

Clinical Article

Aneurysms of Distal Posterior Inferior Cerebellar Artery

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Objective : Aneurysms are very rarely encountered in the distal posterior inferior cerebellar artery (PICA). The authors experienced 5 cases with a distal PICA aneurysm among 368 cases of intracranial aneurysms during the period from January 2003 to January 2008. Here, the authors describe their clinical and surgical experiences and include a review of the relevant literature.

Methods : Using radiologic findings and charts, we retrospectively reviewed the surgical results of 5 cases with a distal PICA aneurysm treated from January 2003 to January 2008.

Results : The current five cases were composed of four cases of 'Good' and one case of 'Fair'. No postoperative complications occurred other than a ventriculo-peritoneal shunt due to hydrocephalus in Case 2. In all five cases, treatment was successful without neurological deficit.

Conclusion : Surgical outcome of PICA aneurysms have been reported to be excellent because the amount of intraparenchymal injury is limited. More clinical experience, microsurgical technique developments, and endovascular surgery advancements are certain to improve treatment outcomes.

KEY WORDS : Aneurysm · Distal posterior inferior cerebellar artery · Subarachnoid hemorrhage.

INTRODUCTION

Aneurysms in the posterior inferior cerebellar artery (PICA) are rarely encountered, and only constitute 0.5 to 2% of total aneurysms in the brain^{1,14,24,27,29}. The majority of cases involve aneurysms in the proximal area of the vertebral artery from which the PICA arises. Distal PICA aneurysms are very rare, and account for approximately 0.3% of all PICA aneurysms^{14,25}.

We have experienced five cases of distal PICA aneurysms among 368 brain aneurysms. Here, we report our clinical and surgical experiences and include a literature review.

MATERIALS AND METHODS

Among those who visited our institution from January 2003 to January 2008 with a subarachnoid hemorrhage, five patients were diagnosed to have a distal PICA aneurysm and subsequently underwent surgical treatment.

Using brain computed-tomographic or magnetic resonance images, brain radiographs including cerebral angiographs, and clinical and surgical records, we conducted a detailed analysis of clinical data, which included age, sex, clinical symptoms at the time of outpatient visit, the site of occurrence, surgical methods, and surgical outcome.

Case report

Case 1

A 68-year-old woman visited the emergency center at our hospital with sudden onset neck stiffness and mental deterioration. A neurological examination revealed a drowsy mentality and paralysis of the right 6th cranial nerve. Brain CT scans taken at the emergency center revealed the presence of cerebellar, intraventricular, and subarachnoid hemorrhages. Cerebral angiography detected the aneurysm responsible, which had an approximate diameter of 3 mm, in the cortical segment of the right PICA (Fig. 1). On day 3, she underwent midline suboccipital craniotomy. Under the surgical microscope, the cerebellar tonsil was retracted to the lateral side, and the presence of an aneurysm of the distal PICA was confirmed under the vermian artery. The aneurysm was clipped after inspection, and 3 weeks postoperatively, the patient was discharged with no neurological sequelae.

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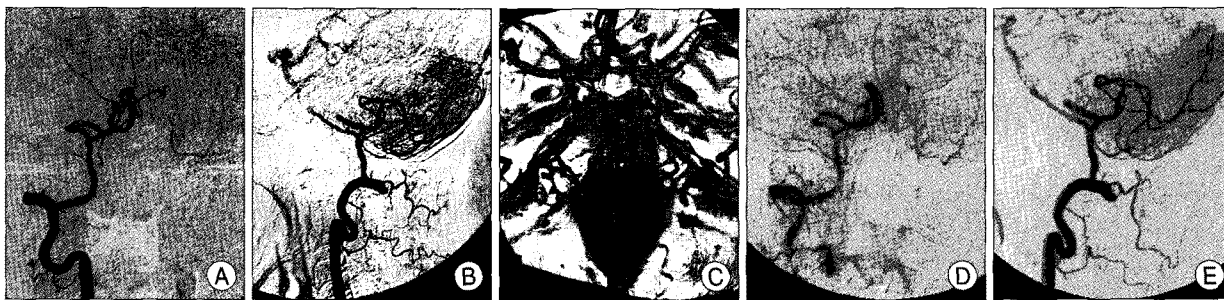


Fig. 1. Anterior-posterior and lateral views (A and B) of right vertebral angiogram and computed tomographic angiography image (C) showing a saccular aneurysm located at the cortical segment of the posterior inferior cerebellar artery. Follow-up angiography identified a successful aneurysm clipping from the cortical segment of the right posterior inferior cerebellar artery (D and E).

