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Endoscopic Trans-Spheroidal Approach for Embolization of Carotid-Cavernous Fistula without a Hybrid Room, With Relatively Aseptic Procedure.

Case report

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Abstract

Endovascular embolization is the treatment of choice for Carotid-Cavernous Fistulas (CCFs), but rarely catheterization of the cavernous sinus via venous or arterial pathway is not possible. The authors present one of such cases in which a straightforward route to the CCF. The route was accessed via endoscopic trans-spheroidal puncture of the cavernous sinus with aseptic procedure.

This 58-year-old woman presented with chemosis of left eye and left frontal excruciating headache. Digital Subtraction Angiography (DSA) revealed a Type D CCF. Regurgitation of left superior ophthalmic vein and cortical veins were noted. There were no patent sinuses or venous plexuses connecting to the CCF except for the right inferior petrosal sinus. The CCF could not be embolized with a trans-venous approach, we therefore created a direct access to the CCF with an endoscope-assisted transsphenoidal puncture. Embolic agents were deployed through the puncture needle to achieve complete obliteration. Endoscope-assisted transsphenoidal puncture of the cavernous sinus is a feasible alternative to treat difficult-to-access CCFs. For concern risk of infection, we present a relative aseptic “double sheath” technique to access to CCF via endoscopic transsphenoidal approach.

Keywords: Carotid-cavernous fistula; Embolization; Endonasal; Endoscope; Endovascular; Trans-sphenoidal approach.

Abbreviations:

- CCFs: Carotid-Cavernous Fistulas
- ICA/ECA: Internal Carotid Artery/External Carotid Artery
- CS: Cavernous Sinus
- SOV: Superior ophthalmic vein
- CTA: Computerized tomographic angiography
- DSA: Digital subtraction angiography
- NBCA: N-butyl 2-cyanoacrylate

Introduction

Carotid-Cavernous Fistulas (CCFs) are pathologic arteriovenous shunts between the Internal Carotid Artery/External Carotid Artery (ICA/ECA) and the Cavernous Sinus (CS). These abnormal communications cause retrograde venous congestion that results in ophthalmic symptoms and intracranial haemorrhage.

The Barrow classification divides CCFs into 4 categories: Type A, a direct high-flow shunt between the ICA and the CS; and Types B, C, and D, which are indirect low-flow Dural shunts with arterial feeders from meningeal branches of the ICA, ECA, both ICA and ECA, respectively.

Endovascular therapy is the gold standard treatment of CCFs. Access to CCFs can be approached both via the inferior petrosal sinus or Superior Ophthalmic Vein (SOV) and through the trans arterial catherization of the feeders. Access through these routes can sometimes be difficult due to different anatomies such as vascular tortuosity, hypoplasia or stenosis. For direct embolization of CCFs, transsphenoidal approaches have been described in the literatures. (List on discussion section).

A recent case report described an endoscopic endonasal transsphenoidal approach for direct puncture of the CS in a neurosurgical hybrid operating room [1]. We treat a patient with CCF operated similarly but some modified technique using a relative aseptic route.

Case Presentation

History and Presentation

This 58-year-old woman with a medical history of hypertension, suffered from aggravating frontal headaches, progressive left eye redness and blurred vision for 6 months. The patient denied history of trauma. On physical examination, the patient presented with left eye chemosis and conjunctival injection. Bilateral extraocular movements were intact. The remainder of the cranial nerve examination was unremarkable.

Radiological study

Brain Computerized Tomographic Angiography (CTA) ordered by the ophthalmologist showed early pacification of the left cavernous sinus and an engorged cortical vein. Her digital subtraction angiography (DSA) confirmed the diagnosis of an indirect CCF, Barrow Type D, with feeding arteries arising from branches of the bilateral internal maxillary artery, bilateral middle meningeal artery and dural branches from right ICA. Engorged retrograde cortical veins were also noted. The left inferior petrosal sinus, superior petrosal sinuses, basilar plexus, and pterygoid plexus were not patent except for the right inferior petrosal sinus (Figure 1).

