

Case Report

Stent-Assisted Angioplasty of Spontaneous Bilateral Extracranial Vertebral Dissections under Intravascular Ultrasound Guidance

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Keywords

Angioplasty · Dissection · Intravascular ultrasound · Stent · Vertebral artery

Abstract

The authors here report a case of stent-assisted angioplasty under intravascular ultrasound (IVUS) guidance for the treatment of spontaneous bilateral extracranial vertebral artery (VA) dissection. A 47-year-old woman presented with spontaneous severe posterior neck pain. Examinations revealed bilateral extracranial VA dissection, which was thought to be the reason for her symptom. However, since the pain was gradually worsening even after sufficient medical treatment, she underwent stent angioplasty under IVUS guidance, following which her symptoms improved. We propose that stent placement under IVUS guidance is a safe and feasible method for treating extracranial VA dissections. Since the intravascular environment is seen in real time with IVUS, this technique is useful for confirming a true lumen and evaluating appropriate stent apposition. More clinical experience with this technique is required and mandatory, and devices with smaller diameters with improved trackability are essential for further introduction of IVUS into the field of endovascular neurosurgery.

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Introduction

Extracranial vertebral artery (VA) dissection occurs commonly after head and neck trauma, or after trivial traumatic events such as coughing, head turning, chiropractic manipulation, or endovascular or surgical management [1–3]. Also, spontaneous VA dissection is known to occur in vessels weakened by a primary arteriopathy or connective tissue disorder [1, 4]. The most common symptoms of VA dissection include ipsilateral posterior headache and/or neck pain; neurological symptoms include dizziness, vertigo, double vision, ataxia, and dysarthria due to cerebral ischemia resulting from either thromboembolism or hypoperfusion. Preventing and treating these conditions by dissection has various therapeutic options, including (1) medical treatment such as antithrombotic therapy, (2) surgical treatments such as carotid ligation, aneurysm resection, and bypass surgery, and (3) endovascular management. Recently, intravascular ultrasound (IVUS) has been widely used in coronary artery intervention. It provides useful information that can help in the endovascular treatment for in-stent restenosis with intimal hyperplasia, in-stent thrombosis, appropriate stent apposition, and characteristics of atherosclerotic plaques [5, 6].

We here present a case of successful treatment of bilateral spontaneous extracranial VA dissection accomplished with IVUS-guided stent angioplasty and report the usefulness of this technique and device.

Case Report

A 47-year-old woman had been experiencing a gradual thunderclap or throbbing bilateral suboccipital headache and neck pain for 3 months. Despite consuming analgesics, these symptoms had been aggravating over time. Magnetic resonance imaging (MRI) and angiography (MRA) revealed the presence of bilateral V2 stenosis (Fig. 1a).

Digital angiography of the right VA revealed a severe intimal dissection extending through the level of C5–C6 (Fig. 1b, c). The left VA presented a slightly dissected intimal flap (Fig. 2a, b). After careful consideration, she was offered endovascular management using stent-supported angioplasty under IVUS guidance at the right VA. The left VA dissection was completed with antithrombotic therapy.

The procedure was performed under local anesthesia via the right femoral route. Heparin was injected intravenously, and the activated clotting time was confirmed as 250–300 s. After placement of a 6-Fr Envoy guiding catheter (Cordis Neurovascular, Miami Lakes, FL, USA) at the VA orifice, we selected the supposed true lumen using a 0.014-inch Transend microguide-wire (Boston Scientific, Miami, FL, USA). After inserting the IVUS catheter (Atlantis SR Pro 40-MHz coronary imaging catheter; Boston Scientific), IVUS images were obtained using the motorized pull-back system.

The IVUS images showed the dissection of the right VA at the level of C5–C6, with an intimal flap and a true lumen as narrow as 78% of the normal diameter (Fig. 1d). An eccentric soft atherosclerotic plaque appeared on the IVUS image of the right VA as circumferential homogeneous hypoechoogenicity due to their high lipid content. This lesion was unstable and could have resulted in cerebral infarction owing to plaque rupture.

According to the IVUS data, we selected a 4.0 × 30.0 mm balloon-mounted stent (Driver RX; Medtronic, Minneapolis, MN, USA) and deployed it at 11 atm for 35 s, 14 atm for 50 s at the proximal end, and 6 atm for 21 s at the distal end. After stent placement, the vertebral angiogram showed generally good stent apposition and dilatation, but the IVUS images

revealed insufficient dilatation of the true lumen and the presence of a residual partial pseudolumen (Fig. 3).

Repeated vertebral angiography at 6 months demonstrated complete spontaneous healing at the left VA and no evidence of any residual pseudolumen, and in-stent restenosis at the right VA (Fig. 4).

