CASE REPORT

Stenting of the vertebral artery origin with ostium dilation: technical note

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ABSTRACT

Endovascular treatment of vertebral artery (VA) origin stenosis typically requires placement of the proximal end of the stent within the lumen of the subclavian artery or aorta to provide complete coverage of the ostial lesion. This configuration may complicate subsequent endovascular access into the stented VA. We describe a technique modification of VA origin stenting and angioplasty with a monorail angioplasty balloon system designed specifically for dilation of the ostial origin which may be helpful in conforming the proximal portion of the stent to the VA origin. Simplified endovascular access to the VA origin after angioplasty is demonstrated.

INTRODUCTION

Endovascular treatment of vertebral artery (VA) origin stenosis requires placement of some part of the proximal end of the stent within the lumen of the subclavian artery or aorta to provide complete ostial stenosis coverage.1 This configuration may preclude access to the stented VA (figure 1) because of the difficulty in catheterization of the proximal opening of the stent, which is positioned within the lumen rather than at the wall of the parent vessel. Technically difficult access to a previously stented VA may be problematic in cases in which in-stent stenosis develops or endovascular treatments of the distal vertebrobasilar system are planned. This is a relevant problem because in-stent stenosis may be more frequent within a stent placed at an arterial origin rather than elsewhere in the vessel.2 For patients undergoing VA origin stenting, in-stent stenosis can be expected in approximately 20%–5 but may exceed 30%4,5.

A unique angioplasty balloon designed as a dual balloon dilation catheter with an ostial balloon to ensure proper location and dilation of the lesion at the ostium may be useful to circumvent these problems. The Ostial Flash balloon catheter (Ostial Corporation, Mountain View, California, USA) is a monorail angioplasty system designed with two separate balloons (a proximal compliant balloon and a distal non-compliant balloon) to dilate within an arterial ostium and to conform to its anatomical position. Although designed for location and dilation of ostial lesions, in our experience this novel dual balloon catheter has been shown also to allow for expansion of the stent at the stenotic site as well as the arterial ostium (figure 2).

In this report, VA origin stenting with ostium reconstruction is described. Two cases illustrating the use of the Ostial Flash balloon catheter at the VA origin are presented.

TECHNIQUE

After administration of fentanyl and midazolam for conscious sedation, standard right femoral or brachial artery access is obtained. A 7F guide catheter is placed within the right subclavian artery at the VA origin. When femoral artery access is used, a stiff 0.018 inch (‘buddy’) microwire is advanced into the distal subclavian artery for stability of the guide catheter during placement of the stent and angioplasty balloon. A steerable 0.014 inch microwire is directed under roadmap guidance with effort to avoid plaque trauma into the VA origin and through the stenotic lesion and placed in the distal cervical VA to allow sufficient purchase to pass a stent to the site of the stenosis. Due to difficulties with removal of embolic protection devices through the deployed stent, distal embolic protection is presently not performed during VA origin stenting cases at our hospital. A balloon-expandable open-cell stent is selected according to the lesion length and diameter of the non-diseased distal segment of the VA. An open-cell stent is preferred for ostial balloon dilation as asymmetric dilation of a single cell at the proximal margin of an open-cell stent is theoretically more likely to occur than at the proximal end of a closed-cell stent. The stent is advanced over the microwire and positioned at the diseased VA origin and deployed at nominal pressures with the proximal 5 mm of the stent overhanging into the subclavian artery. The stent delivery catheter is exchanged for the Ostial Flash balloon catheter, which is advanced over the microwire and positioned within the stent at the VA origin using radiopaque markers for both of its balloons. The balloon catheter is advanced so that the end of the stent is between the markers for the ostial balloon. Once in position, the distal non-compliant balloon is expanded to a subnominal pressure, providing an anchor inside the stent. Subsequently, the compliant ostial balloon is expanded to flare the proximal edges of the stent and appose them to the wall of the subclavian artery. Proximal migration of the ostial balloon was noted despite the compliant balloon anchor in both cases. As an adjunct, the 7F guide is advanced to buttress and prevent proximal migration of the compliant balloon. Angiography is
used to confirm revascularization of the artery and conformation of the proximal end of the stent to the VA origin. Upon completion, the microwires and guide catheter are carefully removed and the arteriotomy closed percutaneously.

