



Original Article

AICA-PICA Variant Aneurysms: Spectrum of a rare aneurysm and management

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Received: 04-05-2026

Accepted: 27-06-2026

Available online: 04-07-2026

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Medical and Pharmaceutical Research

ABSTRACT

Background: Aneurysms of the posterior circulation are 10–15% of all aneurysms. Amongst the posterior circulation aneurysms, anterior inferior cerebellar artery (AICA) aneurysms account for 1–2% and amongst the AICA aneurysms, even more rare is AICA–PICA variant aneurysms. Only 13 cases are reported in literature (Table 1) **Objective:** The aim of the present study was to evaluate the management strategy of these rare aneurysms. **Materials and Methods:** We reviewed previous 8 studies comprising of 13 patients and our study comprising of 2 patients to find a novel method of treatment and complications pertaining to the different treatment modalities. **Results:** Endovascular and microsurgical procedures can be done to treat these aneurysms but endovascular treatment appear simpler than microsurgical treatment for aneurysms located at the meatal and post meatal portion of AICA. **Conclusion:** In AICA–PICA variant aneurysms, parent vessel occlusion is very detrimental as the whole brain area of PICA supply is supplied by AICA. Endovascular treatment is better option for meatal and post meatal segments of AICA.

Keywords: AICA, PICA, Aneurysms, Variant

INTRODUCTION

Aneurysms of the posterior circulation account for only 10–15% of all intracranial aneurysms. Amongst the posterior circulation aneurysms, AICA aneurysms account for only 1–2%. AICA aneurysms can be associated with arterio-venous malformations (AVM), cerebello-pontine angle tumors, moya- moya disease or may be AICA -PICA variant. Agenesis of the PICA leads to a well-developed AICA so that it can supply the areas that would have been perfused by the absent vessels. This is known as “AICA-PICA variant” with an overall prevalence rate of 20–24% in literature. As the aneurysms of the AICA-PICA variant are concerned, the exact cause is not known. The aneurysms may develop due to increased blood flow in the variant or a vascular injury such as dissection.¹

AICA originates from basilar artery and encircles the pons near the pontomedullary sulcus. After coursing near and sending branches to the nerves entering the acoustic meatus and the choroid plexus protruding from foramen of lusk, it passes around the flocculus to reach the surface of the middle cerebellar peduncle and terminates by supplying the lips of the cerebellopontine fissure and the petrosal surface of cerebellum. AICA usually bifurcates near the facial and vestibulocochlear nerves to form a rostral and caudal trunk. The rostral trunk courses along the middle cerebellar peduncle to supply the upper part of the petrosal surface and the caudal trunk passes near the lateral recess and supplies the lower part of the petrosal surface. The trunk of AICA is divided into four segments: Anterior pontine, lateral pontine, flocculopeduncular and cortical. Lateral pontine segment is again subdivided into three segments: Pre-meatal, meatal and post-meatal. The Pre-meatal segment begins at the basilar artery and courses around the brainstem to reach the region of the meatus. The Meatal segment is located in the vicinity of the internal acoustic meatus. The post meatal segment begins distal to the nerves and courses medially to supply the brainstem and cerebellum. The meatal segment after

forms a laterally convex loop, the meatal loop, directed towards or into the meatus. The branches of AICA are labyrinthine (internal auditory) arteries which supply the facial and vestibule-cochlear nerves and adjacent structures; the recurrent perforating arteries which supplies the brainstem and the subarcuate artery which enters the subarcuate fossa to end in the bone below the Superior canal but it may infrequently supply the distal territory of the labyrinthine arteries.

Anatomical variants of the AICA and the PICA occur. They are classified into four types, According to their origin and distribution of blood supply. Type 1 is a single trunk originating from proximal basilar artery (BA), BA with 2 peripheral branches that act as an AICA and PICA. Types II is a bifid PICA originating from an intradural segment of vertebral artery (VA). Type III is a bifid PICA, originating from vertebro-basilar junction and type IV is a PICA without an AICA. Depending on its origin, the AICA-PICA covers different territories. Aneurysms arising from the AICA- PICA variant are extremely rare, there are only 13 cases reported in literature.

CASE HISTORY:

Case I: A 47 years old lady presented with headache, vomiting, transient loss of consciousness.

