Diagn Interv Radiol 2013; 19:345–348

INTERVENTIONAL RADIOLOGY
CASE REPORT

Flow diverter as a rescue therapy for a complicated basilar angioplasty

Murat Velioğlu, Ersin Öztürk, Güner Sönmez, Tansel Kendirli, Hakan Mutlu, Çınar Başekim

ABSTRACT
Intracranial atherosclerotic disease is a major cause of ischemic stroke. Stenting and aggressive medical management for preventing recurrent stroke in intracranial stenosis was terminated prematurely due to a high stroke and death rate in patients randomized for intracranial stent placement. However, for some patients, angioplasty and/or stent placement remains the best approach. Flow diverters (FDs) are designed to produce a hemodynamic flow diversion by constituting a laminar flow pattern in the parent artery and are mainly used in non-ruptured complex wide-neck aneurysms as well as in ruptured aneurysms. Herein, we present a case where an FD was used in a complicated angioplasty for basilar artery atherosclerosis. A 72-year-old female patient was admitted to our hospital with left side weakness and vertigo. Her diffusion magnetic resonance imaging and magnetic resonance angiography showed right-sided pontine and left-sided occipital acute infarcts with left-sided pontine and right-sided occipital chronic infarcted areas and preocclusive mid-basilar stenosis. The patient was under supervised medical treatment. Despite chronic brain stem and occipital infarcts her modified Rankin Scale was 2. Diagnostic angiography showed no posterior communicating arteries and no pial-pial collaterals and a critical mid-basilar artery stenosis. We decided to perform intracranial angioplasty to increase the perfusion of posterior circulation and reduce the risk of additional embolic infarcts. Angioplasty was complicated with dissection and vessel perforation. We used an FD for rescue therapy to avoid rebleeding. The patient was discharged with good clinical and angiographic results.

From the Departments of Radiology (M.V. ✉ *muratvelix@yahoo.com*, E.Ö., G.S., H.M., Ç.B.), and Neurology (T.K.), GATA Haydarpaşa Teaching Hospital, İstanbul, Turkey.

Received 10 November 2012; revision requested 4 January 2013; revision received 5 January 2013; accepted 15 January 2013.

Published online 21 February 2013
DOI 10.5152/dir.2013.073

Flow diverters (FDs) are a new option in endovascular therapy that are particularly suitable for wide-necked aneurysms, fusiform aneurysms, very small aneurysms (<2 mm) or blister-like aneurysms, which are hard to treat. FDs can alter aneurysmal inflow such that progressive thrombosis and exclusion of the aneurysm from the circulation can be induced. Although long-term follow-up data are currently unavailable, there is accumulating evidence of good results with these devices. FDs are mostly used for non-ruptured aneurysms but there are several case reports and series where FDs are also used in ruptured aneurysms (1, 2). In this report, we present a case in which FD was used as a rescue therapy for basilar artery perforation after balloon angioplasty.

Case report

A 72-year-old female patient was admitted to our hospital with left side weakness and vertigo. Her diffusion weighted imaging and magnetic resonance (MR) angiography showed right-sided pontine and left-sided occipital acute infarcts with left-sided pontine and right-sided occipital chronic infarcted areas and preocclusive mid-basilar stenosis (Fig. 1). The patient was taking oral antidiabetic and antihypertensive medicine for 20 years, as well as double antiaggregants (aspirin 100 mg, clopidogrel 75 mg) and antilipidemics for one year since her previous pontine infarct. Despite chronic brain stem and occipital infarcts, her modified Rankin Scale was 2. Diagnostic angiography showed no posterior communicating arteries and no pial-pial collaterals and a preocclusive mid-basilar artery stenosis. We performed intracranial angioplasty to increase the perfusion of posterior circulation and reduce the risk of additional embolic infarcts.

The procedure started under general anesthesia and the right femoral artery was accessed using a 6-French sheath. After insertion of the femoral sheath, an intravenous (IV) bolus of 5000 IU heparin was given. The left vertebral artery was catheterized with a 5-French vertebral catheter and a 0.035-inch, 260-cm long guidewire (Terumo, Somerset, New Jersey, USA). Additionally, a 6-French delivery catheter (Neuron, Penumbra Inc., San Diego, California, USA) was positioned in the proximal V2 segment over the exchange guidewire. After insertion of a microcatheter (Rebar 18) and a floppy-tipped exchange 0.014-inch microwire, the delivery catheter was positioned distal to the V2 segment over the microcatheter-microwire combination. The poststenotic segment of the basilar artery diameter was measured 3.3 mm and the prestenotic segment was 3.7 mm. The stenotic segment was passed with gentle microwire manipulations and then an angioplasty balloon (Gateway 3×15 mm, Boston Scientific, Natick, Massachusetts, USA) was advanced across the

