Endovascular Treatment of a Vertebral Artery Aneurysm via Puncture of the Surgically Exposed Vertebral Artery

F. OKA, H. ISHIHARA, S. KATO, M. SHINOYAMA M. SUZUKI

Department of Neurosurgery, Yamaguchi University School of Medicine; Ube, Japan

Key words: vertebral artery aneurysm, coil embolization, surgical exposure, direct puncture

Summary

We describe a case of subarachnoid hemorrhage due to a ruptured right vertebral artery (VA) aneurysm where endovascular therapy via a trans-femoral route was not feasible. Therefore we surgically exposed the VA and directly punctured it at the C4 level, followed by successful coil embolization. Direct access to the vertebral artery using an anterior surgical approach is an alternative in cases where the proximal side of the artery is occluded.

Introduction

Endovascular embolization of posterior circulation aneurysms has become increasingly feasible due to advancements of interventional neuroradiological techniques and technologies^{1,2}. However, for tortuous arteries or those with steno-occlusive changes, a trans-femoral approach is not always feasible^{3,4}. Although several authors have described successful endovascular treatment for vertebro-basilar arterial stenosis or aneurysms using direct percutaneous puncture of the cervical vertebral artery (VA), the risks of inaccurate puncture and bleeding after sheath removal make this approach less desirable^{3,4,5}. The present report describes a case of subarachnoid hemorrhage due to a ruptured right VA aneurysm where the vertebral arteries were occluded bilaterally at the orifice of the subclavian artery. Due to this occlusion, we surgically exposed the right VA at the C4 level and coil embolized the aneurysm with no complications.

Case Report

A 77-year-old man presented to a local hospital complaining of sudden severe headache. On admission, he was alert with no neurological deficit; a computed tomography revealed a Fisher group 3 subarachnoid hemorrhage (Figure 1A). CT angiography demonstrated a right VA aneurysm (Figure 1B) and he was transferred to our institution. Diagnostic angiography was done via the right femoral approach. The vertebral arteries were occluded bilaterally at the orifice of the subclavian artery with the right VA being mainly supplied from the right occipital artery at the level of the arch of the atlas; retrograde back flow was detected to the C6 level (Figure 2A-C). An aneurysm was detected at the V4 segment (Figure 2C). The right posterior inferior cerebellar artery (PICA) was absent, and the right anterior inferior cerebellar artery (AICA) supplied the territory of the PICA (Figure 2D). As the right VA mainly supplied from the right occipital artery at the level of the arch of the atlas, we deemed it very risky to access it when discussing surgical approaches. Therefore we decided to coil embolize the aneurysm following surgical exposure of the right VA at the C4 level and direct puncture of the artery for endovascular treatment access.

Under general anesthesia, the patient was positioned supine on the operating table. After confirmation of the position of C4 by fluoroscopy, a transverse skin incision was made in the skin crease of the neck at the level of the thyroid cartilage (Figure 3A). After drilling the transverse process of vertebra, the VA was exposed and sutures of 5-0 GoreTex were placed

Figure 1 A) CT scan on the day of admission showed a Fisher group 3 subarachnoid hemorrhage in the basal cistern. B) Three-dimensional CT angiography on the day of admission demonstrated a right VA aneurysm (arrow).

Figure 2 A) Right subclavian artery angiogram. The right VA was occluded at the orifice of the right subclavian artery. The arrow indicates the deep cervical artery (anteroposterior view). B) Left subclavian artery angiogram. The left VA was occluded at the orifice of the left subclavian artery (anteroposterior view). C) Right occipital artery angiogram. The right VA was predominantly supplied from the right occipital artery at the level of the arch of the atlas (arrow). An aneurysm was detected at the V4 segment pointing backward (arrowhead; lateral view). D) Right occipital artery angiogram. The right PICA was absent, and the right AICA supplied the territory of the PICA (arrow). The arrowhead indicates the aneurysm (anteroposterior view). E) Right occipital artery angiogram after direct puncture of the VA. The right VA was directly punctured by 18G catheter (arrow). The arrowhead indicates the aneurysm (lateral view). F) Right occipital artery angiogram after direct puncture at the end of treatment. The VA aneurysm was occluded by coils (arrow head; lateral view).

