Transbrachial Coil Embolization for Posterior Circulation Aneurysm in Elderly Patients Using a 4 Fr. Guiding Sheath

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Objective: Authors describe our experience of transbrachial coil embolization for posterior circulation aneurysms by using a 4 French (Fr.) guiding sheath.

Case Presentations: We retrospectively evaluated the technical feasibility, access site complications, and concomitant use of adjunctive techniques on transbrachial coil embolization from April to July 2015.

Results: Three patients underwent transbrachial coil embolization for a posterior circulation aneurysm using a 4 Fr. guiding sheath. The patients’ average age was 78.7 years (range 74–87 years). Two patients had a ruptured aneurysm (two aneurysms), and one had an unruptured aneurysm. The site of the aneurysms included a right vertebral artery-posterior inferior cerebellar artery bifurcation, basilar bifurcation, and basilar artery-left superior cerebellar artery bifurcation. All procedures were successfully performed using the brachial approach and balloon neck remodeling technique. No periprocedural or access site complications were observed.

Conclusion: Transbrachial coil embolization of a posterior circulation aneurysm may be a useful alternative method, especially in elderly patients with an undesirable arterial anatomy for a transfemoral approach. Additionally, the 4 Fr. guiding sheath is a useful device for this approach, as it enables the adjunctive techniques and minimizes the brachial puncture size.

Keywords: transbrachial approach, coil embolization, elderly patients, sheatheless, posterior circulation cerebral aneurysm

Introduction

There have been a number of reports that approaches other than the transfemoral access were useful for diagnostic brain angiography and carotid artery stenting in intracranial endovascular treatment but less in aneurysm coil embolization. Despite coil embolization of cerebral aneurysms for elderly patients has recently been performed, the stability of the guiding catheter occasionally cannot be achieved by the transfemoral approach due to atherosclerosis. Navigating the devices to the right vertebral artery, which is markedly tortuous in elderly patients, is particularly difficult. In this report, we present three elderly patients with cerebral aneurysms of the posterior circulation in whom embolization was performed by the transbrachial approach using 6 Fr. guiding catheters (4 Fr. guiding sheath) which permits direct percutaneous placement as the catheter sheath, and discuss its usefulness with a review of the literature.

Case Presentation

Subjects and methods

In patients who underwent coil embolization of posterior circulation aneurysms by the transbrachial approach using a 4 Fr. guiding sheath between April and July 2015, the results of the procedure, access site complications, and the therapeutic method were retrospectively evaluated. ASAHI FUBUKI Dilator Kit 4 Fr (Asahi Intecc, Aichi) was used as the guiding sheath in all patients. As pre-procedural evaluation of the feasibility of the transbrachial approach, the angle between the vertebral artery (VA) and subclavian artery (AVS) was measured on digital subtraction angiography (DSA), and the vertebral...
artery diameter (VAD) at a distal site the foramen of the transverse process, which was the intended site of guiding sheath placement, was measured on a three-dimensional-computed tomography angiography (3D-CTA) workstation (ZIO Station, Zio Soft, Tokyo), according to the report by Iwata et al.6)

Results
Aneurysms of the posterior circulation were treated by coil embolization via the transbrachial approach using a 4 Fr. guiding sheath in three patients. The patients were all females with a mean age of 78.7 (74–87) years. Two lesions were ruptured, and one was unruptured. They were located at the bifurcation of the right VA and posterior inferior cerebellar artery (PICA), basilar bifurcation, and bifurcation of the basilar artery and left superior cerebellar artery. In all patients, the aortic arch was type III,13) following failed transfemoral approach in one, and obvious tortuosity of the aorta on pre-procedural examination in two, the transbrachial approach was selected. The guiding sheath could be successfully navigated from the brachial artery to the vertebral artery in all patients, and no procedural or access site complications were noted. Embolization was performed with the neck remodeling technique using an occlusion balloon in all patients. The mean AVS was 58.3° (45°–73°), and the mean VAD was 3.8 (3.7–3.9) mm (Table 1).

Case
The patient was a 74-year-old female who had onset with sudden headache and vomiting. Since subarachnoid hemorrhage was revealed by head computed tomography (CT) scan at a local hospital, she was transferred to our hospital by an ambulance. She had a history of hypertension.

On admission, her consciousness was E3V4W6 on Glasgow Coma Scale (GCS) with any other neurological defects, and was Grade II by the World Federation on Neurological Surgeons (WFNS) grading scale.14)

Clinical course
CT scan showed Fisher group 3 subarachnoid hemorrhage which extended diffusely in the basal cistern and thickly in the right cerebellomedullary cistern, and signs of acute hydrocephalus were observed. 3D-CTA revealed a saccular aneurysm sized 4.7 × 4.3 × 3.7 mm with a neck of 2.6 mm at the right VA-PICA bifurcation. Ventricular drainage for acute hydrocephalus followed by coil embolization of the aneurysm was planned.

