137 Posterior Inferior Cerebellar Artery Aneurysm: Incidental Aneurysm, Trapping by Microsurgical Clipping, and Resection of the Aneurysm

Marvin Darkwah Oppong and Ulrich Sure

Abstract

An otherwise healthy 53-year-old female was diagnosed with an incidental right-sided posterior inferior cerebellar artery (PICA) aneurysm. After significant aneurysm growth on follow-up imaging performed over more than a year, it was decided to offer treatment. After a discussion of multiple treatment strategies, the decision was made to recommend microsurgical clipping of the aneurysm, which was performed in a semi-sitting position via a lower lateral suboccipital approach. Clip reconstruction with various clipping strategies failed, since the aneurysm was partially thrombosed and not saccular but rather a whole parent vessel involvement. Intraoperative ICG angiography revealed retrograde flow in the distal segment of the PICA. Therefore, the decision was made to trap and resect the aneurysm through proximal and distal clipping. The aneurysm sac was then excised and sent for pathological examination. The subsequent postoperative course was uneventful with no neurological deficits. The therapeutic decision-making in the treatment of PICA aneurysm is the main topic of this chapter.

Keywords

Posterior inferior cerebellar artery (PICA) · Incidental aneurysm · Microsurgical clipping · Posterior circulation

Patient

A 53-year-old female patient with an incidental finding of a solitary intracranial aneurysm diagnosed during the imaging workup of vertigo.

Diagnostic Imaging

Time-of-flight magnetic resonance angiography (MRA) followed by computed tomography angiography (CTA) and digital subtraction angiography (DSA) revealed an aneurysm of the right posterior inferior cerebral artery (PICA) at the anterior medullary segment, with a maximal diameter of 8.5 mm. The vertebral artery was not identified on imaging after the origin of the right PICA. The left vertebral artery was dominant. Follow-up imaging with MRI after 12 and 16 months revealed the growth of the aneurysm to a maximal diameter of 9 mm (Fig. 1).

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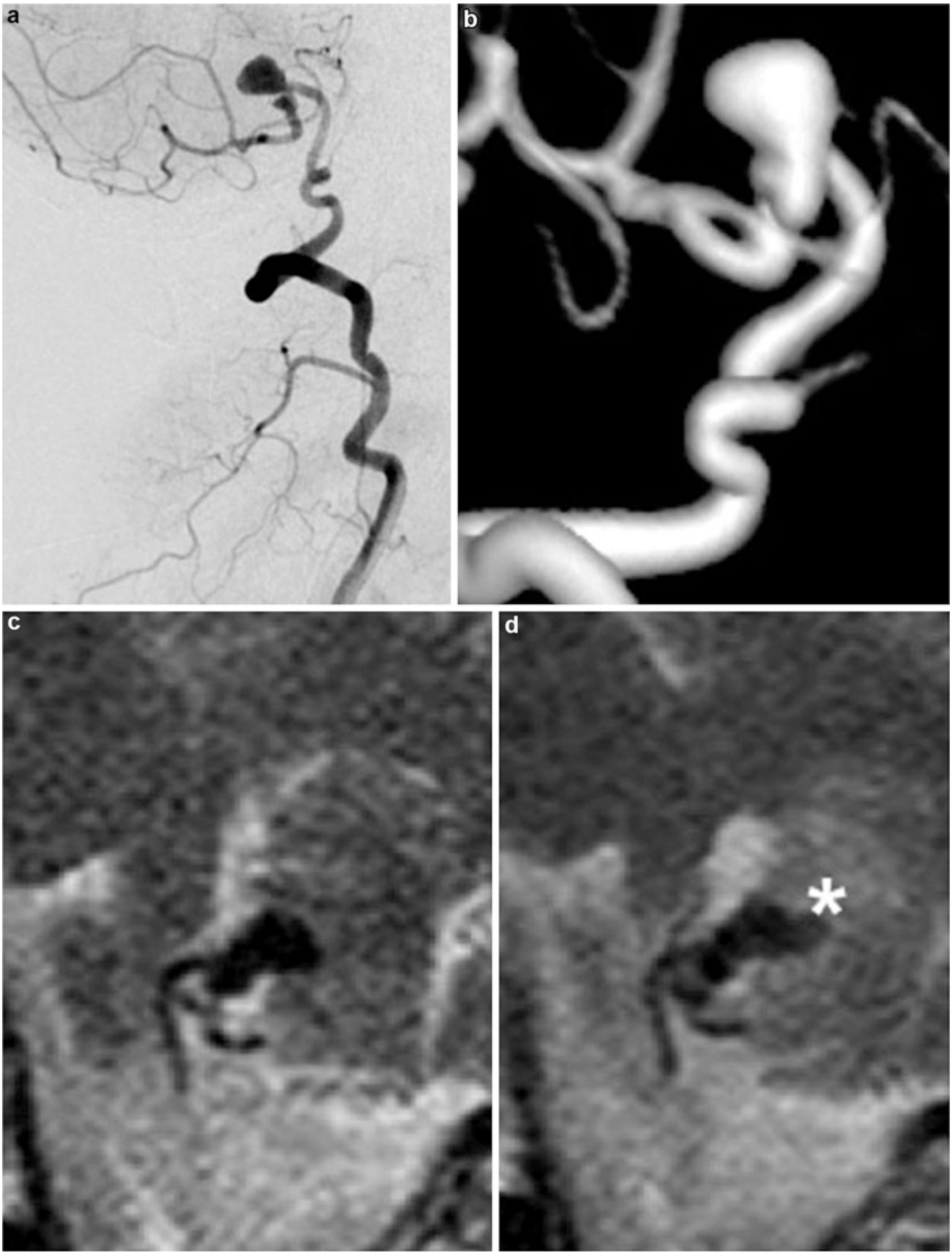

