Endovascular treatment for atherosclerotic stenosis within V3 segment of a hypoplastic vertebral artery

Case report

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Abstract

Introduction: The endovascular treatment of intracranial atherosclerotic stenosis has become a common intervention. However, few reports are available regarding stenting performed for hypoplastic vertebral artery (HVA) with multiple atherosclerotic lesions. Combining multiple neuroendovascular devices provides more possibilities for technical success. We describe a stenting technique using a distal intracranial catheter (Navien) for providing an approach to an HVA with multiple existing atherosclerotic lesions. The technique involves a coaxial system comprising a 6F 70-cm long sheath and 5F 115-cm Navien catheter, which provides a stable support and a shorter distance for the navigation of a balloon-mounted stent. Thus, a stent can be easily delivered avoiding any obstacles such as curves or tortuosity in the VA without distal advancement of the microwire.

Conclusion: The procedure was completed successfully with neither arterial perforation nor injury of the vessel wall. To the best of our knowledge, this is the first study that has reported the use of a Navien catheter in an HVA as an adjunctive technique for the delivery of an Apollo intracranial stent. The combination of the Apollo stent and Navien catheter is an alternative technique that may improve the safety of intracranial stenting procedure.

Abbreviations: HVA = hypoplastic vertebral artery PICA = posterior inferior cerebellar artery, VA = vertebral artery.

Keywords: atherosclerotic stenosis, distal intracranial catheter, endovascular treatment, hypoplastic vertebral artery, stent

1. Introduction

Atherosclerosis of the vertebral artery (VA) is a major pathogenic factor in 20% of all posterior circulation strokes.[1] Many studies have reported about endovascular treatment of stenosis located in the origin of extracranial VA, intracranial segment, and vertebrobasilar junction. However, stenting for a distal V3 segment, especially in a hypoplastic vertebral artery (HVA) terminating in the posterior inferior cerebellar artery (PICA) has scarcely been reported. Although HVA has not been identified as an independent risk factor for stroke, clinical and pathological studies have shown that an infarction in the lateral medullary or posterior inferior cerebellum was often attributed to occlusion of the intracranial VA.[2] Moreover, several studies have demonstrated that an HVA was associated with posterior circulation stroke.[3,4] Using a stent for treating a lesion of the distal V3 segment is an option for the prevention of stroke. The relatively small diameter of HVA as well as the tortuous course and atherosclerotic stenosis within V1 or V2 segments have been known to be constant obstacles to the approach of a delivery system such as conventional vertebral stenting. In this study, a 5Fr 115-cm Navien intracranial support catheter was used to complete a balloon-expanded stent deployment.

2. Case report

Ethical approval was obtained from the Human Research Ethics Committee of Tianjin Huanhu Hospital and informed consent from the patient was obtained. A 61-year-old woman with a history of hypertension, type 2 diabetes mellitus, hyperlipidemia, and current smoking presented with recurrent transient attacks of dizziness and lower limb weakness for the past 2 months. Magnetic resonance angiography (MRA) showed an occlusion in left intracranial VA, and cerebral angiography confirmed a left HVA, a severe stenosis in left V3-4 segment VA, and a moderate stenosis in the right vertebrobasilar artery junction (Fig. 1). The rate of stenosis was measured using 3D angiography according to the Warfarin–Aspirin Symptomatic Intracranial Disease (WASID) trial method. High-resolution magnetic resonance imaging (HR MRI) performed 5 days before stent placement revealed an atherosclerotic lesion in the distal V3 segment of the left HVA (Fig. 1a).

Oral aspirin 300mg and clopidogrel 75mg was prescribed daily for 5 days before the procedure. The procedure was performed in a biplanar angiography unit (Artis zee; Siemens Medical). Under general anesthesia, a femoral approach was
established by a 6Fr short sheath placement. Heparin, 3000 U, as an intravenous bolus was administered after the insertion of the femoral sheath. A coaxial system which comprised a 6Fr guiding catheter (Chaperon, MicroVention, Tustin, CA) and a 5Fr Navien (Covidien, Mansfield, Massachusetts) intracranial support catheter was assembled to establish a distal access just proximal to the origin of the V4 segment. When the VA was catheterized by this system, the Navien catheter passed through smoothly but the 6Fr guiding catheter could not be delivered into the V2 segment because of atherosclerotic stenosis (Fig. 2). The 6Fr femoral sheath was replaced by an 8Fr femoral sheath. A 70-cm long sheath was placed into the subclavian artery to provide a stable support and a 5Fr 115-cm Navien catheter was advanced through the long sheath to the level of the distal V3 segment. The biplane roadmap was obtained. A 0.014” micro-guidewire (Traxcess, MicroVention, Tustin, CA) and a balloon-expandable stent (Apollo, Micro-port Neuro Tech, China) were assembled coaxially in a fast exchange mode. The micro-guidewire was carefully steered to negotiate the stenotic lesion. The tip of the wire was positioned within the V4 segment and the stent was advanced to pass the lesion along the guidewire (Fig. 1b). The balloon was inflated slowly to 4 ATM while monitoring the waist of balloon under fluoroscopy. Angiography was performed to identify the residual stenosis, following which full deployment of the stent was achieved by gradually increasing pressure (6 ATM). Final control angiography was performed to observe the arterial patency, followed by the removal of all devices.