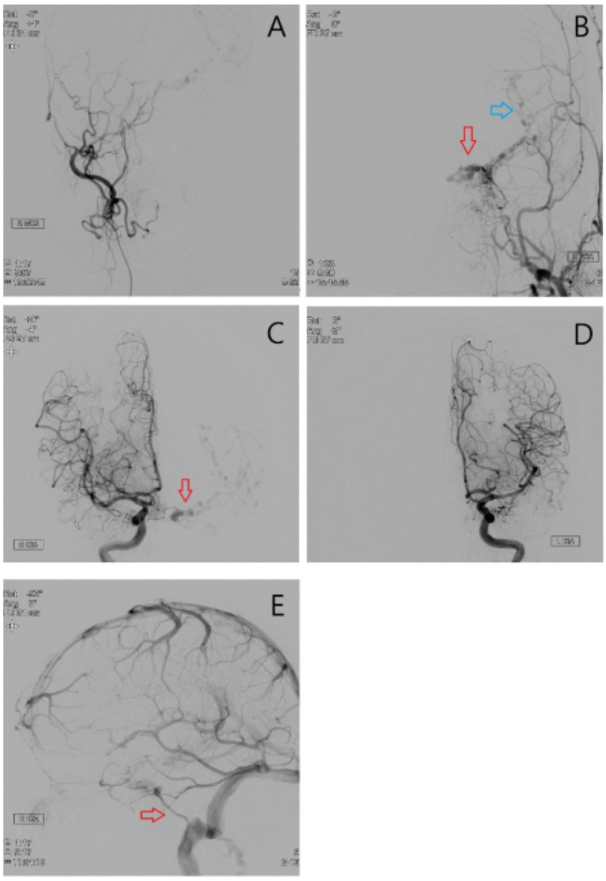

Figure 1: DSA revealed a Type D CCF on the left side. A: In the anteroposterior view and arterial phase of right ECA B. arterial phase of left ECA, the red arrow indicates a CCF located medial to the left ICA, the blue arrow indicates retrograde cortical veins C: arterial phase of right ICA, CCF was noted. D: arterial phase of left ICA E: lateral view and venous phase of right ICA, the red arrow indicates our available venous route to this CCF

Operation and Embolization

Attempts to reach the fistula site by cannulating both the left and right inferior petrosal sinuses and left ophthalmic vein were unsuccessful due to either vascular tortuosity or stenosis.

Under general anaesthesia, the patient was placed supine with his head fixed using a head holder and pins. A simple endoscopic endonasal transsphenoidal approach was performed to get access to the cavernous sinus. We employed a double sheath technique to keep the intervention less contaminated (relatively aseptic).

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This procedure was performed through the right nostril by the neurosurgeon (2-hand technique) using a neuro endoscope (outer diameter of 4 mm; angle of zero degree).

Both the right and left sphenoid ostia were enlarged to expose the seller floor and left carotid prominence. We chose the entry point to the left cavernous sinus using a neuro navigation system based on the patient's CTA (Figure 2). A three millimetre hole was made on the seller floor where the entry point was and the dura was exposed. An 8-Fr. sheath was attached to the dura with tissue glue (DuraSeal®Dural Sealant System). In order to keep the sheath in place, we also sutured the anchor of the sheath

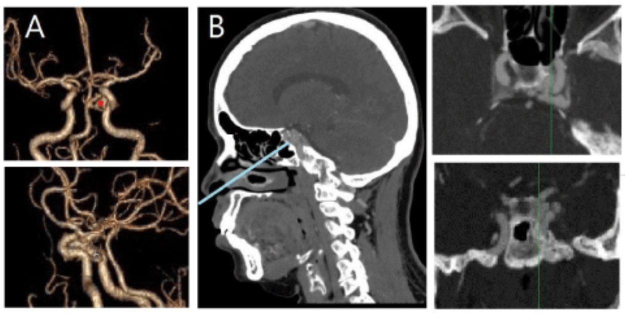

Figure 2: CTA demonstrating the entry point of trans-sphenoidal approach A: 3D anteroposterior view of the left CS region, the red dot indicates our entry point. B: With a cross-referencing tool, the location of the lesion could be confirmed, which helped us plan the surgical trajectory.

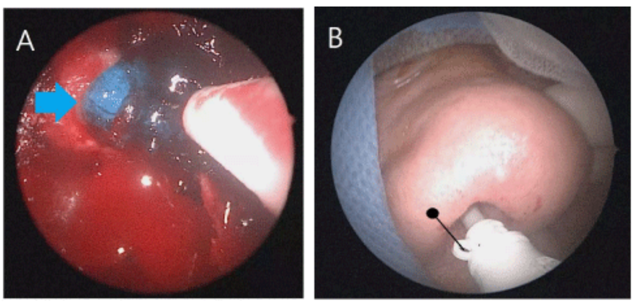

Figure 3: Intra-operative photo demonstrated fixation between 8-Fr. sheath and A.dura (DuraSeal®Dural Sealant System, blue arrow) B. nasal skin (with suture, black dot)

Figure 4: Skull x-ray demonstrating our "double sheath" technique in A. anteroposterior view B. lateral view. C. Contrast was injected through the needle into the before transportation to angiographic room.

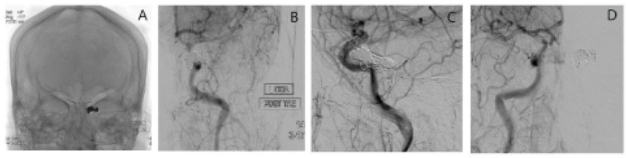

Figure 5: Post-embolization angiography. A,B and C: In the anteroposterior and lateral views of left CCA (common carotid artery), no filling of the CCF is seen in the arterial phase. D: In the lateral views of right CCA, no filling of the CCF is seen in arterial phase.

to the nasal septum (Figure 3). The lumen of the sheath was sterilized with beta-iodone and rinsed with normal saline. Then, a 5-Fr. coaxial introducer needle was used to puncture the left cavernous sinus. A second 5-Fr sheath was introduced with the help of a guide wire (Figure 4) Direct angiography through the sheath ensured its proper position (Figure 4).