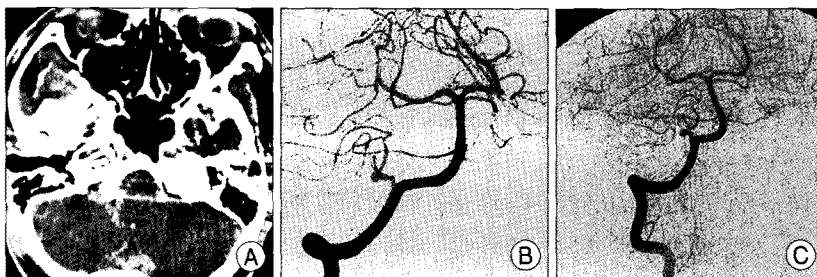


Fig. 2. Computed tomographic scan (A) showing hemorrhage in the fourth ventricle. Lateral and anterior-posterior (B and C) right vertebral angiographic views showing a saccular aneurysm located at the lateral medullary segment of the posterior inferior cerebellar artery.



Fig. 3. Magnetic resonance angiography (A) identified the dissecting aneurysm in the anterior medullary segment of the posterior inferior cerebellar artery. Left vertebral angiogram, anteroposterior and lateral views (B) demonstrating a dissecting aneurysm arising from the medial trunk of the left posterior inferior cerebellar artery. On day 3, the aneurysm was treated by Bem-sheet wrapping and Histoacryl blue coating via a transcondylar approach. Follow-up angiography (C) identified a complete obstruction from the anterior medullary segment of the posterior inferior cerebellar artery without a collateral circulation arising from the anterior inferior cerebellar artery.

Case 2

A 32-year-old man was referred due to a sudden change in mentality. Prior to this referral, the patient had been diagnosed with a subarachnoid hemorrhage and hydrocephalus at the other institution, where he underwent EVD. Cerebral angiography performed at our hospital identified an aneurysm of diameter 5 mm in the lateral medullary segment of the right PICA (Fig. 2). On day 5, the aneurysm was successfully clipped via a transcondylar approach. Postoperative follow-up angiography showed no residual aneurysm. Postoperatively, the patient presented with hydrocephalus and underwent a ventriculo-peritoneal shunt operation. On day 42, the patient was discharged with no neurological sequelae.

Case 4

A 38-year-old woman visited us with a chief complaint of a sudden onset mental change. Emergency CT scans revealed the presence of a subarachnoid hemorrhage, and cerebral angiography visualized the aneurysm in the anterior medullary segment of the PICA (Fig. 4A, B). The aneurysm was successfully clipped via a far lateral transcondylar approach. Follow-up angiography performed at four weeks postoperatively revealed no evidence of a residual aneurysm (Fig. 4C)

Case 5

A 38-year-old woman visited the emergency care center at our institution with chief complaints of a sudden onset

Case 3

A 58-year-old man was hospitalized at our institution with a sudden onset headache. A brain CT scan on admission showed no subarachnoid hemorrhage, but a lumbar puncture identified the presence of hemorrhage. Subsequent cerebral angiography identified a dissecting aneurysm in the anterior medullary segment of the PICA (Fig. 3). On day 3, the aneurysm was treated by Bem-sheet wrapping and Histoacryl blue coating via a transcondylar approach because the aneurysm had a broad neck due to dissection and clipping was not possible. Followup angiography identified complete obstruction from the anterior medullary segment of the PICA, but there was a collateral circulation arising from the AICA (Fig. 3). Three weeks postoperatively, the patient was discharged with no neurological sequelae.

headache and mental deterioration. Emergency brain CT scans visualized intraventricular and subarachnoid hemorrhages, and cerebral angiography detected the aneurysm in the cortical segment of the PICA (Fig. 5A, B). The patient then underwent midline suboccipital craniotomy (Fig. 5C), and the cervical portion of the aneurysm was clipped. Follow-up angiography performed three weeks postoperatively revealed no residual aneurysm.

