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Comparison of the Different Repair Models for Cerebrospinal Fluid Fistulas During Endoscopic Transsphenoidal Surgery

Endoskopik Transsfenoidal Cerrahi Sırasında Gelişen Beyin Omurilik Sıvısı Fistüllerinde Farklı Onarım Modellerinin Karşılaştırılması

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Abstract

Objective: Intraoperative cerebrospinal fluid fistula, one of the most concerning complications of endoscopic transsphenoidal surgery, may result in significant morbidity if not adequately managed. We performed an analysis for different methods, used for repair of cerebrospinal fluid fistula occurring during endoscopic transsphenoidal surgery.

Methods: Neurosurgical operations performed between November 2023-March 2025 were analyzed retrospectively using hospital records. In group 1, repair was performed by an irregularly shaped fat autograft, which was placed in the sphenoidal sinus with a Haddad nasoseptal flap. In group 2, a dumbbell-shaped fat autograft with a Haddad nasoseptal flap was used.

Results: Controlling the variables, such as age and sex, we found that there was no statistical difference in gender distribution in groups. Group 1 patients needed postoperative lumbar drainage more often and also had longer hospital stays. However, no significant difference was observed between the hospitalization costs.

Conclusion: Centers around the world make efforts to decrease the complication rates and invoices. Prolonged cerebral fistula can lead to serious consequences and cause distress to the patient, their relatives, and their doctor.

Keywords: Endoscopic, skull base, repair, transphenoidal

Öz

Amaç: Endoskopik transsfenoidal cerrahinin en endişe verici komplikasyonlarından biri olan intraoperatif serebrospinal sıvı fistülü, uygun şekilde yönetilmezse önemli morbiditeye neden olabilir. Endoskopik transsfenoidal cerrahi sırasında oluşan serebrospinal sıvı fistülünün onarımı için kullanılan farklı yöntemler için bir analiz gerçekleştirdik.

Yöntem: Kasım 2023-Mart 2025 arasında gerçekleştirilen nöroşirürjikal operasyonlar hastane kayıtları kullanılarak retrospektif olarak analiz edildi. Grup 1'de onarım, Haddad nazoseptal flep ile sfenoidal sinüse yerleştirilen düzensiz şekilli bir yağ otogreftiyle gerçekleştirildi. Grup 2'de, Haddad nazoseptal flep ile dumbell şekilli bir yağ otogrefti kullanıldı.

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Abstract

Bulgular: Yaş ve cinsiyet gibi değişkenleri kontrol ederek, gruplar arasında cinsiyet dağılımında istatistiksel olarak bir fark olmadığını bulduk. Grup 1 hastalarının postoperatif lomber drenaja daha sık ve ayrıca daha uzun hastanede kalmaları gerekti. Ancak hastane yatış maliyetleri arasında anlamlı bir fark gözlenmedi.

Sonuç: Dünya çapındaki merkezler komplikasyon oranlarını ve faturaları azaltmak için çaba göstermektedir. Uzun süreli serebral fistül ciddi sonuçlara yol açabilir ve hem hasta, hem yakınları hem de doktorları için ciddi sıkıntılara neden olabilir.

Anahtar Kelimeler: Endoskopik, kafa tabanı, onarım, transsfenoidal

Introduction

Endoscopic transsphenoidal surgery (ETS) is a minimally invasive approach widely used in the treatment of sellar, parasellar, and most skull base pathologies. This method is often preferred by patients because it is minimally invasive, does not require a craniotomy, does not leave a surgical incision scar on the patient, and is relatively more comfortable. However, cerebrospinal fluid (CSF) fistula developing during this surgery can be a significant complication. CSF fistula occurs when it leaks from the subarachnoid space into the nasal cavity as a result of a defect in the skull base during ETS. This can lead to serious complications such as meningitis. Therefore, early recognition and appropriate repair of CSF fistulas that develop during surgery are of great importance[1-4].

Also, it is clear that the patient group with rhinorrhea after ETS brings an additional cost burden. Patients who do not have any health insurance are quite distressed, especially. Besides all these, this undesirable condition significantly prolongs hospital stay. Additionally, the quality of life of the patients are also negatively affected[5].

Different techniques are used in the repair of CSF fistula. The method to be chosen depends on the size of the defect, its location, the pressure of the CSF that leaks from the fistula, and the general condition of the patient[6,7].

In small defects, conservative management should be performed as first-line treatment. This treatment plan includes bed rest and head elevation. Appropriate antibiotic prophylaxis should be initiated for the patient. If a high-flow fistula has developed, the use of multilayer repair methods may be considered. Fascia lata grafts, autologous fat grafts, free mucosa grafts, and pedicled mucosa flaps are among these methods. The Haddad-Bassagasteguy nasoseptal flap is especially the most commonly used method for repairing large defects and has a high success rate. In more difficult cases, collagen-based patches, fibrin adhesives and lumbar drainage are also among the preferred methods[2,4,6,7].

