Selection of Guiding Catheter Based on the Anatomical Structures when Performing TVE to Treat an Anterior Condylar Confluence Dural AVF

Fumihiro Hiraoka, Kouhei Nii, Ritsurou Inoue, Takafumi Mitsutake, Kimiya Sakamoto, Ayumu Eto, Hayatsura Hanada, Yusuke Morinaga, Misato Kawaguchi, and Masanori Tsutsumi

Objective: For transvenous embolization (TVE) of dural arteriovenous fistulae (dAVF) in the anterior condylar confluence (ACC), stable placement of a guiding catheter is important to approach the ACC from the jugular bulb (JB) with a microcatheter. We document our method and present a review of the literature.

Case Presentations: We used a 5-Fr internal mammary artery (IMA) catheter to guide the microcatheter into the ACC for coil embolization. In one patient, we placed the steeply angled tip of a 5-Fr IMA catheter into the entrance of the ACC from the JB, guided the microcatheter into the ACC, and performed coil embolization. In another patient, we created a coaxial setup by inserting a 5-Fr IMA catheter into a 6-Fr guiding catheter and advanced the tip of the IMA catheter from the JB into the ACC entrance in accordance with the angulation of the ACC entrance.

Conclusion: It is useful to select an IMA catheter based on anatomical structure when a direct approach from the JB to the ACC is required. Ours is the first report of an approach for TVE from the involved side using a guiding catheter adapted to the anatomical structure. We recommend the use of an IMA catheter adapted to the anatomical structures when a direct approach from the JB to the ACC is needed for TVE of dAVF in the ACC.

Keywords: anterior Condylar confluence, anatomy, dural arteriovenous fistulae, guiding catheter, transvenous embolization

Introduction

Transvenous embolization (TVE) is a first-line endovascular treatment for dural arteriovenous fistulae at the anterior condylar confluence (ACC dAVF). However, the configuration of anatomical structures and progressive sinus occlusion can render selective cannulation during TVE difficult. Therefore, it is useful to select a guiding catheter based on the anatomical structure when using a microcatheter to approach the ACC from the jugular bulb (JB). We present our method and a review of the literature.

Case Presentations

Case 1

A 78-year-old woman with hypertension, type 2 diabetes mellitus, and no relevant family history visited our hospital with the chief complaints of persistent left-sided pulsatile tinnitus and headache of 2-year duration. At his admission, neurologic examination showed no abnormal findings except for the bruit around the left ear. MRI/MRA identified hyper-intense vessels surrounding the left hypoglossal canal and dilation of the ACC, which was continuous with the JB. Cerebral angiographs showed an ACC dAVF on the left. The main feeder was the left ascending pharyngeal artery (APA), the dAVF was also supplied by the right APA and the posterior meningeal artery branching off the left vertebral artery (VA). Venous outflow was mainly anterograde into the left internal jugular vein (IJV). There was no retrograde flow into the inferior
petrosal sinus (IPS) or the sigmoid sinus. The anastomosis between the ACC and IPS was hypoplastic (Fig. 1).

She underwent TVE under general anesthesia. A 6-Fr guiding catheter was placed in the left IJV and a micro-guidewire was used to guide an Echelon10 STR (Medtronic, Minneapolis, MN, USA) into the ACC. However, as the steep entry angle into the ACC from the JB rendered catheter placement difficult, we used a 5-Fr internal mammary artery (IMA) Goodtec catheter (Goodtec Inc., Aichi, Japan) with a steep angle for advancement into the bifurcation of the ACC from the JB (Fig. 2). By placing its tip into the entrance of the ACC, we were able to guide the Echelon10 into the ACC, it was possible to place the coil in the ACC in a stable state without kicking back the microcatheter (Fig. 3). We identified the shunt point on images from the contralateral APA and, while gradually down-sizing from a 4-mm first coil (ED coil Extrasoft; Kaneka Medix Corp., Osaka, Japan) to 3-mm soft coils, we loosely packed 12 coils into the ACC. These procedures resulted in complete disappearance of this arteriovenous fistulae (AVF) (Fig. 4).

Postoperatively, her left-sided pulsatile tinnitus and objective bruit disappeared immediately. We encountered no complications such as hypoglossal nerve paralysis and the patient was discharged home on the 8th postoperative day. Cerebral angiography performed 6 months later revealed no findings indicative of recurrence.

**Case 2**

A 70-year-old man with no relevant medical or family history visited our hospital with the chief complaint of a 2-month history of right-sided pulsatile tinnitus. At his admission, neurologic examination showed no abnormal findings except for the bruit around the left ear.

Cranial MRI/MRA showed hyper-intense vessels in the right hypoglossal canal and dilation of the right IJV. Cerebral angiography revealed a right ACC dAVF. The right APA and dural branches of the right occipital artery (OA) were the main feeding vessels; other feeders were the posterior meningeal artery branching off the right APA and right VA. Venous outflow was mainly anterograde into the right IJV; retrograde flow into the right IPS was also observed. The anastomosis between the ACC and IPS was hypoplastic (Fig. 5).
He underwent TVE under general anesthesia. To identify the shunt point correctly, 4F catheter was placed in the right OA for control angiography.

A 6-Fr Road Master STR (Goodman Co. Ltd, Aichi, Japan) was introduced into the right IJV. Our attempt to guide an Echelon10 STR (Medtronic) into the ACC with the aid of a micro-guidewire was hampered by the steep angle of the ACC entrance and the wide diameter of the IJV. Therefore, we inserted a 5-Fr IMA Goodtec catheter through a 6-Fr guiding catheter and advanced the tip from the JB into the ACC entrance to match its angulation. Next, we inserted a GT wire12 (90°) using the Echelon10 STR over the 5-Fr Goodtec catheter, guided them into the ACC, and placed the coils (Fig. 6). It was possible to place the coil in the ACC in a stable state without kicking back the microcatheter. We gradually down-sized from a 4-mm fast coil (Axium 3D; Medtronic) and loosely packed 14 soft coils into the ACC, focusing on the shunt point. These procedures resulted in complete disappearance of this AVF (Fig. 7).