There was no history of any co-morbid illness like hypertension, diabetes, mellitus, or bleeding diathesis etc. On examination, her GCS was E1 V2 M 5, neck rigidity was present. Initial CT scan brain revealed subarachnoid hemorrhage in the prepontine cistern with extension into left cerebello pontine cistern. Digital subtraction angiography (DSA) revealed an aneurysm from left AICA having a size of 4mm and 2mm with well-defined neck and arising from the meatal segment (Fig 1). It was evident from DSA that PICA was absent and AICA was dominant. AICA-PICA variant (Fig 2). The aneurysms was clipped by left retro sigmoid sub-occipital craniotomy (Fig 3). Postoperatively the patient developed transient VIIIth cranial nerve palsy which resolved over a span of 5 months and mild sensorineural hearing loss on the left side.

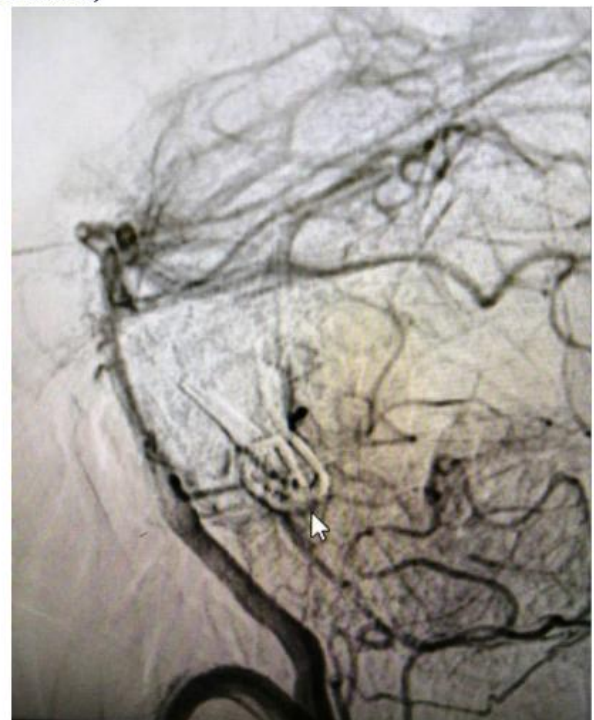
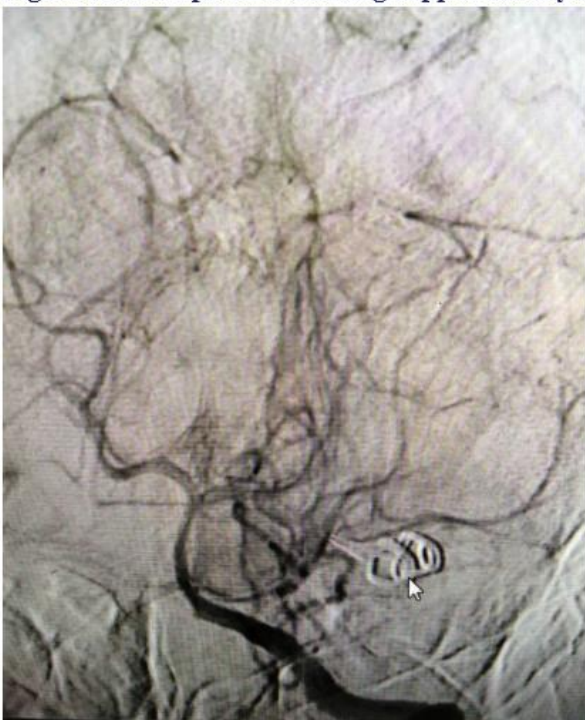
Figure 1: Aneurysm arising from AICA (Meatal segment)



Figure 2: DSA showing left AICA aneurysm with absent PICA



Figure 3: Post ope DSA showing clipped aneurysm (AP & Lateral)



Case II: A 51 years old lady presented with headache and neck pain of sudden onset. There was no co-morbid illness. On examination her GCS was 15 with neck rigidity. Initial CT scan brain revealed subarachnoid hemomhage.3-D CT

Angiography of brain revealed left AICA aneurysms in the meatal segment with neck partially within the meatus. PICA on the both sides were absent. The aneurysms was clipped by left retrosigmoid sub-occipital craniotomy and drilling of the meatus. Post operatively there was transient VII cranial nerve palsy.

