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Aneurysm Associated with a Fenestrated Basilar Artery: Report of Two Cases Treated by Endovascular Detachable Balloon Embolization

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Summary: The authors report two cases of aneurysms originating at a fenestration of the basilar artery treated by endovascular placement of a balloon inside the aneurysm with preservation of the parent vessel.

Index terms: Aneurysm, therapeutic blockade; Arteries, basilar; Arteries, abnormalities and anomalies; Catheters and catheterization, balloons; Interventional neuroradiology

Fenestration of intracranial arteries is a rare anomaly. Most cases have been reported in the Japanese literature (1–6). The true incidence of fenestration of the basilar artery is difficult to ascertain and the data vary according to the type of series, whether pathologic (from 1.3% (7) to 5.3% (8)) or angiographic (from 0.022% (5) to 0.6% (4)). The basilar artery is the second most frequent site of fenestration of intracranial arteries (3) after the vertebral artery. Most of these fenestrations involve the proximal segment of the basilar artery. There have been several reports of aneurysms distal to or at the site of a fenestration (1, 2, 6, 7, 9–14).

We found four reports of surgically treated aneurysms originating on a fenestrated basilar artery (7, 9, 10, 12), the most important series being that of Campos et al (9) reporting 21 cases.

Case Reports

Case 1

A 51-year-old man presented at another hospital with headaches, vomiting, and confusion on April 2, 1990. The following day he developed diplopia related to bilateral sixth nerve palsies. Computed tomography showed subarachnoid hemorrhage; an angiogram revealed a bilobed aneurysm arising from the proximal portion of the basilar

artery. The patient was then referred to our institution. A repeat angiogram performed on April 10 confirmed the presence of an aneurysm at the proximal end of a fenestration of the basilar artery (Fig. 1A). There was also diffuse spasm. Because of patient confusion and uncontrolled movements, the procedure was performed under general anesthesia. An 8 French catheter was placed in the right vertebral artery and a 6 French catheter was placed in the left vertebral via bilateral femoral punctures. We consider this bilateral femoral approach to be necessary in case of migration of the detachable balloon. This technique allows us to have a second coaxial system in place with a non-detachable balloon available for repositioning of a migration balloon.

The V4 segment of each vertebral artery was dilated using a no. 1 latex balloon (Balt Montmorency, France) attached to a standard Magic catheter (Balt) in order to allow access to the aneurysm. Through a double-lumen Moret catheter (Balt), a no. 1 x-ray latex balloon was placed in the proximal lobe of the aneurysm. After confirmation of obliteration of the aneurysmal sac and preservation of the parent vessel, the initial intraballoon contrast medium was replaced by hydroxyethylmethacrylate (Polymérane, Balt) and the balloon detached (Fig. 1B). The patient was started on anticoagulant therapy and recovered except for a right sixth nerve palsy, which was thought to be related to the mass effect of the aneurysm. On April 23, a follow-up angiogram showed that the balloon had migrated into the distal pouch with recanalization of the proximal pouch, which contained signs of a fresh clot within it (Fig. 1C). We decided to delay further treatment because of the possibility of dislodging the clot during endovascular manipulation. On June 5, a second balloon was placed in the proximal pouch and detached using the same technique. Obliteration of the aneurysm was confirmed by a follow-up angiogram 8 months later (Fig. 1D). The patient is now neurologically intact, the right sixth nerve palsy having disappeared after 8 months.

