

The Effect of lumbar drains on spontaneous cerebrospinal fluid leak repair

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ABSTRACT

الأهداف: لمعالجة العوامل التي تؤثر على إعادة عمليات التنظير الجراحية بالمنظار لتسرب السائل النخاعي العفوي، وتحديد تأثير استخدام المنطقة القطنية.

الطريقة: اشتملت هذه الدراسة على تحليل البيانات بأثر رجعي، بما في ذلك مراجعة الرسم البياني لجميع حالات تسرب السائل النخاعي العفوي (CSF) الذين خضعوا لإصلاح قاعدة الجمجمة الأمامية بالمنظار خلال الفترة من 2012-2017م في مدينة الملك فهد الطبية، الرياض، المملكة العربية السعودية.

النتائج: تم تحديد وتقييم 13 مريضاً يعانون من تسرب السائل النخاعي CSF. كانت الغالبية من الإناث (92.3%) بمتوسط مؤشر كتلة الجسم من 34.9. خضع جميع المرضى لإصلاح بالمنظار مع عمل جراحة داخل تحويلة المنطقة القطنية. استمر نزيف المرضى في أسفل الظهر بعد الجراحة بمعدل 6.4 أيام. حصلت نكسة 4 مرضى (30.8%)؛ ومع ذلك، كان واحد فقط من هؤلاء لديه ضغط الفتحة عالي وموثق.

الخلاصة: إن علاج تسرب CSF مؤشر عالي الخطورة وقد يكون لديه أمراض كامنة تنطوي على انتقال CSF. استخدام المصارف القطنية وعوامل خفض الضغط داخل الجمجمة مثيرة للجدل ويبدو أنها مطبقة فقط للمرضى ذوي المخاطر العالية؛ ومع ذلك، يمكن إدارة المخاطر أعلى من تكرار العملية في هذه المجموعة بشكل أفضل عن طريق التقييم المناسب قبل العملية وبروتوكولات التدبير العلاجي لكل مريض.

Objectives: To address the factors affecting recurrence after endoscopic surgical repairs of spontaneous cerebrospinal fluid leak, specifically the influence of using lumbar drains.

Methods: This study involved a retrospective data analysis, including a chart review of all spontaneous cerebrospinal fluid (CSF) leak cases who underwent endoscopic anterior skull base repair from 2012-2017 in King Fahad Medical City, Riyadh, Kingdom of Saudi Arabia.

Results: Thirteen patients with spontaneous CSF leaks were identified and evaluated. The majority were females (92.3%) with an average body mass index of 34.9. All patients underwent endoscopic repair with intra-operative lumbar drain placement. Patients continued having post-operative lumbar drain for an average of 6.4 days. Four patients (30.8%) developed recurrence; however, only one of those had a documented high opening pressure.

Conclusion: Spontaneous CSF leak repairs are at a higher failure risk and may have an underlying pathology involving CSF circulation. The use of lumbar drains and intracranial pressure lowering agents are controversial and seems to be reserved only for high risk patients; however, the higher risk of recurrence in this group may be better managed by proper pre-operative evaluation and selective, patient-specific management protocols.

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Spontaneous cerebrospinal fluid (CSF) rhinorrhoea is an idiopathic leakage, lacking an identifiable cause such as tumour, trauma, or previous surgery.¹ Recent studies have associated the diagnosis of spontaneous CSF leaks with the presence of a raised intracranial pressure (ICP) and an underlying diagnosis of idiopathic intracranial hypertension (IIH).² The underlying mechanism of spontaneous CSF leaks is that

of circulation which manifests itself via a dehiscence at the skull base.¹ The classical presentation of spontaneous CSF rhinorrhoea is unilateral intermittent clear watery nasal discharge that may be affected by posture and valsalva manoeuvres.¹ In the presence of IIH, patients may have other symptoms such as headache, tinnitus, imbalance, and visual disturbances.¹ They may also have radiographic findings consistent with total or partial empty sella.¹ Obese middle-aged females are more commonly affected by IIH and spontaneous CSF rhinorrhea.² The hypothesis behind IIH ranges from vitamin A metabolic abnormalities, adipose tissues acting as actively secreting endocrine tissues, and cerebral venous anomalies.³ Erosions of the skull base, specifically in the thinnest areas, are exacerbated by these high pressures.¹ Excessive pneumatization of the sinuses is also associated with thinning of the skull base and is well recognized in patients with spontaneous CSF leaks.^{1,3} Since it is not a well understood disease entity, and its management lacks a clear evidence base, more studies are needed to properly understand the underlying mechanism and proper management of this disease entity. In This study we aim to address the factors affecting recurrence after repairs of spontaneous cerebrospinal fluid leak, specifically the influence of using lumbar drains.

