Transcallosal interforniceal approach for a posteriorly projecting high basilar bifurcation aneurysm

Case report

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A transcallosal interforniceal approach was used for treatment of a posteriorly projecting high basilar bifurcation aneurysm with a neck located 30 mm above the posterior clinoid process. The aneurysm was successfully clipped via the third ventricle with minimal neurological deficits. This approach appears to be appropriate for basilar bifurcation aneurysms located more than 20 mm above the posterior clinoid process when the fundus projects posteriorly, and permits direct visualization of the aneurysmal neck and vital perforators with minimal brain retraction.

KEY WORDS  transcallosal approach  aneurysm  basilar circulation  subarachnoid hemorrhage

Advances in neurosurgical technique have made the treatment of vertebral and basilar aneurysms as safe as approaches to lesions of the anterior circulation. However, the management of very high basilar bifurcation aneurysms that impinge upon the floor of the third ventricle still presents a difficult challenge. Repair of these lesions is associated with a high risk of morbidity and mortality, particularly when the fundus projects posteriorly. Exposure of the neck of the aneurysm may require excessive retraction, and the perforating vessels may not be spared.

In selecting a surgical approach to an aneurysm of the basilar bifurcation, the main consideration should be how to minimize brain retraction and how to spare the tiny perforating vessels arising from the terminal basilar and proximal posterior cerebral arteries. Keeping these two factors in mind, we selected the transcallosal interforniceal approach in treating a posteriorly projecting high basilar bifurcation aneurysm and successfully clipped it via the third ventricle, with minimal resulting neurological deficits.

Case Report

This 50-year-old right-handed woman was admitted to our hospital with a subarachnoid hemorrhage (SAH) caused by a ruptured basilar bifurcation aneurysm.

Examination. On angiography, the aneurysm was seen to be located 30 mm above the posterior clinoid process, projecting posteriorly (Fig. 1). Computerized tomography confirmed a massive SAH without ventricular clot. The patient's clinical condition was Grade III according to the Hunt and Hess scale. The patient was initially managed conservatively, but an operation was performed 16 days after the SAH.

Operation. The patient was placed in the supine position, with her head elevated approximately 20° from horizontal and supported in a Mayfield headholder. A U-shaped right frontal scalp incision was made and a right paramedian trapezoid free bone flap, 6 × 4 × 3 cm in size, was elevated which bisected the coronal suture. A trapezoid dural incision was performed with the broad base at the margin of the sagittal sinus. With microsurgical techniques, the midline plane was developed between the cingulate gyri. A 2-cm incision was made in the corpus callosum, and the right lateral ventricle was exposed. Next, a 1-cm incision was made in the septum pellucidum and the columns of fornices were separated bluntly. Ependymal bulging of the wall of the third ventricle was observed just beneath the foramen of Monro. This was the expected location of the aneurysm, based on the angiographic findings.

The neck of the aneurysm was exposed by dissecting
Transcallosal interforniceal approach to aneurysm

Fig. 1. Preoperative vertebral angiograms, lateral (left) and anteroposterior (right) views, showing a posteriorly projecting basilar bifurcation aneurysm with its neck located 30 mm above the posterior clinoid process.

the overlying neural tissue around the hypothalamic sulcus. When the basilar tip was exposed, the aneurysm was found to originate from the posterior wall of the basilar bifurcation and to project posteriorly. Numerous perforating vessels arose from the posterior wall of the posterior cerebral artery and ran downward, adjacent to the aneurysmal neck (Fig. 2). Two of these crossed the fundus of the aneurysm and would not have been seen if this aneurysm had been approached from the anterior inferior direction. The aneurysm was clipped using a straight Sugita clip, sparing all perforators.

Postoperative Course. The patient remained somnolent for the first 3 weeks after surgery. A postoperative angiogram revealed that the aneurysm was obliterated (Fig. 3). Three months after surgery, the patient exhibited no motor weakness or sensory disturbance, but she did have a mild memory impairment. Neuropsychological tests were administered to evaluate if a disconnection syndrome, impairment of intelligence, or memory disturbance were present. The Aphasia Battery (Japanese edition) showed neither left-hand apraxia nor left-hand agraphia. Tactile anomia with the left hand was not observed on testing with 10 common objects. Evaluation on the Hasegawa Dementia Rating Scale and Miyake Memory Scale revealed mild memory and intelligence disturbance.

Discussion

Drake has classified the risk of basilar bifurcation aneurysm surgery according to the direction of the aneurysmal axis, the size of the aneurysm, and the height of the aneurysm. The higher the aneurysm lies above the posterior clinoid process, the poorer the prognosis, because greater brain retraction is required to expose the neck. Additionally, the more posterior the location of the aneurysm, the poorer is the prognosis, because there is a tendency for more vital perforating vessels to be involved when the aneurysm projects posteriorly.

The pterional approach is considered to be more appropriate for high basilar bifurcation aneurysms than the subtemporal approach. The supraorbital and orbitocranial approaches and, for more lateral and
inferior access, the zygomatic\textsuperscript{1} and orbitozygomatic temporo-polar\textsuperscript{2} approaches have been developed to obviate excessive brain retraction. However, all reports of successful clipping using these approaches have been of aneurysms with necks less than 20 mm above the posterior clinoid process. It is difficult to avoid excessive brain retraction when the neck of the aneurysm is more than 20 mm above the posterior clinoid process, even when one of these approaches is used, and they may not be suitable for basilar bifurcation aneurysms when the fundus projects posteriorly, because the neck is behind the basilar artery.\textsuperscript{15}

Kodama, et al.,\textsuperscript{10} have successfully clipped a basilar bifurcation aneurysm located 24 mm above the interclinoideal basal line via the third ventricle by splitting the lamina terminalis. However, when the aneurysm is extremely high and projects posteriorly, this approach has some anatomical disadvantages, since the neck of the aneurysm and the perforators lie behind the basilar artery.

The transcallosal interforneical approach allows direct visualization of the aneurysm from the superior direction. The perforators, which run downward in cases of extremely high basilar bifurcation aneurysms, are well visualized. Furthermore, the high position itself is not a disadvantage. This approach may be ideal anatomically, but it does carry a certain risk of postoperative neurological sequelae; these include the disconnection syndrome due to splitting of the corpus callosum, memory disturbance due to limbic system injury, and hypothalamic dysfunction due to surgical trauma to structures around the third ventricle.\textsuperscript{1} In our patient, the incision afforded ready access to both foramina of Monro, with virtually no postoperative deficit. One possible exception is a tactile transfer deficit, although this syndrome did not develop in this case. The patient’s postoperative hypersomnia may have been caused by surgical trauma to the posterior hypothalamus. Ranson and Ingram\textsuperscript{13} proposed that the posterolateral hypothalamus is essential in maintaining the patient’s normal waking state and that removal of the downward projecting system results in hypersomnia. Memory impairments are a common postoperative complication of surgery in the vicinity of the third ventricle.\textsuperscript{13} Neuroanatomical studies suggest that damage to structures around the third ventricle will disrupt major connections to other limbic structures that form the neural systems related to aspects of normal memory.\textsuperscript{2}

Fig. 3. Postoperative vertebral angiograms, lateral (\textit{left}) and anteroposterior (\textit{right}) views, showing that the aneurysm is fully obliterated.

References

Transcallosal interforniceal approach to aneurysm


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