Fig. 1 Preoperative imaging showing a right PICA aneurysm arising from the lateral medullary segment. 2D DSA (**a**) and 3D DSA (**b**) showed a bilobed aneurysm at the PICA loop. Preoperative T2-weighted magnetic resonance imaging (MRI) at initial diagnosis (**c**) and at 16-month follow-up (**d**) revealed growth and change of shape of the aneurysm, primarily concerning the superiorly pointing lobe of the aneurysm sac (asterisk)

Treatment Strategy

The goal of treatment was the prevention of further aneurysm growth and rupture. Endovascular treatment was considered, but due to the tortuosity of the right V4 segment and the ill-defined boundary between the aneurysm neck and the medullary segment of the right PICA, reconstruction of the parent artery appeared difficult. We intended to attempt a microsurgical reconstruction of the parent vessel by clipping the aneurysm neck. If this was not possible, we intended to perform aneurysm trapping, with or without direct anastomosis of the PICA depending on the intraoperative findings.

Treatment

Procedure, 06.02.2019: microsurgical trapping of a right PICA aneurysm

Anesthesia: general anesthesia

Technical equipment: Zeiss Kinevo 900 operating microscope, indocyanine green angiography (ICG), continuous electrophysiological monitoring

Course of treatment: the operation was performed with the patient in a semi-sitting position with the head rotated and angled to the right. The margins of the transverse and sigmoidal sinus were marked on the skin using anatomic landmarks. A skin incision was performed and the sulcus digastricus was identified. Bone flap removal was performed as for a lower lateral right-sided suboccipital craniotomy. The craniotomy was extended laterally with partial resection of the mastoid, and the dura was opened along the sigmoid sinus. Relaxation of the cerebellum was achieved by draining CSF from the basal cistern. The accessory, vagus, and glossopharyngeal nerves were identified and gently separated from the cerebellum. Afterward, a very small right vertebral artery could be identified, which gave very little supply to the basilar artery, the main portion of the vessel continued as PICA ventrally to the cerebellar tonsils. Further preparation of the PICA was performed with preservation of the perforators. One small aneurysm lobe could be identified which appeared to be completely thrombosed and calcified, whereas the other larger lobe pointed superiorly and medially in direction of the fourth ventricle and was not completely visible. The aneurysm was not saccular rather than formed by the parent vessel itself. After further preparation of the aneurysm neck, different clip placements were tried in order to achieve the reconstruction of the vessel lumen. However, both intraoperative ICG and Doppler ultrasound repeatedly revealed occlusion of the proximal PICA, and ICG angiography demonstrated a well-established collateral-flow in the distal PICA. Next, clipping of the larger, non-thrombosed upper aneurysm lobe was attempted, which also led to complete vessel occlusion. Therefore, a clip was placed proximal to the aneurysm at the PICA, and after waiting for 10 min and checking the electrophysiological monitoring, the decision was made to trap the aneurysm with the application of a distal clip onto the PICA. Further evaluation of the PICA revealed that the vessel wall was pathologically altered for a distance of around 5 mm proximally and distally to the aneurysm; no perforators emerged from this portion of the PICA. Final clips were placed at the junction between regular and irregular vessel lumen. The pathologically altered vessel segment, including the aneurysm, was resected completely. Final ICG again demonstrated adequate cross-flow into the distal PICA. The dura was closed using a watertight technique, and the partly opened mastoid cells were closed using muscle and fibrin glue. Finally, the bone flap was reinserted and fixed using mini osteosynthesis material followed by skin closure in classical fashion (Fig. 2).

