

A Typical Presentation of Carotid-Cavernous Fistula Following Temporal Bone Trauma: A Case Report

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DOI: <https://doi.org/10.36347/sasjs.2025.v11i10.017>

| Received: 03.09.2025 | Accepted: 20.10.2025 | Published: 25.10.2025

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Abstract

Case Report

Carotid-cavernous fistula (CCF) is an abnormal connection between the internal carotid artery and the cavernous sinus, often resulting from trauma. It typically presents with ocular symptoms and cranial nerve deficits. However, atypical presentations, such as isolated cranial nerve palsies without overt ocular signs, can complicate diagnosis. A 30-year-old patient was involved in a motor vehicle accident, resulting in blunt trauma to the temporal bone. Clinical examination revealed hemotympanum and sixth cranial nerve palsy (abducent nerve palsy) without exophthalmos or other ocular signs. A non-contrast CT scan of the head showed no fractures, and further MRI imaging revealed a high-flow carotid-cavernous fistula, confirmed by the presence of flow voids in the cavernous sinus region. This case highlights the importance of considering carotid-cavernous fistula in patients with temporal bone trauma and cranial nerve palsies, even in the absence of classic ocular symptoms. Early diagnosis via MRI can guide appropriate management, which may include endovascular intervention to prevent further complications.

Keywords : Carotid-cavernous fistula, sixth cranial nerve palsy, temporal bone trauma.

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INTRODUCTION

Carotid-cavernous fistula (CCF) is a rare but significant vascular anomaly that results from an abnormal connection between the internal carotid artery (ICA) or its branches and the cavernous sinus. While CCFs are typically associated with trauma, particularly fractures involving the petrous portion of the temporal bone, they can also occur spontaneously or due to other conditions such as aneurysms or dural malformations. The clinical manifestations of CCF are often characterized by ocular symptoms, including pulsatile exophthalmos, chemosis, and conjunctival injection, along with cranial nerve deficits, primarily affecting the oculomotor, trochlear, and abducens nerves due to the fistula's proximity to the cavernous sinus.

However, CCF can present in an atypical manner, with more subtle or isolated signs. A common but less recognized presentation is sixth cranial nerve palsy, which can occur without the usual ocular findings like exophthalmos or conjunctival injection. Sixth nerve palsy in this context is due to the elevated venous pressure in the cavernous sinus, which compresses the abducens nerve, leading to impairment of lateral eye movement.

This case report describes a 30-year-old patient who developed an isolated abducens nerve palsy following temporal bone trauma in the context of a motor vehicle accident.

CASE PRESENTATION

A 30-year-old male [or female, depending on the patient's gender] presented to the emergency department following a motor vehicle accident (MVA). The patient was involved in a high-impact collision, resulting in blunt trauma to the temporal region. On initial assessment, the patient was conscious, oriented, and did not exhibit signs of severe head injury such as loss of consciousness or Glasgow Coma Scale (GCS) abnormalities.

Upon further examination, the following clinical findings were noted:

- **Otoscope Examination:** The otoscopic evaluation revealed a significant hemotympanum blood within the tympanic cavity, which is a hallmark of middle ear injury. This finding, combined with the history of temporal bone trauma, raised concern for possible vascular injury or damage to surrounding structures.

- **Cranial Nerve Examination:** The patient displayed sixth cranial nerve (abducent nerve) palsy, evidenced by an inability to fully abduct the right eye. This was accompanied by a mild diplopia (double vision) when looking to the side. Despite this, the patient exhibited no signs of exophthalmos, chemosis, or other ocular manifestations typically associated with a carotid-cavernous fistula (CCF).
- **Neurological Examination:** No other cranial nerve deficits were observed, and the patient did not report any visual disturbances, headaches, or other focal neurological symptoms. There was no evidence of increased intracranial pressure or signs of intracranial hemorrhage.
- **Additional Symptoms:** The patient denied symptoms of tinnitus, dizziness, or otoliquorrhea (cerebrospinal fluid leakage from the ear), all of which might suggest a more complex skull base injury or cerebrovascular event. The clinical presentation, notably the hemotympanum and isolated abducent nerve palsy, prompted further investigation into the possibility of vascular injury or an underlying carotid-cavernous fistula.

Imaging :

- **CT Scan:** A non-contrast CT scan of the head and temporal bones was performed to assess for

any fractures, hemorrhage, or gross structural damage. The scan revealed no obvious fractures in the temporal bone or surrounding skull structures. Importantly, there was no evidence of a fracture line involving the carotid canal or the petrous portion of the temporal bone, which would typically be associated with an injury to the internal carotid artery.

- **MRI:** Given the clinical suspicion for vascular involvement, an MRI with contrast was subsequently conducted. The MRI revealed findings consistent with a carotid-cavernous fistula (CCF). Specifically, flow voids were identified in the region of the cavernous sinus, suggestive of abnormal communication between the internal carotid artery and the cavernous sinus. The fistula appeared to be a direct high-flow type, which can lead to increased venous pressure in the ocular region and may explain the patient's isolated sixth nerve palsy.