Figure 3 A) A transverse skin incision was made in the skin crease of the neck at the level of the thyroid cartilage. B,C) After drilling the transverse process of C4 vertebra, the VA was exposed. The artery was punctured with an 18G catheter needle.

crosswise in the vertebral artery. The artery was punctured with an 18G catheter needle and the catheter was fixed to the skin edge (Figures 2E, 3B and C). A 4F catheter was additionally placed by the right femoral route at the origin of the right occipital artery for control angiography. We reached the aneurysm easily using a microcatheter (Excelsior SL-10, J shaped; Boston Scientific, Boston, Mass, USA) and the aneurysm was treated with four Trufill DCS Orbit coils (Cordis endovascular system, Miami, Florida, U.S.A.; 4 mm × 7 cm, 5 mm × 10 cm, 3 mm × 4 cm, 2 mm × 1.5 cm) and one ED 10 Extra Soft coil (Kaneka, Osaka, Japan; 1.5 mm × 2 cm; Figure 2F). After the procedure the catheter was removed under direct vision and the

puncture site was closed using sutures. The patient did not show any neurological deterioration following the procedure and his post-operative course has been uneventful.

Discussion

We described a case of subarachnoid hemorrhage due to ruptured VA aneurysm accompanied by an occluded proximal side of the VA. This situation is rare but can be encountered. We treated the aneurysm by coil embolization after direct puncture following surgical exposure from the anterior side.

Several authors have reported successful en-

dovascular treatment of vertebro-basilar arterial stenosis or aneurysms using direct percutaneous puncture or direct puncture following surgical exposure of the cervical VA^{3,4,6}. Weill et al. reported two cases of direct percutaneous puncture of the VA at the level of C4 for endovascular treatment of basilar tip aneurysms⁴. Terada et al. reported a case of basilar artery stenosis treated by stenting via the surgically exposed C1 VA⁶. Although it is obvious that direct percutaneous puncture is a less invasive technique for patients than surgical exposure of the artery, there are some possible complications. Blanc et al. reported their experience in using direct puncture of 39 carotid and three vertebral arteries for endovascular treatment. In their report, complications were encountered in six procedures; cervical hematoma was seen in three, vasospasm in two and aneurysm formation was in one³. Another group also reported an iatrogenic arterio-venous fistula after percutaneous direct puncture of the VA⁶. To avoid those risks in the anterior circulation, Ross et al. advocated accessing the common carotid artery by cut down and then suturing of the vessel⁵.

In the present case, because the vertebral arteries were occluded bilaterally at the junction of the subclavian artery, there was no access route for endovascular treatment except for direct puncture. To puncture the artery accurately

ly and to close the artery safely, we decided to surgically expose the VA and puncture the artery under direct vision. The right VA was predominantly supplied from the right occipital artery at the level of the arch of the atlas and thus it was risky to surgically expose the C1 VA using the approach reported by Terada et al.⁶. Therefore we decided to expose the C4 VA. In our experience, exposure of the VA at the C4 level is not as complicated, and both puncture and closure of the vessel were done safely under direct vision. Although there are some potentially risks of anterior surgical approach of VA, those are esophageal injury, recurrent laryngeal nerve palsy, nerve root injury and infection, the treatment was done with no complication in this case.

To our knowledge this is the first report of an endovascular coil embolization of a VA aneurysm using direct puncture following surgical exposure of the C4 VA. This technique is an alternative method in cases where the trans-femoral route is not feasible.

Conclusion

Direct puncture following surgical exposure of the VA is a viable option to access lesions of the posterior circulation when the trans-femoral route is not feasible.

References

- 1 Mordasini P, Schroth G, Guzman R, et al. Endovascular treatment of posterior circulation cerebral aneurysms by using Guglielmi detachable coils: A 10-year single-center experience with special regard to technical development. *Am J Neuroradiol.* 2005; 26: 1732-8.
- 2 Pandey AS, Koebbe C, Rosenwasser RH, et al. Endovascular coil embolization of ruptured and unruptured posterior circulation aneurysms: Review of a 10-year experience. *Neurosurgery.* 2007; 60: 626-637.
- 3 Blanc R, Piotin M, Mounayer C, et al. Direct cervical arterial access for intracranial endovascular treatment. *Neuroradiology.* 2006; 48: 925-929.
- 4 Weill A, Cognard C, Spelle L, et al. Endovascular treatment of basilar tip aneurysms after direct puncture of the vertebral artery. *Am J Neuroradiol.* 1998; 19: 1554-1556.
- 5 Ross IB, Luzardo GD. Direct access to the carotid circulation by cut down for endovascular neuro-interventions. *Surg Neurol.* 2006; 65: 207-211.
- 6 Terada T, Nakai E, Tsuura M, et al. Combined surgery and endovascular stenting for basilar artery stenosis refractory to balloon angioplasty: Technical case report. *Acta Neurochir (Wien).* 2001; 143: 511-516.

Fumiaki Oka, MD, PhD
Department of Neurosurgery, Yamaguchi
University School of Medicine
1-1-1, Minami-Kogushi
Ube, Yamaguchi, 755-8505, Japan
Tel.: +81-836-22-2295
Fax: +81-836-22-2294
E-mail: okafumiaki85@yahoo.co.jp