Giant partially thrombosed 4th ventricular posterior inferior cerebellar artery aneurysm; microsurgical management

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ABSTRACT

A 42-year-old woman presented with a 3-month history of progressive occipital headache, vomiting, walking difficulty, and repeated fall. She had no history of sudden and severe headache. She had positive cerebellar signs, predominantly on the right side. Computerized tomography (CT) scan, CT angiogram, and magnetic resonance image (MRI) of the brain showed suspected partially thrombosed giant 4th ventricular posterior inferior cerebellar artery aneurysm. Patient developed severe hypersensitivity reaction during both CT scan and MRI after contrast injection. Though needed, digital subtraction angiogram (DSA) of cerebral vessels was not done. The aneurysm was managed by microsurgical clipping of the aneurysm neck and partial excision of thrombosed aneurysm. Here, we report the details of management of these difficult giant aneurysm without DSA.

Key words: Giant partially thrombosed 4th ventricular aneurysm, microsurgical management, posterior inferior cerebellar artery giant aneurysm

INTRODUCTION

Vertebrobasilar system aneurysm account for 5–10% of all intracranial aneurysms.[1] Vertebral artery-posterior inferior cerebellar artery (VA-PICA) aneurysms constitute 0.5–3% of all intracranial aneurysms.[2] When aneurysm size exceeds 2.5 cm is called giant aneurysm. Aneurysms of this size or larger are very rarely found in the vertebrobasilar system, and giant aneurysms of the PICA are also quite rare.[1] Surgery for these aneurysms is extremely challenging. Here, we report microsurgical management of a giant partially thrombosed 4th ventricular PICA aneurysm.

CASE REPORT

A 42-year-old woman was referred to us with a 3-month history of progressive occipital headache, vomiting, walking difficulty and repeated fall. He had no history of sudden and severe headache. Examination revealed an awake, fully oriented patient with positive cerebellar signs predominantly on the right side. Her vital signs were normal. Computerized tomography (CT) scans and CT angiogram were done in same sitting. CT scan displayed a large, 2.5 cm × 2.5 cm × 3.5 cm, nonhomogeneous, rim-calcified hemorrhagic lesion in lower and middle part of 4th ventricle and upper spinal canal up to C1 level [Figure 1a and b]. CT angiogram showed nonvisualization of right vertebral and right PICA. A small (0.5 cm × 0.75 cm) suspected aneurysm was seen in medullo-tonsillar segment of left PICA. The aneurysm occupying in left anterio-inferior portion of the suspected mass lesion in 4th ventricle. There was no perilesional edema [Figures 1c and d and 2a-f]. Patient developed skin hypersensitivity reaction with rash and itching after contrast administration during CT scan. Magnetic resonance images (MRIs) demonstrated the lesion with high signal intensity on T1-weighted images and low signal intensity on T2-weighted images except small hyperintense area in left anterior-inferior part of the lesion (target sign) which was in close relation with left PICA [Figures 3 and 4]. The mass showed irregular (mainly peripheral areas) enhancement after gadolinium administration [Figure 4b]. Patient again developed skin hypersensitivity after gadolinium administration in a milder form. Other markable MRI findings were hypoplastic right VA and nonvisualized PICA on the right side. All these findings supported that

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this was a partially thrombosed left PICA giant aneurysm. Digital subtraction angiogram (DSA) of cerebral vessels was not done due to possible contrast hypersensitivity reaction and patient refusal.

Preoperative thinking

- Possibility of drug-induced hypersensitivity
- DSA was not done. So there was no idea about.

*The supplying area of right and left PICA, anterior-inferior cerebellar artery, and superior cerebellar artery.
*Whether right PICA was absent or hypoplastic.
*There was no idea regarding neck of the aneurysm.

