

Dissecting aneurysms of the posterior inferior cerebellar artery: retrospective evaluation of management and extended follow-up review in 6 patients

ERIC S. NUSSBAUM, M.D., MICHAEL T. MADISON, M.D., MARK E. MYERS, M.D.,
JAMES GODDARD, M.D., AND TARIQ JANJUA, M.D.

National Brain Aneurysm Center, St. Joseph's Hospital, St. Paul, Minnesota

Object. The authors report the management protocol and successful outcomes in 6 patients with dissecting aneurysms of the posterior inferior cerebellar artery (PICA).

Methods. Medical records and neuroimaging studies of 6 patients who underwent surgical treatment of dissecting PICA aneurysms were reviewed. The mean follow-up duration was 1.8 years. No patient was lost to follow-up review.

Results. Four patients presented with acute subarachnoid hemorrhage and 2 with PICA ischemia. All patients underwent surgery, which entailed proximal occlusion with distal revascularization in 3 cases and circumferential wrap/clip reconstruction in 3 cases. The revascularization techniques used were occipital artery–PICA bypass and PICA–PICA anastomosis. Delayed follow-up angiography was performed in all cases. In patients treated with proximal occlusion, delayed angiography showed minimal retrograde opacification of the dissected segments. The 3 patients treated with wrap/clip reconstruction showed unexpectedly significant normalization of their lesions on angiographic studies. Outcome was good in all cases.

Conclusions. Dissecting PICA aneurysms are rare lesions with an apparent propensity for bleeding. Individualized management including distal revascularization with PICA sacrifice or circumferential wrap/clip reconstruction to reinforce the dissected segment produced good outcomes. Patients treated with aneurysm wrapping may show dramatic angiographic improvement of the dissected segment. (DOI: 10.3171/JNS.2008.109.7.0023)

KEY WORDS • aneurysm • brain • bypass surgery • dissection • posterior inferior cerebellar artery • stroke

DISSECTING aneurysms of the PICA are rare lesions that have been described only cursorily in the neurosurgical literature.^{1,2,5,8,22} As a result, their treatment is controversial, and few data are available regarding long-term results for these patients.²² We describe an unusual series of 6 patients with dissecting PICA aneurysms, including long-term clinical and angiographic follow-up review. To our knowledge, this represents the largest series of dissecting PICA aneurysms reported in the literature. Management strategies for these unusual lesions are described and the literature is reviewed.

Methods

We retrospectively reviewed the records of all patients with intracranial aneurysms treated by our neurovascular service between July 1997 and December 2006. Of 1850 patients with intracranial aneurysms treated during this period, we identified 6 (0.32%) with dissecting aneurysms

Abbreviations used in this paper: OA = occipital artery; PICA = posterior inferior cerebellar artery; SAH = subarachnoid hemorrhage; VA = vertebral artery.

of the PICA. Patients with dissecting aneurysms involving the VA were not included. Hospital records, neuroimaging studies, operative reports, and follow-up clinic notes were available in all cases. Follow-up review ranged from 6 months to 4 years (mean duration 1.8 years). No patient was lost to follow-up review.

All patients underwent surgical exploration of their aneurysms through a far-lateral suboccipital craniotomy with C-1 laminectomy and partial condylar resection. In all patients, the OA was identified and preserved. The ipsilateral VA was identified extradurally and then traced intradurally to the PICA origin. When proximal control was achieved, the dissected segment was then explored. Mild hypothermia (34°C) and barbiturate anesthesia were used in all cases.

Results

Information about the patients, presenting findings, and surgical results are detailed in Table 1. There were 4 men and 2 women ranging in age from 39 to 62 years. Two patients presented with acute SAH, hemorrhage within the fourth ventricle, and associated hydrocephalus. Two others presented with ischemia in the PICA distribution; a dis-

TABLE 1
*Characteristics of 6 patients with dissecting aneurysms of the PICA**

Case No.	Age (yrs), Sex	Presentation	Op Procedure	Outcome
1	40, M	SAH/IVH	proximal occl, OA-PICA bypass	good
2	56, M	SAH (delayed)	proximal occl, PICA-PICA anastomosis	good
3	62, F	SAH/IVH	circ wrap/clip	good
4	59, M	SAH (delayed)	proximal occl, PICA-PICA anastomosis	good
5	39, M	PICA infarct, then SAH/IVH	circ wrap/clip	good
6	39, F	PICA infarct	circ wrap/clip	good