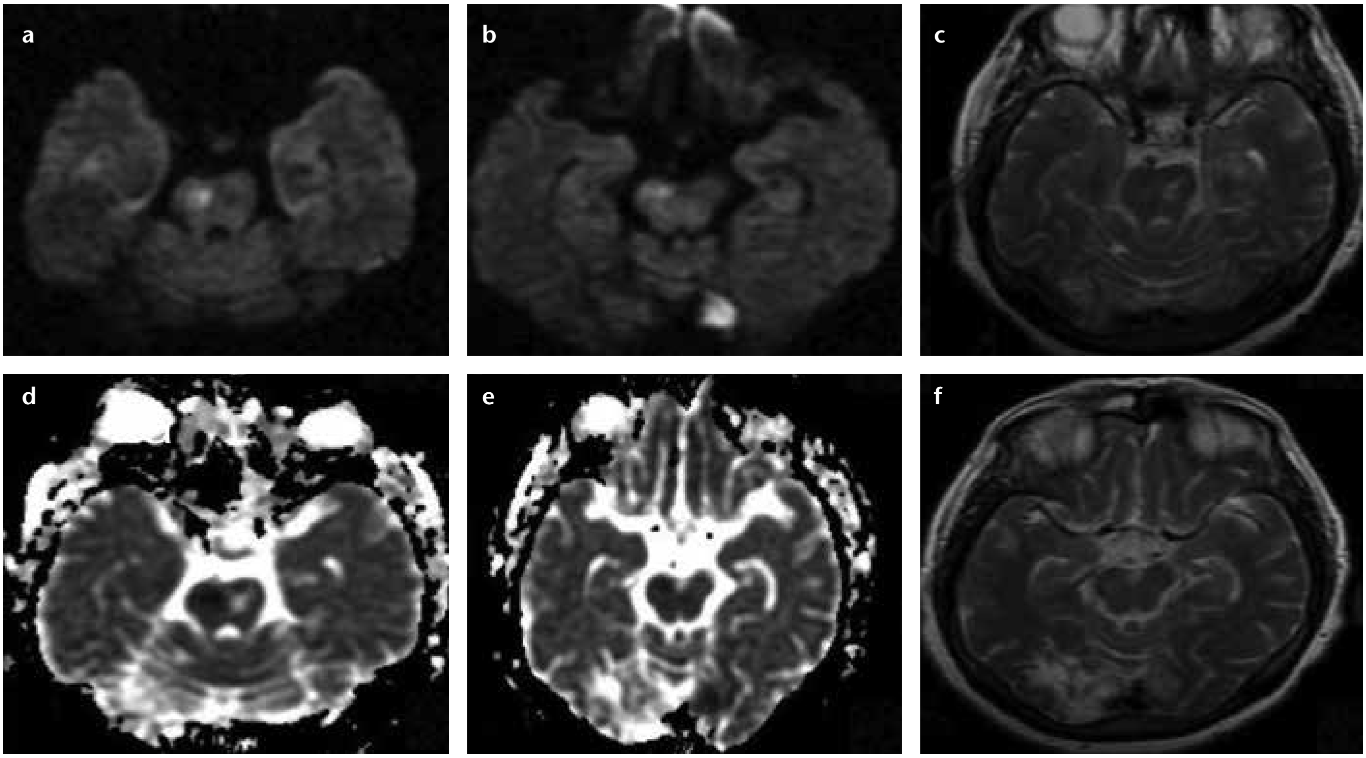

Figure 1. a–f. Axial diffusion weighted MR images **(a, b)** and apparent diffusion coefficient maps **(d, e)** show acute right-sided pontine and mesencephalon and left-sided occipital infarcts. Axial T2-weighted MR images **(c, f)** show left-sided pontine and right-sided occipital chronic infarcts.