RESULTS

Clinical analysis

The five described patients had ages ranging between 32 and 68 years old, and three were in their fourth decade. Mean patient age was 46.8 years and the male-to-female ratio was 2 : 3. Clinical symptoms at times of outpatient visits were; four cases of symptoms associated with increased intracranial pressure (a sudden onset severe headache, nausea, and vomiting), two cases of mental deterioration, and one case of paralysis of the 6th cranial nerve. Hunt-Hess grades were; four cases of Grade III and one of Grade II. On brain CT scans performed at the times of admission, degrees of subarachnoid hemorrhage were evaluated using Fisher's Grades, which showed one case of Grade I and two cases each of Grades II and III.

Aneurysm morphologies were dissecting in one and saccular in the remaining four, and aneurysmal locations were; anterior medullary segment in two, lateral medullary segment in one, and the cortical segment in two (Table 1).

Surgical treatment

In all five cases, surgery was performed under general anesthesia. When necessary, lumbar puncture and CSF drainage were performed to reduce cranial pressure. Surg-

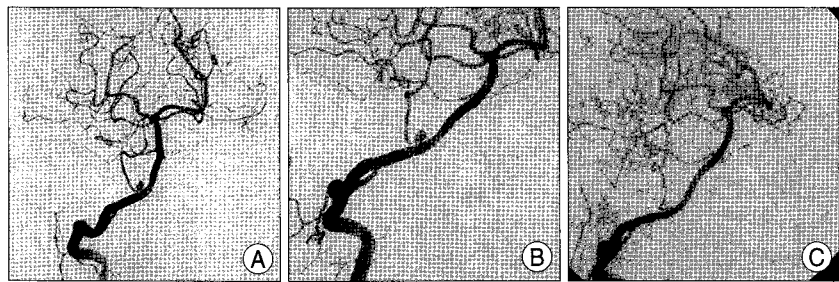


Fig. 4. Cerebral angiography (A and B) identified this aneurysm in the anterior medullary segment of the posterior inferior cerebellar artery. The aneurysm was successfully clipped via a far lateral transcondylar approach. At a follow-up angiography (C) performed four weeks postoperatively, show no evidence of a residual aneurysm.

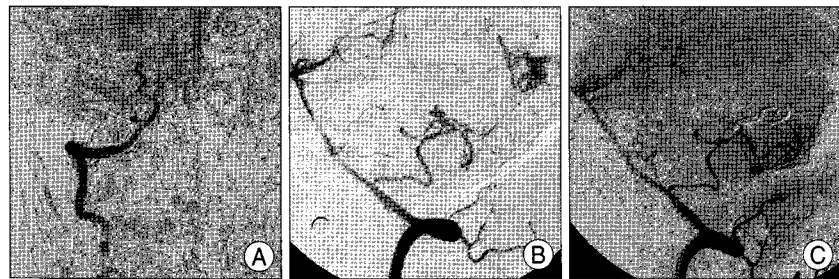


Fig. 5. Cerebral angiography (A and B) showing this aneurysm in the cortical segment of the posterior inferior cerebellar artery. The patient underwent midline suboccipital craniotomy. At a follow-up angiography (C) shows no evidence of residual aneurysm.

ical approaches included midline suboccipital craniotomy in two cases and the transcondylar approach in three. In three cases in which the lesion developed in anterior medullary segment and lateral medullary segment, under the lateral position, a hockey stick skin incision was made in the suboccipital region. Then, following the unilateral suboccipital craniotomy, C1 partial laminectomy (Case 4) was performed for proper exposure of extradural segment of vertebral artery, and then the dura mater was resected. Aneurysm clipping was performed after the presences of anatomical structures, such as, cerebellar hemisphere, tonsil, medulla, lower cranial nerve and vertebral artery had been confirmed under the surgical microscope.

