Technical Notes

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Usefulness of the Fubuki catheter for embolization of a dural arteriovenous fistula with liquid material via the middle meningeal artery: technical notes

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●Abstract●

Objective: We report a useful technique for transarterial embolization with liquid material using a 4.2Fr Fubuki catheter as an intermediate catheter.

Materials and Methods: Five consecutive cases of dural arteriovenous fistula (dAVF) of the transverse/sigmoid sinus with cortical venous reflux were treated by transarterial embolization (TAE) using a 4.2Fr Fubuki catheter as an intermediate catheter inserted into the middle meningeal artery (MMA). With this support, the microcatheter could be advanced to the shunt point and the shunt was occluded successfully with N-butyl cyanoacrylate (NBCA). All cases were managed using the same strategy. In all cases, NBCA was injected into the venous portion of the shunt and complete obliteration of the shunt was achieved in one session. We report in detail the illustrative case of a 71-year-old man who presented with visual symptoms and speech disturbance and was found to have a Borden type Ⅲ dural arteriovenous fistula in the left transverse sinus.

Conclusion: With its highly flexible distal tip and hydrophilic coating, the 4.2Fr Fubuki catheter was found to be useful in performing TAE of dAVFs via the MMA.

●Key Words●

cortical venous reflux, dural arteriovenous fistula (dAVF), Fubuki catheter, liquid embolization

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Introduction

The middle meningeal artery (MMA) is one of the endovascular routes used for treatment of intracranial lesions, mainly those involving the dura mater. Transarterial embolization (TAE) is one of the therapeutic options chosen for dural arteriovenous fistula (dAVF) among other techniques, such as direct puncture of the involved sinus or direct surgery in cases where transvenous embolization is not feasible.[2-4,6,10] In these circumstances, TAE requires delivery of a liquid embolic material into the venous side of the shunt. We have found that the use of the Fubuki catheter (Asahi Intecc, Aichi, Japan) facilitates navigation of the microcatheter, resulting in higher cure rates by TAE.

Materials and Methods

Five consecutive cases of Borden type Ⅲ dAVF[1] in the transverse sinus area were treated by TAE from August 2012 to February 2013. All treatments were performed after administration of general anesthesia. The final goal of treatment was to achieve complete occlusion of the shunt. N-butyl cyanoacrylate (NBCA, histoacryl; B. Braun Melsungen AG, Melsungen, Germany) was used as the embolic material. After thorough investigation of the particular shunt anatomy and the venous drainage of the brain, the standard procedure consisted of placing an inner catheter (Fubuki 4.2Fr) with a 6Fr guiding system. With the 6Fr catheter in the common carotid artery or the proximal part of the external carotid artery, the

Fubuki catheter was advanced with the aid of a 0.032 inch guidewire through the orifice of the MMA and placed as far distally as possible. A microcatheter was then inserted through the Fubuki and advanced as close to the shunt as possible, preferably into a wedged position. A low concentration of NBCA and lipiodol (Lipiodol Ultra Fluide; Guerbet, Roissy, France) between 20% and 50% NBCA, depending on the catheter position and the precise anatomy of the lesion was injected in an attempt to fill, as much as possible, the venous portion of the shunt. To ensure greater penetration and less migration of glue into cortical veins, other arteries participating in the shunt, such as the occipital artery, were usually embolized prior to entering the MMA with liquid material and/or gelatin sponge since the occlusion of these arteries does not need to be permanent.

Results

In all cases, the Fubuki catheter could be safely and smoothly inserted into the MMA to the upper level of the foramen spinosum, and in some cases exiting the foramen spinosum into the distal branch leading to the shunt. In this series we used the Magic 1.2 FM (Balt, Montgomery, France) as the microcatheter. With the aid of the Mirage 0.008 inch guidewire, we were able to advance the microcatheter close enough to the shunt to get it into a wedged, or nearly wedged, position. In one case, the catheter was advanced through the shunt point and into the venous pouch itself. The shunt was completely obliterated immediately in all cases except one, in which a pial artery contributed to the shunt and was confirmed by follow-up angiogram to have complete occlusion. No complications directly related to the liquid embolization occurred. However, in one case, mild hemiparesis due to an embolic event was observed on investigation of the contralateral side by angiography.

Illustrative case

A 71-year-old man with a past history of lacunar infarction presented with visual field abnormality and transient speech disturbance. Magnetic resonance imaging revealed intensity changes in occipital lobe gyri. Diagnosis of dural arteriovenous fistula of the left transverse sinus was later confirmed by angiography. A dural arteriovenous shunt was located at the site of the transverse sinus and had arterial contributors from ipsilateral occipital artery branches and the posterior branch of the middle meningeal artery (Fig. 1A, B). The drainage of the shunt was through gyral subpial veins with reflux that drained through the vein of Trolard and the straight sinus (Fig. 1A). There was no transverse sinus detectable on the left side by angiography. Instead, a prominent occipital sinus on the left side was identified. There was no connection of the shunt venous drainage to the normal sinuses. Normal drainage of the left hemisphere was through the superior sagittal sinus and the cavernous sinus. There was venous delay around the occipitotemporal area (Fig. 1C) without involvement of the venous circulation in the posterior fossa.