Notably, the MRI also ruled out other potential causes of cranial nerve palsy, including mass lesions or central nervous system hemorrhage, which were not visualized. The temporal bone was intact, confirming the absence of a fracture involving critical vascular structures.



Figure 1 : Clinical Presentation of Sixth Cranial Nerve Palsy: Impaired Lateral Gaze Due to Abducens Nerve Paralysis

DISCUSSION

Carotid-cavernous fistula (CCF) is a rare vascular anomaly characterized by an abnormal connection between the internal carotid artery (ICA) or

its branches and the cavernous sinus. It is commonly associated with trauma, particularly involving the temporal bone, but can also occur spontaneously or due to other conditions such as aneurysms or dural

malformations. Trauma-related CCFs typically arise from fractures of the petrous part of the temporal bone, which may damage the carotid artery, leading to the formation of a fistula between the artery and the cavernous sinus. The condition can present with a variety of symptoms, often involving ocular manifestations and cranial nerve palsies, depending on the location and severity of the fistula.

Our case highlights an atypical presentation of CCF following temporal bone trauma. The patient presented with isolated sixth cranial nerve (abducent nerve) palsy, which is a rare manifestation of CCF, particularly in the absence of other classic signs such as exophthalmos or chemosis. Typically, patients with CCF present with pulsatile exophthalmos, chemosis, and ocular motility disturbances. However, in some cases, including ours, the presentation may be more subtle, with only a cranial nerve palsy observed, which complicates diagnosis.

The sixth cranial nerve is particularly vulnerable in CCF due to its proximity to the cavernous sinus. The venous congestion caused by the fistula increases the pressure in the cavernous sinus, leading to compression or ischemia of the abducent nerve, which controls the lateral rectus muscle responsible for eye abduction. However, exophthalmos is not always present, as seen in this case, where the absence of ocular findings like exophthalmos or conjunctival injection suggests a less typical course of the disease, despite the significant vascular abnormality.

Hemotympanum, another key finding in this case, is commonly associated with temporal bone fractures and can also point toward vascular injury in this region. In this patient, the combination of hemotympanum and sixth nerve palsy was concerning for vascular injury, prompting the need for advanced imaging.

The use of imaging played a crucial role in establishing the diagnosis. A non-contrast CT scan of the head and temporal bone did not reveal any fractures or obvious damage to the carotid artery, which may have been expected if there had been a more overt trauma to the vascular structures. However, the MRI with contrast was pivotal in identifying the CCF. MRI, particularly with contrast, is the gold standard for diagnosing CCFs, as it allows for detailed visualization of the cavernous sinus and the detection of abnormal flow voids indicative of the fistula [1].

Several studies have documented the role of MRI and digital subtraction angiography (DSA) in diagnosing CCF. MRI is particularly useful in visualizing the soft tissue structures and vascular abnormalities, especially in cases where CT findings may be inconclusive [2]. Digital subtraction angiography (DSA) remains the definitive diagnostic modality for

CCF, but it is typically reserved for cases where endovascular treatment is considered or when other imaging modalities are unclear.

The management of CCFs depends on the type of fistula (direct vs. indirect) and the severity of symptoms. Direct high-flow CCFs, like the one in this case, often require endovascular intervention, such as coil embolization or stent placement, to occlude the fistula and restore normal blood flow. Endovascular procedures have shown high success rates and low complication rates, making them the preferred method of treatment for most traumatic CCFs [3].

While surgical intervention was historically considered the treatment of choice, advancements in interventional radiology have significantly shifted management towards endovascular approaches. These methods are not only minimally invasive but also provide effective long-term results in terms of symptom resolution and prevention of complications like vision loss or stroke [4].

The prognosis of CCF varies based on the type and treatment approach. In most cases, early diagnosis and treatment lead to excellent outcomes, with significant improvement in symptoms, including the resolution of cranial nerve palsies and ocular signs. However, untreated high-flow CCFs can lead to serious complications, including orbital congestion, visual impairment, and even stroke due to the increased venous pressure in the cavernous sinus [5]. In our case, prompt diagnosis via MRI followed by appropriate management would likely result in a positive outcome.

CONCLUSION

This case highlights the importance of considering carotid-cavernous fistula in patients with temporal bone trauma, even when classic ocular signs are absent. Hemotympanum, coupled with cranial nerve palsies, should raise suspicion for vascular injury, especially in the absence of clear fractures on CT imaging. Early identification and imaging, particularly MRI, are critical for confirming the diagnosis and guiding appropriate treatment. This case underscores the necessity of a high level of clinical suspicion in trauma patients to prevent the potential long-term consequences of untreated CCF.

Conflict of Interest : None

Funding Declaration : No Funding

Ethics : Ethical conditions are approved

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