In the two cases in which the lesion developed in the cortical segment of the PICA, a median skin incision was made in the prone position. The dura mater was incised in the form of Y after bilateral suboccipital craniotomy, and

Table 1. Clinical data in patients with a posterior inferior cerebellar artery aneurysm

Sex/ Age	Symptom	Hunt-Hess grade	Fisher grade	Aneurysm shape & size	Site & segment	Surgical approach	Out- come	Complication	F/U angiogram
F/68	Headache, drowsy mentality, 6th CN palsy	III	II	Saccular, 3 mm	C, Rt	MSO	Good		No residual sac
M/32	Drowsy mentality	III	III	Saccular, 5 mm	LM, Rt	TCA	Good	Hydrocephalus	No residual sac
M/58	Headache	II	I	Dissecting	AM, Lt	TCA	Good		PICA occlusion
F/38	Drowsy mentality	III	II	Saccular	AM, Rt	TCA	Good		No residual sac
F/38	Headache, drowsy mentality	III	III	Saccular	C, Lt	MSO	Fair		No residual sac

AM : anterior medullary segment, LM : lateral medullary segment, C : cortical segment, MSO : midline suboccipital craniotomy, TCA : transcondylar approach

C1 laminectomy was then performed. Following this, the presence of the distal PICA and its aneurysm were confirmed after the cerebellar tonsil has been retracted superiorly.

Surgical outcomes and complications

With Glasgow outcome scale, postoperative outcomes were assessed based on patient status at discharge or at most recent outpatient visits. No postoperative complications were identified, excluding the requirement for a ventriculo-peritoneal shunt due to hydrocephalus in Case 2. In all five cases, treatments were successfully performed without neurological deficits.

DISCUSSION

The PICA (posterior inferior cerebellar artery) shows many variations of morphology and course. It originates from the postero-lateral wall of vertebral artery located 10 mm superior to the foramen magnum, and then runs posteriorly across the variable and complex routes around the medulla oblongata. It is then distributed in the suboccipital surface to the cerebellar vermis and the inferior part of cerebellar hemisphere. The PICA is the greatest of the branches of the vertebral artery, and is the causative vessel for aneurysms in the posterior cranial fossa (including dissecting aneurysms), which cause cerebral infarction and cranial nerve compression in many cases. PICA usually branches intracranially from the vertebral artery (17% branch extracranially)^{3,10,20}. The PICA defective rate has been reported to be 4-16%, and in these cases, the AICA is located on the ipsilateral side forms the common trunk.²²

From the neuroradiologic viewpoint, Huang et al.¹³ classified the PICA into four segments, i.e., the anterior medullary, lateral medullary, posterior medullary and supratonsillar segments. PICA aneurysms account for less than 1% of total aneurysms, and thus, they are rare entities. In most cases a PICA aneurysm develops in the region where the PICA arises from the vertebral artery^{15,17,19,28}. According to our literature review, Cruveilhier⁵ first described a globular form aneurysm at the junction between the PICA and vertebral artery in 1829. In 1958, DeSaussure et al.⁶ surgically managed two cases of PICA aneurysm using the trapping method.

Given the recent diagnostic and surgical instrument developments, excellent surgical outcomes have been reported aneurysms that develop in these areas. PICA aneurysms commonly occur in patients in their fifth and sixth decades without gender predelection. In fact, the age and sex distributions of PICA aneurysms are similar to those of general aneurysms. In our series, the male-to-female ratio

was 2 : 3 and most of our cases were 30 years or older.

Symptoms of PICA aneurysms are similar to those of subarachnoid hemorrhage, and develop due to rupture and the release of arterial blood; symptoms include a sudden onset severe headache (the suboccipital area in particular), mental change, syncope, and meningeal irritation. Aneurysms that occur in PICA are smaller than 1.2 cm in most cases, but giant aneurysms develop at a higher rate in this area than in other areas. Aneurysms that developed in PICA can be accompanied by arteriovenous malformations in rare cases^{2,16,21}. According to Hudgins et al.¹⁴, two of 21 cases of the PICA aneurysms were accompanied by an arteriovenous malformation at the distal portion of the PICA. These arteriovenous malformations show a predelection for the distal portion of PICA rather than the junction between the PICA and the vertebral artery. However, in our five cases, no lesion was accompanied by a giant aneurysm or an arteriovenous malformation.