Postoperatively, his right-sided pulsatile tinnitus disappeared immediately. We encountered no complications such as hypoglossal nerve paralysis and the patient was discharged home on the 8th postoperative day. Cerebral angiography performed 3 months later showed no recurrence.

Discussion

The ACC is a venous structure located on the anteromedial wall of the JB lateral to the hypoglossal canal. It is...
Fig. 5 Case 2: MRA (A) shows arterial filling of the venous pouch (arrow) and retrograde venous flow through the inferior petrosal sinus (arrowheads). Right occipital artery angiogram (B) AP view demonstrates a dural arteriovenous fistula at the anterior condylar confluence and retrograde drainage to the inferior petrosal sinus (arrowheads) and antegrade drainage to the internal jugular vein (arrow). AP: anteroposterior

Fig. 6 Case 2: Ipsilateral occipital angiogram (A) right anterior oblique (RAO) view and the schema (B) demonstrates a microcatheter (arrow) is advanced to the right anterior condylar confluence via a "Goodtec Catheter IMA" supported by a 6-Fr guiding catheter. ACC: the anterior condylar confluence; GC: guiding catheter; IJV: internal jugular vein; IMA: internal mammary artery; IPS: inferior petrosal sinus; JB: jugular bulb; MC: microcatheter

Fig. 7 Case 2: After the coil embolization, fluoroscopic image (A) AP view after coil embolization shows loose coil packing in the venous pouch (arrows). Right common carotid angiogram (B) AP view demonstrates disappearance of the dural arteriovenous fistula (arrows). AP: anteroposterior
formed from various emissary veins and venous plexuses. The ACC has direct connections with the IJV, IPS, anterior condylar vein (ACV), internal carotid artery of the venous plexus (ICAVP; by way of the inferior petrooccipital vein), and lateral condylar vein (LCV). While the ACC is frequently formed by an anastomosis at the confluence of the JB and the caudal end of the IPS, the Anastomotic pathway size varies among patients; 31% manifested a wide anastomosis to the IPS, 45% a narrow or absent anastomosis to the IPS, and 24% an anastomosis that involved the basilar plexus. If ACC does not have an anastomosis with IPS, ACC is directly connected to JB and its angle is steep.

The ACC dAVF represented 3.6%–4.2% of all intracranial dAVFs. The location of ACC dAVF shunts varies greatly; they can be near the hypoglossal canal and near the diploic vein in the clivus (intraosseous shunt). As venous anastomoses are complex, the symptoms they elicit differ based on the venous outflow pathways from the shunt. Three major types of venous drainage are associated with distinct clinical patterns: Type 1, with anterograde drainage (62.5%), mostly presents with pulsatile tinnitus; Type 2, with retrograde drainage to the cavernous sinus and/or orbital veins (23.3%), is associated with ocular symptoms and may mimic cavernous sinus dAVF; and Type 3, with cortical and/or perimedullary drainage (14.2%), presents with either hemorrhage or cervical myelopathy.

The first-line treatment for ACC dAVF is TVE from the ipsilateral JB to the ACC shunt point; it has been reported to be highly effective and safe. However, when there is no common trunk between the ACC and IPS in the presence of hypoplasia, a direct approach is required from the JB to the ACC. As this approach involves proceeding from the JB, whose vessel size can vary greatly, to the steep ACC entrance, confirming the location of the guiding catheter and manipulating the guide wire can be difficult. With a micro-device only, handling of the guidewire and the guiding catheter featuring a conventionally preshaped tip was complicated due to the narrowness and steep angulation of the area from the JB to the ACC entry in our patients. Our search of the literature revealed some instances in which TVE from the ipsilateral IJV was difficult due to occlusion or narrowing of the venous outflow pathways into the venous pouch. Although it was not treatment of ACC dAVF, under such circumstances, the shunt point was reached via the contralateral IJV or IPS, the intercavernous sinus, or from the ipsilateral cavernous sinus via the IPS. However, the access route may be longer and the procedures become more complicated. If it is possible to stabilize and place a support catheter in the ACC via the ipsilateral JB, there will be fewer difficulties when guiding microcatheters into the ACC.

The IMA catheter features a strongly angled tip that fits the origin of the IMA and tends to retain its shape. We found its angle facilitated accessing the ACC originating from the JB at a steep angle. Although it seems that stable placement is possible even with shapes of the tip of other intermediate catheter, it seems necessary to some experience. Pitfalls include overlapping of the tips of the guiding- and the IMA catheter because the catheters are rigid. This raises the risk for iatrogenic vessel injury if marked flexion occurs. To avoid such a risk, we did not put in and out of the IMA catheter and we put out only the tip and only hooked on the ACC's orifice. Or IMA catheter was used only to change the shape of the tip of the guiding catheter without getting out of the guiding catheter. We proceeded carefully and encountered no procedural complications.

Conclusion

This is the first report of the use of an IMA catheter as a support catheter during TVE to treat ACC dAVF. If ACC does not have an anastomosis with IPS, ACC is directly connected to JB and its angle is steep. In such a case, the IMA catheter can be easily placed in a stable manner, it is useful for TVE to enhance the operability of the microcatheter.

Disclosure Statement

There is no conflict of interest for the author and coauthors.

References