3. Discussion

In this case, a severe stenotic lesion was present in the ipsilateral HVA. HVA is typically defined as a luminal diameter less than 3 mm, or ipsilateral and contralateral vessels with an asymmetry ratio of equal to or greater than 1:1.7. Previous studies have suggested that stenosis of HVA contributed to dynamic problems in the focal flow and was related to atherosclerotic and thrombotic events that were underlying factors causing posterior circulation stroke. Some clinical trials describing proximal extracranial or intracranial VA disease have demonstrated the feasibility of stenting for these lesions. However, stenotic lesions located in HVA have special anatomical and angiographic characteristics. Smaller arterial lumens in the V1 and V2 segments of HVA, especially with multiple atherosclerotic lesions, make it difficult for the passage of neurointerventional devices. This type of artery not only had severe atherosclerotic lesions but also a hypoplastic segment between the PICA and basilar artery. Furthermore, digital subtraction angiography (DSA) revealed an artery terminating in the PICA due to reduced contribution to the basilar artery blood flow. Therefore, navigation of the microwire was limited. Based on the above reasons, a balloon-expandable stent in combination with a Navien catheter was selected for completion of the procedure.

Since the publication of the results from Stenting and Aggressive Medical Management for Preventing Recurrent Stroke (SAMMPRIS) trial, endovascular treatment for intracranial stenosis has been debated due to a high rate of periprocedural complications. The wingspan system that contained a Gateway percutaneous transluminal angioplasty and a self-expanding nitinol stent were exclusively used in the SAMMPRIS series. Owing to the multiple devices contained therein, some degree of complexity and difficulty in procedural technique was encountered. The microwire was always delivered as far as possible in order to guarantee a smooth passage of the stent in a tortuous vessel. If a wingspan stent system was used to treat this lesion, the tip of the microcatheter might need to be advanced into the slender PICA which might cause a perforation of this small artery. A balloon-expandable stent was often chosen to treat intracranial atherosclerotic lesions in the post-SAMMPRIS era. An Apollo balloon-expandable stent was used in our case, which was...
made by MicroPort Scientific Corporation of China. This kind of stent had a rapid exchange balloon catheter and excellent maneuverability, which helped simplify the procedure.

Luminal narrowing caused by atherosclerosis and HVA can hamper the advance of the guiding catheter during the procedure. With the progress of technology, new catheters have been developed to provide safe intracranial navigation and more distal positions than previously with guiding catheter.\textsuperscript{12} The Navien 058 catheter, a kind of distal intracranial catheter that can be advanced into the middle cerebral artery and basilar artery has been used in cerebral aneurysm and acute ischemic stroke.\textsuperscript{13,14} However, the use of this device for the stenting of intracranial atherosclerosis has been rarely reported. Navien 058 has a distal outer diameter of 5F and an inner lumen of 0.058” allowing for the passage of the Apollo stent. Using a Navien catheter might make it possible to access a more distal position, resulting in a

Figure 2. Stenting procedure for a stenotic lesion in an artery terminating in the posterior inferior cerebellar artery. Digital subtraction angiography reveals a severe stenosis in the distal V3 segment (A) and multiple atherosclerotic lesions in V2 segment of hypoplastic vertebral artery (B). The tip of Navien catheter lies in the distal end of V3 segment, and an attempt is being made to deploy the Apollo stent to cross the lesion (C). Digital subtraction angiography after the procedure shows a patent vessel with negligible residual stenosis.
more stable and safer approach for the delivery of a stent in a tortuous and hypoplastic artery.

When selecting a stent system for intracranial atherosclerotic stenosis, it is necessary to consider the anatomy characteristics of the lesion and the physical properties of various devices. Using the advantage conferred by the combination of an Apollo stent and a Navien catheter, it was possible to safely and effectively treat a stenotic lesion with difficult imaging characteristics and technical challenges without causing a periprocedural stroke or hemorrhage. This method provides an alternative treatment for a severely stenotic lesion in HVA.

Author contributions
Conceptualization: long yin.
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