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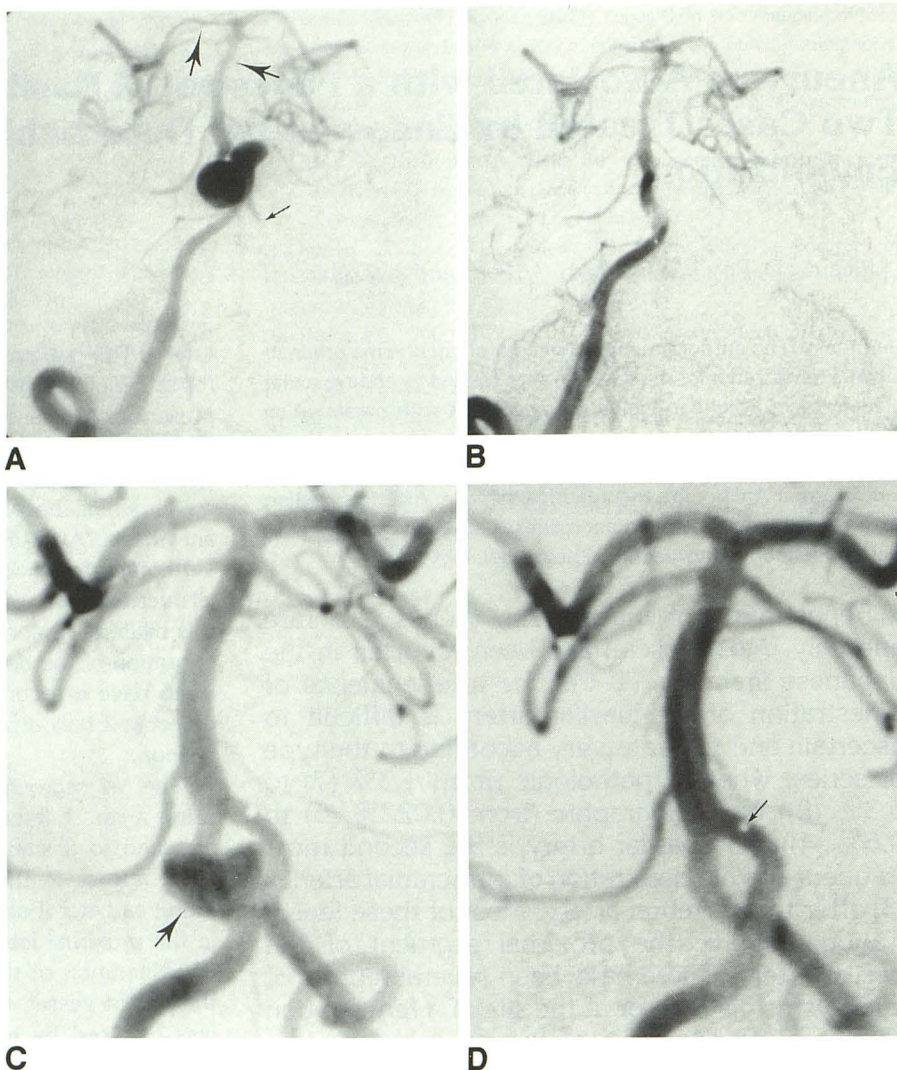
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Fig. 1. A, Right vertebral angiogram anteroposterior view: a bilobed aneurysm arises from the "bifurcation" created by a fenestration of the proximal basilar artery (*small arrow*: distal left vertebral artery). Note diffuse spasm of intracranial vessels (*large arrows*).

B, Right vertebral angiogram anteroposterior view: occlusion of the aneurysm after balloon embolization.

C, Right vertebral angiogram, anteroposterior view 2 weeks after first embolization. The proximal pouch has recanalized (*arrow*). Mixed intraluminal densities (compared with the first angiogram) indicate clot.

D, Right vertebral angiogram anteroposterior view, 8 months later. Complete exclusion of the aneurysm. (*arrow*: clip of the balloon superimposed on the left limb of the fenestration.)



Case 2

A 29-year-old man was referred to our institution following a subarachnoid hemorrhage on May 12, 1990. An angiogram on the same day showed an aneurysm arising from the proximal part of a fenestrated basilar artery (Fig. 2A). After discussion with the attending neurosurgeon, immediate endovascular treatment was elected. Because of patient agitation, the procedure was performed under general anesthesia. Using a double-lumen Moret catheter, a no. 1 latex balloon (Balt) was placed at the neck of the aneurysm ("endovascular clipping") and detached after it was filled with Polymerane. There was immediate occlusion of the aneurysm with preservation of the parent vessel (Fig. 2B). The patient subsequently developed hydrocephalus requiring external ventricular drainage, which was complicated by infection. On June 6, a follow-up angiogram showed recanalization of the aneurysm secondary to migration of the balloon into the aneurysm fundus (Fig. 2C). On June 11, a second procedure was performed at which time the aneurysm lumen was packed with a balloon,

