Cerebrospinal fluid fistula after endoscopic skull base surgery

Latest Pubmed News

- Continuous sitting position during the postoperative period as an intervention to reduce risk of cerebrospinal fluid leak after endoscopic endonasal surgery
- Clival dural reconstruction via transnasal approaches: fat graft fixation technique
- Section and repositioning of the inferior turbinate in the design of extended septal flaps
- Traumatic CSF rhinorrhea associated with COVID-19 testing: a case series and systematic review
- Dural arteriovenous fistula embolisation with venous remodelling following venous sinus stenting
- Postoperative Diabetes Insipidus Mimicking Radiological Findings and Symptoms of Intracranial Hypotension: A Case Report
- Autologous fibrin glue for endoscopic skull base repair in patients with cerebrospinal fluid leakage
- Endoscopic Endonasal Transsphenoidal Approach to Repair Cerebrospinal Fluid Rhinorrhea After an Anterior Clinoidectomy for Aneurysm Clipping: Series of 4 Cases

---

Cerebrospinal fluid fistulas are notable endoscopic skull base surgery complications complications

Managing CSF fistulas effectively is critical for patient safety and surgical success.

Causes

- **Surgical technique**: Inadvertent dura or arachnoid membrane injury during tumor resection. - **Intraoperative factors**: Large skull base defects or difficulty in achieving a watertight dural closure. - **Postoperative factors**: Increased intracranial pressure, improper wound healing, or infection. - **Patient-related factors**: Obesity, chronic rhinosinusitis, or history of radiation therapy.

Prevention

Cerebrospinal fluid fistula after endoscopic skull base surgery prevention

Diagnosis

see Cerebrospinal fluid fistula diagnosis.

Postoperative CSF fistula typically presents with:

- **Rhinorrhea**: Clear, watery nasal discharge that increases with head movement.

- **Headache**: Positional headaches due to low CSF pressure.

- **Meningitis**: Fever, nuchal rigidity, or altered mental status, necessitating immediate attention.

- **Halo sign**: Detection of CSF in nasal secretions using beta-2 transferrin testing.

Management

1. **Conservative treatment** (for low-output fistulas):

    1. Bed rest with head elevation.
    2. Lumbar drain to divert CSF and reduce pressure on the repair site.
    3. Avoidance of activities that increase intracranial pressure (e.g., straining, sneezing).

2. **Surgical intervention** (for persistent or high-output fistulas):

    1. Revision endoscopic surgery to identify and repair the defect.
    2. Reapplication or enhancement of the multilayer repair technique.
    3. Consideration of a vascularized flap for extensive defects.

3. **Infection control**:

    1. Prompt initiation of antibiotics for suspected or confirmed meningitis.
    2. CSF culture and sensitivity testing to guide therapy.

Prognosis

- With meticulous technique and appropriate management, the success rate for repairing CSF fistulas exceeds 90%. - Delayed intervention or improper management can lead to significant morbidity, including recurrent meningitis, brain abscesses, or neurological deficits.

Emerging Trends

- **Advances in materials**: Bioengineered grafts and improved sealants. - **Enhanced imaging**: Use of intraoperative navigation systems for precise localization of defects. - **Techniques like fluorescence-guided surgery**: To identify and repair CSF leaks during the procedure.

Although rates of postoperative morbidity and mortality have become relatively low in patients undergoing transnasal transsphenoidal surgery (TSS) for pituitary neuroendocrine tumor, cerebrospinal fluid fistulas remain a major driver of postoperative morbidity. Persistent CSF fistulas harbor the potential for headache and meningitis.

Staartjes et al., trained and internally validated a robust deep neural network-based prediction model that identifies patients at high risk for intraoperative CSF. Machine learning algorithms may predict outcomes and adverse events that were previously nearly unpredictable, thus enabling safer and improved patient care and better patient counseling [1].

The objective of a study of Umamaheswaran et al., was to assess the incidence of CSF leak following pituitary surgery and the methods of effective skull base repair. This retrospective observational study conducted in a tertiary care hospital after obtaining due clearance from the Institutional ethics committee. The charts of patients who underwent endonasal pituitary surgery between 2013 and 2018 were studied and details noted. Patients undergoing revision surgery or with history of preoperative radiotherapy were excluded from the study. 52 patients were included in the study. Based on the type of CSF leak, the patients were grouped into four. 19 patients (36.5%) had an intraoperative CSF leak. 3 patients developed a postoperative CSF leak. Based on the histopathology, 4 patients had ACTH secreting tumor. 8 patients had growth hormone secreting tumor, 22 had gonadotropin secreting tumor, 9 patients had a non-functioning tumour and 9 patients had prolactinoma. The type of skull base repair performed in these patients were grouped into 4.18 patients underwent type I repair, 21 patients underwent type II repair, 8 patients underwent type III repair and 5 patients underwent type IV repair. They observed that the Hadad-Bassagasteguy flap is particularly advantageous over other repair techniques, especially in low pressure leaks. The strategy for skull base repair should be tailored to suit each patient to minimise the occurrence of morbidity and the duration of hospital stay [2].