* Circ wrap/clip = circumferential wrap/clip reconstruction; IVH = intraventricular hemorrhage; occl = occlusion.

secting aneurysm was not initially diagnosed in either of these patients. One was treated with heparin intravenously and suffered a massive SAH, prompting urgent referral. The other patient initially underwent cerebellar decompression for the infarct without recognition of the underlying pathological condition. Angiography subsequently demonstrated the dissecting aneurysm, and the patient was then referred for definitive therapy. The other 2 patients were referred at 4 and 6 weeks, respectively, after suffering an SAH. In both of those cases, the initial angiograms were interpreted as showing no abnormalities, but serial angiographic evaluations showed progressive aneurysmal dilation of the PICA. In retrospect, irregularity of the PICA without clear aneurysmal change had been present on their initial studies.

In all of these cases, preoperative selective VA angiography showed focal irregularity with aneurysmal dilation of the involved PICA. The first few millimeters of the vessel from its origin off the VA were spared. The immediately distal segment showed the irregular aneurysmal dilation, and then the vessel normalized at or before the tonsillar loop (Fig. 1). All of the lesions were small (< 1 cm maximum dimension), and the left PICA was involved in 4 of the 6 cases. Magnetic resonance imaging was performed in all cases, but diffusion-weighted imaging showed abnormalities in only the 2 patients with ischemic presentations and, in those cases, most of the PICA territory was spared. No patient in this series suffered associated brainstem ischemia.

Serial angiography demonstrated the highly dynamic nature of these lesions in 3 cases. The 2 patients whose referrals were delayed showed progressive dilation of the aneurysmal segment that was initially interpreted as normal. In the patient who presented with PICA ischemia and in whom massive SAH developed after heparin therapy, immediate angiography showed occlusion of the PICA 1 cm distal to its origin. Angiography repeated at 48 hours showed reopening of the vessel with aneurysmal dilation and severe irregularity of the involved segment.

At the time of surgery, in all cases the appearance of the involved PICA was that of a classic arterial dissection, with a blue-black vessel dilated in fusiform fashion (Figs. 1 and 2). The aneurysmal segment was typically 2 to 3 times more dilated than would have been expected based on the angiogram, and the dark discoloration extended distally beyond the point where the vessel caliber normalized both angiographically and on microsurgical inspection. There

were brainstem perforating vessels arising from the aneurysmal segment in every case.

In 3 cases, the patient was treated with distal revascularization—a PICA-PICA or OA-PICA bypass—followed by occlusion of the PICA with a clip placed proximal to the dissected segment. We elected to perform distal revascularization in these cases because of the proximal location of the dissections and the uncertain adequacy of the collateral supply. In the other 3 cases, the aneurysmal segment was wrapped circumferentially with gauze, which was then secured with aneurysm clips. In 2 cases, multiple separate segments were wrapped and secured independently, leaving intervening openings for brainstem perforating vessels. Intraoperative angiography was performed in all cases to confirm patency of the distal bypass or to evaluate the wrapped segment. In 2 cases, the clips securing the circumferentially wrapped gauze were repositioned to loosen the wrapping because intraoperative angiography showed significantly diminished flow through the vessel.

Four patients required external ventricular drainage for acute hydrocephalus, and 3 ultimately underwent placement of a ventriculoperitoneal shunt. One patient with a severe hemorrhage required antibiotic treatment for pneumonia and underwent temporary tracheostomy. No patient suffered brainstem injury. The 2 patients who presented with PICA ischemia had mild cerebellar deficits but improved with physical and occupational therapy. At the time of their 3-month follow-up review, all patients were independent and had returned to the lifestyle and occupation they had pursued before treatment. One-year follow-up data were available for 4 patients, and 2 of them were followed for 2 and 4 years, respectively. All continued to do well and had no residual neurological disability.