<table>
<thead>
<tr>
<th>Case No.</th>
<th>Age (years)</th>
<th>Sex</th>
<th>Location</th>
<th>Aneurysm</th>
<th>AVS (°)</th>
<th>VAD (mm)</th>
<th>Device</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>74</td>
<td>F</td>
<td>Rl VA PICA</td>
<td>Ruptured</td>
<td>45</td>
<td>3.8</td>
<td>Headway-17</td>
</tr>
<tr>
<td>2</td>
<td>87</td>
<td>F</td>
<td>BA top</td>
<td>Ruptured</td>
<td>73</td>
<td>3.7</td>
<td>Echelon-10</td>
</tr>
<tr>
<td>3</td>
<td>75</td>
<td>F</td>
<td>Lt BA SCA</td>
<td>Unruptured</td>
<td>57</td>
<td>3.9</td>
<td>Headway-17</td>
</tr>
<tr>
<td>Average</td>
<td>78.7</td>
<td>58.3</td>
<td></td>
<td></td>
<td>3.8</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

AVS: angle formed by the vertebral artery and subclavian artery; BA: basilar artery; F: female; Lt: left; M: male; PICA: posterior inferior cerebellar artery; Rl: right; SAH: subarachnoid hemorrhage; SCA: superior cerebellar artery; VA: vertebral artery; VAD: vertebral artery diameter
Endovascular procedure

Embolization was initiated by the transfemoral approach under general anesthesia. The aortic arch was type III as the brachiocephalic artery arising at the lower margin of the aortic arch. Although the guiding catheter could be placed in the right vertebral artery, it was unstable and slipped down the aortic arch during manipulation of the microcatheter (Fig. 1A). As we considered that stable placement of the guiding catheter was necessary to improve the manipulability of the microcatheter in its navigation into the aneurysm, the approach was changed to the transbrachial approach. The right branchial artery was punctured, and a 90-cm ASAHI FUBUKI Dilator Kit 4 Fr was placed in the right vertebral artery at the 4th cervical vertebrae with coaxial manner using a 4 Fr. catheter (Cathex OK2, Kadelius Medical, Tokyo) (Figs. 1D–1F). Despite the AVS was 45°, the tip of the ASAHI FUBUKI Dilator Kit 4 Fr was extremely flexible, and as it was given a hydrophilic coating, it could be navigated without any technical problem. Also, the VAD was 3.8 mm, and the
vertebral artery was patent without bending or spasm after catheter placement. An occlusion balloon catheter (Transform SC 4 × 7 mm, Stryker, Kalamazoo, MI, USA) was placed in the neck of the aneurysm, and a microcatheter (Headway17, TERUMO, Tokyo) was placed in the aneurysm. Compared with the transfemoral approach, the guiding sheath could be firmly fixed, the movements of the microcatheter were markedly stabilized, and it could be navigated safely into the aneurysm. The aneurysm was tightly embolized by six coils, and the procedure was finished by confirming that the blood flow of the PICA was maintained (Fig. 1C). After generalized heparinization was reversed with 30 mg of protamine, the puncture site of the brachial artery was compressed manually for hemostasis.

Post-procedural course
No complication related to the puncture site of the brachial artery was observed. Although post-procedural diffusion-weighted imaging of magnetic resonance imaging (MRI) showed micro infarctions in the PICA territory, no neurological deficits were noted. No aggravation due to cerebrovascular spasm was observed. On the 32nd hospital day, the patient was discharged from our hospital to the rehabilitation hospital at grade 4 on the modified Rankin scale (mRS). Three months after the onset, the condition improved to mRS grade 1.

Discussion
Recently, with the aging of the demographic composition, it has been liable to experience subarachnoid hemorrhage and unruptured aneurysms of elderly patients.11) Catheter manipulation or navigation in such cases is difficult due to changes in the vascular course associated with atherosclerosis, and thus modification of the therapeutic strategy is often required. Coil embolization is known to be superior to clipping as a treatment for ruptured aneurysms.15,16) In elderly patients, also coil embolization is often selected for the treatment of cerebral aneurysms and has been reported to be superior.16,17) However, according to several reports,10–14) the procedure to some of these elderly patients cannot be completed by the transfemoral approach due to tortuous blood vessels associated with atherosclerosis or concurrence of thoracic or abdominal aortic aneurysm. Also, while coil embolization is frequently selected for the treatment of posterior circulation aneurysms,8,16) navigation of the guiding catheter to the right vertebral artery is difficult by the transfemoral approach in most of the elderly patients due to atherosclerosis of the aortic arch or subclavian artery.

On the other hand, navigation of the guiding catheter to the right vertebral artery is relatively easy via the right brachial artery, and Iwata et al. reported that the procedure could be completed in all 32 patients with posterior circulation aneurysms (right VA in 28, left VA in four) using the transbrachial approach.60) According to their analysis, lesions were accessible if the AVS was 45° or greater, and the guiding catheter could be navigated to the vertebral artery if the VAD was 3.18 mm or greater.

