Techniques for Passing the PercuSurge Guardwire System Through Severe and Tortuous Stenotic Lesions

—Technical Note—

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Abstract

Distal embolism is one of the major causes of morbidity and mortality associated with treating stenotic lesions by endovascular procedures, such as percutaneous angioplasty and stenting. Many devices have been designed and used to prevent this complication. The PercuSurge Guardwire system is recognized as the best system available to prevent distal embolism during stenting. However, this system is sometimes hard to pass through severe stenotic, tortuous lesions because of the poor selectivity and support. The PercuSurge device was safely introduced into two cases of severe stenotic and tortuous lesions with a triple coaxial system and the buddy wire technique, and stenting was performed successfully. These techniques are very helpful for introducing and maintaining this system in the correct position across stenoses with unfavorable configurations.

Key words: stenting, embolism, distal protection, PercuSurge, triple coaxial system, buddy wire

Introduction

Cerebral embolism is one of the major causes of morbidity and mortality associated with percutaneous transluminal angioplasty (PTA) and stenting for extracranial stenotic lesions, and results from the scattering of thrombi and/or debris located in the atheromatous plaque in the stenotic lesion into the distal distribution of the vessel in the brain. The distal protection method, in which a protection device is introduced distal to the stenosis, thus preventing thrombi and debris passing into the intracerebral arteries, is the most frequently used method to prevent this complication. The PercuSurge Guardwire Plus (Medtronic AVE, Santa Rosa, Calif., U.S.A.) is commonly used in Japan, but is sometimes hard to position safely in severe stenotic and/or tortuous lesions. Here we describe some useful techniques for positioning the PercuSurge device in such lesions.

Case Presentations

Case 1: A 66-year-old male suffered transient right hemiparesis. Carotid echography identified severe stenosis (approximately 90%) at the origin of the left internal carotid artery. This lesion was considered responsible for the symptoms, and carotid artery stenting was selected because he had unstable angina.

Two months after his last attack, carotid artery stenting was performed through the transfemoral approach under local anesthesia. A 9-French BriteTip Guiding Catheter (Cordis, Miami Lakes, Fla., U.S.A.) was introduced into the left common carotid artery. Control angiography revealed that the stenosis was severe and tortuous (Fig. 1). First we attempted but failed to pass the PercuSurge device through the lesion. Therefore, a triple coaxial system consisting of a Tempo 4 catheter (Cordis)/Transit microcatheter (Cordis)/0.016-inch GT wire (Terumo, Tokyo) was easily passed through the stenosis (Fig. 2). The PercuSurge device was then introduced. A 9 mm × 60 mm SMARTeR stent (Cordis) was deployed with distal protection using the PercuSurge device during the procedure. No neurological or physical deterioration was observed. Postprocedural angiography showed favorable dilation of the stenosis (Fig. 3A) and postprocedural diffusion-weighted magnetic resonance (MR) imag-
Fig. 1 Case 1. Initial angiogram of the left common carotid artery showing the configuration of the stenosis like a chicane.

Fig. 2 Case 1. Triple coaxial system used to introduce the PercuSurge device. (A) The Transit microcatheter was easily passed through the tortuous and severe stenosis over the 0.016-inch GT wire. (B) The Tempo 4 catheter was advanced across the stenotic lesion gently along the Transit microcatheter. (C) The PercuSurge Guardwire Plus was successfully positioned through the Tempo 4 catheter.

Fig. 3 Case 1. (A) Postprocedural angiogram of the left common carotid artery showing the stenotic lesion was successfully dilated. (B) Postprocedural diffusion-weighted magnetic resonance images revealing no signs of new ischemic lesion.

Techniques for Using the PercuSurge System

Case 2: A 65-year-old man developed right hemiparesis, dysarthria, and cerebellar ataxia. He was transferred to our hospital 10 days later. MR imaging revealed many infarcts in the bilateral cerebellum and brainstem, and multiple stenoses at the origins of the bilateral vertebral arteries (VAs) and basilar artery (BA). His symptoms fluctuated even during the best medical treatment, so we performed PTA and stenting of the stenoses at the origins of the left VA (Fig. 4A, B) and BA 17 days after the onset. His symptoms were stable and no ischemic attack occurred after stenting. Follow-up angiography 3 months later showed severe restenosis at the origin of the left VA (Fig. 4C), but no restenosis in the BA. Therefore, re-PTA and stenting were planned.