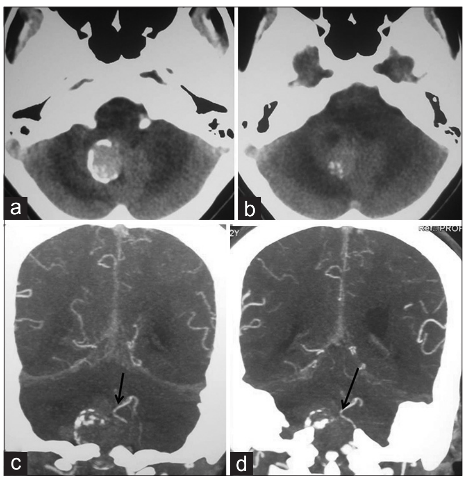

Figure 1: (a and b) Plain axial computerized tomography (CT) scan of the brain showing calcified lower posterior fossa mass lesion. (c and d) CT angiogram of the brain showing calcified outlined suspected giant aneurysm with closely related left posterior inferior cerebellar artery (PICA) (arrow marked). Right PICA is not seen

*Whether left PICA was to sacrifice or not.

As right PICA was absent or hypoplastic, we decided for a revascularization of left PICA by occipital artery-PICA anastomosis in case of the segmental occlusion the artery.

Operation

Patient was operated under general anesthesia with endotracheal intubation, taking care with the possibility of drug-induced hypersensitivity. Patient position was prone with head end elevation in neck flexed state. All monitorings were placed *in situ*. By keeping in mind, the necessity of harvesting of left occipital artery for a bypass, midline suboccipital craniotomy was done with excision of posterior C1 arch. Foramen magnum margin was cut laterally up to condylar joint on both sides taking care not to damage VA. Dura was opened in "Y" fashion. The mass lesion was identified and opened by midline incision. Thrombus was removed carefully with gradual excision of calcified wall. After adequate thrombus and wall removal, hypoplastic right vertebral and right PICA could be seen. Then thrombus and wall were removed at the anterior-inferior part. With further careful dissection left PICA, aneurysm neck and patent part of the aneurysm were identified [Figure 5a]. The neck was small and was in medullo-tonsillar segment of PICA. Even with the careful and conscious effort, no branch of the artery was identified at or near the neck of the aneurysm. Neck of the aneurysm was easily clipped with a simple Yasirgil aneurysm clip by keeping the parent vessel in intact. A small part of the wall of the aneurysm was (seem to be adhered with the floor of 4th ventricle)

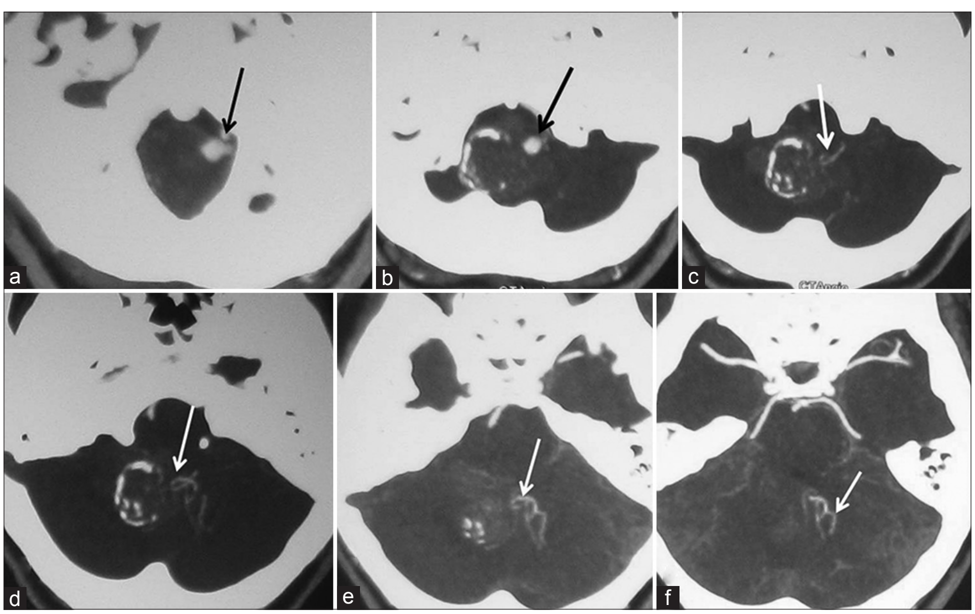

Figure 2: (a-f) Serial axial section of computerized tomography angiogram showing suspected giant partially thrombosed calcified outlined left posterior inferior cerebellar artery (PICA) aneurysm. (a and b) Arrow mark; patent part of partially thrombosed aneurysm. (c-f) Arrow mark indicating left PICA

kept *in situ* [Figure 5b-d]. Hemostasis was achieved; dura and wound were closed accordingly.