Methods. A retrospective chart review was carried out with the aim of finding all patients who underwent endoscopic CSF leak repair under the care of one surgeon at King Fahad Medical City, Riyadh, Saudi Arabia. The study was initiated following the approval of the institutional review board (IRB no.17-215). Eighteen patients were identified from the period of 2012 to 2017. After excluding all patients with an identifiable etiology including head trauma, tumor, previous sinus or skull base surgery, congenital cranial or sinonasal malformations, or history of head and neck radiation, a total of 13 patients were included.

A data collection sheet was prepared and filed for each patient including age, gender, body mass index (BMI), co-morbidities, presenting symptoms, symptom duration, location and size of defect, presence of a meningoencephalocele, type of surgical procedure, type of repair and material used, duration of lumbar

drain use, use of intracranial pressure lowering agents, post-operative complications, and recurrence. These data were analysed, and patients were allocated into recurrent and non-recurrent groups in which factors affecting recurrence were studied.

Statistical analysis. Statistical Package for the Social Science (SPSS) software was used for analysis where categorical factors have been described as frequencies and percentages whereas continuous factors have been described as means with standard deviations. Categorical variables were assessed using the Fischer's exact test, and continuous variables were assessed using Wilcoxon rank sums. A p -value \leq 0.05 was considered significant.

Results. A total of 13 patients underwent CSF leak repair for spontaneous CSF leak. Out of the 13 patients, 12 were females (92.3%) and one was a male (7.7%). Their mean age was 43.6, and average BMI was 34.9 kg/m². Most of the patients (92.3%) presented with nasal discharge as their sole symptom, and only 15.4% had symptoms of headaches and blurred vision. Five patients (38.5%) had a previous episode of meningitis prior to their presentation. The mean duration of symptoms was 9.5 months.

All patients underwent analysis for CSF rhinorrhea including beta-2-transferrin fluid analysis, computed tomography (CT) examination of paranasal sinuses, and magnetic resonance imaging (MRI). The defects were assessed radiologically and were confirmed intraoperatively by endoscopic visualization of the site of the leak after intrathecal fluorescein injection.

Computed tomography and MRI evaluations of all patients revealed a defect in the ethmoid (69.2%) followed by the cribriform (15.4%) and sphenoid (7.7%). One patient had a combined cribriform and sphenoid defect.

Eight patients (61.5%) also had a meningocele, and the mean size of the defect on radiological imaging was 4.25 mm.

The majority of the cases were repaired using a middle turbinate graft (46.2%), and (30.8%) had both a tutoplast allograft underlay and a middle turbinate graft overlay. Only one case (7.7%) was repaired using a nasopseptal flap combined with cartilage graft for a sphenoidal defect, and another case (7.7%) was repaired using fascia latta as both an underlay and an overlay.

All of the patients had a lumbar drain placed during the procedure in order to document the opening pressure, to inject 0.1ml of 1% fluorescein into 10ml of CSF, and to localize the defect. In 30.8% of the patients, the opening pressure was normal (<20cm H₂O), in 30.8% it was abnormal (>20cm H₂O),

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and the remaining 38.5% had no documentation of opening pressure. The lumbar drain was kept in place for a mean of 6.4 days. Six patients (46.2%) received post-operative acetazolamide, and one patient (7.7%) received furosemide. The remaining 6 patients (46.2%) did not receive either drugs. The mean hospital stay was 12.1 days in which all patients were monitored closely.

There were only 2 post-operative complications with a total incidence of (15.4%), of which there was one case of postoperative meningitis (7.7%) and one case of pneumocephalus (7.7%). All patients were followed post-operatively for a minimum of 6 months with the exception of one patient who developed recurrence at 3 months. The mean follow up period was 22 months (Table 1). The incidence of recurrence was (30.8%).

