

Balloon Assisted Transvenous Coil Embolization of Posttraumatic Direct Carotid-Cavernous Fistula with the Successful Outcome: A Case Report

Shailendra Katwal¹, Dinesh Chataut², Sundar Suwal², Sushmita Bhandari³,
Aastha Ghimire⁴

¹Department of Radiology, Dadeldhura Subregional Hospital, Dadeldhura, Nepal

²Department of Intervention Radiology, Tribhuvan University Teaching Hospital, Kathmandu, Nepal

³Department of Medicine, Shankar Nagar Health Post, Butwal, Nepal

⁴Department of Medicine, Patan Academy Of Health Sciences, Lalitpur, Nepal

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ABSTRACT

A carotid cavernous fistula (CCF) is an abnormal connection between the internal carotid artery and the cavernous sinus. This case pertains to a 19-year-old male who presented with left periorbital swelling following a road traffic accident and was found to have direct CCF on imaging. The patient underwent balloon-assisted transvenous embolization, with access to the fistula being gained through the femoral vein and the inferior petrosal sinus. The use of coils successfully blocked the fistula, leading to the resolution of symptoms without any complications. This case underscores the significance of a multidisciplinary approach and the effectiveness of balloon-assisted embolization.

Keywords: *Cavernous Sinus; Femoral Vein; Young Adult*

INTRODUCTION

A carotid cavernous fistula (CCF) is an abnormal vascular connection between the internal carotid artery and the cavernous sinus. CCFs can be classified in various ways, one of which is based on their source, whether they originate directly from the internal carotid artery (direct type) or the dural branches of the internal carotid artery (indirect type).¹

According to Barrow's classification, Type A CCF represents direct communication and is characterized by high blood flow. Types B, C,

and D fall into the indirect category, where the communication occurs with the dural branches of the external and internal carotid arteries. Type B involves communication with the dural branch of the internal carotid artery, while Type D involves communication with the dural branches from both external and internal carotid arteries. This communication can result in venous overload, leading to venous congestion syndrome, which manifests as symptoms like eye congestion, proptosis, a red eye, nerve compression, and hemorrhage. Endovascular embolization is the

Correspondence to: Dr. Shailendra Katwal

Department of Radiology

Dadeldhura Subregional Hospital

Dadeldhura, Nepal

Email: shailendrakatwal@gmail.com



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first-line treatment for the carotid-cavernous fistula.^{2,3}

CASE REPORT

A 19-year-old male presented with left periorbital swelling persisting for four months following a road traffic accident. The patient underwent surgery to repair a mandibular fracture. During the neurological examination, he exhibited normal levels of consciousness and intact sensory and motor functions. Upon orbital examination,

proptosis of the left eye, conjunctival congestion, and dilated blood vessels were observed. Laboratory tests for blood count and renal function yielded results within normal ranges. Magnetic resonance imaging and magnetic resonance angiography revealed the enlargement of the left cavernous sinus and the cavernous segment of the left internal carotid artery, demonstrating direct communication between them (Figure 1a, b, and c).

