Trapping of giant basilar trunk aneurysms

Report of two cases

SHIRO KASHIWAGI, M.D., JOHN M. TEW, JR., M.D., HARRY R. VAN LOVEREN, M.D., AND GEOFFREY THOMAS, M.D.

Department of Neurosurgery, University of Cincinnati College of Medicine, Good Samaritan Hospital, Cincinnati, Ohio

Two cases of successful trapping of giant basilar trunk aneurysms are presented. The aneurysms were trapped by clipping the basilar artery distal to the anterior inferior cerebellar arteries and proximal to the superior cerebellar arteries. The outcome was excellent in both cases. In the treatment of giant basilar trunk aneurysms, trapping the involved segment of the basilar artery is an effective way to obliterate and decompress the aneurysm. Preoperative assessment of potential collateral vascular supply, operative technique, and the efficacy of intraoperative monitoring are discussed.

Key Words • giant aneurysm • basilar aneurysm • trapping procedure

Surgical management of giant aneurysms of the posterior circulation remains a difficult challenge to neurosurgeons. This is especially true of aneurysms arising from the trunk of the basilar artery. In theory the optimal treatment is direct clipping of the neck of the aneurysm to prevent subsequent rupture or enlargement, but in practice this is often impossible because of the size of the aneurysm neck, fusiform dilatation of the parent vessel, mural thrombus, or a difficult location. Effective alternatives for exclusion of aneurysms from the normal circulation include occlusion of the proximal basilar or vertebral artery to induce its thrombosis, or trapping the involved segment of the basilar artery.

Drake reported that, in his initial experience with direct basilar artery occlusion in seven patients with giant posterior circulation aneurysms, three patients benefited from the procedure, two worsened, and two died. Drake has since modified his procedure, utilizing a tourniquet around the parent vessel which is tightened after the patient has awakened, with clinical monitoring and angiographic control (Hunterian ligation). This technique was applied in 13 cases of basilar trunk aneurysm; seven patients had good results and six had poor results. Although Hunterian ligation appears to be a feasible therapeutic option for giant basilar trunk aneurysms, the major disadvantage of this method is the unpredictable amount of thrombosis, as well as the risk of acute ischemia. Incomplete thrombosis leads to incomplete protection from expansion and rupture, while excessive thrombosis results in ischemic complications at both the acute and the delayed stages.

Trapping is another therapeutic option for giant basilar trunk aneurysms. However, only limited experience is reported in the literature. Two cases of successful trapping of giant basilar trunk aneurysms are presented. The angiographic and anatomical considerations for trapping of the basilar artery are discussed.

Case Reports

Case 1

This 39-year-old white woman, an emergency room nurse, began to notice generalized fatigue and occasional diplopia occurring toward the end of her work day approximately 8 months prior to admission. The symptoms recurred periodically and were occasionally associated with paresthesias of the left hand and a cold feeling in the left side of her face. Approximately 1 month prior to admission, the patient noticed weakness of the left arm and dragging of her left leg. Diplopia and weakness of the left arm and leg became progressively worse. She was admitted to the hospital on December 26, 1984.

Examination. Neurological examination on admission revealed an alert and oriented patient with normal speech and cognitive function. Pupils were equal and reactive to light. Visual fields and extraocular move-
Trapping of giant basilar aneurysms

FIG. 1. Case 1. Left: Computerized tomography scan with contrast enhancement showing a partially thrombosed giant aneurysm in the posterior fossa. There was significant mass effect on the brain stem. Center and Right: Vertebral angiograms demonstrating an 18 × 17 × 30-mm giant aneurysm arising from the basilar artery trunk between the superior cerebellar arteries and the anterior inferior cerebellar arteries.

ments were intact. Mild left central facial palsy was noted. The remainder of the cranial nerve examination was normal. Motor examination revealed mild weakness of the left arm and leg. Sensory examination was normal. Deep-tendon reflexes were symmetrical with no Babinski sign. Mild truncal ataxia was noted. A computerized tomography (CT) scan with contrast administration demonstrated a mass lesion in the brain stem (Fig. 1 left). A region of eccentric enhancement, as well as an enhancing peripheral rim, suggested a partially thrombosed giant aneurysm. Cerebral angiography demonstrated an 18 × 17 × 30-mm giant aneurysm arising from the basilar trunk between the superior cerebellar arteries (SCA's) and the anterior inferior cerebellar arteries (AICA's) (Fig. 1 center and right). Carotid artery injections showed a patent posterior communicating artery (PCoA) bilaterally filling the posterior cerebral arteries on each side.