Postoperative period was uneventful. Her symptoms improved postoperatively within 4 weeks. Postoperative MRI of brain (contrast; contrast was administered with all preparation of resuscitation) 9 weeks after operation, showed small residual part of aneurysm the wall attached with 4th ventricular floor and wall [Figure 6].

DISCUSSION

Posterior inferior cerebellar artery has the most complex and variable course among all arteries of the posterior circulation. The complexities involved in the surgical approach to the PICA aneurysms relate to the narrow corridor limited by the brain-stem, petrous-occipital bones, and multiple neurovascular structures occupying the cerebellomedullary and cerebellopontine cisterns.[2,3] Moreover, an anomalous PICA is reported in 4–16% patients. PICA originates from the intracranial portion of VA in 80–95% patients, approximately 8.6 mm above the foramen magnum and 1 cm proximal to the vertebrobasilar junction.[2,4] PICA aneurysms may take origin from one of its six segments and two loops. Based on its relationship to the medulla oblongata and the cerebellum PICA segments are: (a) The basilar artery (BA)-VA-PICA junction; (b) the anterior medullary segment, from VA-PICA origin to the inferior olivary prominence; (c) the lateral medullary segment, extending until the origin of IX-X-XIth cranial nerves; (d) the tonsillomedullary segment, until the caudal portion of tonsils (including the caudal loop); (e) the telovelotonsillar segment, from the midportion of its ascent along the medial surface of tonsil to the cortical cerebellar surface (including the cranial loop); and (f) the cortical segment, extending until the cerebellar vermis and hemisphere.[4,5]

The size of saccular aneurysms of PICA that produced subarachnoid hemorrhage (SAH) ranged from 4 mm to >2.5 cm. Some of them represented extremes of sizes

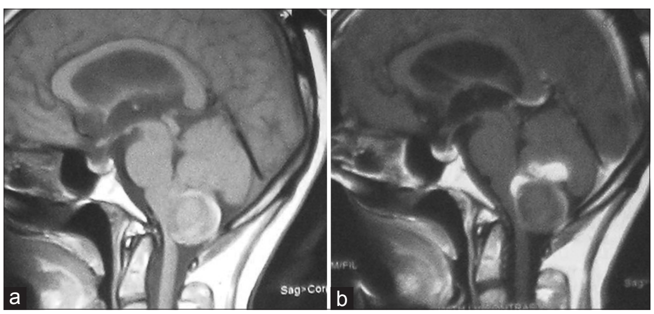

Figure 3: (a) Plain and (b) contrast magnetic resonance image of brain sagittal section in midline showing suspected giant aneurysm in 4th ventricle

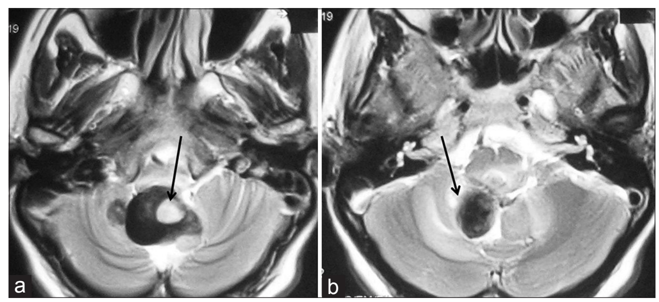

Figure 4: (a) Magnetic resonance image of brain T2-weighted axial images showing suspected 4th ventricular partially thrombosed aneurysm with "target sign" (arrow marked). (b) Aneurysm with closely related left posterior inferior cerebellar artery (arrow marked)

