Treatment of vertebral artery aneurysms with transposition of the posterior inferior cerebellar artery to the vertebral artery combined with parent artery occlusion

Technical note

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✓The authors describe transposition of the posterior inferior cerebellar artery (PICA) to the vertebral artery (VA) combined with parent artery occlusion for the treatment of VA aneurysms in cases in which a clip could not be applied because of the origin of the ipsilateral PICA. The aneurysm is trapped through a lower lateral suboccipital craniectomy. The PICA is then cut just distal to the aneurysm, and the PICA and VA proximal to the aneurysm are anastomosed in an end-to-end or end-to-side fashion.

The surgical procedure was successfully performed in two patients, each of whom had hypoplastic occipital arteries (OAs). The PICA contralateral to the lesion was hypoplastic in one patient and distant to the ipsilateral PICA in the other patient. Mild transient dysphagia developed postoperatively in one patient due to glossopharyngeal and vagus nerve palsy, and the other patient had an uneventful postoperative course. In both patients, postoperative cerebral angiography demonstrated good patency of the transposed PICA. These results show that transposition of the PICA to the VA is a useful procedure for the reconstruction of the PICA when parent artery occlusion is necessary to exclude a VA aneurysm involving the origin of the PICA and when OA–PICA anastomosis or PICA–PICA anastomosis cannot be performed.

KEY WORDS • vertebral artery aneurysm • posterior inferior cerebellar artery • cerebral revascularization

A PPLYING surgical clips to the neck of an aneurysm is the procedure of choice for the treatment of VA aneurysms. However, large or dissecting aneurysms are not amenable to direct clamping, and concomitant parent artery occlusion or trapping may be necessary to exclude the lesion from the systemic circulation. Large or dissecting VA aneurysms occasionally involve the origin of the PICA. If there is a high probability of PICA blood flow disturbance after surgical treatment for a local aneurysm, PICA reconstruction should be considered to prevent cerebellar infarction and lateral medullary syndrome. Various anastomotic strategies have been employed, including OA–PICA anastomosis, 2,3,5,12,15,18,20 VA–PICA anastomosis using an STA or radial artery graft (VA–STA/radial artery graft–PICA anastomosis), 4,8,9 and side-to-side anastomosis between the bilateral PICAs (PICA–PICA anastomosis). 11,13,17

We describe transposition of the PICA to the VA (VA–PICA transposition) combined with parent artery occlusion in two patients, one with a large ruptured VA aneurysm (Fig. 1) and the other with a dissecting VA aneurysm (Fig. 2); both procedures involved the origin of the ipsilateral PICA.

Operative Technique

The patient is placed in the prone position. Prior to craniectomy, a 5-cm segment of the left STA is isolated for use as an arterial graft for VA–STA–PICA anastomosis. A straight incision is made in the paramedian area, and a lower lateral suboccipital craniectomy and partial resection of the jugular tubercle are performed, after which the foramen magnum is opened. The cerebellum is retracted and the aneurysm is lifted to reveal the VA and the lesion. In both patients described in this report, the ipsilateral PICA originated from the aneurysm itself (Figs. 1B and 2B). Therefore, the aneurysm was trapped by occluding the VA just proximal and distal to the lesion and the PICA. The VA proximal to the aneurysm and the proximal portion of the PICA are dissected and the two arteries are mobilized. The VA and PICA are cut just proximal and distal to the aneurysm, respectively. If the calibers of the two arteries are

Abbreviations used in this paper: OA = occipital artery; PICA = posterior inferior cerebellar artery; STA = superficial temporal artery; VA = vertebral artery.
approximately consistent, the two arteries are anastomosed in an end-to-end fashion (Fig. 1C). In contrast, if there is a discrepancy in the calibers of the two arteries, they are anastomosed in an end-to-side fashion (Fig. 2C). Finally, the aneurysm is removed.

