Stiff Guide Technique: Technical Report and Illustrative Case

Donald A. Eckard, Kyle A. Krehbiel, Philip L. Johnson, Timothy G. Raveill and Valerie R. Eckard

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Technical Note

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Summary: Endovascular techniques are gaining wider acceptance in the treatment of intracranial lesions. Tortuous vasculature is a common reason for failure to treat an intracranial lesion, especially when balloon catheters or stents are used. In these cases, the guiding catheter often buckles into the aorta during an attempt to place the balloon or stent. In our experience, a stiff wire can be used to support the guiding catheter, allowing the balloon catheter or stent to more readily navigate tortuous vessels.

Tortuous anatomy of the aortic arch, carotid arteries, or vertebral arteries can create problems when trying to place balloon catheters, stents, or, occasionally, microcatheters into the intracranial vasculature (1–6). As many as 4% to 6% of cases fail because of tortuosity of the access vessel (3, 4). Buckling of the introducer sheath or guiding catheter back into the aorta frequently occurs in such cases, often completely slipping out of the carotid or vertebral artery. We have developed a technique that allows us to overcome this problem in some patients.

Technical Report and Illustrative Case

During the last 18 months, we encountered five patients in whom we were unable to initially treat an intracranial lesion secondary to vessel tortuosity. Two of the patients were referred for severe intracranial stenosis, one was sent for GDC treatment of an aneurysm requiring the "remodeling technique," (7) one referred for vasospasm angioplasty, and one was referred for stroke thrombolysis. Each patient was eventually treated with the use of our "stiff guide technique." The technique involves placing a stiff wire through the introducer or guiding catheter alongside the microcatheter. This technique is illustrated in the case report presented herein.

Case Report

A 60-year-old right-handed man with a history of coronary artery disease and a long history of cigarette smoking, hypertension, and dyslipidemia was admitted to the hospital with unstable angina and transient ischemic attacks. The transient ischemic attacks consisted of left-sided amaurosis fugax and slurred speech. The patient was experiencing these symptoms while receiving Aggrenox (Boehringer Ingelheim GmbH, Germany) therapy. He received percutaneous transluminal coronary angioplasty and stent placement for severe stenosis of a vein graft leading to the right coronary artery with improvement in his angina. He underwent carotid Doppler studies, the results of which were negative. MR angiography, however, showed severe stenosis in the distal left internal carotid artery (ICA). After placement of the coronary stent, the patient's anticoagulation regimen was changed to aspirin, Plavix (Bristol-Myers Squibb, New York, NY), and Lovenox (Aventis, Bridgewater, NJ). The patient experienced no further transient ischemic attacks but was thought to be at high risk for future events and was referred for angioplasty and stent placement in the left ICA.

After obtaining informed consent from the patient, diagnostic arteriography was performed. The angiogram of the right common carotid artery showed no significant stenosis of the right ICA, but it was noted that the left anterior cerebral artery filled through the anterior communicating artery. The angiogram of the left common carotid artery revealed no significant stenosis of the left cervical ICA, mild narrowing of the proximal petrous portion of the ICA, and severe stenosis of the proximal cavernous carotid artery with ulceration. The left anterior cerebral artery filled only minimally (Fig 1A).

A 6-French, 90-cm-long Arrow sheath (Arrow International, Reading, PA) was placed in the left carotid artery with its tip positioned in the proximal left ICA as a guiding catheter. At this point, 5000 U of IV heparin was administered (Lovenox had been held 24 hr before the procedure). A 4 × 18 mm Velocity stent (Cordis, Miami, FL) mounted on a balloon was passed in a coaxial fashion through the guiding sheath. The Arrow sheath had a 0.083-in inner diameter and a 0.11-in outer diameter. These dimensions allowed for easy passage of the Velocity stent, which required a 5-French (0.056-in inner diameter) guiding sheath. However, the stent could not be passed into the cavernous carotid because of marked tortuosity in the proximal common carotid artery, which caused the guiding sheath and balloon/stent catheter to buckle back into the aorta. This occurred despite

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From the Department of Radiology, University of Kansas Medical Center, Kansas City, KS.

Address reprint requests to Donald A. Eckard, MD, Department of Radiology, University of Kansas Medical Center, 3901 Rainbow Boulevard, Kansas City, KS 66160.

FIG 1. Images from the case of a 60-year-old man with a history of transient ischemic attacks consisting of left-sided amaurosis fugax and slurred speech.

A, Angiogram of the left ICA shows severe stenosis of third and fourth portions of the left cavernous carotid artery with ulceration.

B, Image shows buckling of the sheath into the aorta with a standard glide wire in place as a stiffening wire.

C, Left carotid artery sheath with Stiff Shaft glide wire, balloon/stent catheter, and Agility wire. (Balloon/stent catheter and Agility wire were radiolucent except at the tip and are therefore not visualized on this image.)

