

Case Series

Spontaneous cerebrospinal fluid leak in a resource-limited setting: diagnostic strategy and surgical outcomes without advanced imaging

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ABSTRACT

Spontaneous cerebrospinal fluid (CSF) leaks remain diagnostically challenging, particularly in resource-limited settings where access to Beta-2-transferrin testing and CT cisternography is restricted. The objective was to describe the clinical characteristics, diagnostic approach, and surgical outcomes of spontaneous CSF leaks managed without advanced diagnostic modalities in a tertiary referral centre in Indonesia. A retrospective case series was conducted on six patients diagnosed with spontaneous CSF leak between 2023 and 2025. Diagnosis was established using clinical evaluation, nasal endoscopy, bedside testing, and high-resolution computed tomography (HRCT). Surgical repair was performed using endoscopic techniques. Clinical outcomes and postoperative complications were evaluated. The majority of patients were middle-aged females (83.3%) with elevated body mass index and associated comorbidities. Leak sites were predominantly located at the sphenoid sinus and cribriform plate, with meningoencephaloceles identified in four cases. Despite the absence of β 2-transferrin testing and CT cisternography, HRCT combined with clinical assessment successfully localized defects. All patients underwent endoscopic repair with favorable outcomes, minimal complications, and short hospital stays. In resource-constrained settings, a structured diagnostic approach integrating clinical evaluation and HRCT can effectively guide management of spontaneous CSF leaks. Endoscopic repair remains a safe and effective treatment modality even in the absence of advanced diagnostic tools.

Keywords: Cerebrospinal fluid, Rhinorrhea, Endoscopic sinus surgery, Resource-limited setting

INTRODUCTION

Spontaneous cerebrospinal fluid (CSF) leak is characterized by the abnormal communication between the subarachnoid space and the sinonasal tract in the absence of trauma, prior surgery, or intracranial neoplasm.¹ Despite the low global incidence estimated at 1 to 5 cases per 100,000 individuals annually, CSF leaks present substantial clinical challenges, particularly regarding timely diagnosis to reduce the risk for serious complications, such as meningitis.²

Patients with a CSF leak often present with unilateral, clear watery discharge without other nasal symptoms. The symptom usually worsens with changes in posture,

especially when bending forward. In some cases, neurological symptoms such as headaches, blurred vision, or tinnitus may also be present, indicating an increase in the intracranial pressure. In high-resource settings, confirmation of CSF leak relies on Beta-2 transferrin testing and precise localization using CT cisternography or magnetic resonance imaging. However, such modalities are not universally accessible, particularly in low-and middle-income countries (LMICs), where healthcare systems often face limitations in advanced diagnostic infrastructure.^{2,3}

These limitations highlight a need for alternative diagnostic strategies that rely on clinical evaluation, endoscopic findings, and conventional imaging, such as

HRCT. Although endoscopic approach to CSF leak repair has become the standard of care with documented success rates, evidence describing its implementation and outcomes in resource-constrained healthcare settings remains limited.⁴

This study aims to describe the clinical profile, diagnostic approach, and surgical outcomes of spontaneous CSF leaks managed in a tertiary referral center in Indonesia, highlighting practical adaptations in a resource-limited environment.

CASE SERIES

A retrospective study on patients presenting with a chief complaint of unilateral clear, watery nasal discharge, without any history of other nasal symptoms was conducted at CiptoMangunkusumo National General Hospital between 2023 and 2025. Cerebrospinal fluid leak was confirmed through careful history taking, followed by a nasoendoscopic examination, halo test, and radiological imaging. Patients with a prior history of head trauma, cranial surgery, or active intracranial tumors were excluded from the study.

Data collected were patient demographics (age, sex, body mass index, and previous history of hypertension), clinical presentation, site of CSF leak, defect size, repair approach, repair technique, use of tissue sealant, use of lumbar puncture, and post-operative administration of Acetazolamide. The follow-up period was for two months or longer. Clinical outcomes and length of hospital stay were also documented.

Six cases of spontaneous CSF leak were identified over a two-year period at the center. Table 1 illustrates the

demographic profile of the subjects. Among these cases, five were female and only one was male, with an age range between 35 to 63 years old and a mean age of 48.17 years. All patients were either overweight or obese, with BMIs ranging from 24.1 to 38.1. All but one patient presented with history of hypertension, yet none exhibit definitive neurological symptoms of intracranial hypertension.