In all cases, follow-up angiography was performed 1 week and 3 months postsurgery. In 3 patients follow-up angiography was also performed at 1 year after surgery. In the patients treated with proximal occlusion and distal revascularization, results of angiography at 3 months (all cases) and at 1 year (1 case) indicated a stable condition, showing limited or no retrograde filling of the dissected segment with filling of the distal anastomosis. Interestingly, delayed angiography showed dramatic angiographic normalization of the dissected segment in all 3 patients treated with wrap/clip reconstruction (Fig. 2). In these patients, angiography performed 3 months postsurgery already showed significant improvement in the angiographic appearance of the PICA in all cases. In the 2 patients who underwent 1-year follow-up

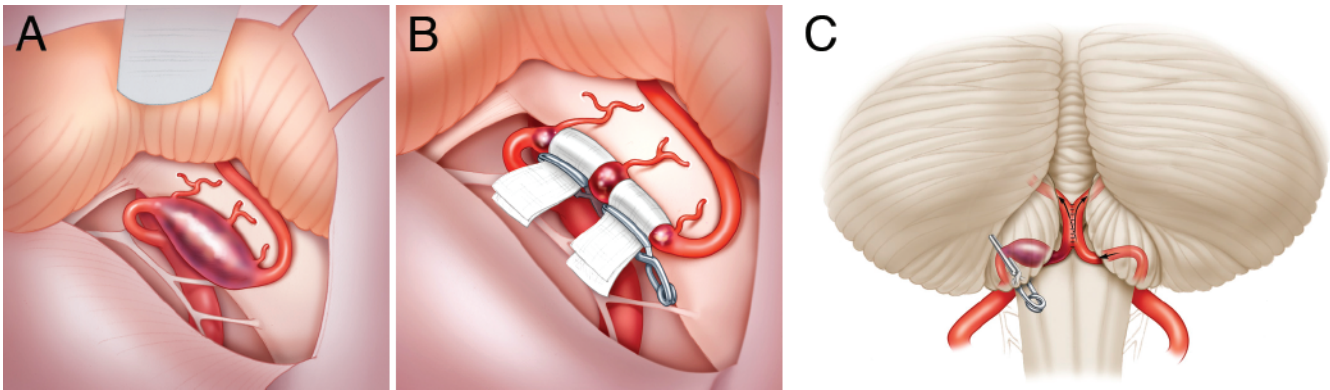


FIG. 1. Artist's drawings depicting a typical dissecting aneurysm of the PICA before (A) and after (B) wrap/clip reconstruction of the involved segment, as used to treat 3 patients in our series. A PICA–PICA anastomosis followed by clip occlusion of the PICA proximal to the aneurysmal segment (C) was performed in 2 other cases.

angiography after wrap/clip reconstruction, the vessel appeared normal angiographically.

Discussion

Aneurysms involving the PICA distal to its origin from the VA are extremely rare, representing < 1% of all intracranial aneurysms.^{7,13,17–19,23} Although some of these lesions are true saccular aneurysms that may be treatable with direct clip reconstruction, many are fusiform, requiring parent artery occlusion with or without revascularization, and a significant minority are dissecting aneurysms.^{7,13,17} Even in comparatively large series of peripheral PICA aneurysms, most lesions are identified as saccular or fusiform, and few if any have been considered dissecting in nature.^{13,17,18} We suggest that these dissecting lesions are being recognized increasingly often due to more meticulous and better quality angiographic evaluation. As has been described in the past, these lesions may be angiographically dynamic and are potentially unstable, with a high propensity for bleeding.^{1,5,22}

Management Considerations

The management of dissecting PICA aneurysms is controversial. Isolated case reports have described the treatment of these lesions with wrapping or by PICA sacrifice with or without distal revascularization.^{1,3,4,8–10,12,15,16,21,22,24,25} Most cases reported in the literature have been treated with surgical occlusion of the PICA or trapping of the dissected segment.^{1,22} Ali et al.¹ reviewed 24 cases of isolated PICA dissection from the literature and added 1 case of their own. They suggested that trapping of the involved segment with distal revascularization may be the treatment of choice. Several cases of endovascular PICA sacrifice have been described as well.^{12,21,25} Fujimura et al.⁶ reported a case in which the aneurysmal portion of a dissection was treated with coil embolization, leaving the PICA itself patent. The patient in this case later suffered fatal rebleeding, and Fujimura's group concluded that this approach is a dangerous option in cases of PICA dissection.

We have not used endovascular treatment for our patients because endovascular options have generally been limited to PICA occlusion with coils. Although balloon

occlusion testing has been described in this setting, there is no test that definitively assesses the adequacy of collateral supply to the PICA territory, and for that reason we have used distal revascularization when sacrificing the PICA.^{17,22} Most dissecting PICA aneurysms appear to occur proximal to the telovelotonsillar segment, and that was true in all cases in our series. We suggest that the potentially severe consequences of brainstem ischemia from the loss of perforating vessels that arise from the proximal PICA segments warrant an attempt at revascularization whenever possible.^{1,9,10,17} In addition, endovascular coil occlusion of the PICA typically requires that coils be deposited over some length of the vessel, potentially occluding critical brainstem perforating vessels that can often be spared by a strategically placed aneurysm clip. Intraluminal stent placement might well be the ideal treatment for these lesions in the future, but with currently available technology, the small luminal diameter and significant irregularity of the dissected PICA have typically precluded this option.