Discussion

Spontaneous VA dissection is an important cause of ischemic stroke in young and middle-aged patients, and usually arises from an intimal tear [4]. Most patients have at least two symptoms: localized warning signs such as headache and/or neck pain are common, and they provide an opportunity to recognize and treat patients before cerebral ischemia occurs [4]. Dissection of VA is a dynamic process. Although the angiographic appearance may worsen during the acute phase of dissection, about 90% of stenoses eventually resolve, with recanalization of two-thirds of the occlusions and spontaneous healing of most dissections [4, 7, 8]. However, endovascular treatment entails a lower risk than surgical treatment and has widely replaced surgery as the initial therapy of choice after failure of medical therapy [4, 9].

Although conventional angiography has long been the gold standard in the diagnosis of arterial dissections, pathognomonic features of dissections, such as an intimal flap or a double lumen, are detected in fewer than 10% of dissected arteries [4, 7]. MR techniques are replacing conventional angiography. On MRI and MRA, an eccentric signal void surrounded by a crescent-shaped hyperintensity on T1- and T2-weighted images is suggestive of dissection [8]. However, in some series, these lesions can be confounded by turbulent flow, bony artifacts, and patient movement, and it may not be possible to discern dissection from other causes of arterial narrowing or occlusion [8, 10, 11].

IVUS is an invasive imaging modality capable of overcoming these limitations. Significant limitations of conventional angiography include the fact that the estimations rely on the accuracy of the calibration from the guide catheter and on the choice of the angiographic projection to delineate the lesion. Where conventional angiography is unable to accurately evaluate the severity of the lesions, IVUS is able to estimate luminal dimensions and assess the extent of a lesion [12, 13].

IVUS provides the information for deciding appropriate management, since it is able to detect plaque composition, which is critical for predicting future ischemic events. Predictors of future events include the presence of a thin or ruptured fibrous cap, intraplaque hemorrhage, larger mean intraplaque hemorrhage, larger maximum percentage of lipid-rich/necrotic core, and larger maximum wall thickness [14, 15]. Also, stent implantation in calcified lesions is associated with a lower success rate and an increased risk of restenosis related to inadequate stent expansion, leading to a poorer prognosis [13, 16]. In our patient, the IVUS images revealed an eccentric homogeneous hypoechoic soft plaque and mobile intramural flap; these lesions are more dangerous dissections that require immediate treatment.

IVUS is a useful tool for assessing in-stent status and stent apposition of the lesions already remedied with stents. In stent angioplasty of arterial dissection, it is important to accurately identify the most distal and proximal end points of the arterial dissection. Also, the entire length of dissection needs to be sufficiently covered with the stent. In the current case under discussion, we confirmed good stent apposition by conventional angiography and IVUS. However, a remnant pseudolumen was observed on IVUS, which was not found by conventional angiography. We believe that IVUS should be used to identify the exact location of the

proximal and distal ends of the causative lesion after stent deployment, since failure to mold the stent to the arterial wall and wrinkling at the ends of the stent may result in flow irregularities leading to subsequent thromboembolic events [17]. Also, IVUS can provide information on in-stent thrombosis or a residual pseudolumen in real time. Thus, IVUS assists as an additional treatment providing all the necessary information for optimal management.

In contrast to the effective application of IVUS in the coronary specialty, there are only limited reports on the application of IVUS in vertebrobasilar cases. Unlike for coronary arteries, IVUS catheters require strong trackability to overcome the tortuous and long pathways to the vertebrobasilar arteries. Moreover, due to the anatomical complexity or possible distal embolism or vessel injury, introducing the probe into the VA is difficult and requires good skills [18]. Routine use of IVUS during stenting is potentially expensive and increases the initial procedural costs due to the expense of IVUS catheters and the need for more balloons to optimize stent deployment. However, these expenses are partially offset by the lower cost incurred for revascularization procedures [13, 19].

Conclusions

IVUS is a new modality among endovascular techniques that allows a more precise deployment of stents and an understanding of the intravascular environment and stent deployment, thereby reducing adverse events. Although simple lesions can be managed with angiographic guidance alone, IVUS has a role to play in more complex lesions and in high-risk interventional procedures.

Statement of Ethics

The study received ethical approval from local independent ethics committees. All subjects provided their written, informed consent.

Disclosure Statement

The author has no conflicts of interest to disclose.

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Fig. 1. Findings on magnetic resonance angiography in a 47-year-old woman indicative of dissection of the bilateral vertebral arteries (a). Conventional angiography of the right vertebral artery, in anteroposterior (b) and lateral projection (c), shows a dissection at the C5–C6 level. The intravascular ultrasound image reveals 78% stenosis with a pseudolumen (asterisk) which is formed between the hyperechoic intima (arrow) and adventitia, and an intimal flap (arrow heads) containing a hypoechoic soft plaque at the C5–C6 level (d).