Illustrative Cases

We have used this technique in two patients, both of whom had a ruptured VA aneurysm involving the origin of the ipsilateral PICA. The first patient had a large saccular aneurysm in the junction of the left VA and the PICA (Fig. 1A), and the left PICA perfused the left cerebellar hemisphere as well as the lower portion of the right cerebellar hemisphere. The right PICA was hypoplastic in this patient, and both posterior cerebral arteries, both superior cerebellar arteries, the basilar artery, and the right anterior inferior cerebellar artery were perfused by the right VA. The second patient had a dissecting aneurysm in the left VA (Fig. 2A), and the calibers of the right and left VAs were equal. However, the right PICA coursed far from the left PICA and could not be mobilized intraoperatively, because it gave rise to several vessels that supplied the cerebellar hemisphere. In addition, both OAs in the two patients were hypoplastic.

All surgical procedures were accomplished successfully. Mild transient dysphagia developed postoperatively in the first patient due to glossopharyngeal and vagus nerve palsy, and the second patient had an uneventful postoperative course. In both patients, a computed tomography scan performed 1 month postoperatively revealed no ischemic lesion. Results from a postoperative cerebral angiography confirmed the disappearance of the aneurysm, and adequate perfusion of both cerebellar hemispheres (in the first patient) or the left cerebellar hemisphere (in the second patient) via the transposed PICA (Figs. 1D and 2D).

Discussion

Most published studies provide descriptions of the use of the OA as a donor artery to revascularize the PICA, 2,3,5,12,15.
However, dissection of the OA poses difficulties, particularly because of its location under and vascular connections to the splenius capitis, longissimus capitis, suboccipital, and occipitalis muscles, and because the proximal OA is surrounded by a plexus formed by its companion veins. Further, establishing a watertight dural closure is impossible in the context of an OA–PICA anastomosis.

Other surgeons have described their experience with PICA–PICA anastomosis using a side-to-side method and reported some advantages to this technique: 1) the calibers of the posterior medullary segments of the PICAs are relatively consistent; 2) the proximity and parallel course of the bilateral caudal loops of the PICA greatly facilitate their mobilization and anastomosis to one another; and 3) the short bypass segment and resulting single suture line are also desirable. Although areas perfused by the PICAs are theoretically placed at risk of ischemia during anastomosis, this complication has not been observed.

We previously achieved good results after performing PICA–PICA anastomosis combined with parent artery occlusion.
clusion in patients with aneurysms involving the origin of the PICA and requiring occlusion of the VA. In the first patient in this report, however, the PICA ipsilateral to the lesion perfused the ipsilateral cerebellar hemisphere as well as the lower portion of the contralateral cerebellar hemisphere, and the contralateral PICA originating from the contralateral VA was hypoplastic. In the second patient, the contralateral PICA coursed far from the ipsilateral PICA and could not be mobilized, because the artery gave rise to several vessels that supplied the cerebellar hemisphere. In addition, the OAs in both cases were hypoplastic. Thus, we elected to perform VA–PICA transposition for reconstruction of the PICA.

The VA–PICA transposition technique possesses several limitations. Because of the depth and space constraints of the operative field, the procedure is more technically challenging than OA–PICA or PICA–PICA anastomosis. The lower cranial nerves, specifically the vagus nerve, may be injured, and mild transient dysphagia developed postoperatively in one of our patients due to glossopharyngeal and vagus nerve palsy. Lastly, the proximal segment of the PICA gives rise to several perforating vessels that supply the brainstem, further complicating PICA mobilization; the forced mobilization of the PICA may injure the perforating vessels, resulting in lateral medullary syndrome. Thus, when the proximal portion of the PICA cannot be mobilized, VA–STA/radial artery graft–PICA anastomosis may be a useful alternative. In both patients in the current study, the ipsilateral STA was isolated as an arterial graft for VA-STA-PICA anastomosis before craniectomy. However, performing the anastomoses in two sections (VA-STA-PICA) in the deep and narrow operative field would result in increased overall technical difficulty of the procedure.

Conclusions

We have found VA–PICA transposition to be a useful procedure for the reconstruction of the PICA when parent artery occlusion is necessary to exclude a VA aneurysm involving the origin of the PICA. However, we would not have used VA–PICA transposition if the OAs had been available, despite the limitations of OA–PICA anastomosis, including difficulty in dissecting the OA and the inability to establish a watertight dural closure.

References


Manuscript received December 18, 2005. Accepted in final form April 20, 2006.

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