Materials and Methods

Ethics committee approval was obtained from University of Health Sciences Türkiye, İzmir City Hospital for this study (approval number: 2025/167, date: 16.04.2025). A total of 70 patients with hypophysis adenoma operated via endoscopic transsphenoidal approach between November 2023 and March 2025 in our hospital were analyzed retrospectively from patient medical records.

The patients whose CSF fistula was repaired with a traditional fat graft placed in the sphenoid sinus were named as group 1. Patients repaired with dumbbell-shaped fat grafts (Figure 1), where half of the dumbbell graft was pushed into the dura, and the remaining half remained in the sphenoid sinus, were named as group 2 (Figure 2).

The groups were analyzed for the perioperative hemostatic agents fibrin tissue glues synthetic dura lumbar drainage

Figure 1. Dumble shaped fat graft

catheter, primary or recurrent operation of the tumor, postoperative diabetes insipidus cavitron ultrasonic surgical aspirator, postoperative rhinorrhea, and the type of sphenoidal sinus. The differences between the groups were then investigated.

Statistical Analysis

In descriptive statistics, continuous data are given with mean, standard deviation, minimum and maximum values, and categorical data are given with number and percentage values. In the statistical comparison of the data, the suitability of the normal distribution for continuous data was evaluated with the Kolmogorov-Smirnov analysis, and the Mann-Whitney U test was used for non-parametric data. The chi-square test was used to compare categorical data.

P<0.05 was considered significant at a 95% confidence interval. Statistical analyses were performed using Statistical Package for the Social Sciences (SPSS Inc, Chicago, IL, USA), version 21.0.

Results

A total of 17 patients who had peroperative CSF fistula were included in the study. There were nine patients in group 1 and eight patients in group 2. The gender distribution of patients was as follows: 3 men (33.3%) and 6 women (66.7%) in group 1, and 6 men (75%) and 2 women (25%) in group 2. Age range was 30.0-74.0 with an average age of 42.0 years in group 1. In group 2, the age range was 33.0-76.0 with an average age of 46.5. Controlling for variables such as age and sex, we found that there was no statistically significant difference in gender distribution rates (p=0.481) for patients shown in Table 1 (group 1 and group 2). There was no significant difference between groups in terms of the use of hemostatic materials (p=0.944), use of fibrin glue (p=0.274),

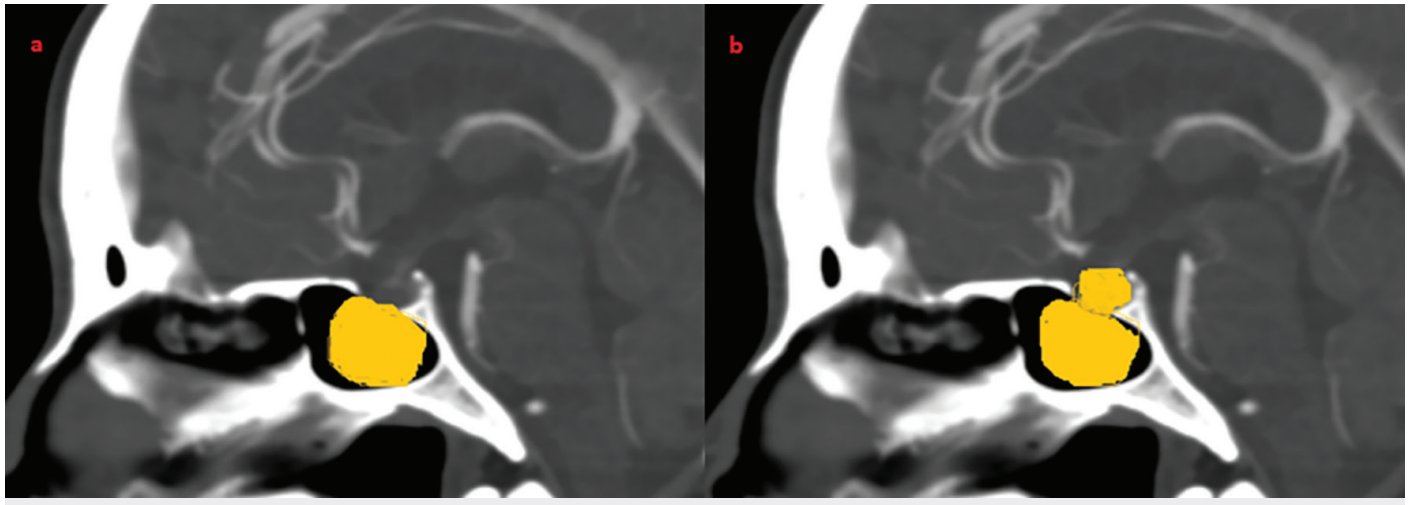

Figure 2. Representative illustration of fat graft placement in the sagittal plane, group 1 (a), group 2 (b)