We decided to perform TAE with the goal of total obliteration of the shunt to relieve the brain from venous congestion. A 6Fr sheath was introduced into the femoral artery. A 6Fr catheter was advanced to the left common carotid artery and a 4.2Fr Fubuki catheter was then advanced to the occipital artery. We embolized the transosseous branches of the occipital artery with NBCA and its proximal part with pieces of absorbable gelatin sponge, with the objective of reducing the blood flow. The next step was to bring the Fubuki catheter into the MMA, which was accomplished smoothly. After using the Fubuki catheter to create a stable platform, a Magic 1.2 FM catheter with the aid of a Mirage 0.008 inch micro-guidewire was advanced as distally as possible (Fig. 2A). The catheter advanced very easily, because the Fubuki (serving as a "tunnel") prevented catheter loop formation in the internal maxillary artery. In this case, the microcatheter could be advanced through the shunting zone into the venous pouch itself (Fig. 2B). Glue was injected first within the pouch and later into the other feeders in a single shot. No glue migration was observed distally, because the flow was almost completely arrested by the wedging of the Fubuki catheter into the proximal MMA, giving excellent flow control. Complete obliteration of the shunt was confirmed (Fig. 2C).

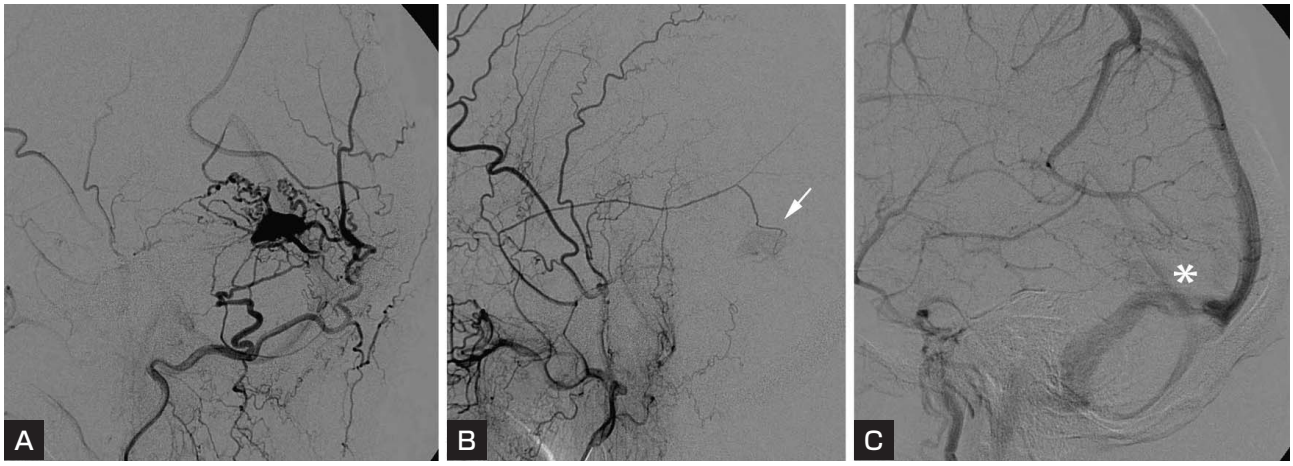

Fig. 1
A : Injection of the left occipital artery demonstrates a shunt at the transverse sinus. There is no drainage to the normal sinuses, only reflux into the pial vein and later into the vein of Trolard and the straight sinus.
B : On left internal maxillary artery injection, only slight contribution of the posterior branch of the middle meningeal artery is revealed. This is selected as the final approach route to the shunt, since it has the least convoluted course, as compared to other feeder vessels (arrow).
C : The venous phase of the left internal carotid artery injection shows venous congestion in the occipitotemporal area (asterisk). There is no demonstrable vein of Labbé.

