

Risk Reduction of Recurrent Cerebrospinal Fluid Leaks with Postoperative Intracranial Pressure Management: A Systematic Review

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ABSTRACT

BACKGROUND

Chronically elevated intracranial pressure (ICP) is thought to drive skull base erosion and predispose to cerebrospinal fluid leak formation. This pathophysiology explains why idiopathic intracranial hypertension (IIH) symptoms may emerge or worsen after spontaneous cerebrospinal fluid (sCSF) leak repair, with recurrence reported to be more likely if elevated ICP is not adequately addressed.

OBJECTIVE

To evaluate whether postoperative ICP-lowering interventions reduce recurrence of lateral skull base sCSF leaks after surgical repair.

METHODS

The review followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses guidelines and included studies of adults with lateral skull base sCSF leaks undergoing primary repair in which postoperative ICP-lowering interventions were specified. Pooled recurrence rates were calculated by intervention type and compared with cohorts that did not receive ICP-lowering therapy.

METHODS

Thirty-six studies including 689 patients (740 cases) met inclusion criteria. Six comparative cohorts (34 treated, 155 untreated) showed no significant difference in recurrence (risk ratio = 1.16; 95% CI, 0.14–9.76; $I^2 = 0\%$). Across 82 intervention-only cases, recurrence occurred in three (pooled proportion = 0.10; 95% CI, 0.04–0.26; $I^2 = 0\%$). Among 653 control-only cases, 44 recurred (pooled proportion = 0.09; 95% CI, 0.07–0.12; $I^2 = 0\%$). No heterogeneity was observed across pooled analyses.

CONCLUSION

Current evidence remains limited and fragmented, preventing definitive conclusions about the benefit of postoperative ICP-lowering interventions after lateral skull base sCSF leak repair.

BACKGROUND

Population-level data on cranial spontaneous cerebrospinal fluid (sCSF) leaks are lacking, though small series suggest many occur at the lateral skull base.^{1–2}

Elevated intracranial pressure (ICP) has been proposed as a contributor to leak formation and recurrence, particularly in patients with obesity or idiopathic intracranial hypertension (IIH).^{3–4}

Recurrence after sCSF leak repair is usually low (3%–7%) but may vary with comorbidities and defect patterns.⁵

Evidence on the role of postoperative ICP-lowering interventions in reducing lateral skull base leak recurrence is sparse and largely indirect.

METHODS

Design: Systematic review per Preferred Reporting Items for Systematic Reviews and Meta-Analyses

Search: Embase, MEDLINE, Cochrane CENTRAL, Web of Science, and Scopus through April 7, 2025; 17,880 records imported into Covidence.

Selection: Five reviewers screened studies of adults (≥ 18 years) with lateral skull base sCSF leaks undergoing first-time surgical repair. Eligible studies specified use or absence of postoperative ICP-lowering interventions.

Data extraction: Two reviewers collected demographics, comorbidities, leak/surgical characteristics, interventions (acetazolamide, lumbar drain, shunt, venous sinus stenting), and outcomes (recurrence, follow-up). Standardized coding was applied for missing or unclear data.

Analysis: Descriptive statistics summarized study and patient characteristics. Random-effects models pooled recurrence rates and compared treated vs. untreated cohorts; heterogeneity was assessed with I^2 .

RESULTS

- Studies included:** Thirty-six studies, 689 patients (740 cases); most were retrospective case series (level IV evidence).
- Patient characteristics:** Mean age ranged from 38.7–68 years; 61.1% ($n = 354$) were female. Mean body mass index (BMI) ranged from 30–45.4. Race was rarely reported.
- Comorbidities:** Obesity was documented in 176 patients; obstructive sleep apnea (OSA) in 62; IIH in 12.
- sCSF leak/surgical characteristics:**

- Unilateral in 92.2% ($n = 601$); bilateral in 7.8% ($n = 51$).
- Most common sites: tegmen tympani and tegmen mastoideum.
- Surgical approach: middle cranial fossa, 46.5% ($n = 275$); transmastoid, 41.6% ($n = 246$); combined, 10.7% ($n = 63$); other, 1.2% ($n = 7$).
- Postoperative interventions:** lumbar drain ($n = 69$), acetazolamide ($n = 14$), shunt ($n = 4$), none ($n = 653$).
- Recurrence outcomes:**
- Mixed cohorts: pooled risk ratio = 1.16 (95% CI, 0.14–9.76); treated, 5.9% (2/34) vs untreated, 9.7% (15/155) (Figure 1).
- Intervention-only: pooled recurrence, 10% (95% CI, 4%–26%); crude, 3.7% (3/82) (Figure 2).
- No intervention: pooled recurrence, 9% (95% CI, 7%–12%); crude, 6.7% (44/653) (Figure 3).

RESULTS

Figure 1. Mixed cohorts: intervention vs control.