except for residual proximal neck. Four days later, the patient developed transient right-sided weakness. Spasm of the left carotid siphon was confirmed by a transcranial Doppler and an angiogram. This was thought to be delayed spasm caused by the initial aneurysm rupture, as no endovascular maneuver was performed in the left carotid siphon, and there was no sign of recurrent hemorrhage on computed tomography or lumbar puncture. The last angiogram confirmed complete exclusion of the aneurysm (Fig. 2D). Six days later, after complaining of abdominal and leg pain due to phlebitis, the patient died suddenly of pulmonary emboli.

Discussion

Padgett (15) demonstrated that the basilar artery is formed by fusion of paired fetal longitudinal arteries around the 5–9 mm fetal stage. Partial failure of this process is the best explanation for the formation of a basilar artery fenestration. The

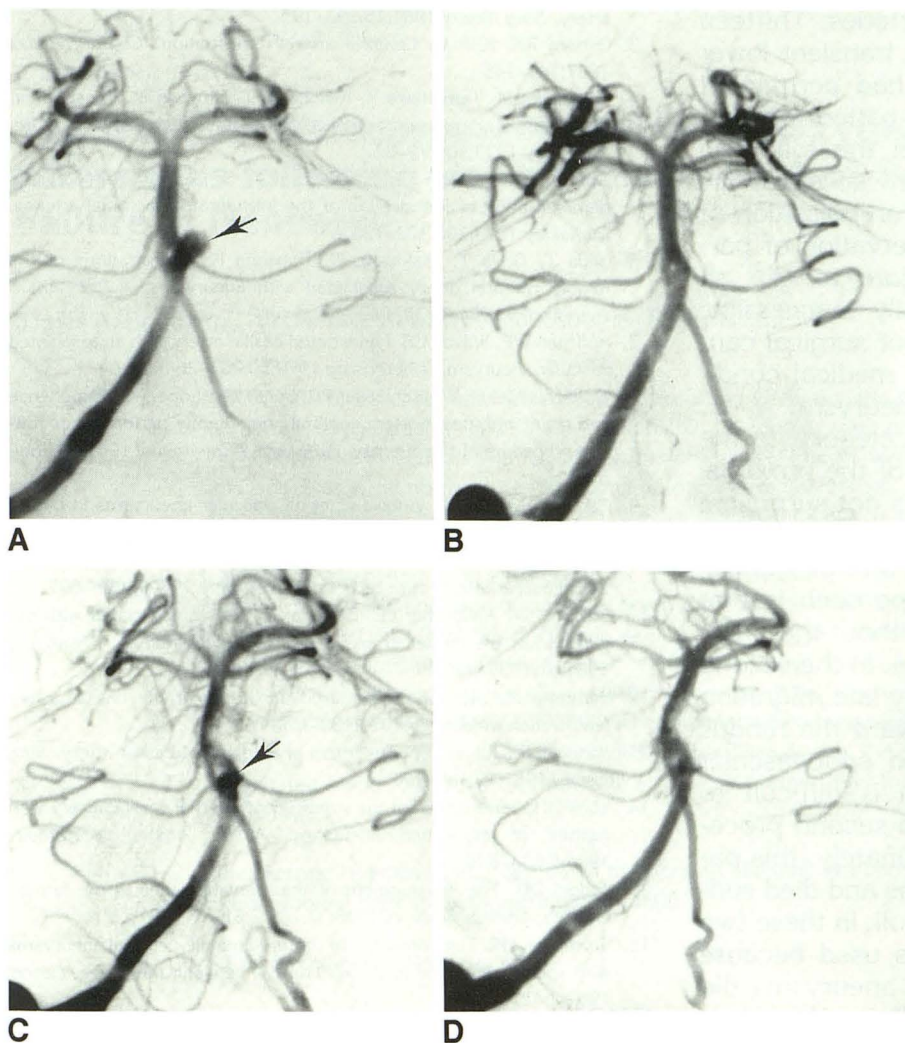


Fig. 2. A, Right vertebral angiogram anteroposterior view. Aneurysm (arrow) is arising from the "bifurcation" created by fenestration of the basilar artery.