A 9-French BriteTip Guiding Catheter (Cordis) was introduced into the left subclavian artery. However, the PercuSurge device could not be passed through the tortuous lesion. The triple coaxial system was used as in Case 1, and the PercuSurge device was successfully positioned distal to the stenotic lesion (Fig. 5A).

Predilation using a SAVVY balloon catheter (Cordis) was attempted, but the catheter could not be passed through the stenosis because of the tortuosity and the poor support from the PercuSurge device.
Therefore, a 0.018-inch SV wire (Cordis), which is very stiff, was introduced via the guiding catheter and passed through the stenosis parallel to the PercuSurge device (Fig. 5B). This buddy wire technique straightened the lesion and the SAVVY balloon catheter was easily positioned.

After the predilation, a 15 mm Palmaz stent mounted on a PowerFlex P3 balloon catheter was introduced for stenting. Further support was necessary for delivering and placing the stent in the correct location, so the SV wire was used again, but this time was introduced through the lumen of the balloon catheter together with the PercuSurge device to avoid any damage to the SV wire, which might result in disastrous complications during stenting (Fig. 5C).

The stenting was successfully carried out. No neurological or physical worsening occurred. Postprocedural angiography showed favorable dilation of the stenosis (Fig. 6A) and postprocedural diffusion-weighted MR imaging revealed no signs of fresh ischemic change in the posterior fossa.
Fig. 6 Case 2. (A) Postprocedural angiogram of the left subclavian artery showing the stenotic lesion was successfully dilated. (B) Postprocedural diffusion-weighted magnetic resonance images showing no signs of new ischemic lesion.

Discussion

The PercuSurge Guardwire Plus, which has been available in Japan since 2002, is now generally considered to be the best available distal protection device. The PercuSurge device consists of a 0.014-inch Nitinol hypotube, with a balloon and shapable wire tip at the distal end, so can function both as a guidewire and a balloon catheter. The advantage of this system, compared with the flow-guided balloon catheter or the monorail-type balloon catheter, is that once this system is introduced, all procedures can be performed by the exchange of devices, such as balloon catheters and stents, along this system, so providing distal protection at every step of the procedure.

The PercuSurge system has some shortcomings. First, the wire tip on the edge has poor selectivity because of the poor torque response to rotational maneuvers by the operator, so severely stenotic and/or tortuous lesions are often hard to navigate. Excessive rotation can cause serious damage to the hypotube, resulting in inability to inflate or deflate the balloon, or even tear the hypotube. Second, the balloon may be damaged when passing a severely stenotic lesion, which can make the balloon useless.

In addition to these two disadvantages, this system provides poor supportability compared with other guidewires for delivering and maintaining high profile devices such as balloon catheters and stents in the correct position.

In the present two cases, the use of the triple coaxial system allowed the PercuSurge device to be safely passed through the severe and tortuous stenoses without damage. A Tempo 4 catheter was navigated through the stenoses over a Transit microcatheter and 0.016-inch GT wire. The former reduces the gap between the 4F catheter and microguidewire, and the latter has excellent torque ability and selectivity. The Tempo 4 has the smallest outer diameter of the catheters available with adequate inner diameter (0.042 inch) allowing the PercuSurge to pass (deflated balloon diameter 0.036 inch). This method carries the risk of formation of cerebral embolism when the catheter passes the stenosis, although there was no evidence of this complication in our patients. This method is not recommended if the plaque is considered soft and easy to rupture. However, this possibility is also true of any distal protection method, in which the protection device must go through the stenosis prior to dilation. The risk of embolism would be reduced by using smaller protection devices, or Parodi's proximal occlusion system. Parodi's system is better for severe and tortuous lesions with unstable plaque, because protective devices are not required to pass through the stenosis.

The “buddy wire technique” has been commonly used in coronary intervention, but not so much in neurointervention. The buddy wire gives adequate support, lacking in the PercuSurge device, to stretch the vessel, thus allowing other high-profile devices to pass the lesion. The triple coaxial system allows safe navigation of PercuSurge through severe and/or tortuous stenoses, and the buddy wire technique adds support. These techniques can be of great help to introduce the PercuSurge device into severe and/or tortuous stenoses.