We have used circumferential wrap/clip reconstruction when it was possible to dissect the abnormal segment fully. When true circumferential wrapping could not be achieved, we performed distal revascularization followed by PICA occlusion. The lesions were then followed with serial angiographic evaluation to ensure stability. We have not trapped the involved segment because of the presence of brainstem perforating vessels arising from that segment in all of our cases. It is not clear that trapping of the involved segment is warranted, except in rare circumstances when there are no brainstem perforating vessels arising from the dissected segment or when proximal occlusion with distal revascularization fails to achieve stability when reviewed on follow-up angiography.

It must be noted that this strategy does not definitively exclude the involved segment from the arterial circulation and thus cannot completely eliminate the potential for repeated hemorrhage.³ Nevertheless, none of the aneurysms treated in our series rebled or enlarged, even in the long term, as shown with follow-up angiography. In addition, it is of great interest to us that angiographic follow-up review showed dramatic angiographically confirmed healing of the dissected segment in those cases in our series treated with wrapping. To our knowledge, this result has not been described previously in dissecting aneurysms of the PICA.

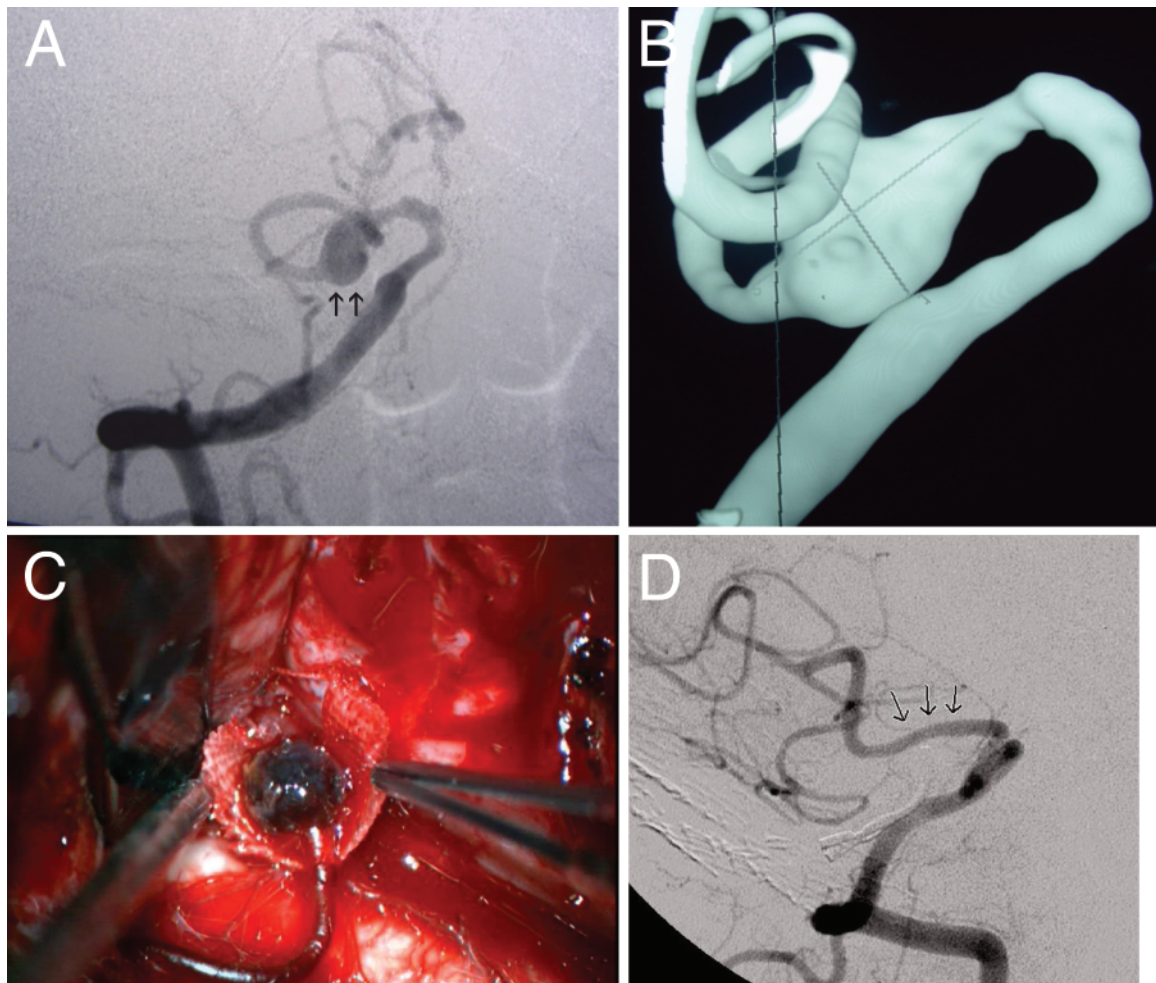


FIG. 2. A: Preoperative selective VA angiographic image showing irregularity and aneurysmal dilation (*arrows*) of the PICA ~ 1 cm distal to its origin. Of note, the VA terminated in the PICA in this case. B: A 3D rotational angiographic image providing greater anatomical detail of the dissecting aneurysm. C: Intraoperative photograph showing the blue-black aneurysm and associated PICA dissection prepared for circumferential wrap/clip reconstruction. D: Follow-up angiography performed 1 year after circumferential wrap/clip reconstruction showing dramatic normalization of the angiographic appearance of the PICA (*arrows*).

In those patients treated with occlusion and distal revascularization, we suggest that the limited retrograde filling of the dissected segment should provide little impetus for enlargement of the aneurysmal dilation or for rebleeding.

The usefulness of intraoperative angiography in the treatment of intracranial aneurysms has been described previously.^{11,20} We consider intraoperative angiography critical in the surgical management of dissecting PICA aneurysms, either to ensure patency of the distal bypass before vascular sacrifice or to guide the wrapping procedure. In our experience, the dissected vessel typically has intramural clot within a dilated wall, and we have found that even gentle external compression by gauze wrapping can significantly and unexpectedly impair intraluminal flow. In 2 cases of wrapping in this series, intraoperative angiography showing decreased flow through the vessel resulted in our repositioning the clips securing the circumferentially wrapped gauze to loosen the wrapping.