Discussion. In CSF leak repairs, the endoscopic endonasal approach replaced open surgery after Wigand's description of the first successful endoscopic surgery in 1981.⁴ Initially, endoscopic experience with CSF leak repair was evaluated by Hegazy et al in 2000 and included 14 studies published from 1990 and 1999.⁵ The success rate in the initial studies ranged from 60%-100% with an average of 90%. Since then, this approach has gained more popularity, and new methods have been published with larger and more diverse case series describing different experiences.⁶

Endoscopic CSF leak repair aims to establish a separation of the subarachnoid space and the nasal cavity. Therefore, minimizing the risk of intracranial infections which can be as high as 20% if not addressed.⁷ This also restores normal CSF circulation, which is vital to the maintenance of brain buoyancy and the prevention of CSF hypotension.⁸ Spontaneous cerebrospinal fluid (CSF) fistulae closure by endoscopic approach is now recognized to be the golden standard of management and has been associated with high success rates.^{3,9} Among all causes of CSF rhinorrhea, the most challenging subgroup to address is the spontaneous CSF rhinorrhea, which has been found to have more recurrence and reported failure rates of 25%-87% in the 1970s.³ However, in more recent series, failure rates have been found to be less than 10%.^{3,9}

Initially, the placement of lumbar drains was routinely performed for cases of CSF leak and skull base reconstruction because of the uncertainty about the dural repair healing. They were used to establish brain relaxation to lessen retraction-related cerebral edema in open cranial procedures. Retraction is not an issue with the endoscopic endonasal approach, and the drains have been used primarily to decrease the stress on the repair of the skull base. Post-operatively, lumbar drains are

often retained in order to reduce intracranial pressure by continuous CSF drainage. This method is believed to facilitate wound healing therefore, improving the success rate of the reconstruction by obtaining a watertight closure. As a rule, low-flow CSF leaks are easier to control than high-flow leaks. Low-flow CSF leaks can be defined as a leak that occurs after dura opening but not involving the opening of a ventricle or an arachnoid cistern (such as the basilar or suprasellar cistern). High-flow CSF leaks occur in cases in which there is a violation of either a ventricle or cistern in the setting of endoscopic endonasal surgery as described by Patel et al.¹⁰ When encountering a high-flow CSF fistula during a procedure, CSF diversion is considered of particular importance because these are inherently more challenging to manage. However, the need for routine lumbar drains (LDs) in skull base reconstruction is being challenged even when there is a high-flow

Table 1 - Patient's demographics and data.

Factors	All patients N=13
<i>Age</i>	
age, years mean±SD	43.6±12.5
<i>Gender, n (%)</i>	
Males	1 (7.7)
Females	12 (92.3)
BMI (kg/m ²), mean±SD	34.9±6.27
<i>Concurrent symptoms, n(%)</i>	
Headaches	3 (23.1)
Blurred vision	2 (15.4)
Convulsions	1 (7.7)
meningitis before presentation	5 (38.5)
<i>Duration of CSF leak at presentation</i>	
(months), mean±SD	9.5±1.3
<i>location of defect, n (%)</i>	
cribriform plate	2 (15.4)
ethmoid	9 (69.2)
sphenoid	1 (7.7)
combined cribriform and sphenoid	1 (7.7)
Meningoencephalocele, n (%)	8 (61.5)
<i>Sella status, n (%)</i>	
Empty Sella	2 (15.4)
Partially Empty	3 (23.1)
<i>Adjuvant therapies, n (%)</i>	
Lumbar drain	13 (100)
Acetazolamide	6 (46.2)
Furosemide	1 (7.7)
Duration of lumbar drain, mean±SD	6.38±1.3
Hospital stay in days, mean±SD	12.1±6.7
Recurrence, n (%)	4 (30.8)

SD - standard deviation, BMI - body mass index,
CSF - Spontaneous cerebrospinal fluid

fistula, especially with the increased dependability of vascularized pedicled flaps in the repairs of skull base defects. An increasing body of evidence suggests that LDs are not necessary in the setting of endoscopic skull base reconstruction.¹¹

Lumbar drains may not be needed even in the challenging settings of high-flow CSF fistulae,^{12,13} in addition to large skull base defects,¹⁴ since the advent of the pedicled nasoseptal flaps popularized by Hadad et al.¹⁵ However, the precise indications for perioperative CSF diversion remain unclear and controversial.¹⁶ Multiple studies have investigated the use of lumbar drains in endoscopic repairs of CSF leak; some concluded that they do not appear to affect the repair rates,⁵ or could not ascertain their benefits,⁶ and others found that they do not significantly contribute to the success of surgical repairs.^{17,18}

