Results of the Endoscopic Anterior Skull Base Cerebrospinal Fluid Rhinorrhea Repair Without a Rigid Graft: A Retrospective Analysis

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Abstract

Objective: Endonasal endoscopic techniques have been widely used with different tissues to close the cerebrospinal fluid (CSF) fistula defects. The use of a rigid graft material is generally proposed for larger defects and in patients with an increased intracranial pressure. We investigated possible changes such as dural sagging, which may be developed at the level of the skull base in patients with CSF rhinorrhea, operated without a rigid graft.

Material and Methods: Patients with anterior skull base CSF rhinorrhea managed by the transnasal endoscopic approach between January 2007 and December 2015 at a tertiary medical center hospital were included in this study. During that period, a total of 40 patients were operated for the CSF fistula using transnasal endoscopy. The standard magnetic resonance (MR) cisternography imaging (initial scans and all the available follow-up studies) of the patients were retrospectively evaluated by an experienced neuroradiologist.

Results: Among the 55 patients whose CSF rhinorrhea was reconstructed without a rigid graft, only 18 patients had preoperative and postoperative MR cisternography that we could evaluate. The mean size of the skull-base defects detected during surgery was 8.4 mm (3 mm-20 mm; ±5.1 mm). The number of patients with a defect greater than 10.0 mm was 9. Accompanying meningocele or encephalocele was present in 9 of the patients. The two-layered fascial graft (temporal muscle fascia [n=10], fascia lata [n=8]) was used to repair the defect in all cases. There were no signs of the CSF leakage in any of the MR cisternographies. The areas of encephalomalasia were noticed in 6 cases. Dural layer continuity was not well seen in 3 cases. There were no signs of encephalocele observed in the coronal and sagittal section in any patient.

Conclusion: All the practice regarding the usage of rigid grafts in the CSF rhinorrhea repair depends on the theoretical acceptance and beliefs. This study has shown that the rigid graft use is not a must for the CSF rhinorrhea surgery, especially for the small and medium-sized defects.

Keywords: Cerebrospinal fluid fistula, endoscopic sinus surgery, MR cisternography

INTRODUCTION

The transnasal endoscopic approach is now an accepted route in the repair of the anterior skull base cerebrospinal fluid (CSF) rhinorrhea (1). Since CSF rhinorrhea may lead to life threatening conditions such as meningitis, brain abscess, or pneumocephalus, it must be closed. CSF leakages can be spontaneous, traumatic, or iatrogenic (2, 3). The management of CSF rhinorrhea has been a controversial topic from many points of view. While the defect sites may be healed with observation or conservative treatment, surgical treatment is generally required. Surgical repair may be achieved extracranially (bifrontal craniotomy, external ethmoidectomy, and frontal sinusotomy) or transnasally (microscopic and endoscopic way).

Low morbidity and high success rates (90% after the first attempt and 95%-98% after the second attempt) have currently made endonasal endoscopy the preferred surgical technique in the treatment of an anterior cranial base CSF leak (4). Endonasal endoscopic techniques have been widely used with different tissues to close the defect. The literature reports a wide range of grafting materials, including septal mucoperiosteal or mucoperichondrial grafts, free or pedunculated middle turbinate, temporalis muscle fascia, fascia lata, or septal cartilage. In addition to such

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autologous materials, homologous materials from cadaver and allografts can also be used to repair the defects (5-9).

To reconstruct the defect at the skull base, rigid grafts such as cartilage and bone can also be used. The use of a rigid graft material is generally proposed for larger defects and in patients with an increased intracranial pressure (10). This suggestion has unfortunately not been supported by controlled clinical studies.

We investigated possible changes, such as dural sagging, which may develop at the level of the skull base in patients with CSF rhinorrhea, operated without a rigid graft with magnetic resonance (MR) cisternography.

MATERIAL AND METHODS

Patients with the anterior skull base CSF rhinorrhea were managed by the transnasal endoscopic approach between January 2007 and December 2015 at a tertiary medical center hospital. A total of 55 patients were operated for the CSF fistula using transnasal endoscopy during that period. These patients were contacted by telephone and recalled for the clinical and radiological examinations. Only 18 patients accepted to participate in this study. An approval for this study was obtained from the local ethics committee of our institution. Written informed consent was obtained from all participants before enrollment in the study.

Patients were questioned about nasal symptoms and examined with rigid endoscopy for possible sinonasal infections and rhinorrhea. Medical data of the patients including age, gender, the etiology of the CSF fistula, size, and localization of the defect detected during surgery, and grafting materials used were recorded.

Magnetic resonance (MR) examinations were performed with a 1.5 T scanner (Symphony, Siemens, Erlangen, Germany), using a standard head coil. The standard MR cisternography protocol included coronal 2 mm T2WI and T1WI, coronal and sagittal oblique three-dimensional constructive interference in steady state (CISS) imaging. CISS-3D imaging was performed with a TR/ TE: 7.42/3.71 ms, the flip angle of 45°, NEX: 1 mm slice thickness, the field of view of 170 mm, and a matrix of 448x352. MR images (initial scans and all the available follow-up studies) of the patients were retrospectively evaluated by an experienced neuroradiologist.

RESULTS

We investigated medical records of 55 anterior skull base CSF rhinorrhea patients operated within an 8-year period. An allograft or xenograft was not used in any procedure. Among 55 patients, a rigid graft was used in 7. Among the 48 patients whose CSF rhinorrhea was reconstructed without a rigid graft, only 18 patients could be reached and accepted to participate in this study.