Table 1 Review of literature of AICA-PICA Variant aneurysms

Author	No. of Cases	Presentation	Location	Size	Origin of Trunk	Treatment	Outcome
Kojima ⁴ 1996	1	Reported in Japanese					
Ebara ⁵ 1999	1	SAH	Distal	Small	BA	MSOC	HP,LCNP,Ataxia
Maskaya ⁶ 2006	1	SAH	Distal	Small	BA	MSOC	Good
Gopalakrishnan ⁷ 2009	2	SAH SAH	Distal Distal	Small Small	BA BA	MSOC RMSOC	Hemo. stable Vegetative
Suh ⁸ 2011	5	SAH SAH Incidental Incidental SAH	Proximal Proximal Proximal Proximal Proximal	Small Small Small C Large (15mm)	NA	Coiling	Good Good Good Good Good
Doigawa ⁹ 2015	1	Mass effect	Distal	3 cm	BA	Endovascular trapping & Surgical thrombectomy	Good
Akhtar ¹⁰ 2016	1	SAH	Distal	Small	NA	MSOC	Good
Ansari ¹¹ 2018	1	Mass effect	Proximal	Large (18mm)	VA	RMSOC	Good
Our cases 2018	2	Mass effect Headache	Meatal Meatal	Small Small	VA VA- BA junction	RMSOC RMSOC	Facial Palsy Good

SAH– Sub Arachnoid Hemorrhage, BA– Basilar Artery, VA– Vertebral Artery, MSOC– Midline Sub Occipital Craniotomy, RMSOC– Retro Mastoid Sub Occipital Craniotomy, HP– Hydrocephalus, LCNP– Lower Cranial Nerve Palsy, NA– Not Available.

Table 2: Summary of AICA aneurysms in the literature

	Total	Pre meatal	meatal	Post meatal
Number	47	16	21	10
Mean age (years)	53	54	52	53

Female	32	14	12	06
Presentation	27	09	10	08
<input type="checkbox"/> SAH	09	02	07	00
<input type="checkbox"/> <input type="checkbox"/> SAH + V/VI/VIII/LCNP <input type="checkbox"/> <input type="checkbox"/> V /VII/VIII	06 05	01 04	04 00	01 01
<input type="checkbox"/> Incidental				
Surgical Management	08	0	8	0
<input type="checkbox"/> <input type="checkbox"/> Clipping	10	4	5	1
<input type="checkbox"/> <input type="checkbox"/> Trapping	1	0	1	0
<input type="checkbox"/> <input type="checkbox"/> Trapping + Bypass <input type="checkbox"/> <input type="checkbox"/> Resection + end to end suture	2	0	2	0
Endovascular Management	4 3	3 3	0 0	1 0
<input type="checkbox"/> <input type="checkbox"/> Coiling	14	4	4	6
<input type="checkbox"/> <input type="checkbox"/> Stent Assisted Coiling <input type="checkbox"/> <input type="checkbox"/> PAO using Coils / NBCA				

DISCUSSION

AICA aneurysms are rare. Published series indicated 47 AICA aneurysms in the literature (Table 2). These aneurysms arise in relation to AVM, moya-moya disease, dissection or AICA – PICA variant. There are considerable variations in the anatomy of the vertebra-basilar system. The most common variation is agenesis of the right PICA followed by agenesis of the left PICA as reported in literature. An inverse relationship between the sizes of the AICA and PICA is thought to exist. Agenesis of PICA leads to well developed AICA so that it can supply the areas that would have been perfused by the absent vessels. This is AICA-PICA variant. Overall prevalence rate of 20 -24% as reported in literature. Only 13 cases of AICA- PICA variant aneurysms have been described in literature (Table-2). 7 of these aneurysms were treated microsurgically, 6 were treated by endovascular method. As far as the aneurysms of the AICA-PICA variant are concerned, the exact cause is not known. The aneurysms may have developed due to increased blood flow in the variant artery or a vascular injury such as dissection. Anatomical variations of AICA-PICA are classified into 4 types (Table-3).

Table 3: Variations of AICA and PICA. AICA – anterior inferior cerebellar artery, SAH – subarachnoid hemorrhage, LCNP – Lower Cranial Nerve Palsy, PAO – Parent Artery Occlusion, NBCA – n-butyl cyanoacrylate.