D, Angiogram of the left ICA, obtained after stent placement. Minimal residual stenosis is seen. The previously seen ulceration is no longer seen. Improved flow in the anterior cerebral artery and some filling of the posterior cerebral artery are shown.

distal placement of an Agility 10 wire (Cordis) into the middle cerebral artery. The Arrow sheath was replaced in the left carotid artery by reselecting the artery with the diagnostic catheter. A 0.038-in glide wire (Terumo Medical Corp., Somerset, NJ) was then placed alongside the stent catheter in the Arrow sheath to stiffen it and prevent buckling of the sheath into the aorta. After placing the glide wire, it was possible to pass the balloon/stent closer to the stenosis. However, the balloon/stent was still unable to be passed up to the stenosis, again because of buckling of the sheath into the aorta (Fig 1B). We were, however, able to place the Arrow sheath back into the left carotid artery by passing it over the glide wire. The 0.038-in glide wire was removed and replaced with a Stiff Shaft glide wire (Terumo). After performing this maneuver, the sheath was much more stable and allowed for easy passage of the stent across the stenotic segment (Fig 1C). The stent was positioned across the lesion, and angiography was performed to confirm its position. The stent was deployed and the next angiogram showed marked improvement in the narrowed segment of the artery and improved flow into the left anterior cerebral artery (Fig 1D). The patient continued to receive aspirin and Plavix after the procedure. At the time of this writing, he had not experienced any transient ischemic attacks after placement of the stent.

Discussion

Vessel tortuosity is a common cause for failure to treat intracranial lesions. In our review of the literature and in our experience, it is the most common cause of treatment failure in patients referred for stent placement of intracranial stenotic lesions (3). Aletich et al (4) found the primary limitation to the treatment of aneurysms by using the remodeling technique to be tortuosity of the access vessel. This problem occurred in 11% of their cases and was primarily due to kinking of the balloon catheter or failure of the balloon to advance through the access vessel. Kinking of the balloon catheter occurred mainly with use of the Endeavor balloon (Target Therapeutics/Boston Scientific, Fremont, CA). Advancement of the balloon was more of a problem with the stiffer over-the-wire balloons. The stiff guide technique may have been useful in some of these cases. In our hands, the stiff guide technique has allowed for catheterization of the distal intracranial circulation in five patients whose lesions were not initially accessible. In four of the patients, the technique was successful with a standard 0.038-in glide wire. In the case described above, the technique required use of a 0.038-in Stiff Shaft glide wire.

Other techniques have been described to help overcome the problem of vessel tortuosity. Some have used a stiff microwire to provide greater wire support to the stent catheter. Morris et al (2) described passing a stiff microwire (Mailman, SciMed Life Systems; Boston Scientific, Maple Grove, MN) into the basilar artery to facilitate placement of a stent across a stenotic lesion in the distal vertebral artery. However, there is some increased risk associated with placing stiff microwires into the intracranial circulation. Terada et al (5) navigated a stent over a stiff 0.014-in guidewire to facilitate placement of the stent in the basilar artery, which resulted in intimal injury and basilar artery occlusion. The microwire can also be placed into the intracranial circulation very distal to the stenosis to help facilitate placement of the stent. This technique was used in conjunction with our technique but was not sufficient to complete the treatment in any of our cases.

Another method of circumventing tortuous vascular anatomy is by direct puncture of the carotid or vertebral artery (4–6, 8). However, using this technique increases the possibility of injury, such as vasospasm or dissection, to the carotid artery when compared with puncture of the femoral artery. Halbach et al (8) described a case of direct carotid puncture in a patient with Ehlers-Danlos syndrome that resulted in a massive hematoma causing airway compromise that required intubation and emergent surgical repair. Terada et al (5) reported a case in which direct puncture of the vertebral artery at C6 led to a vertebral AVF. Also, hemostasis may be difficult to achieve at the end of the case, especially if it is necessary to continue anticoagulation therapy. Finally, this method is technically cumbersome when long catheters and wires must be used.

A third way to overcome the problem of tortuous vasculature is to alter the position of the introducer sheath. The sheath can be positioned more distally in the vessel to access a lesion. However, moving a sheath too distal can increase the possibility of vasospasm or dissection. Furthermore, it can kink the artery and lead to slow flow, which may allow formation of thrombus.

Saucedo et al (9) devised a method to circumvent tortuous vessels in the coronary circulation. They used a 0.018-in stiff wire adjacent to the Palmaz-Schatz stent delivery system to "straighten" the coronary vessel and provide additional guide catheter support. This maneuver allowed the advancement and deployment of the coronary stent through tortuous coronary arteries. Although straightening the coronary vessel may be acceptable, it is not a desired technique in the cerebral circulation where straightening the vessel can cause sluggish flow and thrombus formation.

Although we think that our technique is safe, care is exercised when placing the stiff wire through the sheath. We make an effort to keep our guiding catheter and stiff guidewire proximal to any tortuous loops in the carotid or vertebral artery, thus reducing the risk of injury. We want to avoid straightening and possibly crumpling a tortuous artery, as sometimes occurs in cases of interventional neuroradiology and has been described in the cardiology literature as the *crumpled coronary artery* or *accordion effect* (10). We also want to avoid the possibility that the stiff guidewire could cause dissection or vasospasm.

The standard guiding catheter that we use is an Arrow sheath (0.083-in inner diameter). It is very easy to introduce the stiffening wire (0.038 in) through the valve on the sheath next to the balloon or stent catheter. The wire must be placed after the stent has been passed out of the tip of the catheter to allow easy passage because the shaft on the stent catheter is only 0.030 in and the stent/balloon diameter is 0.056 in. Other guiding catheters should also work with this technique if the diameter of the stiff wire plus the diameter of the working catheter is slightly less than the diameter of the guiding catheter.

Conclusion

Tortuous intracranial vasculature can present a hurdle for the interventionalist, but we have developed a technique that is safe and effective at overcoming this obstacle in many patients. The stiff guide technique may allow patients to receive therapy for intracranial lesions that were formerly considered untreatable.

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