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Endoscopic repair of cerebrospinal fluid rhinorrhea in a tertiary centre

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ABSTRACT

Background: Cerebrospinal fluid (CSF) rhinorrhea results from a skull base defect with disruption of the arachnoid, dura mater, and sinonasal mucosa, leading to CSF leakage through the nose. The purpose of this study was to compare CT and MRI findings and CSF leak location, and to evaluate the role of endoscopic repair in improving outcomes.

Methods: We retrospectively evaluated thirty patients with CSF leaks between January 2016 and August 2025, analyzing treatment decisions, the endoscopic endonasal approach, and neurosurgical outcomes.

Results: Twenty-two patients (14 male, 8 female) with CSF rhinorrhea underwent endoscopic endonasal skull base repair during the study period. Clinical features included headache in two-thirds of patients (n = 14, 63%), frequent meningitis (n = 6, 28%), focal neurologic symptoms (n = 5, 23%), and epileptic seizures (n = 5, 23%). The most common sites of skull base defect were the cribriform plate, ethmoid, and planum sphenoidale, in 12 (55%), 8 (37.7%), and 2 (9%) patients respectively. All patients underwent endoscopic endonasal repair followed by lumbar drain placement, uneventfully. Two referred patients developed meningitis after repair, which resolved with appropriate antibiotics. Endoscopic repair of CSF leaks is now the standard procedure given its minimally invasive nature.

Conclusion: The endoscopic endonasal approach is the best method for repairing CSF leaks, reducing morbidity and mortality.

Keywords
Endoscopic,
Skull base defect,
Cerebrospinal fluid leak,
Traumatic CSF leak

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INTRODUCTION

CSF rhinorrhea describes nasal discharge of CSF related to accidental trauma, iatrogenic trauma, a localized tumor, or previous radiation therapy, and sometimes occurring spontaneously. It occurs due to trauma in 80% to 90% of cases and spontaneously in 3% to 4%. Most traumatic CSF leaks resolve without surgical intervention, but persistent CSF rhinorrhea can be life-threatening.

Historically, CSF leaks were managed through craniotomy (1,13). Dandy reported the first case of intracranial repair of CSF rhinorrhea by a bifrontal craniotomy approach (3,9,20). In this minimally invasive era, endoscopic nasal surgery for CSF leak repair has almost entirely replaced past transcranial

and extracranial techniques, improving quality of life through better visualization of the entire sinonasal region and anatomy.

Materials and Methods

A retrospective study was conducted on thirty patients with CSF leaks admitted to the neurosurgical department from January 2016 to August 2025. All patients were evaluated with computed tomography (CT), magnetic resonance imaging (MRI), or both. Patient characteristics including age, history, Glasgow Coma Scale (GCS) on admission, etiology, site of leak, number of prior surgical procedures, postoperative complications and their management, laboratory tests, CT and MRI findings, surgical technique, outcome, and postoperative course were recorded.

After endoscopic surgical intervention and successful recovery, all patients were managed in the same standardized manner: monitored in the neurosurgical intensive care unit for 2 days, then kept on bed rest for a further five to seven days with the head elevated 30 to 45 degrees. Patients were instructed to avoid nose-blowing, sneezing, coughing, and straining during their stay. Stool softeners, antihistamines, and antiemetics were prescribed for 1-2 weeks to reduce intra-abdominal pressure, and appropriate antibiotics were given to prevent intracranial infection.

A lumbar drain was placed for one week to reduce intracranial pressure and allow the operative site to seal properly. Non-absorbable nasal packing was removed on the third postoperative day. Outcome was assessed from hospital records, the Glasgow Outcome Scale (GOS), and a 6-month follow-up period after discharge.

Results

All patients were initially treated conservatively before surgery. Twenty-two patients (14 male, 8 female) with CSF rhinorrhea underwent endoscopic endonasal repair during the study period. Their clinical features were headache in two-thirds of patients (n = 14, 63%), frequent meningitis (n = 6, 28%), focal neurologic symptoms (n = 5, 23%), and epileptic seizures (n = 5, 23%).

The etiology of CSF rhinorrhea was spontaneous in 5 patients (22%), traumatic in 5 (22%), delayed post-traumatic in 4 (18%), postoperative sellar in 3 (14%), and postoperative cranial (referred from another center) in 3 (14%).

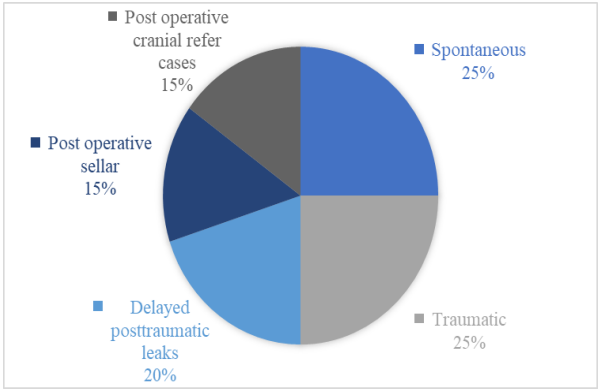

Figure 1. Distribution of etiologic factors of CSF leak.

The most common site of skull base defect was the cribriform plate, ethmoid, and planum sphenoidale, in 12 (55%), 8 (37.7%), and 2 (9%) patients respectively.