Revascularization Techniques and Rationale

Because of the potential need for revascularization, we suggest that dissecting aneurysms of the PICA should be managed by a surgeon who is comfortable with the use of posterior circulation revascularization techniques. Over time, we have come to prefer PICA–PICA anastomosis over OA–PICA bypass, but both options have been used successfully in our experience. Although PICA occlusion distal to the telovelotonsillar segment generally does not result in brainstem injury and may be reasonably well tolerated by most patients, in our series these lesions uniformly involved the PICA proximal to this point.^{1,7,9,10,14,22} In addition, although distal PICA infarction is not disabling in most cases, postoperative cerebellar edema and the resulting clinical cerebellar dysfunction are unnecessary adverse events if revascularization can be performed successfully. Although some patients have excellent collateral supply to

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the PICA territory, others certainly do not, and it can be very difficult to predict which patients are at risk for ischemic injury preoperatively. Some patients have a very large PICA that supplies the anterior inferior cerebellar artery territory as well. For those patients, PICA sacrifice, even distal to the tonsillar point, may be dangerous because of the severe cerebellar edema that may develop.

Conclusions

Dissecting PICA aneurysms are rare lesions that appear to have a high propensity for bleeding. We describe a series of 6 patients with dissecting PICA aneurysms presenting with SAH or PICA ischemia. All lesions were managed surgically with either circumferential wrap/clip reinforcement or proximal occlusion with distal revascularization. There was dramatic angiographically documented improvement of the dissected segment in the patients treated with aneurysm wrapping.

We suggest that young adults with unexplained, acute PICA ischemia should undergo VA angiography to rule out PICA dissection. Patients with SAH and prominent fourth-ventricle hemorrhage should be evaluated with complete 4-vessel angiography. The diagnosis of a dissecting PICA aneurysm is easily missed on initial angiography. Therefore, even a subtle irregularity of the PICA should raise the suspicion of possible dissection, and follow-up angiography is warranted in such cases.

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Address correspondence to: Eric S. Nussbaum, M.D., 3033 Excelsior Boulevard, Suite 403, Minneapolis, Minnesota 55416. email: lnussbaum@comcast.net.