CASE REPORT

Stent-assisted coiling of a ruptured vertebrobasilar junction aneurysm via direct vertebral artery puncture

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SUMMARY

A 78-year-old patient was admitted with subarachnoid hemorrhage caused by rupture of a broad-based vertebrobasilar junction aneurysm. Direct endovascular access to the vertebrobasilar circulation was not possible due to chronic occlusion of the proximal dominant left vertebral artery (VA), hypoplastic right VA and posterior communicating arteries. The distal cervical left VA was reconstituted by muscular branches of the ascending cervical artery. Therefore, endovascular access was gained by direct percutaneous VA puncture guided by a roadmap-controlled anterior approach at the level of C5 proximally to the main reconstituting collateral feeders. Successful endovascular treatment of the aneurysm was performed by stent-assisted coiling. Closure of the puncture site at the cervical VA level was achieved by occluding the proximal part of the VA with coils. The post-interventional clinical course was uneventful; early post-interventional CT showed no evidence of cervical hematoma.

BACKGROUND

Endovascular procedures in the posterior intracranial circulation usually entail catheterization of the vertebral artery (VA) via the transfemoral or transbrachial approach. Occasionally, tortuosity or chronic occlusion of the VA and hypoplastic or aplastic posterior communicating arteries may impede the endovascular access to the target vessel necessitating an alternative access route. We describe the stent-assisted endovascular treatment of a ruptured aneurysm of the vertebrobasilar junction via direct puncture of the left VA at the level of the V2 segment.

CASE PRESENTATION

A 78-year-old man who had persistent headache following an episode of acute cephalgia 4 weeks earlier was transferred to our hospital. CT and CT angiography examination revealed subarachnoid hemorrhage in the posterior fossa and intraventricular blood due to rupture of a broad-based fusiform vertebrobasilar junction aneurysm (figure 1A–C). On clinical examination the patient presented fully awake and oriented without any focal neurological deficits (Hunt and Hess grade 1).

INVESTIGATIONS

Diagnostic digital subtraction angiography performed via a transfemoral approach confirmed a fusiform aneurysm with a broad-based saccular

component (11×7 mm) at the vertebrobasilar junction. The V4 segment of the left VA exhibited a high-grade stenosis just proximal to the aneurysm, suggesting a possible dissection as the underlying cause. Severe atherosclerotic disease with tortuosity and wall irregularities of all supra-aortic vessels was present. The dominant left VA was chronically occluded at its origin by a large arteriosclerotic calcified plaque and reconstituted in the V2 segment at the level of the fifth cervical vertebra (C5) by muscular collaterals from the ascending cervical artery (figure 1D–F). All attempts to recanalize the VA ostium to gain endovascular VA access failed. The right VA was hypoplastic with almost complete termination of the V4 segment in the posterior inferior cerebellar artery. Access to the basilar artery via the anterior circulation was not possible due to hypoplastic posterior communicating arteries on both sides. Due to the inaccessibility of the posterior circulation via the transfemoral approach, we rescheduled the patient for the following day to gain access to the aneurysm via direct puncture of the left VA at the cervical level.

Treatment and outcome

The procedure was performed under general anesthesia. The patient was placed in a supine position with slight extension of the shoulders and neck. A diagnostic angiography run was performed via femoral access through a 5F diagnostic catheter placed in the left subclavian artery. The left VA was then punctured at the level of the transverse foramen of C5 using an anterolateral approach with a 9 cm long micropuncture needle (21G) under roadmap guidance (figure 2A–C) and the needle was inserted between the aerodigestive lumen medially and the carotid artery laterally. See figure 3 for illustrative demonstration of anatomy. The access was complicated by hypertrophic osteophytes impeding the smooth introduction of a 4F vascular sheath into the VA. After several attempts, a 4F Berenstein catheter was finally advanced over a 0.035 inch guide-wire (Terumo; Terumo Medical, Tokyo, Japan) and used as a guiding catheter. A remodelling stent (Enterprise 2, 4×23 mm; Codman & Shurtleff, Miami, Florida, USA) was deployed through a Prowler Select Plus microcatheter (Codman & Shurtleff) at the vertebrobasilar junction, covering the aneurysm neck. Prior to stent placement the patient received 5000 IU heparin and 500 mg acetylsalicylic acid, which is our standard protocol for stent-assisted coiling of ruptured aneurysms. After navigation of a coiling microcatheter (SL-10,

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Figure 1 (A, B) Non-enhanced CT scan showing subarachnoid hemorrhage in the posterior fossa as well as intraventricular hemorrhage. (C) CT angiogram showing a broad-based fusiform aneurysm at the vertebrobasilar junction with a proximal stenosis of the distal V4 segment on the left. (D) Highly calcified chronic occlusion of the dominant vertebral artery (VA) at its orifice on the left. (E, F) Anteroposterior and lateral view angiograms demonstrating reconstitution of the VA through muscular collaterals of the ascending cervical artery.

Stryker Neurovascular, Fremont, California, USA) through the stent struts, the aneurysm was occluded with eight detachable coils (Target 360 Soft; Stryker; four 7 mm × 20 cm, two 6 mm × 15 cm, two 3 mm × 6 cm). A control run demonstrated good occlusion of the aneurysm (figure 4B, C). Since an underlying dissection could not be excluded, angioplasty of the stenosis just proximal to the aneurysm in the V4 segment was not performed. To prevent post-interventional hemorrhage or vertebrovertebral

fistula at the cervical puncture site, a short vessel segment in the V2 segment proximally to the main reconstituting muscular collateral branches was occluded on withdrawal of the Bernstein catheter with coils (two Target 360 Soft 4 mm × 6 cm and 11 Complex Helical-18, Boston Scientific, Fremont, California, USA) (figure 4D–F). Post-interventional monitoring of the patient revealed no new neurological deficit and no signs of cervical soft tissue hematoma. The next day the control CT scan

Figure 2 (A, B) Anteroposterior and lateral roadmap views demonstrating fluoroscopy-guided direct percutaneous vertebral artery (VA) puncture at the level of the transverse foramen of C5. (C) Lateral fluoroscopic view showing the introduction of a 4F Bernstein catheter over a 0.035 inch guidewire into the VA as a guide catheter.