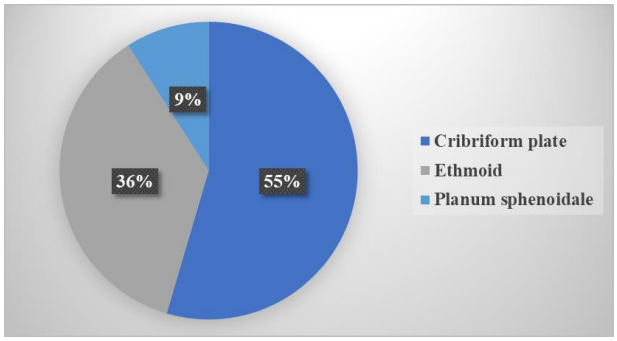

Figure 2. Distribution of Site of CSF leak.

All patients underwent endoscopic endonasal repair followed by lumbar drain placement, uneventfully. Two postoperative patients developed meningitis, which resolved with appropriate antibiotics. The transnasal endoscopic approach for CSF rhinorrhea repair showed a good success rate and offered better visualization and identification of the leak site, fewer complications, rapid postoperative recovery, and a low recurrence rate.

Discussion

CSF rhinorrhea is a neurosurgical emergency that presents a challenge for early evaluation, diagnosis, and treatment. Neurosurgeons in different parts of the world have followed their own institutional protocols for managing CSF leaks. Since St Clair

Thompson's first description of 20 cases of nontraumatic rhinoliquorrhea in the late 1800s (20), Walter E. Dandy described a bifrontal craniotomy approach to reinforce the dura mater using surrounding pericranium or an autograft of fascia lata in 1926 (2). We had practiced Dandy's approach until the last decade. Nowadays, endoscopic endonasal repair of the anterior skull base has become the gold standard, with success rates ranging from 33% to 100%, averaging around 90% (2,4,6,7,11,12,14).

Figure 3. Endoscopic intraoperative image showing leak from the tuberculum sphenoidale.

The clinical manifestation of CSF rhinorrhea is watery nasal discharge (82.7% of cases), followed by nasal obstruction (40.7%). Presentations of raised intracranial pressure such as headache, nausea, altered sensorium, focal seizures, frequent meningitis, and lateralizing neurological deficits should raise suspicion of intracranial pathology (5). CSF rhinorrhea should not be misdiagnosed as nasal cavity disease. A history of sinonasal or neurosurgical procedures, road traffic accidents, intracranial or skull base tumor extension, and recurrent meningitis should raise suspicion of a CSF leak.

CSF rhinorrhea can be challenging to diagnose both clinically and radiologically. The presence of CSF in clear nasal drainage should be confirmed by testing for β_2-transferrin, a fast, cost-effective test with a reported sensitivity of 97% and specificity of 93% (15,18). Localization of the leak site requires radiological investigation. High-resolution CT is the imaging modality of choice; it reveals large bony defects, pneumocephalus, soft tissue masses, and hydrocephalus, but cannot reliably localize the leak itself (15,18). CT cisternography may provide more specific information about the leak site, although its sensitivity is relatively low (48% to 96%) (19); it is also invasive, requiring intrathecal contrast injection prior to CT, with the contrast then identified in the nasal cavity or a specific sinus at the completion of the study. The gold standard for localizing a CSF leak is T2-weighted MRI and magnetic resonance cisternography, with a reported sensitivity of 85% to 92% and specificity of 100% (16).

Medical treatment alone achieves a success rate of only about 50% (3) and follows three key principles, escalating if unsuccessful: (1) complete bed rest and avoidance of physical exertion, with prophylactic antibiotic therapy and acetazolamide for four to six weeks; (2) lumbar drain placement for several weeks; and (3) endoscopic surgical reconstruction. Surgery is recommended for CSF rhinorrhea with a history of recurrent meningitis, a persistent leak, post-traumatic leaks that persist after four to six weeks of conservative treatment, delayed post-traumatic leaks, all spontaneous CSF fistulae, and cases with intermittent leaks (17). Skull base repair for CSF rhinorrhea follows seven key principles: (1) identify the site of the leak; (2) determine the optimal surgical corridor; (3) obtain wide exposure of the surrounding sinuses; (4) meticulously prepare the nasoseptal (Hadad) flap; (5) meticulously prepare the graft bed; (6) perform a multilayer, "sandwich" closure when possible; and (7) place a lumbar drain for several weeks.

Surgical repair is recommended to prevent complications such as meningitis when conservative management fails. Endoscopic endonasal repair is the worldwide method of choice, offering excellent illumination, precise localization of the leak site, accurate graft placement, minimal surrounding tissue damage, preservation of olfactory nerve function, preservation of surrounding vital structures, shorter operating time, and faster recovery. This approach achieves a success rate of up to 97% (9,10). We performed endoscopic endonasal repair of CSF rhinorrhea in our series; most leaks were repaired successfully using an endoscope with excellent illumination and precise localization of the leak site. Patients returned to the outpatient clinic without recurrence of CSF rhinorrhea at six months of follow-up.

Conclusion

Endoscopic endonasal repair is a minimally invasive approach for CSF rhinorrhea, best undertaken with the support of a multidisciplinary team including neurosurgeons, neurologists, otolaryngologists, and anesthesiologists.

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