Operation. On December 26, 1984, the patient was taken to the operating room. Intermittent cerebrospinal fluid (CSF) drainage via a lumbar subarachnoid catheter enhanced retraction and exposure. A right temporal craniotomy was performed and the upper brain stem was exposed through the right subtemporal approach with section of the right tentorial edge. Dissection around the anterior portion of the brain stem disclosed the basilar artery and both SCA's. The basilar artery was dissected proximally and the distal and proximal ends of the aneurysm were identified. Two 5-mm straight Yasargil clips were placed across the basilar artery distally. A curved McFadden aneurysm clip was applied to the basilar artery proximal to the aneurysm, sparing the AICA's. The aneurysm was opened and the contents evacuated to decrease the mass.

Postoperative Course. The patient had a mild leftsided weakness and fluctuating level of consciousness for several days. Her mental status returned to normal with remarkable improvement in her gait by the 10th postoperative day. Postoperative angiography showed successful obliteration of the basilar artery aneurysm. The distal basilar artery to a level just proximal to the clip and both SCA's were filled through the PCoA's. The proximal basilar artery and bilateral AICA's were filled through the vertebral arteries (Fig. 2). The patient's status continued to improve and she was discharged in good condition on January 18, 1985. She returned to her full-time emergency room nursing position 6 months later.

Case 2

This 44-year-old male physician had been in good health until 4 days prior to admission, when he developed slurred speech and difficulty in walking, with a tendency to fall to the right. He noted difficulty in holding a pencil and could not write due to incoordination of the right hand. Later that same day, he developed a severe generalized headache. He denied a stiff neck, nausea, or vomiting associated with this headache. Slurred speech, incoordination of the right hand, and ataxia progressed gradually over the next 4 days. The headache continued without relief by analgesics. The patient was admitted to the hospital on February 3, 1987.

Examination. The patient was hypertensive, but not diabetic. His neck was supple and Kernig's sign was negative. Neurological examination revealed a slightly lethargic, well-oriented man. His gait was broad-based and ataxic with a tendency to veer toward the right. His pupils were equal and reactive. Extraocular movements and visual fields were normal. Motor and sensory examinations of the extremities were normal. Deep-tendon reflexes were symmetrical with no Babinski sign. Speech was dysarthric and swallowing was difficult. A CT scan demonstrated a 2 × 2.6-cm round contrast-enhancing mass lesion anterior to the brain stem compressing the pons. A cerebral angiogram confirmed the
presence of a 17×15×12-mm aneurysm arising from the trunk of the basilar artery between the AICA’s and the SCA’s. The aneurysm had no well-defined neck. There was a 6-mm space between the proximal end of the aneurysm and the AICA’s and a 2-mm distance between the distal end of the aneurysm and the SCA’s. Carotid artery injections demonstrated filling of the left posterior cerebral artery by the PCoA. No definite PCoA was demonstrated on the right side. The Allcock maneuver (compression of the carotid arteries during vertebral injection) was not performed.

Operation. On February 10, 1987, the patient was taken to the operating room. Somatosensory evoked potentials (SSEP) were monitored with right and left posterior tibial nerve stimulation during surgery. A lumbar subarachnoid catheter was placed for intermittent CSF drainage. The upper basilar artery was exposed through a right pterional approach with section of the tentorial edge. The distal end of the aneurysm, right posterior cerebral artery, and right SCA were dissected lateral to the right oculomotor nerve. Dissection was carried out to the proximal end of the aneurysm. The AICA was not identified. No evidence of subarachnoid hemorrhage was observed; however, bluish discoloration suggestive of intramural hemorrhage was noted in the proximal part of the aneurysm wall. The mean arterial blood pressure, which had been maintained at 60 mm Hg, was elevated to 80 mm Hg at this time and a 7-mm curved Yaşargil aneurysm clip was applied to the basilar artery just proximal to the aneurysm. Vital signs and SSEP were carefully observed for 3 minutes, but showed no remarkable changes. A straight 7-mm Yaşargil clip was then applied to the basilar artery just distal to the aneurysm. Two small perforating arteries projecting into the brain stem were trapped with the aneurysm. The aneurysmal sac was punctured, and approximately 1 ml of old blood was aspirated.

Postoperative Course. Eight hours after the operation the patient opened his eyes in response to pain. He had partial oculomotor palsy, partial abducens palsy on the right side, and right hemiparesis, including the right side of the face. A CT scan showed findings suggestive of ischemic change in the upper brain stem on the left. A postoperative left vertebral angiogram showed complete obliteration of the aneurysm. The posterior cerebral arteries and SCA’s filled through the left PCoA. The AICA’s filled through the vertebral artery. The patient continued to improve postoperatively. His mental status returned to normal in 2 weeks, with improvement of speech and left-sided weakness to preoperative status.