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References


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Commentary

In this technical note the authors describe two very useful procedures for navigating tortuous stenotic lesions for the purpose of deploying a distal protection device prior to angioplasty and stenting. Several studies focusing on carotid artery stenosis have indicated that the incidence of thromboembolic complications following angioplasty and stenting without distal protection devices may be unacceptably high.\(^1,2\)

A more recent randomized trial comparing the use of angioplasty and stenting with distal protection device vs. carotid endarterectomy has indicated the thromboembolic complication rate to be much lower if such a distal protection device is used.\(^3\) While this most recent trial utilized a different type of distal protection device, the theoretical benefits of all the distal protection devices available on the market today are somewhat similar. And indeed all of these devices have a higher profile than a standard microguidewire and therefore difficulties in passing such devices through narrow and tortuous stenotic lesions are often encountered.

The triaxial support system described by the authors in the first case is a well-known tool to enhance support for the launching of smaller microcatheters into the distal cerebrovascular tree. The “buddy” guidewire system used in the second case, as indicated by the authors, has been used extensively in the coronary vasculature but not often in the cerebral vascular system. Their description of its use is worth noting. However, one should be cautious that while using a stiff buddy guidewire to violently straighten a tortuous stenosis may enable one to successfully perform protected angioplasty and stenting, such a maneuver may also dislodge a friable plaque, increasing the risk of a thromboembolic event even prior to the actual angioplasty itself. In such difficult cases, open carotid endarterectomy should be considered, or, if open surgical treatment is truly contraindicated, the safest procedure may involve proximal temporary flow arrest followed by navigation through the stenosis and deployment of the distal protection device. Only then would angioplasty and stenting be accomplished in order to truly minimize distal thromboembolic complications.

References


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Satow et al. describe their experience in techniques for passing a balloon-type protection device (PercuSurge Guardwire system) through the tortuous internal carotid artery. The techniques are introduction of a triple coaxial system and use of a buddy wire. As illustrated in this article, these techniques can be very effective for navigating devices through very tortuous vasculature. As a comment on this article, we would like to add several technical considerations from our experience with endovascular stenting in carotid and vertebral arteries. First, several insertions of a wire and just waiting for several minutes is helpful for straightening the vascular tortuosity. If it is difficult to pass the lesion with one particular wire, staged wire change may be helpful, for example from a soft wire to a very stiff wire via a microwire catheter. As the authors mentioned, introduction of a 4 F or 5 F diagnostic catheter through the tortuous and stenotic segment may be dangerous. Moreover, when this catheter is used in a coaxial method, it should be removed before the dilatation balloon or stent is delivered. After removing the stiff catheter, the vascular tortuosity usually comes back soon. The buddy wire technique is often more convenient than the coaxial method. Second, sometimes pre-dilatation of the tight and tortuous lesion is helpful for passing the protection device. The embolic risk of unprotected pre-dilatation is very low. Lastly, several types of protection devices are now commercially available. As the authors mentioned, balloon-type protection devices have shown excellent efficacy but other types such as filter devices have also shown similar or somewhat better efficacy and safety. Because the wire systems for these devices have
variable stiffness, we can choose the optimum wire
system for passing difficult anatomy.

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The PercuSurge Guardwire system is now widely used
for distal protection during angioplasty of the cervical
carotid artery in Japan. The weak points of this
system are the difficulty in crossing curved lesions
and inadequate support force. To overcome these
problems, two kinds of adjunctive methods, the triple
goaxial system and buddy wire technique are in-
troduced in this paper. These methods are not
especially new, but are sometimes useful techniques
when we use the PercuSurge Guardwire system.

The triple coaxial system could be applied for pass-
ing a tortuous severe stenotic lesion. However, the
risk of distal embolism in lesion crossing of this
system should be considered. Proximal protection by
the Parodi Anti-Emboli system (PAES) is currently
useful in such tortuous severe stenotic lesions, but the
use of PAES is limited in cases with sufficient collateral
blood flow. Therefore, the triple coaxial system
appears to be beneficial in cases with poor collateral
flow. The buddy wire technique is an assistive method
to supplement the weak support force of the Per-
cuSurge system. This technique makes it easy to
advance the PTA balloon or stent.

In the area of CAS, distal protection devices are
constantly improving, but the methods introduced
here are important. Neurosurgeons engaged in
endovascular treatment should really know these
methods.

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