B, Right vertebral angiogram anteroposterior view. Exclusion of the aneurysm after endovascular clipping. The fenestration is clearly visible.

C, Right vertebral angiogram anteroposterior view, 24 days later. Partial recanalization of the aneurysm due to distal migration of the balloon (arrow).

D, Right vertebral angiogram anteroposterior view after second embolization. The aneurysm is excluded from the circulation.

discrepancy between the prevalence of fenestration reported in autopsy series versus angiographic series is not surprising since this anomaly can easily be overlooked when the fenestrated segment is short, especially if the angiographic technique is not perfect. Moreover, the fusion anomaly can be partial, as shown by Black and Ansbacher (11), who demonstrated the presence of septa consisting only of smooth muscle, internal elastic lamina, and intima in the proximal part of a fenestration. This type of partial defect could easily be overlooked on angiograms.

The occurrence of an aneurysm at the fenestration site can be explained if one considers the proximal part of a fenestration as a bifurcation. Crompton (16) and Black and Ansbacher (11) described medial defects similar to those seen at more common aneurysmal sites. In a review of 59 aneurysms of the vertebrobasilar junction, Campos et al (9) found 21 (35.5%) to be associ-

ated with a fenestration at the proximal basilar trunk; all were located at the proximal end of the fenestration. Nineteen had bled; two had presented with mass effect. Yock (14) found seven aneurysms (five having bled) at the fenestration site in 11 cases with fenestrated basilar artery and associated aneurysms. Peerless (17) has warned of the possible presence of an aneurysm at any site of fenestration.

The surgical approach to the proximal basilar artery is difficult; whether subtemporal (17–19), transoral-transclival (12–20), or suboccipital (7–9). In the series of Campos et al (9), 20 of the 21 patients with basilar artery aneurysms association and fenestrations were explored surgically. Seventeen aneurysms could be clipped, with total exclusion in 14 patients and incomplete clipping in three patients. Two patients were treated by occlusion of one vertebral artery and one patient with a giant aneurysm was successfully treated

by occlusion of both vertebral arteries. Thirteen of these cases had postoperative transient lower cranial nerve palsies; one case had permanent severe neurologic deficit and one patient died.

Higashida et al (22) described the following patient selection criteria generally accepted for endovascular detachable balloon embolization of intracranial aneurysms with preservation of parent artery: 1) neurosurgical failure to clip an aneurysm; 2) aneurysm surgically inaccessible because of location or size; 3) poor surgical candidate because of an underlying medical condition; and 4) high operative risk aneurysm.

Our cases were in the fourth category. In the first case, the late recanalization of the proximal pouch of a bilobed aneurysm was not surprising since balloons are difficult to adapt to aneurysms with complex shapes. However, one of the advantages of this endovascular approach is that the procedure can be repeated without the problems related to a second operation. In the second case, recanalization was caused by late migration of the balloon from the neck toward the fundus of the aneurysm after attempted endovascular clipping (23). This phenomenon is difficult to predict but, as in the first case, a second procedure could be performed. Unfortunately, this patient had pulmonary complications and died suddenly of massive pulmonary emboli. In these two cases, endovascular clipping was used because the size and morphology of the aneurysms did not allow "endovascular packing."

Our two cases illustrate several points. First, endovascular occlusion of an aneurysm can be performed in the acute phase of subarachnoid hemorrhage. Second, the procedure may be repeated in case of migration of the balloon. Third, spasm can be overcome by angioplasty allowing access to the aneurysm. Since the anatomical location of the aneurysm in these cases renders a surgical approach difficult and potentially dangerous, we think that endovascular treatment should be tried first.

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