Table 1. Postoperative complications and materials used after CSF fistula

		Group 1, number (%)	Group 2, number (%)	p-value
Gender	**Male**	2 (25.0%)	6 (66.7%)	0.086
	Female	6 (75.0%)	3 (33.3%)	
Use of hemostatic matrix		0	1 (11.1%)	0.944
Use of fibrin glue		7 (87.5%)	9 (100%)	0.274
Use of dural graft		1 (12.5%)	2 (22.2%)	0.6
Use of lombar dranaige		8 (100%)	3 (33.3%)	0.004
Postoperative diabetes insipitus		1 (12.5%)	1 (11.1%)	0.929
Use of CUSA		4 (50%)	2 (22.2%)	0.232
Postoperative rhinorrhea		4 (50%)	1 (11.1%)	0.079

CSF: Cerebrospinal fluid, CUSA: Cavitron ultrasonic surgical aspirator

use of dural graft (p=0.6), and use of cavitron ultrasonic surgical aspirator (p=0.232).

There was no significant difference in the incidence of postoperative diabetes insipidus between groups (p=0.929). Also, there was no significant difference in postoperative rhinorrhea rates (p=0.079). Group 1 patients needed postoperative lumbar drainage more often, and this was found to be statistically significant (p=0.004). Additionally, it was observed that group 1 patients had longer hospital stays (p=0.001). On the other hand, no statistically significant difference was observed between hospital costs (p=0.259).

Discussion

Today, endoscopic transsphenoidal approaches are widely accepted as the first-line technique in skull base surgery. Although these methods are considered less invasive, they are still susceptible to certain complications. Among the most common complications associated with this approach is the development of intraoperative CSF fistulas. Various repair techniques have been described in the literature to manage this issue[8-11]. In this study, we compared the postoperative outcomes of 17 patients who underwent ETS performed by the same primary surgeon at a single center, with each patient receiving a different type of fat graft.

The group in which standard abdominal fat grafts were used demonstrated a significantly higher need for postoperative lumbar drainage (p=0.004). The flow rate of CSF fistulas developing during endoscopic transsphenoidal procedures is directly proportional to the size of the arachnoid defect. In other words, larger defects tend to result in high-flow fistulas. When such defects are plugged using abdominal fat grafts, the graft often dislodges during patient awakening, extubation, or Valsalva maneuvers, leading to persistent CSF leakage due to graft migration or instability.

In contrast, in patients in whom dumbbell-shaped fat grafts were used-inserted gently so that one end remains within the arachnoid defect and the other fills the sphenoid sinus cavity-a significantly lower incidence of postoperative rhinorrhea and a reduced need for lumbar drainage were observed (p=0.004). Naturally, this also translated into a shorter hospital stay for this group.

To reinforce the repair following graft placement, nasoseptal flaps or synthetic dura substitutes may be applied, secured in place with tissue adhesives such as Tisseel or fibrin glue. Many centers utilize one or more of these techniques in various combinations. As institutions gain more surgical experience over time, they tend to refine their techniques and consequently observe a gradual decline in postoperative CSF fistula rates[9,11].

CSF fistula during ETC can be managed successfully with careful surgical techniques and appropriate repair methods. Primary repair and autologous grafts are sufficient for small defects, while pedicled flaps such as nasoseptal flaps are recommended for large defects. Lumbar drainage and fibrin adhesives also provide additional support and reduce the risk of complications. The prevention and management of CSF fistulas vary depending on the experience of the surgical team and the patient's characteristics. The management of CSF fistulas requires the selected method to be compatible with the size of the defect and the patient's condition. It is accepted today that multilayer repair techniques and pedicled flaps have the highest success rate[8,9,11].

Study Limitations

Although the group that received dumbbell-shaped fat grafts had significantly shorter hospital stays, no significant difference was found when comparing their overall hospital costs. Considering the fluctuating economic conditions and changes in insurance reimbursement policies in our country, a reliable cost comparison could not be made within the timeframe of this study due to differences in pricing between the beginning and end of the study period. Nevertheless, the observed reduction in hospitalization duration can be regarded as clinically meaningful, both in terms of patient comfort and potential cost-effectiveness. We believe that the limitations of this study can be addressed in future research involving larger patient cohorts.

Conclusion

As a result, although our study was conducted with a limited number of patients, we believe that the control of CSF fistula and the duration of hospital stay will be shorter with dumbbell-shaped fat autografts. We believe that this technique, which is simple to apply, offers a practical solution to one of the biggest problems in skull base surgery.

Ethics

Ethics Committee Approval: Ethics committee approval was obtained from University of Health Sciences Türkiye, İzmir City Hospital for this study (approval number: 2025/167, date: 16.04.2025).

Informed Consent: Analyzed retrospectively from patient medical records.

Footnotes

Authorship Contributions

Surgical and Medical Practises: M.Ç., Concept: M.Ç., Design: M.Ç., Ç.T., Data Collection or Processing: M.Ç., Ç.T., Analysis or Interpretation: Ç.T., Literature Search: M.Ç., Ç.T., Writing: M.Ç., Ç.T.

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