Figure 3 Illustration showing the direct puncture of the left vertebral artery at the level of C5.

showed neither cervical hematoma nor any signs of vertebrovertebral fistula at the puncture site and double antiplatelet therapy with 100 mg acetylsalicylic acid and 75 mg clopidogrel daily was started. The further clinical course was uneventful.

DISCUSSION

Reports describing direct vertebral angiography date back to the early 1940s when Takahashi and Sugar published the first techniques advocating puncture of the vessel at different levels with modest success. In 1950 Lindgren reported on his experience of 60 vertebral angiographies performed using an anterolateral approach.¹ A few years later Sjogren presented his outcomes with a similar technique used in 250 patients²; both authors demonstrated good results with low complication rates. In general, a direct percutaneous approach to a cervical artery may become necessary when severe tortuosity of the supra-aortic vessels or proximal vessel occlusion impedes direct transfemoral or transbrachial endovascular access. In 1998 Weill *et al* first reported on two endovascular interventions in the posterior circulation, in which access was gained via direct puncture of the VA to coil a basilar tip aneurysm.³ Since then, only a few more reports on cases using direct VA puncture have been published,⁴ one on coil occlusion of a P1/2 aneurysm⁵ and one on stent retriever thrombectomy in basilar artery thrombosis using ultrasound guidance to gain access.⁶ We used the anterolateral approach as described by Lindgren,¹ inserting the needle just medial to the carotid artery, advancing it in the soft tissue just lateral to the thyroid cartilage and the thyroid gland wrapping around it,

Figure 4 (A) Unsubtracted anteroposterior (AP) view angiogram after deployment of an Enterprise 2 remodelling stent. (B, C) AP and lateral view angiograms showing the final result after stent-assisted coiling of the aneurysm. (D) AP angiogram view depicting collateralization of the VA through the muscular branches in detail prior to occlusion of the proximal reconstituted VA at the puncture site. (E, F) Unsubtracted and subtracted AP angiograms showing proximal VA occlusion using coils and persisting distal reconstitution of the VA.

aiming for the gap between the transverse processes of C5 and C6.⁷ The needle was slightly angulated cranially. Using a pre-acquired roadmap allows exact localization of the target, facilitates guidance of the needle and adjustment of the angle of entry into the artery, and enables precise puncture of the VA within the transverse foramen.

To prevent damage to important structures of the cervical region such as the supra-aortic vessels, airways, nervous structures (recurrent laryngeal nerve, sympathetic chain), brachial plexus or thyroid gland, a thorough knowledge of the local anatomy is essential and should be appraised on cross-sectional imaging. In particular, inter-individual variability in vascular anatomy—for example, retropharyngeal course of the carotid arteries ('kissing carotids')—should be considered. Furthermore, degenerative changes of the vertebral column such as osteophytes may further hinder accurate puncture and also the introduction of sheaths or guiding catheters at the level of the transverse foramen. After several attempts to introduce different kinds of 4F sheaths we were finally successful using a more flexible 4F Berenstein catheter, which could be used as a guiding catheter for further microcatheter insertion.

Since the VA cannot be compressed at the cervical level, closure of the puncture site may be problematic. The use of the smallest possible access using small needles and catheters is recommended in order to reduce the risk of post-interventional hemorrhage. Reversal of heparin with protamine has been advocated and deemed necessary in previous reports.^{3,4} To the best of our knowledge, we report the first case of stent-assisted coiling of a ruptured vertebrobasilar aneurysm via direct VA puncture in a patient taking aspirin and heparin. In our patient it was possible for the puncture site at the proximal VA to be occluded due to predominantly distal reconstitution by muscular branches from the ascending cervical artery on withdrawal of the guide catheter. Alternatively, an open surgical exposure for puncture followed by surgical closure may be considered.⁸ The off-label use of percutaneous closure devices has been described in cases of direct carotid artery puncture⁴ but, to the best of our knowledge, this has not been reported so far for direct puncture of the VA. Furthermore, the use of closure devices is usually limited to a minimal vessel diameter. Moreover, we had some difficulties introducing a 4F sheath into the VA due to the narrow space and steep angle at the level of the transverse foramen. Therefore, we doubt that it would have been possible to introduce the sheath of a closure device due to its relative stiffness and larger size. However, the optimal technique for safe closure of the puncture site still has to be determined on a case-by-case basis depending on the type of intervention, size of access catheters and anticoagulant protocol.

Learning points

- ▶ Direct percutaneous puncture of the cervical VA is possible for endovascular treatment of vertebrobasilar aneurysms that are not amenable to standard transfemoral or transbrachial access.
- ▶ A pre-acquired roadmap facilitates precise needle placement and puncture of the VA at the level of the transverse foramen, especially in patients with degenerative osseous changes.
- ▶ The optimal technique for safe closure of the puncture site has to be determined on a case-by-case basis.

CONCLUSION

Access to the vertebrobasilar circulation for endovascular interventions via direct puncture of the VA is a feasible alternative technique in patients in whom catheterization by a transfemoral or transbrachial approach is not possible. A pre-acquired roadmap facilitates precise needle placement and puncture of the VA at the level of the transverse foramen even in patients with degenerative osseous changes. The optimal technique for safe closure of the puncture site needs to be determined on a case-by-case basis.

Competing interests None.

Patient consent Obtained.

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