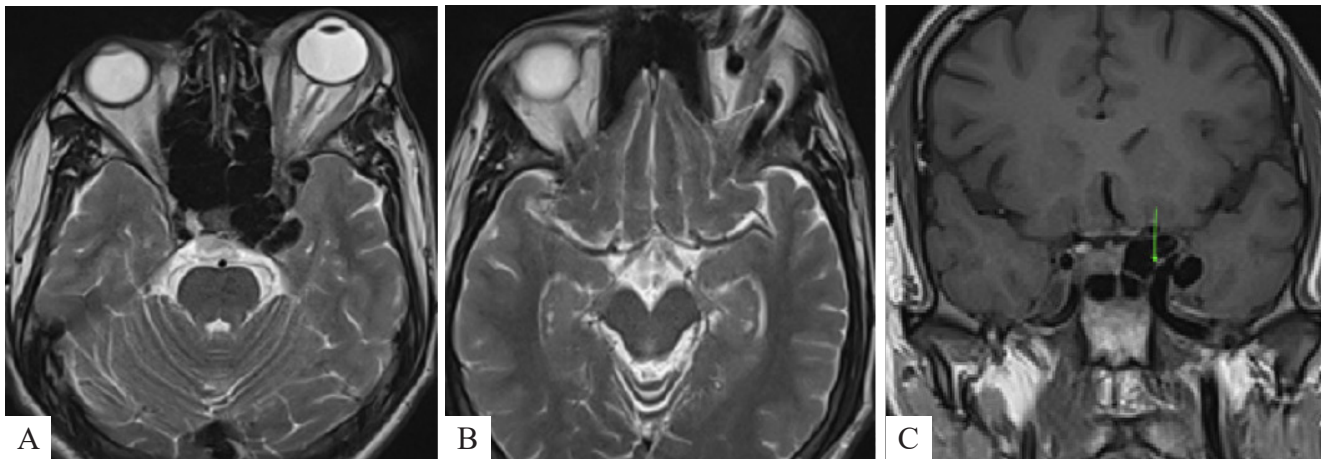


Figure 1: a) T2-weighted axial MRI image, taken at a cerebellopontine level, illustrates the enlargement of the left cavernous sinus with increased convexity and a tortuous internal carotid artery. The left eyeball is protruded, and there is edematous soft tissue b) T2-weighted axial MRI image at the midbrain level, the left superior ophthalmic vein is prominently visible (white arrow), and there is a flow void c) T1-weighted coronal MRI image displays a direct communication (green arrow) between the tortuous left internal carotid artery and the enlarged left cavernous sinus.

Digital subtraction angiography, conducted four days after admission, revealed early opacification of the left cavernous sinus, inferior petrosal sinus, and superior ophthalmic vein (Figure 2a). The direct carotid-cavernous fistula on the left, situated between the inferior aspect of the horizontal part of the left C4 segment of the internal carotid artery and the cavernous sinus, was prominently visible. Subsequently, the patient was referred to the radiology department for further intervention.

Both the right femoral artery and veins were punctured, and a 6F guiding catheter was positioned with its tip in the cervical segment of the left internal carotid artery. A microcatheter was then threaded through the guiding catheter, with its tip

reaching the posterior section of the C4 segment of the left internal carotid artery. To prevent coil migration through the arterial circulation, a non-detachable balloon was deployed at the arterial end of the fistula.

The guiding catheter and microcatheter traversed through the femoral vein to the internal jugular vein and continued through the inferior petrosal sinus to the cavernous sinus (Figure 2b). Road mapping was utilized to identify the vein accurately. Three coils were released into the cavernous sinus via the microcatheter, which had been positioned in the left inferior petrosal sinus. Post-embolization angiography confirmed the complete occlusion of the carotid-cavernous fistula (Figure 2c).

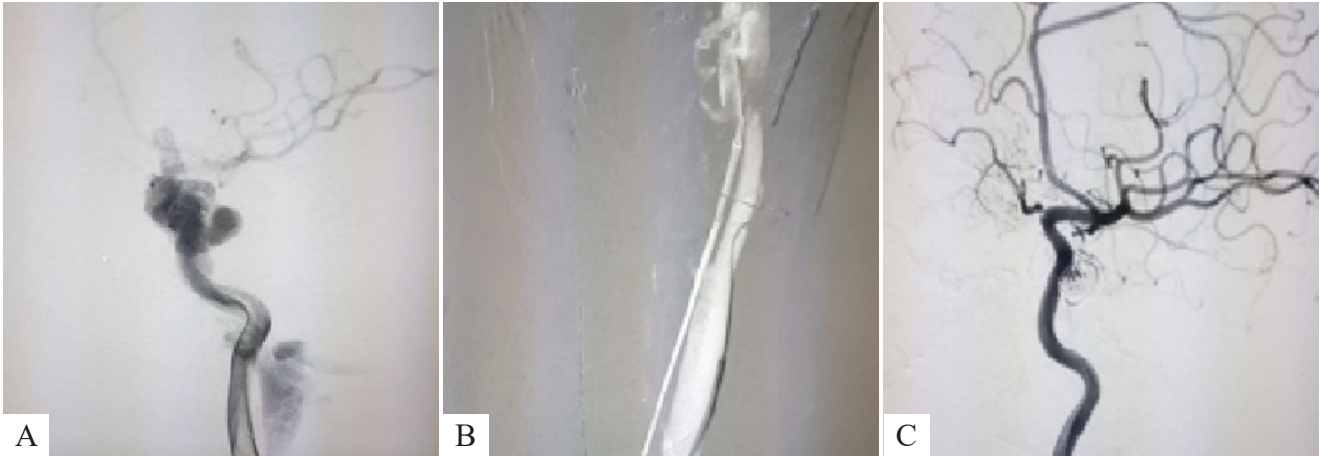


Figure 2: *a) DSA image with the catheter tip positioned within the internal carotid artery, revealing the early opacification of the cavernous sinus. b) DSA image displaying the catheter with a guidewire in the C4 segment of the internal carotid artery. Another guiding catheter advanced to the cavernous sinus through the internal jugular vein. c) Post-coil embolization angiography showing the coil, confirming the complete occlusion of the carotid-cavernous fistula*

The procedure proceeded without any complications, and there were no observed post-operative issues. The patient's vision returned to normal, and the swelling in the left eye had

resolved (Figure 3a & b). His neurological condition remained intact. After spending nine days in the hospital following the surgery, he was discharged in a stable condition.

