

Venous Sinus Stenting Timing Following CSF Leak

Repair: Safety and Outcomes

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Abstract

Background: Venous sinus stenosis has been increasingly identified as a contributing factor to idiopathic intracranial hypertension (IIH) and associated spontaneous cerebrospinal fluid (CSF) leaks. There is significant evidence demonstrating the efficacy and safety of venous sinus stenting (VSS) for this condition. However, the nuanced integration of this minimally invasive treatment option into the treatment paradigm for IIH and CSF leaks remains largely undefined. This includes the safe and optimal timing of VSS following CSF leak repair, which is an important consideration given the need for pre and post-procedure anticoagulation.

Methods: We retrospectively reviewed 6 patients (5 females, 1 male) treated at our institution between 2020-2025 who underwent surgical repair of spontaneous or encephalocele-related CSF leaks followed by VSS. Clinical records and imaging were analyzed for recurrence, reoperation, meningitis, shunting, stent complications, and symptom outcomes. Patients were stratified by time from repair to stenting: short interval (<70 days, n=3) versus long interval (≥70 days, n=3). Descriptive statistics were used to summarize patient characteristics and outcomes.

Results: The mean age was 48.5 years (range 33-61) with a mean BMI of 42 (range 31-54). All leaks were unilateral, occurring at the sphenoid (n=3), cribriform/ethmoid (n=1), temporal tegmen (n=1), and frontal basal (n=1). Four patients had complex defects involving multiple subsites. Encephaloceles/meningoceles were present in 5/6 patients. All patients had symptoms attributable to IIH including headaches (6/6), pulsatile tinnitus (3/6), and visual complaints (3/6). Papilledema was diagnosed in one patient and optic nerve sheath dilation in two others. Intraoperative confirmation of CSF leak was obtained in all patients. All skull base defects were repaired successfully without recurrent leak or need for reoperation. Reconstruction included multilayer closure with vascularized nasoseptal flaps (n=3), free mucosal grafts (n=2), and fat grafts (n=1). Lumbar drains were used in 5 patients for purpose of fluorescein localization. One patient underwent a middle cranial fossa approach for encephalocele resection. The median interval from repair to stenting was 62 days (range 39-146). Three patients underwent short-interval stenting (39-54 days), and three underwent long-interval stenting (70-146 days). Median clinical follow-up was 15 months (range 5-57). No patients experienced recurrent CSF leak, meningitis, or required reoperation or shunting after stenting. Headaches improved in 6/6 patients with complete resolution in 2, while all 3 patients with pulsatile tinnitus achieved resolution. Papilledema resolved or stabilized in all patients with ophthalmologic follow-up. There were no bleeding complications following VSS and associated anticoagulation.

Conclusion: VSS following CSF leak repair is safe and effective across both short and long-interval timing. Short-interval VSS did not compromise reconstruction and the need for post-procedure anticoagulation did not contribute to bleeding-related complications. These findings support the use of VSS in appropriate patients who present with CSF leaks and evidence of IIH and highlight the need for more research to define its nuanced integration into the treatment paradigm.

Introduction

- Spontaneous skull base CSF leaks are increasingly recognized as part of the idiopathic intracranial hypertension (IIH) spectrum, often occurring in obese middle-aged women with radiographic signs of venous outflow obstruction.⁽¹⁾
- Venous sinus stenosis is present in the majority of patients with idiopathic intracranial hypertension (IIH), with bilateral transverse sinus narrowing commonly observed on magnetic resonance venography.⁽²⁾
- Venous sinus stenting (VSS) has been shown to significantly reduce intracranial pressure and improve IIH-related symptoms in medically refractory patients.⁽³⁾
- Emerging evidence, including recent reviews, suggests that VSS may also reduce recurrence in patients with spontaneous CSF leaks associated with venous stenosis.⁽⁴⁻⁵⁾
- However, the optimal timing of VSS relative to CSF leak repair remains undefined, particularly given the need for peri-procedural dual antiplatelet therapy.
- **Objective:** To evaluate the safety and outcomes of VSS following CSF leak repair and to compare short- versus long-interval timing strategies.

Methods

- Design: Retrospective review from 2020-2025
- Setting: Single tertiary academic center

Institutional Treatment Paradigm

Multidisciplinary collaboration between Neurosurgery (NSGY) and Rhinology
All patients with spontaneous CSF leak and venous sinus stenosis underwent:

- Primary surgical repair of the skull base defect first
- Followed by delayed venous sinus stenting (VSS)

VSS was intentionally performed after a healing interval to:

- Allow adequate graft integration
- Reduce theoretical risk of bleeding
- Mitigate concerns related to dual antiplatelet therapy (DAPT) required for stenting

Timing Groups:

Short interval: <70 days

Long interval: ≥70 days

Data Collected:

Demographics (age, sex, BMI), leak location and repair technique, radiographic IIH features, interval to stenting, and clinical outcomes: recurrent CSF leak and reoperation.