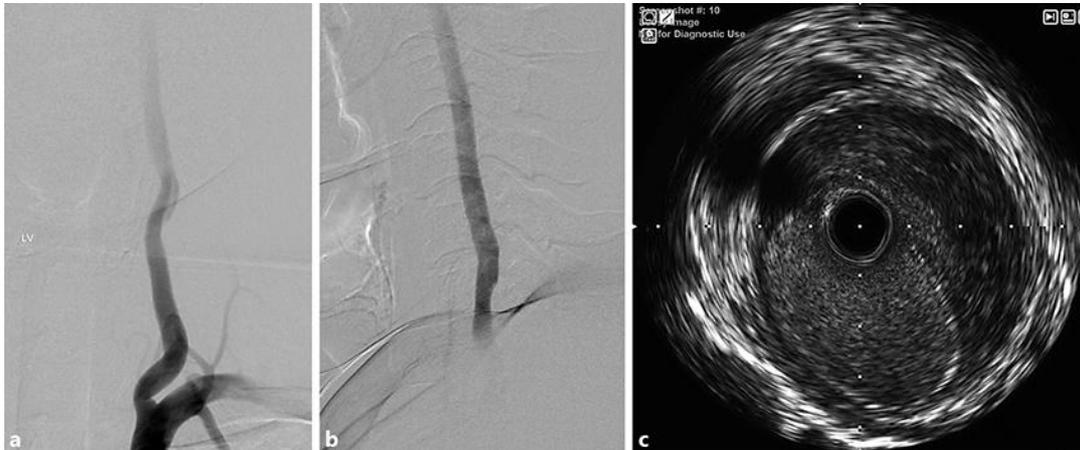


Fig. 2. Anteroposterior (a) and lateral (b) left vertebral angiograms demonstrating mild dissection with an intimal flap suspected at the C6 level. The intravascular ultrasound image confirms 59% narrowing with a hypoechoic atherosclerotic plaque (c).

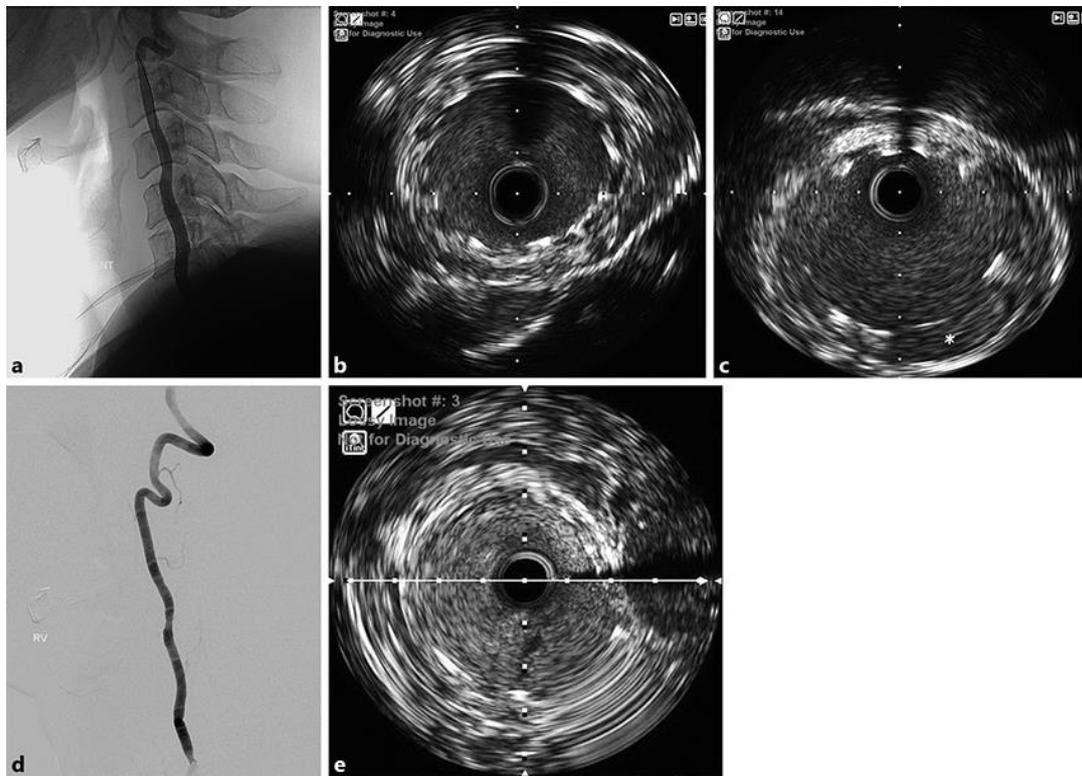


Fig. 3. Conventional angiogram obtained after stent deployment demonstrating good apposition and disappearance of the pseudolumen (a). One of the intravascular ultrasound (IVUS) images reveals appropriate stent apposition, no residual dissection, and no in-stent thrombus formation at the C5–C6 level (b). Another IVUS image was obtained at the C5 level. A persistent pseudolumen (asterisk) was found, indicating that the true lumen was not sufficiently dilated (c). After 6 months, follow-up angiography (d) and IVUS (e) images revealed complete expansion of the dissection with good stent apposition and disappearance of the pseudolumen.



Fig. 4. At follow-up after 6 months, conventional angiography of the left vertebral artery showed complete spontaneous healing at the C6 level (a), and the intravascular ultrasound image demonstrated no residual dissection (b).