The patient was then transferred to the angiography room for embolization. A micro catheter was inserted through the 5-Fr. Angio catheter to deploy platinum framing coils into the CS. After the CCF was densely packed with coils, N-butyl 2-cyanoacrylate (NBCA) 50% was injected to seal the punctured hole on the dura.

The micro catheter, angio catheter and the 5-Fr. Sheath were removed at the same time. A follow-up angiogram showed complete obliteration of the CCF (Figure. 5). The 8-Fr. sheath was then removed.

Postoperative course

There were no procedure-related complications except for a temporary diplopia. The patient's chemosis and headache resolved completely a week after the procedure. She had no diplopia at 1-month follow-up.

Discussions

Indications for treatment of patients with CCF include progressive or disabling symptoms, cosmetic deformity, frank intracranial hemorrhage, and retrograde cortical venous drainage. Our patient presented with left chemosis and left-sided headache, symptoms commonly associated with retrograde ophthalmic and cortical venous drainage.

Endovascular therapy is the mainstay treatment of CCF in current practice. Both transarterial and transvenous approaches have been used. Transvenous route from the ipsilateral inferior petrosal sinus to the cavernous sinus is the most preferred approach. Occasionally, venous tortuosity, stenosis and thrombosis impede the catheterization of the inferior petrosal sinus. Hence, the interventionist may choose other access routes such as the contralateral inferior petrosal sinus through the intercavernous sinus, superior petrosal sinus, the basilar plexus, the clival venous plexus and the pterygoid plexus. In our case, cannulation from the contralateral inferior petrosal sinus to the left cavernous sinus was difficult due to narrowing of the intercavernous sinus. A transarterial approach is less frequently used because of the difficulty in access to the small-calibered arterial feeders and the risk of compromising the blood supply to cranial nerves.

In such cases, direct cannulation of the superior ophthalmic vein via surgical cutdown [2] or direct puncture of the cavernous sinus can be considered. Several methods of puncture have been reported. These include introducing needles into the cavernous sinus through a craniotomy [3], percutaneous transorbital [4], transmaxillary transsphenoidal approaches [5], transethmoidal transsphenoidal exposure of the medial wall of the cavernous sinus [6], direct puncture through the foramen ovale [7].

However, the aforementioned approaches are complicated and many complications have been reported. If the superior ophthalmic vein is not dilated or if it is located deep in the orbit, a transorbital venous access may not be possible [8]. The potential risks of transorbital punctures include orbital hemorrhage, nerve damage, and laceration of the internal carotid artery resulting in direct CCF, globe puncture and infection [9].

Pan HC et. al reported that 90% of patients achieved an obliteration rate and a 85 % of patients showed clinical improvement rate in radiosurgical treatment of dural CCFs. Adverse events including 1 patient with optic neuritis (GKS group), 1 intracranial hemorrhage (XKnife group), 1 brainstem edema (XKnife), and 3 temporal lobe radiation edemas (XKnife) [10]. The continued symptoms and risk of hemorrhage during the latency period are the drawbacks of this modality [11].

Endoscopic transphenoidal surgery is a promising approach for pituitary and skull base tumours. Moreover, direct and precise localization of cavernous sinus is quick and easy with the guidance of neuronavigation system. Tsuei et al. reported a patient with CCF treated by endoscope-assisted transphenoidal embolization in a hybrid operating room. Entry point of cavernous sinus was chosen under endoscopic visualization and neuronavigation system.1 The following coiling was uneventful and complete obliteration of the CCF was achieved. However, patient transportation is a problem when there is no hybrid operating room for this approach. In our case, endoscopic-assisted transphenoidal puncture was performed in operation room and the patient was transferred to an interventional angiography room for the following embolization. We develop a secure way to avoid detachment during transportation. The tip of the introducer sheath was secured with sealant and the anchor was fixed to nasal septum to ensure adequate fixation during the transportation.

Intracranial infection is another issue with this approach as nasal cavity is a contaminated space. The infection rate is even higher because these patients are given embolic agents into the fistula repeatedly. We described a

"double sheath technique" which creates a more hygienic field before needle puncture and insertion of introducer catheter into the cavernous sinus. We believe this technique can make this approach safer in terms of reducing infection rate. Further cases should be collected to evaluate reliable infection rate.

Conclusions

Endoscopic transphenoidal embolization is a direct and safe approach for patients with carotid-cavernous fistulae in which conventional trans venous route is not feasible. With proper fixation of the introducer sheath, this method can be used in an ordinary operating room instead of a hybrid one. The chance of intracranial infection might be lowered with the "double sheath" isolating technique. We share our know-how on fixation of the sheath at transportation and a relative aseptic "double sheath" technique to decrease procedure-related complications.

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