Results

Case	Age	Sex	BMI	Leak Site	Encephalocele	Stenosis Site	Interval to VSS (days)	Repair Approach	Beta 2 transferrin	Leak Outcome	Recurrence	F/U (mo)
1	53	F	54	Left tegmen	Yes	Right TS→SS	70	MCF craniotomy	+	Resolved	None	22
2	45	F	31	Rt lateral sphenoid	Yes	Bilateral TS→SS	53	Expanded endonasal	+	Resolved	None	17
3	58	M	35	Rt sphenoid	No	Left TS→SS	41	Endoscopic	+	Resolved	None	13
4	33	F	51	Rt sphenoid	No	Bilateral distal TS→SS	145	Endoscopic	+	Resolved	None	11
5	41	F	46	Rt cribriform/ethmoid	Yes	Right distal TS→SS	39	Endoscopic	+	Resolved	None	8
6	61	F	34	Left cribriform	Yes	Right TS→SS	70	Endoscopic	+	Resolved	None	57

Table 1. Demographic and Clinical Characteristics of Patients Undergoing Venous Sinus Stenting (VSS) Following Surgical Repair of Cerebrospinal Fluid (CSF) Leak (N = 6).

All patients underwent primary surgical repair of spontaneous skull base CSF leak prior to VSS. Stenosis location is reported by venous segment, including transverse sinus (TS), sigmoid sinus (SS), and transverse-sigmoid junction (TS-SS). MCF craniotomy refers to middle cranial fossa craniotomy. Rt denotes right-sided pathology. Beta-2 transferrin positivity confirmed CSF leak. F/U indicates duration of clinical follow-up in months.

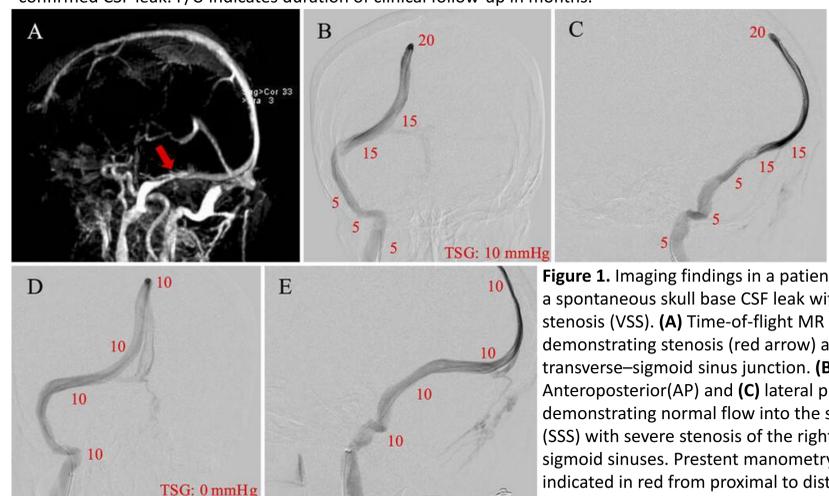


Figure 1. Imaging findings in a patient that presented with a spontaneous skull base CSF leak with venous sinus stenosis (VSS). (A) Time-of-flight MR venogram demonstrating stenosis (red arrow) at the right transverse-sigmoid junction. (B) Anteroposterior (AP) and (C) lateral prestent venograms demonstrating normal flow into the superior sagittal sinus (SSS) with severe stenosis of the right transverse and sigmoid sinuses. Prestent manometry pressures (mmHg) indicated in red from proximal to distal. (D) AP and (E) lateral poststent venograms demonstrating good flow through the stent construct without residual stenosis or thrombosis. Poststent manometry pressures indicated in red, with resolution of the trans-stenotic gradient.

Discussion

- Three patients underwent short-interval venous sinus stenting (39-54 days), and three underwent long-interval stenting (70-146 days).
- No postoperative bleeding, recurrent cerebrospinal fluid (CSF) leak, or meningitis occurred in either group. All six patients achieved complete CSF leak resolution following stenting, regardless of timing from surgical repair.
- Early stenting did not compromise skull base reconstruction despite initiation of dual antiplatelet therapy.
- Recent meta-analyses demonstrate high CSF leak control with adjunctive VSS; however, optimal timing relative to repair remains undefined, with some centers favoring delayed stenting due to DAPT-related bleeding concerns.⁽⁵⁾
- VSS can be safely performed following repair once adequate healing has occurred.
- Further research is needed to clarify postoperative venous flow dynamics and optimal timing.

Conclusion

- VSS after surgical CSF leak repair was safe and effective in this six-patient cohort.
- Leak resolution occurred in 100% of patients, independent of interval from repair to stenting.
- Stenting should follow primary repair, but timing may be flexible.
- Larger prospective studies are needed to define optimal integration into treatment algorithms.

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