). A common AICA-PICA trunk concentrates flow from two territories into a single bifurcation point, predisposing that junction to shear stress and aneurysm formation (25,26). Similarly, unilateral AICA aplasia has been demonstrated to increase the perfusion burden on the PICA or contralateral AICA, a factor which may potentially contribute to aneurysm formation at these origins (10). Developmental defects in vascular wall structure, such as incomplete elastic lamina or collagen irregularities, have been demonstrated to further predispose to aneurysm formation in duplicated or fenestrated segments (10,15,27). Consequently, both embryologic persistence and aberrant hemodynamics offer plausible mechanisms by which AICA anomalies and aneurysm susceptibility may be linked (27,28).

4.1. Microsurgical Anatomy of AICA Segments and Surgical Implications

From a microsurgical standpoint, the AICA can be divided into four segments as it courses from the BA to the cerebellum (1,29). These segments, when arranged in a rostrocaudal order, are commonly termed: The first segment is the anterior pontine segment, the second is the lateral pontine segment, the third is the flocculopeduncular (meatal) segment, and the fourth is the cortical segment (1,8,29). It is imperative for neurosurgeons to comprehend these segments, as each exhibits distinct relationships and potential surgical hazards.

In microsurgical approaches, it is imperative to maintain awareness of segmental anatomy to prevent operative complications. For instance, in the course of microvascular decompression for trigeminal neuralgia (typically involving SCA, but occasionally a "high-riding" AICA can be the offending vessel compressing the trigeminal nerve), it is incumbent upon the surgeon to trace the artery from the lateral pontine segment

upwards (11,21,29). It is imperative to be aware that, under normal circumstances, AICA remains below CN V (6,30). Therefore, if an artery is found above CN V, it may in fact be a variant (e.g. SCA duplication or a persistent trigeminal artery rather than AICA) (10,15,16). Conversely, in hemifacial spasm decompressions, one expects AICA near the CN VII root exit zone; if the patient has an unusual vascular loop, it could even be a duplication with one loop compressing the nerve from above and one from below, necessitating the placement of multiple Teflon pads (11,31). It is imperative that modern imaging techniques, such as high-resolution CTA/Magnetic Resonance Angiography, are meticulously examined prior to surgery to delineate these anatomical structures and any potential anomalies (30). This comprehensive evaluation enables the formulation of bespoke surgical strategies, including the planning of a combined presigmoid approach if necessary to access a high-origin AICA aneurysm, or the anticipation of labyrinthine artery sacrifice with subsequent hearing rehabilitation if an AICA must be occluded (32). In the context of posterior circulation aneurysms, the presence of variant anatomy has been demonstrated to complicate both surgical and endovascular management (32,33). Occlusion of an AICA-PICA common trunk has the potential to result in infarction of both cerebellar territories. In a similar manner, the deployment of endovascular coils in the proximity of variant origins carries the potential to jeopardise multiple territories (26). The finding that 35% of patients with posterior circulation aneurysms in our study had AICA variants underscores the clinical importance of recognizing these configurations preoperatively.

4.2. Clinical Significance of AICA Variations

Recognition of AICA anomalies is crucial in neurovascular approaches. Misinterpretation of a duplicated AICA as an early branch or oversight of a hypoplastic segment has the potential to result in an incomplete diagnostic assessment. The observed coexistence of AICA variants and aneurysms in some patients may justify careful evaluation of the posterior circulation for additional vascular lesions (34). Clinically, AICA variations have been demonstrated to influence both symptomatology and treatment planning. In patients diagnosed with hemifacial spasm, the presence of duplicated or aberrant AICA loops may result in the compression of the CN VII from multiple directions (11,31). It is imperative to note that failure to identify and decompress all loops may result in persistent symptoms. In AICA-PICA common trunks, a single vessel may contact multiple cranial nerves, thus explaining complex neurovascular compression patterns (10). Furthermore, in cases of vestibular schwannoma or brainstem cavernoma surgery, the recognition of variant AICA courses has been shown to prevent intraoperative injury and postoperative deficits (7).

During far-lateral approaches for vertebral or PICA aneurysms, surgeons should be aware that they may encounter a low-origin AICA or AICA-PICA trunk in the vicinity of the IX-X nerve rootlets (28,33,34). Misidentification has the potential to result in inadvertent occlusion of the AICA trunk, which may consequently lead to pontocerebellar infarction (9). The three-dimensional relationships of these arteries, as demonstrated by cadaveric study, facilitate accurate vessel recognition in surgical procedures. Furthermore, AICA variants have been demonstrated to modify the clinical presentations of ischemic disease (9,10,15). Consequently, radiologists and clinicians should incorporate

AICA variant recognition into stroke interpretation and vascular risk assessment.

4.3. Limitations of the Study

This study is limited by its retrospective design, the relatively small number of aneurysm cases in the variation subgroup, and the limited cadaveric sample size. In addition, clinical correlations were not evaluated. Therefore, the observed associations should be interpreted descriptively, and larger prospective studies are needed to confirm these findings.

5. Conclusion and Recommendations

This combined radiologic and cadaveric study delineated the anatomy and variations of the AICA and emphasised their neurosurgical relevance. AICA variations occurred in approximately 6.5% of cases, most commonly as a common origin with the PICA or as early bifurcation configuration. Although rare, these anomalies were found to be associated with a higher prevalence of posterior circulation aneurysms, suggesting a developmental vascular susceptibility. Cadaveric dissections confirmed the AICA's intimate relationship with CN VII-VIII and its role in supplying the inner ear and cerebellum. This arrangement has been shown to magnify surgical risk when variants are present. It is imperative to recognise such configurations on preoperative CTA. For instance, a shared AICA-PICA trunk increases the risk of bilateral cerebellar infarction if injured, while duplicated AICAs necessitate dual preservation during CPA surgery. The findings emphasise the embryological and hemodynamic factors that link AICA anomalies with pathology, highlighting the vital importance of precise anatomical knowledge for ensuring the safety of posterior fossa and endovascular interventions.

6. Contribution to the Field

This study provides one of the few combined radiologic and cadaveric evaluations of AICA variations in a relatively large patient cohort. By integrating CTA analysis with microsurgical dissection findings, the study offers a descriptive characterization of the anatomical spectrum and frequency of AICA variants. The cadaveric component should be regarded as an illustrative anatomical supplement to the radiological analysis rather than a quantitative anatomical investigation. The results descriptively demonstrate a possible association between developmental vascular anomalies and posterior circulation aneurysms. These findings contribute to a more precise understanding of posterior fossa vascular anatomy and may support safer surgical planning in CPA and skull base procedures.

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Conflict of Interest

There is no conflict of interest with any person and/or institution.

Authorship Contribution

Concept: BB, AK, NT; Design: AK, NT; Supervision: AK, NT; Funding: None; Materials: BB, MEY, AK; Data Collection/Processing: BB, MEY, EG, YP; Analysis/Interpretation: BB, YP, AK; Literature Review: BB, MEY, YP; Manuscript Writing: BB, AK; Critical Review: AK, NT.

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