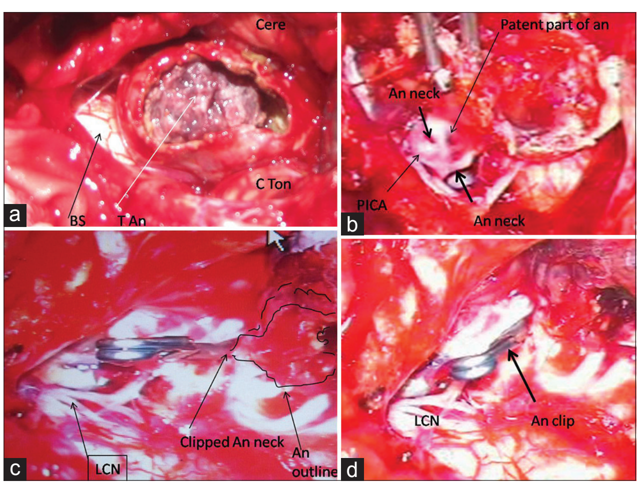

Figure 5: Per operative picture; an-aneurysm. (a) Decompression by removing thrombus with wall of the aneurysm; BS-brain-stem, C Ton-cerebellar tonsil, cere-cerebellum and T an-thrombosed aneurysm. (b) Picture of aneurysm neck originating from left posterior inferior cerebellar artery (PICA), PICA and patent part of aneurysm; (c) LCN-lower cranial nerves (left), free arrow and irregular outline-aneurysm neck and residual aneurysm wall after aneurysm clip application. (d) A clip-aneurysm clip and LCN-lower cranial nerves

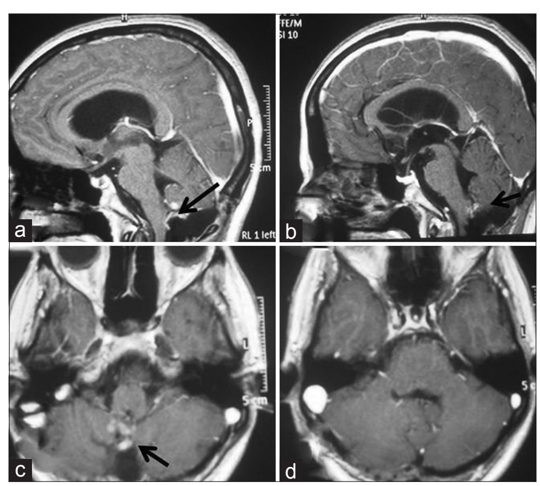

Figure 6: Postoperative contrast magnetic resonance image of the brain. (a and b) Sagittal and (c and d) axial sections showing small residual part of the aneurysm wall (indicated by arrow marks)

that are, usually, not prone to bleeding. The complex and tortuous course of PICA with multiple acute angulations promoted increased luminal shear stress. This resulted in the development of aneurysms even where there were no visible bifurcation sites or branching vessels. Thus, these saccular aneurysms were on thinner and weaker vessel walls (commonly associated with fusiform and dissecting aneurysms) irrespective of whether the aneurysms were extremely small or giant.[2,4,6] They could, however, be adequately clipped (usually with parent vessel preservation) due to their saccular shape and a well-defined neck.

Subarachnoid hemorrhage from rupture PICA aneurysm may be in the form of 4th ventricular, cisternal, cortical, or sulcal blood or in a combination form. In the reported literature, the incidence of intraventricular hemorrhage due to PICA aneurysm rupture has ranged from 83% to 100%.[2,7] These aneurysms may occasionally assume giant proportions mimicking a tumor or a large cavernous angioma. They may also thrombose spontaneously causing a significant brain-stem compression.[6] The laminated appearance of the thrombus in various stages (the target sign) within the lumen of the lesion pointed toward the existence of an aneurysm rather than a tumor. A magnetic resonance angiography and DSA further ruled out partial filling of this giant aneurysm. Removal of the clot, clipping of its neck, and excision of its fundus relieved the brain-stem distortion.[2]

The most common sites from which giant aneurysms arise are the bifurcation of the BA and the origin of the PICA. Giant aneurysms developing from other locations within the posterior cranial fossa are much more uncommon. Giant aneurysms, usually, present clinically as space-occupying lesions and differ from the presentation of the common and medium-sized aneurysms.[1,8] Thus, giant intracranial aneurysms may occasionally be mistaken for tumors.[1,9]

Giant aneurysms typically appear on CT as rounded or oval-shaped masses with distinct outlines. Calcifications are not uncommon findings, and the degree of contrast enhancement is strictly dependent on the amount of intra-aneurysmal thrombosis. Schubiger *et al*. have delineated three types of giant intracranial aneurysms: Partially thrombosed, completely thrombosed, and nonthrombosed.[8] Partially thrombosed aneurysms, which are the most common type, show the so called "target sign," due to the strong enhancement of a part of the aneurysmal cavity. However, completely thrombosed aneurysms, usually, appear as nonhomogeneous masses of increased density that do not enhance with contrast material. CT scans may not be sufficient to confirm the diagnosis of the nature of the lesion as reported by several authors because they could not differentiate between these lesions and tumors.[1]