According to some reports, nerve compression symptoms due to the inferior cerebellar artery include glossopharyngeal neuralgia and hemifacial spasm. These symptoms are known to be improved with neurovascular decompression procedures¹⁸. The area adjacent to the origin of the inferior cerebellar artery is a common site for aneurysms in the posterior cranial fossa. At other sites of cystic aneurysms, the presence of multiple dissecting aneurysms is rare (27%). Moreover, the incidence of atherosclerotic fusiform aneurysms that developed in this site is not low (13%)³¹. Despite the various opinions expressed regarding the neck clipping of aneurysms or proximal vertebral artery clipping, conservation of the inferior cerebellar artery must be undertaken carefully^{11,31}.

Angiography of the bilateral vertebral artery is assumed to provide very useful information that confirms the presence of a contralateral PICA, a collateral circulatory pattern, and dominancy, which are key clues to the clipping of aneurysms³⁰.

The surgical treatment of PICA aneurysms depend on sites of occurrence. When the lesion develops in the junction between the PICA and the vertebral artery and in the proximal area of the first two PICA segments, it can be managed using unilateral suboccipital craniotomy and C1 partial laminectomy in the lateral position. However, depending on aneurysmal size, there are several cases that should be removed the occipital condyle and the lateral mass of the 1st cervical spine. In cases where the lesion develops in the 3rd segment of distal portion, the aneurysm can be approached by bilateral suboccipital craniotomy and C1 laminectomy in the prone position. The Park bench position is advantageous for reducing the risks of air embolism or

hypotension, and for minimizing cerebellar traction and preventing the jugular tubercle interfering with surgical vision. In particular, when a lesion is in close proximity to the vertebral artery, there is a risk of damaging inferior cranial nerves. In such cases when the trapping method is applied to aneurysms that occur in the proximal portion of the caudal loop in the tonsilomedullary segment there is a risk of causing hematologic disturbances and neurological sequelae. Thus, this method should be avoided. On the other hand, when a lesion is present in the distal portion of the caudal loop and the cervical portion of an aneurysm cannot be directly ligated, the trapping method can be used^{4,7,9,12,23,26,32}.

In cases where surgical treatment is relatively difficult or in which the risks for general anesthesia or surgery are high because of concomitant disease, endovascular balloon embolism or embolism using platinum, steel, or GDC coils is indicated. However, the endovascular coil embolism can be perforated with the catheter, guide wire and coil. Dowd et al.⁸⁾ treated three cases of aneurysms of posterior inferior cerebellar artery with by platinum coil embolism, and reported excellent outcomes.

At our institution, the surgical methods that we have used for the described five cases of PICA aneurysm included the far lateral transcondylar or transcondylar approach, because we deemed it safe in three cases with a lesion in the anterior and lateral segment. In two cases with a lesion in the tonsilomedullary, telovelotonsilar and cortical segment, intervention proceeded via a midline bilateral suboccipital approach. In four cases, the cervical portion was directly clipped, and in one patient who was hospitalized due to a dissecting aneurysm, the area adjacent to the aneurysm underwent Bem-sheet wrapping and Histoacryl blue coating.

Surgical outcomes were 'Good' in four cases and 'Fair' in one case. Postoperative complications include one ventriculo-peritoneal shunt operation due to hydrocephalus. There were no cases of local neurological deficits due to inferior cranial nerve damage. We regard these results as excellent.

To achieve good surgical outcomes and to prevent complications, systemic, prompt diagnosis and meticulous monitoring in an ICU setting are mandatory. Furthermore, in patients with a high Fisher grade, it is essential to prevent the occurrence of neurological deficits due to cerebral artery spasms.

CONCLUSION

The PICA aneurysm is present more superficially than other posterior circulation aneurysms, and their surgical outcomes have been reported to be excellent because of the

small amount of intraparenchymal injury in adjacent areas and a relatively straightforward surgical approach. More clinical experience, the further development of microsurgical techniques, and endovascular surgery advancement are certain to improve treatment outcomes in patients with a PICA aneurysm.

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