**ILLUSTRATIVE CASES**

**Case 1**

A patient presented with vertebrobasilar transient ischemic attacks, with symptoms of vertigo and left hemibody numbness despite single antiplatelet therapy (aspirin 325 mg daily) prescribed for a history of carotid artery disease. MRI performed after admission was negative for infarction. Investigation for a cardioembolic cause was negative; however, non-invasive imaging with a CT angiogram showed a stenosis at the origin of the dominant right VA. Angiography confirmed...
a stenosis of approximately 75% at the right VA origin (figure 3) and an atrophic left VA. After discussion of the risks and benefits of VA origin stenting, the patient consented to this procedure. Preoperative medication with dual antiplatelet therapy (aspirin 325 mg daily and clopidogrel 75 mg daily) was commenced.

Standard femoral artery access was obtained with the standard technique as described above. An open-cell balloon-expandable cobalt chromium 5 mm x 18 mm stent (Multi-Link VISION, Abbott Vascular, Santa Clara, California, USA) was selected and deployed into position (figure 4). The Ostial Flash balloon catheter was brought into position (figure 5A) and the distal and proximal balloons were expanded sequentially (figure 5B). After angioplasty no residual stenosis was present and the proximal end of the stent was visualized to have conformed to the VA origin (figure 6). Minimal foreshortening or flaring of the stent was noted in this case, presumably because a suboptimal amount of the stent was extending into the lumen of the subclavian artery. The VA origin was demonstrated to be easily accessible and catheterized (Video).

The patient tolerated the procedure well without cardiopulmonary incident and remained neurologically intact throughout. Postoperatively, monitoring in the neurosurgical intensive care unit was without incident. The patient remains asymptomatic to date 4 months after the procedure.
Case 2
A patient presented with a single vertebrobasilar transient ischemic attack, with symptoms of left-sided weakness and vertigo which resolved within 2 h of onset. Owing to a history of cardiovascular disease, dual antiplatelet therapy (aspirin 325 mg daily and clopidogrel 75 mg daily) had been previously commenced. An MRI at the time of presentation was negative for cerebral infarction. Investigation for a cardioembolic source of the symptoms was negative; however, cerebral angiography showed stenosis of the dominant right VA origin approximating 80% (figure 7). After discussion of the risks and benefits of VA origin stenting, the patient consented to the procedure.

Standard femoral artery access was obtained with the standard technique as described above. An open-cell balloon-expandable cobalt chromium 6 mm x 18 mm stent (Herculink Elite, Abbott Vascular) was selected and deployed into position (figure 8). The Ostial Flash balloon catheter was brought into position and expanded sequentially. After angioplasty, no residual stenosis was present and the proximal end of the stent was visualized to have conformed to the VA origin (figure 8).

The patient tolerated the procedure well without cardiopulmonary incident and remained neurologically intact throughout the procedure. Postoperative monitoring in the neurosurgical care unit was without incident. The patient remains asymptomatic to date 4 months after the procedure. The use of the Ostial Flash balloon catheter may eliminate this problem.

DISCUSSION
Approximately one-third of patients with vertebrobasilar ischemic disease have arterial narrowing as the most likely source of their symptoms, and the VA origin is among the most common sites affected.8 At our hospital, patients with symptomatic VA origin stenosis are offered endovascular treatment on the basis of symptomatic disease and VA caliber. In brief, patients with posterior circulation ischemic stroke with dominant or bilateral VA origin stenosis who have symptoms refractory to medical management are offered VA origin angioplasty and stenting. Restenosis is not uncommon and has resulted in implantation of drug-eluting stents for vessels <4.5 mm. However, in cases of restenosis, subsequent retreatment with angioplasty has presented a technical challenge because of difficulty with catheterization of the proximal stent which is overhanging within the lumen of the subclavian artery rather than at the vessel wall.