Of the identified cases, two presented with an isolated spontaneous CSF leak, while the remaining four cases were associated with a meningoencephalocele. As presented in Table 2, the sites of the leak were identified at the superolateral wall of the right sphenoid sinus, lateral recess of left sphenoid sinus and the right cribriform plate with sizes ranging between 2.2 mm to 30 mm.

Approach to the defect area was achieved through Functional Endoscopic Sinus Surgery in combination with transpterygoid or modified transpterygoid approach in certain patients who presented with meningoencephalocele located in the lateral part of the sphenoid sinus (patient 2, 3, and 6). Multilayer technique was performed in all patients; however, different materials were utilized for the layers, including fat, fat combined with septal cartilage, duragen, pedicle flap or free flap (see Table 3). Material selection for layered closure depended on defect size and the surgeon's preference and experience.

Additional use of tissue sealant was applied in all cases for extra measure. The decision to use a lumbar drain in patient number two was based on the main surgeon preference, reflecting a variation in surgical practice. Acetazolamide, although no longer routinely used, was still prescribed to 4 out of 6 patients.

Table 1: Patients' demographics.

Characteristics	Patient 1	Patient 2	Patient 3	Patient 4	Patient 5	Patient 6
Age (in years)	63	35	36	41	56	58
Sex	M	F	F	F	F	F
BMI	24.1/over weight	27.2/obese gr I	38.1/obese gr II	36.2/obese gr II	31.3/obese gr II	29.1/obese gr I
History of hypertension	+	+	+	+	+	-

Table 2: Characteristics of CSF leak.

Characteristics	Patient 1	Patient 2	Patient 3	Patient 4	Patient 5	Patient 6
Meningoenceph alocele	-	+	+	-	+	+
Site of leak	Superolateral wall of right sphenoid sinus	Superolateral wall of right sphenoid sinus	Lateral recess of left sphenoid sinus	Right cribriform plate	Right cribriform plate	Lateral recess of left sphenoid sinus
Size of defect	10 mm	6.1 mm	7.9 mm	2.2 mm	3.5 mm	30 mm
Patient	1	2	3	4	5	6

Table 3: Closure approach and technique.

Approaches/technique	Patient 1	Patient 2	Patient 3	Patient 4	Patient 5	Patient 6
Approach	FESS*	FESS* + transpterygoid approach + inferior middle turbinate resection	FESS* + modified transpterygoid approach	FESS*	FESS*	FESS + modified transpterygoid approach
Closure technique						
Fat	-	+	+	-	-	-
Duragen	-	+	-	-	+	-
Septal Cartilage	-	-	+	-	-	-
Flap	Contra lateral nasoseptal	Medical concha	Nasoseptal	Nasoseptal	Middle turbinate	Free flap from nasal floor
Glue	+	+	+	+	+	+
Lumbar drain	-	+	-	-	-	-
Acetazolamide use	+	+	+	-	-	+

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Table 4: Outcome and complications.

Complications	Mild headache	-	-	-	-	-
Length of hospital stay	7 days	7 days	8 days	5 days	8 days	5 days

Clinical outcomes at follow-up are shown in Table 4 and were favorable. Only one patient reported a new-onset headache, while the remaining five patients remained asymptomatic. Hospital length of stay was relatively short in all patients, ranging from 5 to 8 days. These findings support functional endoscopic sinus surgery as a much less invasive method compared to open intracranial approach, with minimal post-operative complications and shorter length of hospitalization.

DISCUSSION

This study highlights the clinical significance of careful integration of clinical assessment, endoscopic evaluation and HRCT imaging in diagnosing and managing spontaneous CSF leaks in resource-constrained settings, where advanced diagnostic modalities such as the β 2-transferrin testing and CT cisternography are not available.

Similar to previous studies, subjects' demographics of this study also reports a predominance of middle-aged, overweight women among patients with spontaneous CSF leaks. Individuals who are overweight experience an increase in intra-abdominal and intrathoracic pressures, potentially impairing cranial venous circulation which contributes to permanent benign intracranial hypertension. Although direct data on elevated intracranial pressure were unavailable in this study,

hypertension was considered a comorbidity that may increase the risk of intracranial hypertension.⁵

Other conditions that have been suggested to be associated with spontaneous CSF leak is idiopathic intracranial hypertension, in which chronic increase in intracranial pressures results in gradual skull base thinning and eventual defect formation. Although intracranial pressure was not directly measured in the cohort, the presence of comorbidities such as increased BMI and history of hypertension may serve as clinical indicators to the presence of IIH. However, this assumption should be with careful consideration, as the presence of hypertension has not been confirmed as a reliable indicator of elevated intracranial pressure.^{6,7}