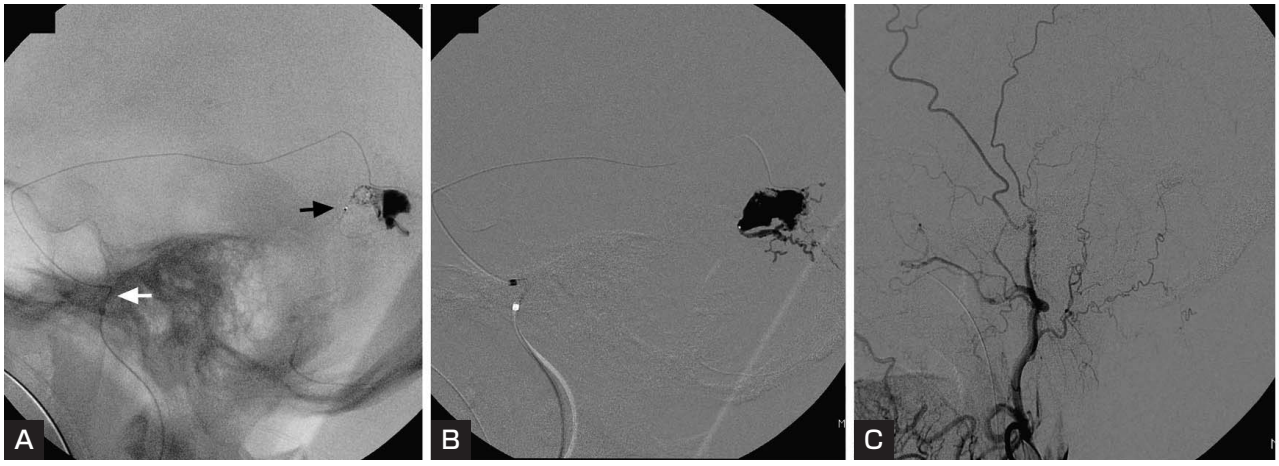

Fig. 2
A : Lateral non-subtracted image showing insertion of the microcatheter through the Fubuki catheter. The latter is advanced up to the level of the exit from the foramen spinosum (white arrow), giving more pushability to the microcatheter. The tip of the microcatheter (black arrow) passes through the shunt into the venous pouch itself. Note the stagnation of the contrast medium inside the venous pouch owing to the wedged effect.
B : Glue cast immediately after glue injection. The venous pouch and the other feeders are well occluded by glue, with no distal migration. Note the Fubuki catheter still in position after microcatheter retrieval.
C : Angiography of the left external carotid artery shows complete disappearance of the shunt. There is no observable vasospasm in the proximal part of the external carotid artery.

The postoperative course was uneventful. Visual symptoms disappeared within 3 days after the procedure.

Discussion

The main problems encountered in TAE are unintentional injection into the internal carotid artery or the vertebral artery system through anastomoses, and cranial nerve impairment.[7] These can be avoided with good anatomical knowledge. DAVFs occurring around the transverse sinus area pose lower risks for these

complications. In this series, no complications were directly related to TAE.

DAVFs with cortical reflux have aggressive clinical courses and should be treated promptly.[9] TAE is one of the treatment options for cases of shunt without direct connection to the original sinus. Cases of "isolated sinus" can also be treated by embolization through direct puncture, requiring an extra surgical procedure.[2,3,10] Surgery aiming to disrupt the cortical venous drainage is effective in certain cases.[6]

In order for TAE to be effective, the embolic material has to reach the venous portion of the shunt.[5,8] Delivering the embolic material into the venous side of the shunt requires special techniques. Maneuvering a microcatheter distally requires use of a small-sized catheter with good flexibility. The drawback in using small and flexible catheters is the relative lack of pushability. This becomes more obvious in the internal maxillary artery-to-MMA transition zone. A loop of micro-catheter is sometimes formed around this point, making pushing the catheter distally difficult. A standard 4 or 5Fr catheter can help with this problem, but the orifice of the MMA can be tortuous and small in caliber; most 4Fr catheters in use currently will not enter with sufficient stability.

NBCA (compared to more recently developed materials, such as Onyx[5]) when used for TAE in cases with cortical venous reflux has been shown to be more effective. However, TAE is still a challenging technique requiring good knowledge of anatomy for safe and effective embolization. Accomplishing adequate distal navigation of the microcatheter is one of the key technical requirements for successful TAE.[8]

The 4.2Fr Fubuki catheter is designed as an intermediate catheter of the triaxial catheter system mainly for embolization of intracranial aneurysms. It has hydrophilic coating up to the length of 1150 millimeters from its distal tip. The distal 10 centimeters of the catheter is designed to be highly flexible. We have approached the MMA with various types of 4 or 5Fr catheters and found that the Fubuki, with its flexible tip and hydrophilic coating, navigates better than others, even in tortuous vessels. We have been using the Fubuki catheter for TAEs since August 2012. In our experience, the Fubuki 4.2Fr catheter can be advanced in all cases at least to the top of the foramen spinosum, and in some cases farther into the branch leading to the shunt. With the support of this catheter, the microcatheter can be pushed distally with great stability, making occlusion of the shunt point and deposition of glue into the venous side of the dAVF more efficient. Furthermore, since the Fubuki can be navigated quite far into the MMA, it can be wedged, giving proximal flow control. Using this strategy, NBCA was delivered into the venous side, resulting in complete cure in all cases of this series. The drawback of using the 4.2Fr Fubuki is that a supporting catheter (in our series, a 6Fr Roadmaster catheter) is needed because the Fubuki itself lacks supportability at the shaft, requiring use of a larger-size introducer sheath. We believe that this technique of TAE with the use of the Fubuki catheter in combination with the Magic catheter is a useful option in cases that require distal navigation of the microcatheter in tortuous vessels.

Conclusions

TAE in dAVF is a challenging procedure requiring distal navigation of the microcatheter. In our experience, TAE using NBCA via the MMA with the aid of the Fubuki 4.2Fr catheter is an effective strategy in the treatment of dAVFs in the transverse-sigmoid sinus area. This technique can be applied in the treatment of other pathologies, such as tumor embolization.

Disclosures

All authors declare that they have no conflicts of interest with regard to the performance or publication of this study.

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