Bilateral vertebral artery balloon occlusion for giant vertebrobasilar aneurysms

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Abstract We describe the clinical presentation, radiological and clinical results in six consecutive patients with a giant vertebrobasilar aneurysm treated by bilateral vertebral artery balloon occlusion. Five patients presented with headache and signs of brain-stem compression and one with subarachnoid haemorrhage. In all patients vertebral artery balloon occlusion was performed. In four, this followed successful test occlusion. In one patient, who did not tolerate the test occlusion, a bypass from the external carotid to the posterior cerebral artery preceded definitive vertebral artery occlusion. One patient underwent bypass surgery prior to test occlusion. At 6–22 months follow-up three patients had a good functional outcome and showed unchanged size or shrinkage of the aneurysm on MRI. Three other patients died; one from recurrent haemorrhage, and two probably from delayed brain-stem ischaemia. The presence of two large posterior communicating arteries predicted good functional outcome, which was also related to the clinical condition at presentation, and the degree of brain-stem compression and oedema on MRI. Bilateral vertebral artery balloon occlusion can be considered in patients with otherwise untreatable giant vertebrobasilar aneurysms. If test occlusion is not tolerated, a surgical bypass to the posterior circulation can be considered.

Key words Aneurysm · Embolisation · Posterior circulation · Vertebral artery occlusion

Introduction Giant aneurysms on the basilar artery are rare. They can present with brain-stem compression or subarachnoid haemorrhage (SAH); in either case prognosis is poor [1, 2, 3, 4]. Selective obliteration of the aneurysm by surgical clipping or endosaccular packing with coils is often not possible, or associated with a high risk of complications. An alternative may be bilateral balloon occlusion of the vertebral arteries to induce reversal and reduction of flow in the basilar artery, followed by stasis and thrombosis of blood in the aneurysm [5, 6, 7].

We report the presentation and radiological and clinical results in six consecutive patients with a giant vertebrobasilar aneurysm, treated by bilateral balloon occlusion of the vertebral arteries.

Material and methods Between 1996 and 1998 we treated five patients with a giant aneurysm (more than 2.5 cm in diameter) of the basilar artery by bilateral balloon occlusion of the vertebral arteries. In another patient the right vertebral artery ended in the posterior inferior cerebellar artery (PICA) and only the left was occluded. In four patients the anatomical characteristics of the aneurysms precluded clipping or clipping, in another clipping had failed, and the sixth developed brain-stem compression from a dissection of the wall of an aneurysm that had ruptured and had been partially occluded with coils 3 weeks earlier.
We noted the size of the posterior communicating arteries, because this size has been found to be related to the patients’ tolerance to basilar artery occlusion [4].

A posterior communicating artery was considered large if was at least 1 mm wide and adequate filling of the posterior cerebral artery was readily seen on carotid angiography. Brain-stem compression was considered severe if more than 25% of the volume was compressed by the aneurysm. High signal on T2-weighted images of the brain stem adjacent to the aneurysm was interpreted as oedema due to compression.

Procedures were performed under local anaesthesia to allow clinical monitoring. During test occlusion, neurological examinations were performed repeatedly. Retrograde filling of the basilar artery by collateral flow from the anterior circulation and stasis in the lumen of the aneurysm was confirmed by carotid angiography. If test occlusion was tolerated during a period of 30 min, we permanently occluded both vertebral arteries with detachable balloons, placing a second ‘security’ balloon proximal to the first.

In five patients the vertebral arteries were occluded proximal and in one distal to the origin of the PICA. All procedures were performed under full heparinisation, continued for 48 h after the treatment.

In two patients a high-flow bypass from the external carotid to the posterior cerebral artery was performed before the endovascular treatment. Patient 6 underwent bypass surgery because he did not tolerate test occlusion, while in patient 5 no test occlusion was performed prior to the bypass [8].

Results

The clinical and radiological results are summarised in Table 1. Three patients had a good functional outcome: at 6–22 months follow-up they were independent in everyday activities and their initial neurological deficits had completely resolved. Follow-up MRI showed complete thrombosis of the lumen of the aneurysm in all three and involution of the aneurysm in two.

Three patients died. The condition of patient 2 improved gradually in the first weeks after treatment, but 1 month after embolisation, symptoms of obstructive hydrocephalus necessitated ventriculoperitoneal drainage. This patient died in his sleep 2 months after treatment, and autopsy was refused. In patient 4, brain-stem function gradually worsened after treatment probably from increasing ischaemia and he died after 17 days. Patient 6 suffered a dissection of the wall of a giant basilar bifurcation aneurysm 3 weeks after incomplete treatment with coils and bilateral vertebral artery occlusion was scheduled. He did not tolerate bilateral test occlusion and a bypass from the external carotid artery to the P2 segment was fashioned. He deteriorated further after this and died 3 months later from recurrent subarachnoid haemorrhage. Autopsy revealed a ruptured basilar bifurcation aneurysm 45 mm in diameter and diffuse, bilateral, haemorrhagic infarction in the pons and thalamus.

Two patients with a good outcome presented with relatively mild symptoms, whereas all three patients who died were in poor condition before treatment. The size of the aneurysm was essentially the same in patients with favourable and poor results. In those with a poor outcome, pre-embolisation MRI more frequently showed severe brain-stem compression and oedema.

Both patients with two large posterior communicating arteries had a favourable outcome. Of the three patients with only one large artery two died, although one because of rebleeding and not ischaemia. The patient with small posterior communicating arteries on both sides did not tolerate the occlusion and went on to have bypass surgery before definitive occlusion.

Case reports

Patient 3

A 40-year-old man presented with sudden, severe headache, drowsiness, nausea and vomiting. In the preceding months he had noted diplopia and difficulties with speech and swallowing. MRI demonstrated a basilar artery aneurysm 30 mm in diameter, moderate brain-stem compression and mild obstructive hydrocephalus (Fig. 1). No trace of subarachnoid blood was found. High signal at the periphery of the aneurysm on T1-weighted imaging were interpreted as fresh clot, caused by dissection of the wall of the aneurysm. Angiography showed a giant, fusiform aneurysm arising from the basilar artery. The left posterior communicating artery was large, the right very small. We performed bilateral vertebral artery balloon occlusion 5 days after he presented, without any procedure-related complications. MRI 1 month after the procedure showed thrombosis of the lumen of the aneurysm with unchanged moderate brain-stem compression and mild hydrocephalus. A ventriculoperitoneal drain was inserted 3 months after the occlusion because of severe headaches and raised intraventricular pressure. At 6 month follow-up, neurological examination was normal but the headaches persisted.

Patient 4

A 56-year-old man was referred with a 3 week history of progressive dysarthria, dysphagia, poor memory, unstable gait and urinary incontinence. MRI showed an aneurysm of the posterior circulation 40 mm in diameter and fresh clot in its wall, indicating recent dissection. There was severe brain-stem compression with oedema and obstructive hydrocephalus. Angiography showed a fusiform aneurysm at the junction of the vertebral and basilar arteries (Fig. 2). Balloon occlusion of both vertebral arteries was performed. The day after treatment, the patient’s condition improved slightly but subse-