β -2 transferrin testing is one of the standardized diagnostic examinations that has never been used because the necessary equipment is not readily available in our healthcare system. As an alternative, we relied on the simpler halo test and the Dandy maneuver in conjunction with the Valsalva maneuver that worsens CSF leak, which could be easily done in the outpatient setting. Precise localization of the defect is a critical step in the management of CSF leak. While CT cisternography is widely regarded as the gold standard, it is often unavailable in many settings. Preoperatively, defects were identified via high-resolution paranasal CT due to the limited availability of CT cisternography and the high cost of MRI. In this study, HRCT has successfully

demonstrated its ability to identify defect sites. Previous meta-analyses have reported high sensitivity and specificity in localizing CSF leaks, which supports the use of HRCT as first-line imaging modality in settings where advanced diagnostics are not readily available.⁸⁻¹⁰

The surgical outcomes reported in this cohort further support the effectiveness of endoscopic approach in defect closure. All patients underwent successful repair with minimal complication. Multilayer closure technique is used according to the current best practices with some differences in material selection, which highlights the role of surgeons' experience and preferences in decision making. The selective use of adjunctive measures such as lumbar drainage and acetazolamide highlights the absence of a standardized protocol in some resource-limited environments.

This study demonstrates that through a structured diagnostic approach as well as adequate anatomical understanding, favorable results are achievable even in resource-limited settings, which can be implemented in many low-middle income countries (LMICs).

The small sample size and the retrospective nature of this study may restrict the generalizability of the findings. Additionally, the absence of confirmatory biochemical testing and an objective ICP measurement are potential diagnostic bias. The relatively short follow-up period is insufficient to predict long-term recurrences or late-onset outcomes. To validate these findings, a large-scale prospective study with more standardized diagnostic protocols should be conducted.

CONCLUSION

Despite the absence of advanced diagnostic modalities in resource-limited settings, spontaneous CSF leaks can be effectively diagnosed through a structured clinical approach, additional bedside examination and basic HRCT imaging. Management is achievable through endoscopic approach, leading to favorable outcomes and minimal complications during follow up.

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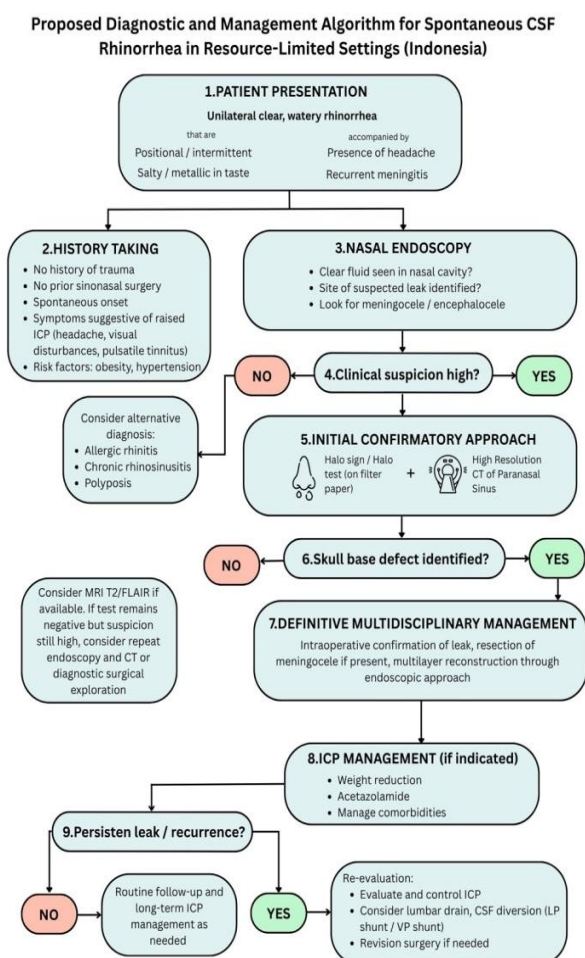


Figure 1: Diagnostic and management algorithm for spontaneous CSF rhinorrhea in resource-limited settings.

Based on this study, we developed a diagnostic and management algorithm (Figure 1) for patients with suspected CSF rhinorrhea in resource-limited settings, where advanced workup such as β -2 transferrin test, CT cisternography and MRI sequence are not readily available.

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