Cerebrospinal fluid fistula is always the primary complication during the endoscopic endonasal skull base surgery.

Dural suturing technique may supply a rescue method. However, suturing and knotting in such a deep and narrow space are difficult. Training in the model can improve skills and setting a stepwise curriculum can increase trainers' interest and confidence.

Xie et al. constructed an easy model using silicone and acrylic as sphenoid sinus and using the egg-shell membrane as skull base dura. The training is divided into three steps: Step 1: extracorporeal knot-tying suture on the silicone of sphenoid sinus, Step 2: intra-nasal knot-tying suture on the same silicone, and Step 3: intra-nasal egg-shell membrane knot-tying suture. Fifteen experienced microneurosurgical neurosurgeons (Group A) and ten inexperienced PGY residents (Group B) were recruited to perform the tasks. Performance measures were time, suturing and knotting errors, and needle and thread manipulations. The third step was assessed through the injection of full water into the other side of the egg to verify the watertight suture. The results were compared between two groups.

Group A finishes the first and second tasks in significantly less time (total time, 125.1 ± 10.8 vs 195.8 ± 15.9 min) and fewer error points (2.4 ± 1.3 vs 5.3 ± 1.0) than group B. There are five trainers in group A who passed the third step, this number in group B was only one.

This low cost and stepwise training model improved the suture and knot skills for skull base repair during endoscopic endonasal surgery. Experienced microneurosurgical neurosurgeons perform this technique more competent [3].

In-Hospital Costs

All endoscopic transsphenoidal approach for pituitary surgeries performed from January 1, 2015, to October 24, 2017, with complete data were evaluated in a retrospective single-institution study. The electronic medical record was reviewed for patient factors, tumor characteristics, and cost variables during each hospital stay. Multivariate linear regression was performed using Stata software.

The analysis included 190 patients and average length of stay was 4.71 days. Average total in-hospital cost was $28,624 (95% confidence interval $25,094-$32,155) with average total direct cost of $19,444 ($17,136-$21,752) and total indirect cost of $9181 ($7592-$10,409). On multivariate regression, post-operative cerebrospinal fluid (CSF) leak was associated with a significant increase in all cost variables, including a total cost increase of $40,981 ($15,474-$66,489, P = .002). Current smoking status was associated with an increased total cost of $20,189 ($6,638-$33,740, P = .004). Self-reported Caucasian ethnicity was associated with a significant decrease in total cost of $6646 (-$12,760 to -$532, P = .033). Post-operative DI was associated with increased costs across all variables that were not statistically significant.

Post-operative CSF leak, current smoking status, and non-Caucasian ethnicity were associated with significantly increased costs. Understanding of cost drivers of endoscopic transphenoidal pituitary surgery is critical for future cost control and value creation initiatives [4].

Case series

see Cerebrospinal fluid fistula after endoscopic skull base surgery case series.

References

1)
Staartjes VE, Zattra CM, Akeret K, Maldaner N, Muscas G, Bas van Niftrik CH, Fierstra J, Regli L, Serra C. Neural network-based identification of patients at high risk for intraoperative cerebrospinal fluid leaks in endoscopic pituitary surgery. J Neurosurg. 2019 Jun 21:1-7. doi: 10.3171/2019.4.JNS19477. [Epub ahead of print] PubMed PMID: 31226693.
2)
Umamaheswaran P, Krishnaswamy V, Krishnamurthy G, Mohanty S. Outcomes of Surgical Repair of Skull Base Defects Following Endonasal Pituitary Surgery: A Retrospective Observational Study. Indian J Otolaryngol Head Neck Surg. 2019 Mar;71(1):66-70. doi: 10.1007/s12070-018-1511-4. Epub 2018 Oct 15. PubMed PMID: 30906716; PubMed Central PMCID: PMC6401034.
3)
Xie T, Zhang X, Gu Y, Sun C, Liu T. A low cost and stepwise training model for skull base repair using a suturing and knotting technique during endoscopic endonasal surgery. Eur Arch Otorhinolaryngol. 2018 Jun 1. doi: 10.1007/s00405-018-5024-2. [Epub ahead of print] PubMed PMID: 29858924.
4)
Parasher AK, Lerner DK, Glicksman JT, et al. Drivers of In-Hospital Costs Following Endoscopic Transphenoidal Pituitary Surgery [published online ahead of print, 2020 Aug 24]. Laryngoscope. 2020;10.1002/lary.29041. doi:10.1002/lary.29041