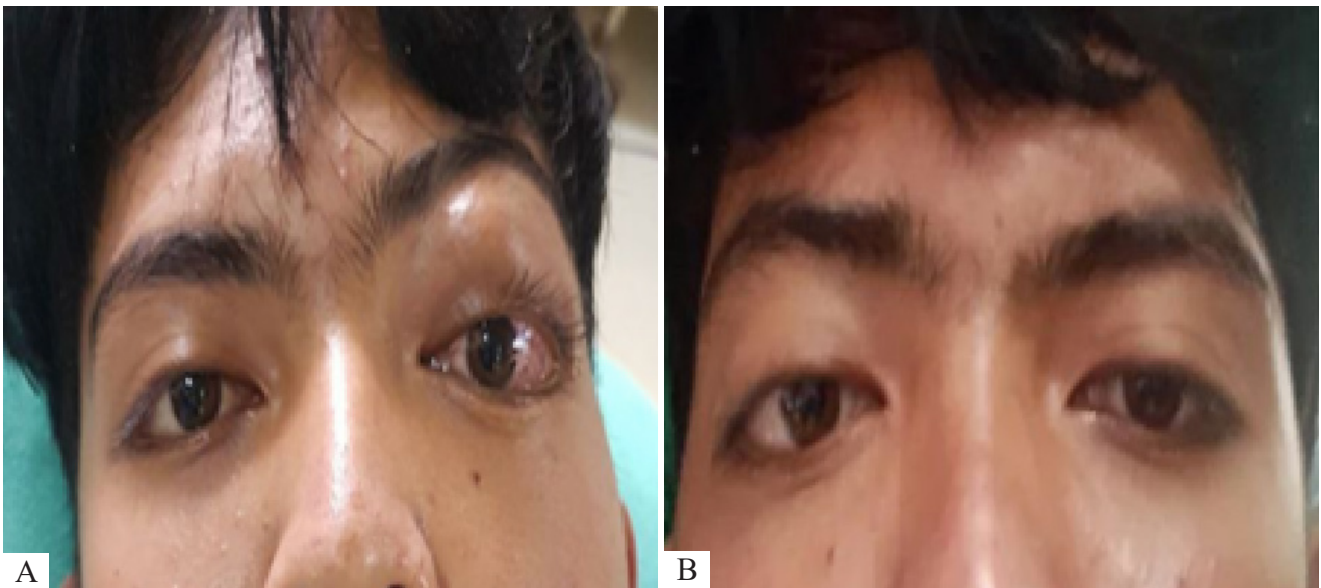


Figure 3: *a) Left periorbital swelling and conjunctival chemosis before embolization. b) Post-embolization image after one year demonstrating the absence of left periorbital swelling and conjunctival chemosis. Patient consent has been obtained for the use of these images*

DISCUSSION

Carotid-cavernous fistula (CCF) refers to abnormal connections between the carotid artery and the cavernous sinus. The trans-arterial approach is typically employed for high-flow

direct CCF cases, while the transvenous approach is favored for the indirect type, even in situations with complex vascular anatomy. The transvenous approach has demonstrated higher success rates and a safer profile.⁴

CCF can be categorized based on the venous drainage site within the cavernous sinus, according to Thomas et al. The inferior petrosal sinus is a commonly chosen route due to its direct and short course. In cases where the inferior petrosal sinus is inaccessible, alternative routes, such as the facial vein or ophthalmic vein, may be selected.^{2,5} Balloon-assisted coiling has proven to be a safe and effective technique for treating direct CCF.⁶ The described case involved a multidisciplinary approach. It began with the maxillofacial surgeon addressing a mandibular fracture, followed by neurosurgery evaluation and embolization performed by the interventional radiologist. Transvenous access via the femoral vein and the inferior petrosal sinus was established, along with trans-arterial access for balloon assistance. The decision to use coil embolization was based on prior experience, and the patient has remained asymptomatic after one year of monitoring.

CONCLUSION

A comprehensive approach that includes angiographic and magnetic resonance imaging is essential for the accurate diagnosis and management of carotid-cavernous fistula (CCF). Balloon-assisted transvenous embolization is highly effective in preventing coil migration and enhancing the visualization of the internal carotid artery. Despite the technical challenges posed by the femoral vessels, intra-arterial balloon assistance proves to be a valuable technique in treating CCF.

CONFLICT OF INTEREST

None

SOURCES OF FUNDING

None

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