Discussion

Drake performed trapping of the involved segment of the basilar artery in two of 13 patients with aneurysms of the giant basilar trunk. In one, the lower third of the basilar artery was trapped to control bleeding when the aneurysm ruptured during exposure. This patient was reported to have no sequelae postoperatively. In the other patient, trapping was planned and clips were placed on the basilar artery as it entered and emerged from the aneurysm. Postoperatively, the patient remained in deep coma until her death 24 hours later. Autopsy revealed that both AICA’s and several small branches arising from the aneurysm sac were included in the trapped segment of the basilar artery and massive pontine infarction had occurred. Yaşargil reported three successful cases of giant basilar trunk aneurysm trapping. In two cases, clips were applied across the basilar artery distal to the AICA’s and prox-
Trapping of giant basilar aneurysms

In our two cases, the aneurysms were trapped by clipping the basilar artery distal to the AICA's and proximal to the SCA's. At surgery, no perforating artery was observed in the trapped segment in Case 1, and the aneurysm was opened and evacuated. The patient returned to her previous occupation. In Case 2, two small perforating arteries were sacrificed in trapping and the aneurysm was aspirated. The patient was able to live independently with mild left hemiparesis.

The advantages of trapping over simple basilar artery occlusion in the treatment of giant basilar trunk aneurysms are complete obliteration of the aneurysm and decompression of the mass effect by evacuation. The major risk is acute brain-stem ischemia because trapping compromises collateral circulation from the parent artery and from any vessels arising from the trapped segment. The PCoA is the major collateral circulation to the rostral brain stem when the basilar artery is occluded. Pelz, et al., correlated the angiographic features of the PCoA with the clinical outcome in 71 patients who underwent therapeutic basilar or bilateral vertebral artery occlusion for giant posterior circulation aneurysms. They found strong evidence that patients with at least one large PCoA would do better than those with small PCoA's. They mentioned that the senior author (CG Drake) was confident enough on this evidence to clip the basilar artery if one large PCoA was present. The angiographic evaluation of patency and knowledge of the number of PCoA's is essential, and is best obtained with the Alcock maneuver.

Ya~argil has examined more than 200 cadaver brains with latex injection of the arteries in order to follow the perforating arteries in the subarachnoid space and to identify their precise site of penetration into the brain stem. He found that the locations of the perforating arteries are not randomly scattered, but have well-defined patterns. In latex-injected specimens, small branches from the undersurface of the basilar artery are seen to enter the medial pons, while perforating arteries entering the lateral pons arise from the SCA's and AICA's. Ya~argil examined five cases of giant basilar trunk aneurysms, and noted that the segment of basilar artery giving rise to the aneurysm was between perforating arteries, such that the perforating arteries arose from a short segment of normal-appearing basilar artery. Therefore, it is possible to save most of the perforating arteries by careful dissection and trapping of the involved segment. Even if a few perforating arteries are sacrificed, ischemic insult can be confined to a small region of the medial ventral pons in the presence of a single large PCoA and with spared SCA's and AICA's. Relatively good outcome reported in the literature and the outcome in our cases support these considerations.

Under general anesthesia, patient tolerance to basilar artery occlusion is difficult to evaluate with conventional electrophysiological techniques. Even with favorable angiographic findings, patients are threatened with substantial risk of motor deficit, for which SSEP and brain-stem evoked potentials can be an incomplete indicator. Recent advances in motor evoked potential monitoring are promising. It is especially suitable to monitor the ventral brain stem, where the highest risk of ischemia is expected when the involved basilar artery is trapped. Incorporation of motor evoked potentials combined with SSEP into intraoperative monitoring will allow neurosurgeons to test the patient's tolerance more accurately.

In treatment of giant basilar trunk aneurysms, trapping the involved segment of the basilar artery is an effective way to obliterate and decompress the aneurysm. It can be safely performed for those aneurysms arising from a relatively short segment of the basilar trunk between the AICA's and SCA's in the presence of a patent PCoA. Careful control of blood pressure to maximize the collateral circulation is important during the operation and postoperatively. Trapping the basilar trunk seems to have a rather stormy postoperative course, but offers surprisingly good results after weeks to months.

Acknowledgment

The authors acknowledge Mrs. Constance Gelber for her diligent efforts in preparing the manuscript.

References

9. Ibid., Vol II, pp 272–279

Manuscript received November 5, 1987.
Address reprint requests to: John M. Tew, Jr., M.D., Department of Neurosurgery, University of Cincinnati College of Medicine, 231 Bethesda Avenue, Cincinnati, Ohio 45267-0515.