Angiography is performed in order to shed further light on the nature of the mass. Angiography is still the most important diagnostic tool because it reveals the true nature of the lesion, especially in patients like ours who do not show the signs and symptoms of subarachnoid bleeding and appear to have space-occupying lesions. In our case, angiography was not done due to the possibility of contrast hypersensitivity and patient refusal.

Surgical treatment of aneurysms of the distal PICA has yielded good results as demonstrated by the series conducted by Lewis *et al*.[4] Present optimal surgical treatment is clipping of saccular aneurysm with preservation of PICA.[1,10]

While planning the surgical trajectory, the location of the aneurysm based upon the segmental anatomy of PICA; its relationship to the anatomical midline (10 mm or less being considered significant), brain-stem and cerebellum; and the variability in the vessel's origin should be carefully assessed.[11,12] The brain-stem and cranial nerves may be compromising the surgical view to these aneurysms. Moreover, one or more parent vessels at the VA-BA junctional region may be ending into or taking origin from the neck of this aneurysm. Application of clip may cause narrowing or twisting of these vessels leading to luminal compromise.[13]

In VA-BA-PICA junctional and anterior medullary aneurysms situated close to midline anterior to the brain-stem, the far lateral or extreme lateral transcondylar approach may be utilized. More posterior aneurysm, usually, operated through suboccipital craniotomy.[13]

Posterior inferior cerebellar artery, usually, arises dorsal or lateral to the aneurysm; occasionally, however, it may be posterior or medial to its neck. The applied clip blades are, usually, pointing forward, distal to VA-PICA junction parallel to the long axis of VA. Fenestrated clips may protect lower cranial nerves or the origin of PICA. Most of these anterior aneurysms are located ventral to lower cranial nerves.[2] While traversing the plane of these nerves, occasionally patient may develop dysphagia, rhinolalia, hoarseness, nasal regurgitation, or aspiration pneumonia related to their functional impairment even when the arachnoidal plane has been meticulously preserved.[1,14] The incidence of lower cranial nerve paresis following clipping of proximal

PICA aneurysms has been reported to be varying between 10% and 45%.[1,14,15] The related morbidity was, fortunately, self-limiting and usually improved in approximately 3–6 months. However, occasionally, lower cranial nerve paresis may lead to disastrous consequences.

Endovascular intervention may have provided similar good results like that of microsurgery. These patients, when given the option between surgical clipping and endovascular approach chose the former due to the lesser expense of the surgical procedure. A complication rate of as high as 13% has been reported with embolization of PICA aneurysms.[16] As PICA often has extremely variable and tortuous course with multiple anomalies and variability in position of the aneurysm relative to the brain-stem[11] superselective catheterization of the PICA is often not feasible or may be associated with complications such as vertebrobasilar dissection can occur during catheterization. Identification of the neck and selective catheterization may be difficult or impossible especially in peripheral aneurysms. When aneurysms are small, the risk of abrupt "jumping" of the catheter or guide wire into the sac increases the chances of its rupture. Moreover, if the microcatheter tip does not conform favorably to the anatomy, the system may be very unstable, and further coils may migrate or displace the catheter into the parent vessel.[17] In giant aneurysm producing mass effects endovascular intervention, is not indicated. It is apparent that the mortality is related more to vasospasm as a result of SAH rather than due to technical aspects of surgery. Thus, surgeons have a responsibility to be well-versed with the surgical approaches and nuances for clipping these aneurysms in case the endovascular treatment fails or is not possible; or, if salvage surgery is required for SAH occurring during the interim period between the endovascular coiling and the development of luminal thrombosis within the aneurysm.[2]

CONCLUSION

Distal PICA aneurysms can grow to giant proportions and can simulate a tumor, like a large cavernous angioma, when they become thrombosed. Proper evaluation of available investigations even absences of necessary DSA, preparation for possible difficulties and proper microsurgical planning and nuances can give the patient cure.

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