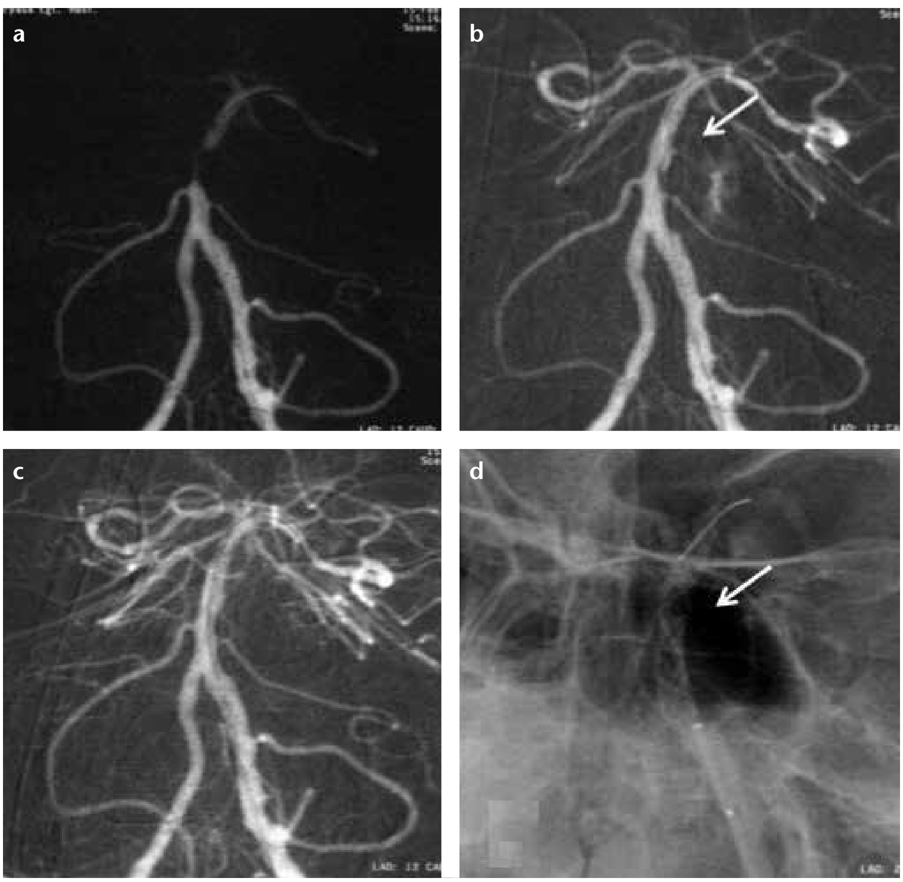

Figure 2. a–d. Subtracted angiography images of mid-basilar high-grade stenosis **(a)** and contrast extravasation and dissection **(b,** *arrow***)** after angioplasty. Angiography image **(c)** after Silk stent implantation shows no extravasation and minimal residual stenosis. Native angiography image **(d)** displays good opening of the stent *(arrow)*.

lesion with the exchange maneuver. The balloon diameter was sized to 80% of the "normal" parent vessel diameter. The balloon was inflated slowly under fluoroscopic roadmap guidance over several seconds to the nominal inflation pressure and kept inflated for approximately 30 s and then deflated. After balloon deflation, a control angiogram was performed and extravasation was detected (Fig. 2). Heparin was reversed with protamine sulfate and the balloon was inflated again on the side of perforation. After three minutes of inflation, extravasation remained in the control angiogram. By this time, mild bradycardia occurred and quickly returned to normal values without any intervention. The balloon was inflated again and after four minutes of inflation time, control angiography was performed. This time there was no extravasation but a small dissection in the proximal part of the plaque. We then decided to implant an FD stent to that segment instead of an open-cell stent to prevent rebleeding and cover the dissected segment. Vasco 21 microcatheter was advanced distal to the lesion over the microwire and than the Silk stent (3.5×15 mm, Balt Extrusion, Montmorency, France) was released beginning from distal basilar artery to the left V4. The opening of the stent and adequate wall apposition were evaluated by native images and control angiograms. Additional heparin or IV antiaggregants were not given because the patient was already taking aspirin and clopidogrel. The patient awakened without any difficulty and was neurologically intact. In control head computed tomography (CT), hemorrhage and contrast media was observed, especially in the interpeduncular cistern and posterior-inferior sulci of the cerebellum (Fig. 3a, 3b). The patient was kept in the neurointensive care unit for 24 hours and discharged on the tenth day of treatment after confirming clearance of subarachnoid hemorrhage and without signs of vasospasm. During that period, the patient rarely developed mild headaches, which were responsive to analgesics.

We performed a CT angiography after the first month of treatment. The stent and both vertebral arteries were patent with no additional infarcted area compared with preprocedural imaging (Fig. 3c, 3d).