Duration: 2 hours 44 min

Complications: none

Clinical Outcome

The patient was discharged home on the 8th day after surgery with no neurological deficit.

Follow-Up Examination

CTA performed on the 6th postoperative day showed complete resection of both the aneurysm and the section of the diseased artery (Fig. 3).

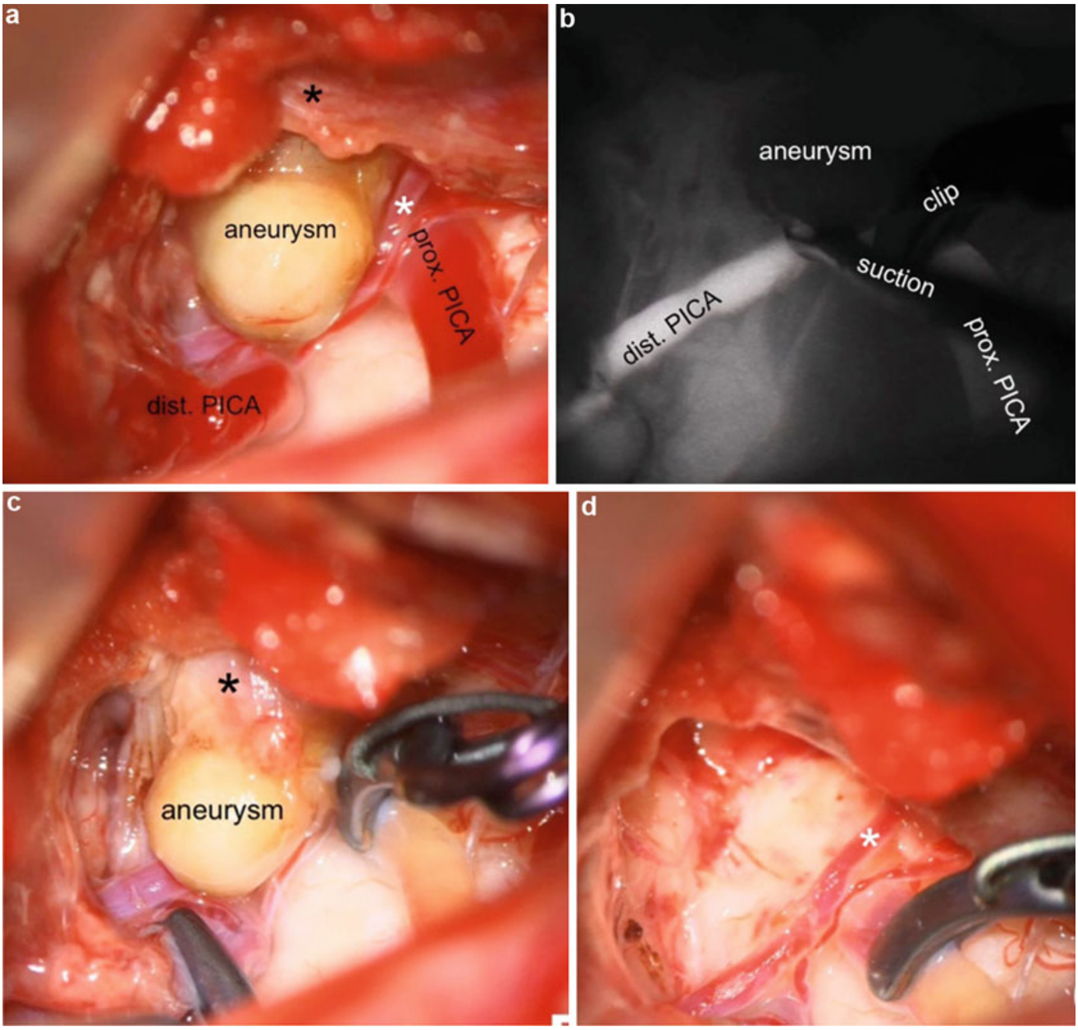

Fig. 2 Intraoperative findings revealing the aneurysm at the loop of the right PICA with a poorly visible upper aneurysm lobe (black asterisk) and a visible calcified lower aneurysm lobe (**a**). After clipping of the PICA proximal to the aneurysm, sufficient collateral-flow could be seen on the distal PICA using indocyanine green angiography (**b**). The aneurysm was then trapped (**c**) and resected (**d**). Note the small vessel running directly underneath the lower aneurysm lobe (white asterisk), which is preserved after aneurysm resection (**a, d**)