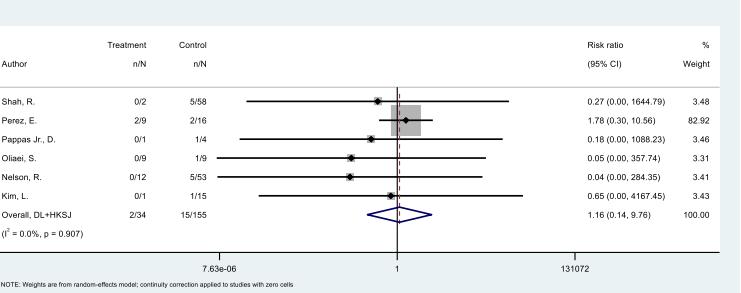


Figure 1. Forest plot of recurrence risk in treated vs untreated patients.

Figure 2. Intervention-only recurrence.

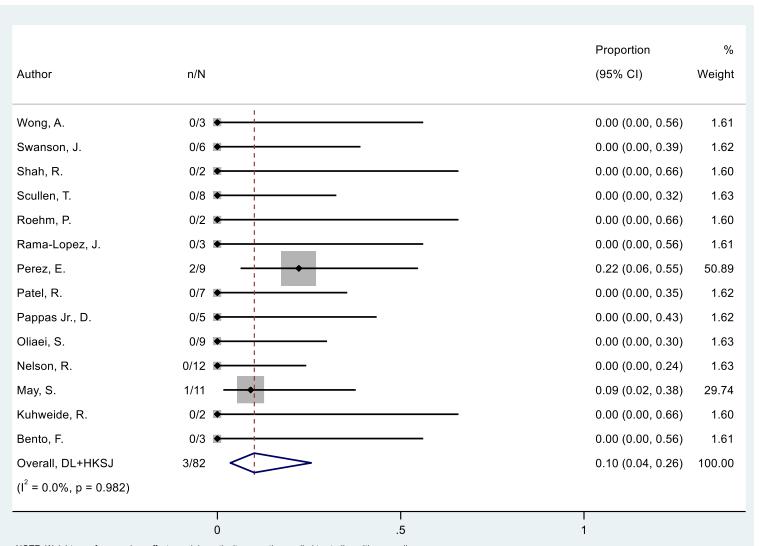


Figure 2. Forest plot of recurrence among patients receiving postoperative interventions.

Figure 3. Control-only recurrence.

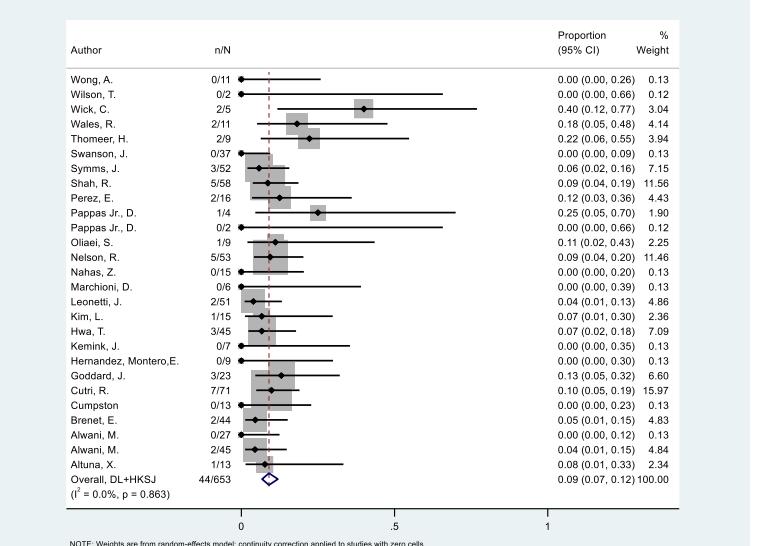


Figure 3. Forest plot of recurrence among patients managed with repair alone.

DISCUSSION

- Most prior reviews have focused on anterior skull base disease, leaving postoperative management in lateral sCSF leaks underexplored.
- To our knowledge, this is the first systematic review to synthesize pooled recurrence outcomes between treated and untreated patients across postoperative acetazolamide, shunting, and lumbar drain utilization specifically in lateral skull base leaks.
- Across studies, recurrence rates did not differ significantly between treated and untreated groups. Acetazolamide showed lower observed recurrence in limited series, lumbar drains did not demonstrate sustained benefit, and shunting data were too sparse to draw conclusions.
- Comorbidities such as obesity, OSA, and IIH were infrequently reported, limiting subgroup analysis.
- Venous sinus stenting has been described in select patients with venous outflow obstruction but remains limited to small series.
- Recurrence among repair-only cohorts was approximately 9%, suggesting that repair alone may be sufficient in many cases.

CONCLUSION

- Evidence for postoperative ICP-lowering intervention after lateral sCSF leak repair remains limited and heterogeneous.
- Acetazolamide may reduce recurrence in select patients, but evidence is sparse. Lumbar drains may provide transient diversion or have utility as a perioperative adjunct.
- Prospective multicenter studies with standardized protocols are needed.
- In the interim, management should be individualized, with ICP-lowering strategies considered most appropriate for high-risk patients (e.g., obesity, IIH, venous sinus stenosis).

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