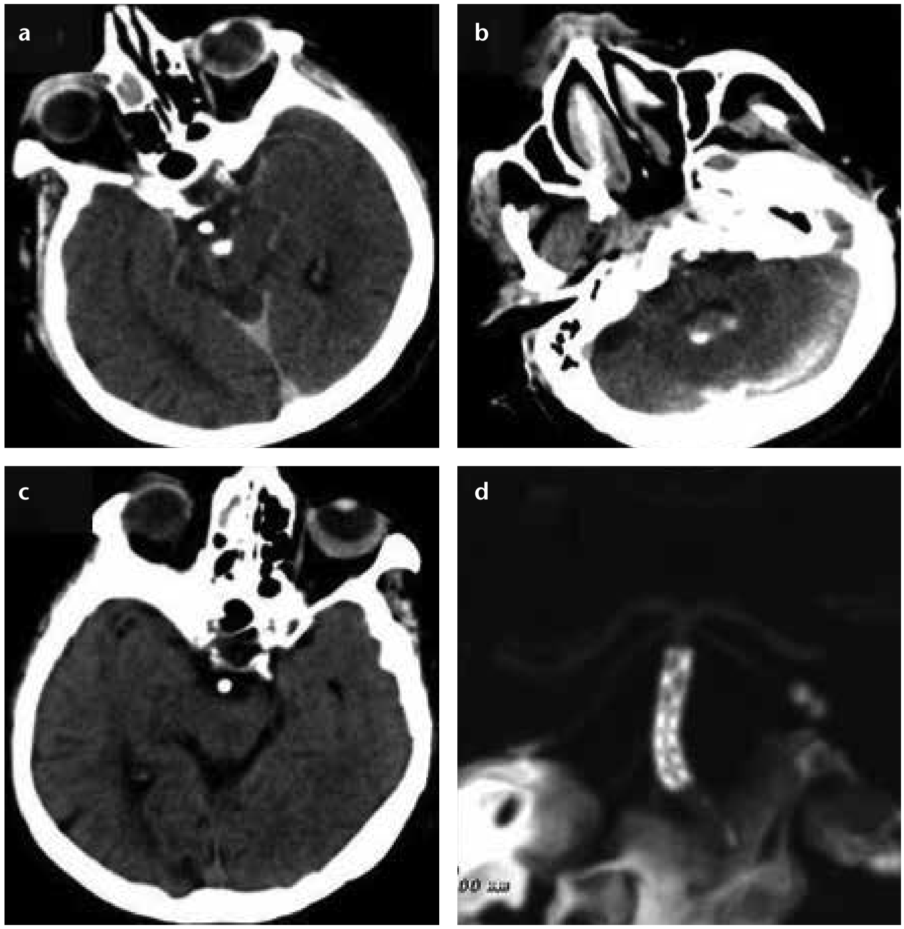

Figure 3. a–d. Postoperative axial CT images **(a, b)** show hemorrhage and contrast media in the interpeduncular fossa and fourth ventricle. Control CT image **(c)** shows no blood and hydrocephalus. First month control CT angiography thick-reformatted image **(d)** displays good stent apposition and patency of the artery and side branches.

Discussion

Intracranial atherosclerotic disease is a major cause of ischemic stroke. The annual risk of a recurrent stroke, estimated at 10% to 23% of patients with symptomatic stenosis, is high despite medical therapy (3). Stenting and aggressive medical management for preventing recurrent stroke in intracranial stenosis was evaluated in a randomized trial, which was terminated prematurely due to a high stroke and death rate in patients randomized for intracranial stent placement (4). However, for some patients, angioplasty and/or stent placement remains the best approach. Both primary angioplasty alone and angioplasty with self-expanding or balloon expanding stents have been evaluated in non-randomized trials with high technical success. A recent large meta-analysis demonstrated technical success in 80% of angioplasty-treated patients versus 95% in the stent-treated group (5). Conversely, acute or subacute arterial occlusion, vessel dissection, vessel perforation, restenosis, and transient or permanent ipsilateral stroke are major complications of these treatments with a highly variable estimated risk, reported between 0% and 36% (6–8).

Vessel perforation or rupture is a hazardous complication of endovascular intracranial atherosclerosis treatment and is highly morbid and mortal (6). The complication is mostly due to microwire manipulations while passing the stenotic segment, and can also occur after balloon angioplasty, especially in highly calcific plaques or after overinflation of the balloon. In the literature, the incidence of vessel rupture is reported to be 0% to 18% (6–8). There is no specific treatment for that particular complication, but balloon reinflation in the perforated segment, reversal of heparin with protamine sulfate, and, if possible, parent artery occlusion with detachable balloons or coils are some treatment options.