In our patient with right VA-PICA aneurysm, treatment was first started by the transfemoral approach. The guiding catheter could be placed in the right vertebral artery. However, the guiding catheter was unstable due to the type III aortic arch, and the guiding sheath could be stabilized well after switching to the transbrachial approach. Regarding the other two patients, since pre-procedural 3D-CTA and DSA proven the type III aortic arch in them, the transbrachial approach was thus selected from the beginning. Satisfactory stability of the guiding sheath could be achieved in both patients. In the 3 patients, the mean AVS was 58.3° (45°–73°), mean VAD was 3.8 (3.7–3.9) mm, no complication was noted in navigation of guiding sheath and at the puncture site.

In transbrachial approach, the angle between the vertebral artery and subclavian artery was widened remarkably by the insertion of the guidewire or catheter to the vertebral artery, and the navigation of the guiding sheath was relatively easy in many patients. However, if the AVS is 40° or less, or if the guidewire is difficult to navigate to the vertebral artery via the brachial artery, the transfemoral approach should be selected. If the VAD is 3.1 mm or greater, ASAHI FUBUKI Dilator Kit 4 Fr (2.09 mm in outer diameter) can be applied to navigation for the vertebral artery. For smooth and safe execution of embolization, it is considered important to check these factors on pre-procedural 3D-CTA or DSA.

In selecting the device for the treatment of posterior circulation aneurysms via the transbrachial approach, it is important not only that the lumen of the device is 0.070 inch or greater to permit adjunctive techniques using two or more microcatheters but also that the diameter of vascular puncture is small for the prevention of access site complications. It is also important that the device can be navigated safely and consistently through the sharp curve from the subclavian artery to the vertebral artery. ASAHI FUBUKI Dilator Kit 4F is a guiding sheath of 1.80 mm/0.071 inch in inner diameter and 2.09 mm/0.082 inch in outer diameter that can be inserted through a puncture hole with a diameter.
corresponding to 6 Fr. and is compatible with adjunctive techniques. Also, having a flexible 5-segment body structure with a 20-mm long flexible tip and given a hydrophilic coating over the 5 cm from the tip, it could be safely and consistently guided to curved vessels.

According to the past reports of transbrachial or transradial coil embolization for posterior circulation aneurysms, a 6 Fr. guiding catheter (about 0.070 inch in inner diameter) have often been used after placing a 6 Fr. sheath (about 2.60 mm/0.101 inch in outer diameter) in the target vessel. Uhlman et al. reported that the incidence of access site complications including radial artery occlusion due to radial artery puncture for coronary catheterization was 33% and 14% when the sheath diameter was 6 Fr. and 5 Fr. respectively, suggesting that minimization of the vascular puncture diameter is reasonable for the prevention of access site complications. In two cases reported by Lawson et al., coil embolization of cerebral aneurysms was performed via the radial artery by placing the guiding catheter Neuron 070 (Penumbra, Alameda, California) without using a sheath by exchanging catheters to reduce the vascular puncture size. However, ASAHI FUBUKI Dilator has a dedicated dilator for puncturing and can be inserted easily and safely into the target vessels.

Table 2 shows the 5 Fr. or thinner guiding sheaths available in Japan. Since Axcelguide 4 Fr, which is a 4 Fr. guiding sheath, has a small outer diameter of 2.03 mm/0.080 inch but an inner diameter of 1.65 mm/0.065 inch, it is not compatible with adjunctive techniques requiring the concomitant use of a microcatheter (10 type microcatheter 2.1–2.4 Fr./0.69–0.79 mm in proximal outer diameter) with an occlusion balloon catheter (2.8 Fr./0.92 mm in proximal outer diameter) or a microcatheter for intracranial stenting (2.8–2.9 Fr./0.92–0.95 mm in proximal outer diameter). ASAHI FUBUKI Dilator Kit 4 Fr is considered to be useful as a guiding sheath in coil embolization of cerebral aneurysms by the transbrachial approach when adjunctive techniques using multiple catheters, etc. are anticipated.

In the present series, an approach via the brachial artery with a large diameter was selected, but the transradial approach, by which the incidence of access site complication is reportedly lowest, is considered possible if small-bore ASAHI FUBUKI Dilator Kit 4 Fr is used.

## Conclusion

The transbrachial approach using a 4 Fr guiding sheath was feasible in coil embolization of posterior circulation aneurysms especially in elderly patients with an undesirable arterial anatomy by atherosclerosis. Since ASAHI FUBUKI Dilator Kit 4 Fr allows us to use adjunctive techniques despite its small outer diameter (6 Fr.) and has excellent guidability to the vertebral artery, it is useful in coil embolization of posterior circulation aneurysms by the transbrachial approach.

## Disclosure Statement

The first author and coauthors have no conflicts of interest.

## References