Most studies in this field included patients with different etiologies predisposing them to CSF leaks. In a study by Albu et al in which lumbar drains and their effects on recurrence were assessed.¹⁹ They found no association between the use of LD's and the success rates of CSF repairs. They also found that increased intracranial pressure was the only factor predictive of recurrence.¹⁹ These findings suggest that spontaneous CSF leaks in the setting of increased intracranial pressure may need to be addressed with more care. Also, a recent systematic review evaluating surgical spontaneous CSF leak repairs concluded that intraoperative placement and use of lumbar drains did not seem to improve the success rates in both anterior and lateral skull base repairs; however, limitations in the available data concerning individual patients makes it difficult to ascertain whether the use of drains directly affects the recurrence rates.²⁰

Since all patients included in this study underwent lumbar drain placement, no comparison could be made for this specific intervention. However, an assessment of other responsible variables was made. Since a high opening pressure was assumed to contribute to recurrence, a comparison was made between patients with normal and high-pressure readings. Only one out of the 4 patients who developed recurrence had a documented high opening pressure. Meanwhile, 3 patients with a high opening pressure did not develop recurrence. These results did not reach statistical significance ($p=0.776$). It is also noteworthy to mention that 5 of the 13 patients (38.5%) had no documented opening pressure, so a true estimate cannot be reached. Out of the 4 cases that developed a recurrence, 2 patients had received acetazolamide and one had

received furosemide. Meanwhile, 4 of the remaining 9 patients who did not develop a recurrence received acetazolamide. Comparison between those variables showed no significant statistical difference ($p=0.35$). Two patients developed post-operative complications; however, only one of those 2 developed recurrence, which was a case of pneumocephalus. The presence of a meningocele and the duration of lumbar drain use did not seem to affect the recurrence rate (Table 2).

The literature is currently lacking prospective randomized studies comparing endoscopic repair of spontaneous CSF rhinorrhea with and without the use of lumbar drains. This study was carried out to evaluate the success rate of endoscopic skull base repairs of spontaneous CSF leaks at our institute. Our results suggest a high recurrence rate (30.8%) despite the use of lumbar drains and an almost similar method of reconstruction in all of our cases. Also, 2 of our cases developed postoperative complications, which may have been exacerbated by the use of lumbar drains.

Limitations. Due to the fact that all patients underwent lumbar drain placement in this evaluation, a comparison of these outcomes could not be assessed. However, the opening pressure was taken into account for comparison since the hypothesis behind recurrence in these cases stems from the fact that some individuals with higher opening pressures are predisposed to higher recurrence rates. This theory, however, was not supported in our results. The use of Acetazolamide was guided by the opening pressures of each patient separately which may have affected the final outcome. Since this is a rare disease entity, the number of patients in this study performed at a single center is small and

Table 2 - Patient factors and group comparison.

Factors	Recurrence	No recurrence	P-value
	n=4	n=9	
	n (%)		
age (mean)	34.2	47.7	0.037
females (%)	4 (100)	8 (88.9)	0.692
BMI (mean)	33.4	35.6	0.699
High opening pressure	1 (25)	3 (33.3)	0.776
Acetazolamide	2 (50)	4 (44.4)	0.35
meningocele	1 (25)	7 (77.8)	0.119
post op complications	1 (25)	1 (11.1)	0.538
LP duration	7	6.1	0.627
defect area	2.73	4.92	0.06

BMI - body mass index, LP - lumbar puncture.

more studies in multiple centers could eventually shed more light on the proper management options for this specific group of patients.

In conclusion, the use of lumbar drains in the setting of spontaneous CSF leak repair has been an area of controversy. In this analysis, the use of these drain did not seem to influence the rate of recurrence, which remained high despite its use in all of the cases.

These findings suggest that more studies comparing cases of spontaneous CSF leaks with and without the use of lumbar drains are needed since the literature is currently lacking prospective randomized trials comparing these cases. There is no standard treatment for these patients, and the decision regarding the use of lumbar drains should be tailored specifically towards each case.

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