I	Single Trunk Originating from basilar artery with 2 peripheral branches as AICA and PICA
II	Bifid PICA originating from vertebral artery
III	Bifid PICA originating from vertebrobasilar junction
IV	PICA without an AICA

AICA has 4 segments: Anterior pontine, lateral pontine, flocculopeduncular and cortical. Lateral pontine segment is again subdivided into: Pre-meatal, meatal and post-meatal segments. AICA aneurysms have a predilection for meatal segment. Management of these aneurysms need DSA and/ or 3D CT angiography of brain to see the location of the aneurysm in relation to the internal auditory meatus. Microsurgical treatment has been mainstay in the management of AICA aneurysms since the first surgical treatment of these aneurysms by Gonzalez² and Schwartz³. Microsurgical treatment consists

of direct clipping, trapping, trapping with bypass and resection with end to end anastomosis¹². Endovascular management consists of coiling, stent assisted coiling or occlusion of AICA using coils, n-butyl cyanoacrylate (NBCA), onyx. The management strategies for treatment differ according to the location and configuration of the aneurysms¹³. As most pre-meatal aneurysms arise proximally, micro-catheter navigation into the aneurysms dome is often feasible and lies in a confined narrow space in the pre-pontine cistern, there by restricting surgical treatment. Meatal and post meatal aneurysms are often wide neck or fusiform, making these type of lesions difficult to preserve the parent artery, either by clipping or coiling. These efforts yield VII / VIII cranial nerve deficits and cerebellar infraction. These aneurysms can be technically difficult to manage surgically because of tight adhesion to the surrounding structures including nerves complex. Because of the small space, in situ clipping is difficult. The internal auditory artery, the location of which may vary, was not identified during surgery. Although several cases with pre-operative eighth cranial nerve deficit showed improvement after surgery, there are no outcome differences between surgery and endovascular treatment. The Endovascular treatment appears simpler than surgical treatment for aneurysms located at the meatal and post meatal portion of AICS.

Surgical corridors:

To most important factors in choosing a surgical approach are:

- a. The craniocaudally location of the aneurysms in relation to the clivus and
- b. Medio-lateral location, along with the course of the artery. High riding aneurysms may be reached by the orbito-zygomatic approach, although this approach is limited by the need to perform posterior clinoidectomy. This may cause morbidities related to cranial nerve paresis.

An alternative method that may be selected for high riding AICA aneurysms would be a sub-temporal middle fossa approach with divisions of the tentorium combined with petrosectomy as popularized by Drake and colleagues¹⁴. In addition to the removal of petrous apex, the use of sub-temporal transtentorial approach involves opening the tentorial edge, posing hazard to cranial nerve IV¹³. The retrosigmoid route with or without partial petrosectomy is the simplest and straight forward way to expose AICA region. The retrosigmoid approach can be combined with either a medical petrosectomy in high riding aneurysms or a far lateral approach when required to expose low lying aneurysms near vertebro basilar junction^{16,17}.

Transpetrosal approaches (Transcochlear and translabyrinthine) provide the most direct route to the brain stem^{18,19,20,21}. However these approaches are associated with significant morbidity, such as deafness, facial nerve palsy and CSF leakage and are rarely performed in the absence of giant AICA aneurysms. The supratentorial-infratentorial presigmoid approach allows various degrees of resection involving the semicircular canals, vestibule and cochlea. Transoral transfacial approaches to AICA aneurysms have been reported but are not routinely used because of their high morbidities^{22,23}.

CONCLUSIONS

Aneurysms of AICA are very rare, only 47 cases are reported in literature. They present with clinical features pertaining to sub-arachnoid hemorrhage like sudden headache, Vomiting, loss of consciousness, seizures. CT scan brain reveals SAH, IVH, DSA of cerebral vessels detects the aneurysms. 3 D- CT angiography of brain with superimposed bony windows give a clear delineation with bones and internal auditory meatus. Microsurgical and endovascular modalities of treatment achieve similar outcomes. Complications of microsurgical treatment are VII/VIII cranial nerve palsy cerebellar symptoms.

One variety of AICA aneurysm is “AICA-PICA Variant” where agenesis of the PICA leads to a well-developed AICA so that it can supply the areas that would have been perfused by the absent vessels. The special concern in the variety is that, the distal flow should be preserved while treating the aneurysm either be microsurgical or endovascular means as a large anatomical area is supplied by a single artery.

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