The Flash balloon system has three radiopaque markers for ease of use. The proximal marker is designed to identify the most proximal point of the compliant balloon and to ensure that the guide catheter is far enough back to allow the compliant balloon to inflate properly; the middle marker is aligned with the origin of the ostium and the distal marker delineates the distal end of the inner non-compliant angioplasty balloon. In our experience, after stent angioplasty an open-cell stent is shaped to conform to the VA origin, simplifying re-access of the vertebral ostia for subsequent procedures. In both cases the proximal end of the stent was dilated to conform to the ostium of the VA, but minimal stretching or shortening of the stent was performed, minimizing risk of stent fracture or vessel injury. Neither case was associated with neurological complications or complications resulting from the technique.

CONCLUSIONS
A modification of VA origin stenting and angioplasty using the Ostial Flash balloon dilation system is described. This procedure has been successfully performed at our hospital in two patients with symptomatic VA origin stenosis without perioperative incident. Reconstruction of the proximal portion of the stent to conform to the VA origin allowed simplified endovascular access after angioplasty in both cases.

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Competing interests TMD and PK report no financial relationships. LNH receives grant/research support from St Jude Medical and Toshiba; serves as a consultant to Abbott, Boston Scientific®, Cordis, Micrus, and WL Gore; holds a financial interest in AccessClosure, Augmenix, Boston Scientific®, Claret Medical, Micrus and Valor Medical; has a board/trustee/officer position with AccessClosure, Claret Medical and Micrus (until September 2010); belongs to the Abbott Vascular speakers’ bureau, and receives honoraria from Bard, Boston Scientific®, Cordis, Memorial Healthcare System, Complete Conference Management, SCAI and Cleveland Clinic. ELL receives research grant/support (principal investigator: Stent-Assisted Recanalization in acute Ischemic Stroke, SARIS), other research support (devices), and honoraria from Boston Scientific® and research support from Codman & Shurtleff and ev3/Covidien Vascular Therapies; has ownership interests in Intratech Medical and Mynx/Access Closure; serves as a consultant on the board of Scientific Advisors to Codman & Boston Scientific.

Figure 8 Angiography, anteroposterior views before (left) and after (right) angioplasty with ostial balloon dilation displaying a change in the conformation of the proximal end of the stent to conform to the origin of the vertebral artery.
Shurtleff; serves as a consultant per project and/or per hour for Codman & Shurtleff, ev3/Covidien Vascular Therapies and TheraSyn Sensors; and receives fees for carotid stent training from Abbott Vascular and ev3/Covidien Vascular Therapies. EIL receives no consulting salary arrangements. All consulting is per project and/or per hour. AHS has received research grants from the National Institutes of Health (co-investigator: NINDS 1R01NS064592-01A1, Hemodynamic induction of pathologic remodeling leading to intracranial aneurysms) and the University at Buffalo (Research Development Award); holds financial interests in Hotspur, Intratech Medical, StimSox and Valor Medical; serves as a consultant to Codman & Shurtleff, Concentric Medical, ev3/Covidien Vascular Therapies, GuidePoint Global Consulting and Penumbra; belongs to the speakers’ bureau of Codman & Shurtleff and Genentech; serves on an advisory board for Codman & Shurtleff; and has received honoraria from American Association of Neurological Surgeons’ and Angioplasty and All That Jazz courses, an Emergency Medicine Conference, Genentech, Neocure Group and from Abbott Vascular and Codman & Shurtleff for training other neurorinterventionists in carotid stenting and for training physicians in endovascular stenting for aneurysms. AHS receives no consulting salary arrangements. All consulting is per project and/or per hour. KVS serves as a consultant to, is a member of the speakers’ bureau and has received honoraria from Toshiba. He serves as a member of the speakers’ bureau for and has received honoraria from ev3 and The Stroke Group (consultants to the healthcare industry, Littleton, CO). *Boston Scientific’s neurovascular business has been acquired by Stryker.

Ethics approval The cases described in this technical note were performed at the former Millard Fillmore Gates Circle Hospital, an affiliate of the University at Buffalo. The University at Buffalo Health Sciences Institutional Review Board waives the requirement for approval for a technical note/case report.

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REFERENCES