Endoscopic Endonasal Repair of Cerebrospinal Fluid Leakage Caused by a Rare Traumatic Clival Fracture

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Abstract

An 89-year-old male presented with cerebrospinal fluid (CSF) rhinorrhea associated with head trauma sustained as a pedestrian in a traffic accident. Computed tomography (CT) showed pneumocephalus and multiple cranial bone fractures, including the clivus. Although the CSF rhinorrhea was treated conservatively for a week, clinical symptoms did not improve and surgical repair was performed. Preoperative thin-sliced bone CT and steady-state magnetic resonance images revealed a bone defect at the middle clivus and a collection of CSF fluid from the clival fistula in the sphenoid sinus. Endoscopic endonasal reconstruction was performed, and the 3-mm diameter dural tear and bone defect at the middle clivus were well visualized. The fistula was repaired using a pedicled nasoseptal mucosal flap. The CSF rhinorrhea completely disappeared as a result of the endoscopic endonasal surgery. The present report describes a rare case of CSF rhinorrhea caused by a traumatic clival fracture and surgical management by endoscopic endonasal surgery.

Key words: cerebrospinal fluid rhinorrhea, clival fracture, endoscopy, head trauma

Introduction

Cerebrospinal fluid (CSF) leakage is a medical condition originating from the breakdown of a physical barrier composed of the skull base bone and dura mater, resulting in abnormal release of CSF from the arachnoid space into an extracranial component.¹

Because CSF leakage carries the potential risk of ascending infection, which may cause critical meningitis, appropriate diagnosis and treatment are essential. Surgical intervention is required when CSF leaks do not resolve with conservative treatment.²⁻⁴

CSF leakage usually occurs following traumatic skull-based fractures, and common locations of such fractures are the anterior skull base, including the cribriform plate; the roof of the sphenoid sinus; and the posterior wall of the frontal sinus.¹⁻³ In contrast, CSF leakage due to a traumatic clival fracture is very rare and has scarcely been described to date.⁵ Herein, we report a rare case of CSF leakage caused by a traumatic clival fracture and successful surgical management by endoscopic endonasal surgery.

Case Report

An 89-year-old male pedestrian injured in a traffic accident during a daily jog was admitted to our hospital. On admission, CSF rhinorrhea was observed and physical examination revealed bruises in the frontal and occipital regions of the head. Glasgow Coma Scale (GCS) was 15 and no cranial nerve deficits were seen. Computed tomography (CT) revealed severe pneumocephalus, traumatic subarachnoid hemorrhage, and multiple occipital bone fractures, including the clivus. The CSF rhinorrhea was treated conservatively by intravenous administration of broad-spectrum antibiotics and bed rest for a week; however, CSF rhinorrhea continued without improvement and disturbance of consciousness deteriorated (GCS 11: E3, V3, M5) with the progress of bacterial meningitis. Thus, surgical repair was performed. Preoperatively, thin-sliced bone CT (Fig. 1A) and steady-state magnetic resonance imaging (MRI; Fig. 1B) were performed, which identified the fistula causing the CSF leakage. The axial CT bone image showed a bone defect at the middle clivus, and a free bone fragment in the sphenoid sinus (Fig. 1A). Moreover, the continuity of CSF between the sphenoid sinus and prepontine cistern was clearly demonstrated.
endoscopic procedure, CSF rhinorrhea completely disappeared, and the clival defect and fluid collection in the sphenoid sinus had improved on MR imaging (Fig. 3A, B). The patient was allowed out of bed and recovered enough to be able to ambulate independently. He was transferred to a rehabilitation hospital for further recovery.

Discussion

Traumatic clival fractures are rare because of their deep anatomic location in the skull base, and typically result from a severe mechanism of injury; the incidence is reported to be between 0.21% and 0.56% of all traumatic head injuries. The majority of clival fractures are demonstrated as linear fractures on CT and can be classified into three types: longitudinal, transverse, and oblique. Additionally, clival fracture cases are associated with a high mortality rate (38.5%) due to primary brainstem damage, brain herniation from associated injuries, or vascular complications of the carotid, basilar, and vertebral arteries. On the other hand, reports of traumatic clival CSF leakage are extremely rare. Non-traumatic clival CSF rhinorrhea has also been reported. The most frequent cause of non-traumatic clival CSF rhinorrhea is considered to be meningoencephalocele, which is a congenital malformation of the skull base. Moreover, there have been reports of spontaneous CSF rhinorrhea due to a vulnerable clival bone in relation to either obesity, benign intracranial hypertension, continuous basilar artery pulsation, or advanced aging.

In the present case, the fracture was not able to be categorized into one of the three types of clival fractures, localized around the spheno-occipital synchondrosis, and showed a round-shaped defect rather than a linear fracture. Moreover, this patient presented with CSF...
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rhinorrhea only, without major brain injury or vascular complications. We hypothesized that this CSF leakage was related to vulnerable clival bone conditions, which included a well-pneumatized sphenoid sinus, advanced age, and the neighboring sphenoid-occipital synchondrosis. The skull base probably sustained a relatively minor injury. Nevertheless, as the clival bone is fragile, this may have resulted in an uncommon clival fracture and subsequent CSF leakage. We found no reported cases of CSF rhinorrhea alone caused by a traumatic clival fracture.

Regarding surgical treatment, endoscopic endonasal repair of the CSF leak was performed using a vascularized nasoseptal mucosal flap. As endoscopic endonasal surgery has developed,27-29 this method of endoscopic repair has been popularized as a reliable technique for closure of a leaking fistula from the anterior midline skull base.30-32 In the present case, the fistula was clearly identified under superb endoscopic view, even in the deepest area of the skull base, and effective repair was accomplished with a minimally invasive technique.

Hydrocephalus is the most influential factor leading to recurrence of CSF leak after endoscopic endonasal repair.23 The patient in the present case was at high risk for hydrocephalus due to traumatic subarachnoid hemorrhage, bacterial meningitis, and advanced age. Therefore, external lumbar drainage was placed, and post-operative CSF dynamics were carefully observed. Fortunately, hydrocephalus did not develop, and further CSF management such as ventriculoperitoneal shunting was not needed. In addition to excellent surgical technique, post-operative CSF management is important for patients who are at risk for hydrocephalus to ensure successful endoscopic endonasal repair of traumatic CSF leakage.

Conclusion

In conclusion, CSF rhinorrhea associated with traumatic clival fracture is very rare, and preoperative evaluation by bone CT and steady-state MRI sufficiently demonstrated this rare condition. Endoscopic endonasal surgery provides a minimally invasive technique for successful repair of CSF leakage due to traumatic clival fracture.

Conflicts of Interest Disclosure

The authors have no conflicts of interest to disclose. All authors who are members of The Japan Neurosurgical Society (JNS) have registered online using the self-reported COI Disclosure Statement Forms through the website for JNS members.

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