Discussion

The PICA is a rare location for intracranial aneurysms with rates between 0.5% and 3% (Bertalanffy et al. 1998; Petr et al. 2016). Furthermore, they are a heterogeneous group arising from different locations along the entire length of the PICA. Various microsurgical and endovascular treatment strategies have been discussed so far (Rodríguez-Hernández et al. 2013; Sejkorová et al. 2016), but the individual treatment strategy is still decided on a case-by-case basis. After the threshold is set for the treatment of the unruptured aneurysm (in our case size, location, morphology, and aneurysm growth over time are considered as risk factors for subsequent rupture), the risks and benefits of different treatment strategies must be discussed. A recent meta-analysis demonstrated

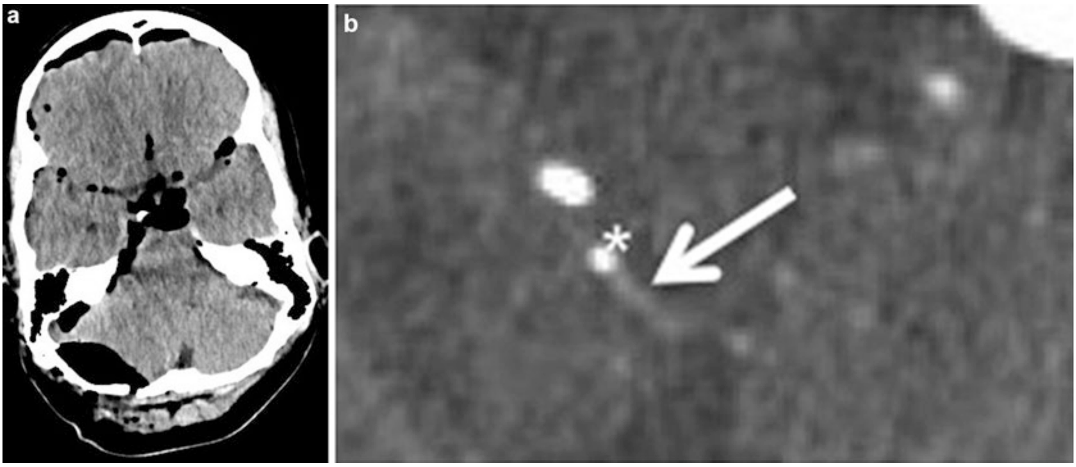

Fig. 3 CT (**a**) and CTA (**b**) after microsurgical clipping of a right PICA aneurysm, showing no infarction in the right PICA territory and the location of the proximal clip (asterisk) and its relation to the proximal PICA (arrow)

higher long-term occlusion rates after surgical treatment. However, this treatment modality was associated with a slightly higher rate of treatment-related mortality and morbidity (Petr et al. 2016). The morphology of the aneurysm also plays a major role, as in this case, the involvement of the entire vessel lumen made the aneurysm unsuitable for stand-alone coiling and an endovascular approach would necessitate the use of a stent or flow diverter (Zanaty et al. 2014). Both devices require dual antiplatelet medication, which is associated with an increased risk of major bleeding (Diener et al. 2004). Additionally, the use of these devices is associated with an increased risk of perforator occlusion (Pierot and Wakhloo 2013). These risks would have been even higher in this case, as a stent or flow diverter would have covered the PICA origin, which has the largest numbers of perforators (Lister et al. 1982). There is no visual control during the procedure to avoid such an occlusion since the tiny perforators may not be easily visible on DSA. With the visual control during an open microsurgical procedure, partial resection of the vessel is possible without causing further ischemic damage (Benes et al. 2006).

The location of the aneurysm with respect to the distal PICA made the surgical approach more straightforward. The surgical treatment of proximally located PICA and vertebral artery aneurysms is more likely to result in cranial nerve palsies due to direct manipulation of the nerves and perforators (Petr et al. 2016). Anatomical considerations regarding the approach and therefore the traction that is put on the cranial nerves play a major role when comparing the individual patient's aneurysm and the specific treatment-associated risks.

Consideration of the patient's baseline clinical status is also important, as an open surgical approach is associated with a higher rate of short-term perioperative complications and a longer hospital stay (Darsaut et al. 2017). This is of particular importance in elderly patients, who often require interim discharge to a care facility, rather than directly at home (Bekelis et al. 2017). Conversely, patients undergoing endovascular aneurysm treatment, for example, with coiling, might have a lower long-term health-related quality of life (Dammann et al. 2019), which is usually of particular importance in younger patients.

In summary, our case represents a PICA aneurysm that was well-suited to surgical treatment in terms of multiple factors including the location of its origin from the PICA, morphology, age, and clinical condition of the patient. Furthermore, it describes in detail the factors which should be considered when deciding on the optimal treatment of nonruptured PICA aneurysms.

Therapeutic Alternatives

Endovascular Coil Occlusion
Flow Diversion
Parent Vessel Occlusion
Stent-Assisted Coiling

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