FDs are designed to produce a hemodynamic flow diversion by constituting a laminar flow pattern in the parent artery with metal surface area coverage of 35%–55% in a Silk stent and 30%–35% in a Pipeline embolization device (ev3, Irvine, California, USA). Although they are mainly used in non-ruptured complex wide-neck aneurysms, there are several reports of their use in ruptured aneurysms. Tahtinen et al. (1) reported the use of a Silk stent in four ruptured aneurysms, two in the acute phase and two in subacute phase. Kulcsár et al. (2) reported three ruptured aneurysms in the subacute phase. Narata et al. (9) reported two Pipeline cases treated within the first day of hemorrhagic vertebral artery dissection. Martin et al. (10) reported three ruptured aneurysm cases, two of which were in the acute phase. In the above-mentioned cases, there was no rebleeding despite dual antiaggregant treatment, which is very promising.

For our patient, the use of a self-expandable stent after balloon angioplasty was initially intended, but was reconsidered after rupture and dissection. First, we considered not placing a stent and not treating after hemostasis, but the dissection was obvious and could lead to thrombosis or emboli. Second, we decided to use an intracranial atherosclerosis stent (Wingspan Stent, Boston Scientific), but because of the delay to obtain hemostasis, the stent's open-cell design was considered not helpful in preventing rebleeding while using dual antiaggregants. We know that FDs are not a prescribed treatment for these types of ruptures; however, their previously usage in acute phase of ruptured aneurysms and up to five years follow-up data for perforator vessels patency, we consider that FDs could be helpful in this particular complication.

In conclusion, we used a FD stent for rescue therapy to cover a ruptured and dissected segment after angioplasty for intracranial atherosclerosis with excellent angiographic and clinical outcome.

Conflict of interest disclosure

The authors declared no conflicts of interest.

References

1. Tähtinen OI, Manninen HI, Vanninen RL, et al. The silk flow-diverting stent in the endovascular treatment of complex intracranial aneurysms: technical aspects and midterm results in 24 consecutive patients. Neurosurgery 2012; 70:617–623. [CrossRef]
2. Kulcsár Z, Wetzel SG, Augsburger L, Gruber A, Wanke I, Rüfenacht DA. Effect of flow diversion treatment on very small ruptured aneurysms. Neurosurgery 2010; 67:789–793. [CrossRef]
3. Chimowitz MI, Lynn MJ, Howlett-Smith H, et al. Comparison of warfarin and aspirin for symptomatic intracranial arterial stenosis. N Engl J Med 2005; 352:1305–1316. [CrossRef]
4. Chimowitz MI, Lynn MJ, Derdeyn CP, et al. Stenting versus aggressive medical therapy for intracranial arterial stenosis. N Engl J Med 2011; 365:993–1003. [CrossRef]
5. Siddiq F, Memon MZ, Vazquez G, Safdar A, Qureshi AI. Comparison between primary angioplasty and stent placement for symptomatic intracranial atherosclerotic disease: meta-analysis of case series. Neurosurgery 2009; 65:1024–1033. [CrossRef]
6. Schumacher HC, Meyers PM, Higashida RT, et al. Reporting standards for angioplasty and stent-assisted angioplasty for intracranial atherosclerosis. J Neurointerv Surg 2010; 2:324–340. [CrossRef]
7. Mori T, Kazita K, Chokyu K, Mima T, Mori K. Short-term arteriographic and clinical outcome after cerebral angioplasty and stenting for intracranial vertebrobasilar and carotid atherosclerotic occlusive disease. AJNR Am J Neuroradiol 2000; 21:249–254.
8. Levy EI, Horowitz MB, Koebbe CJ, et al. Transluminal stent-assisted angioplasty of the intracranial vertebrobasilar system for medically refractory, posterior circulation ischemia: early results. Neurosurgery 2001; 48:1215–1221. [CrossRef]
9. Narata AP, Yilmaz H, Schaller K, Lovblad KO, Pereira VM. Flow-diverting stent for ruptured intracranial dissecting aneurysm of vertebral artery. Neurosurgery 2012; 70:982–988. [CrossRef]
10. Martin AR, Cruz JP, Matouk CC, Spears J, Marotta TR. The pipeline flow-diverting stent for exclusion of ruptured intracranial aneurysms with difficult morphologies. Neurosurgery 2012; 70(1 Suppl Operative):21–28.