Eighteen patients (10 males and 8 females) were clinically and radiologically evaluated. The age of the patients ranged between 4 and 53 years, with a mean of 29.3 years (±18.1 years). There were 11 cases of posttraumatic CSF leaks and 7 cases of a spontaneous CSF leak. The mean follow-up period was 21.0 months (6-60 months; ±14.6) (Table 1). Seven patients were complaining about crusting. None of the patients had a

Table 1. Data of patients with CSF rhinorrhea included in this study

ID	AGE	Sex*	Etio**	Defect size (mm)	Location***	Follow-up (month)	Presence of Meningocele****
1	10	M	T	4	FE	60	A
2	53	F	S	3	FE	42	P
3	9	F	T	10	FE	36	P
4	12	M	T	17	CP	34	P
5	30	M	T	5	FE	32	A
6	45	F	S	3	SP	26	A
7	38	M	T	20	FE	20	P
8	8	M	T	3	CP	20	P
9	41	F	S	10	FE	20	A
10	46	F	S	3	SP	16	P
11	10	M	S	10	CP	14	P
12	50	F	S	10	FE	14	A
13	48	M	S	5	SP	12	P
14	4	M	T	10	CP	10	P
15	47	F	T	10	FE	10	A
16	16	M	T	9	FE	10	A
17	16	M	T	15	CP	8	A
18	45	F	T	5	CP	6	A

* Sex; F: female, M: male
**Etio; T: trauma; S: spontaneous
*** Location; FE: fovea etmoidalis; SP: sphenoid sinus; CP: cribriform plate
**** Presence of Meningocele; P: present; A: absent

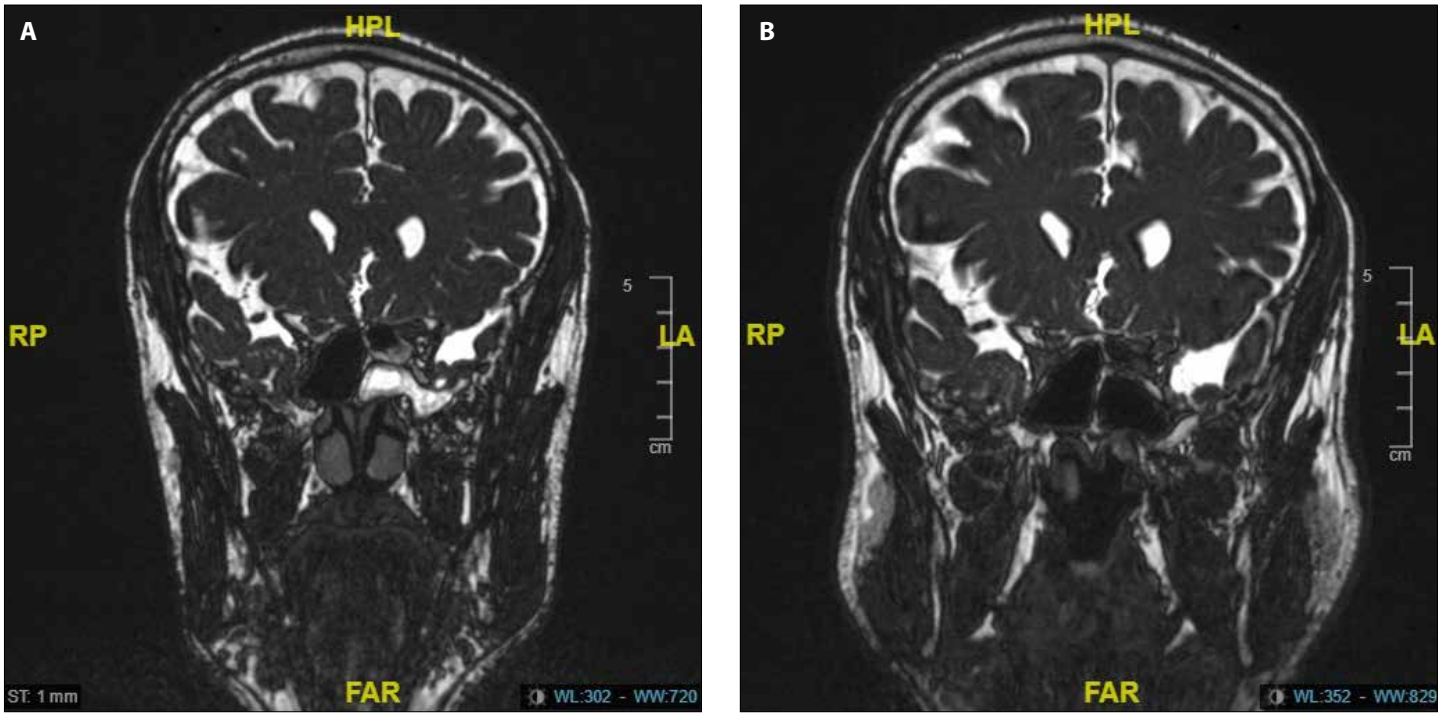

Figure 1. A, B. Preoperative coronal (A) image of a 45 years old patient with history of trauma reveals dural defect (arrow) at the superolateral wall of sfenoid sinus and minimal protrusion of temporal lobe into. The coronal T2 FSE (B) image from the postoperative scan demonstrates absence of the residual meningoencephalocele

symptom of nasal discharge, rhinorrhea, or headache. Meningitis was not experienced by any patient during the postoperative period. We have observed operation-related changes in the endoscopic examination of the nasal cavity.

The mean size of the skull-base defects detected during surgery was 8.4 mm (3 mm-20 mm; ±5.1 mm). The number of patients with a defect greater than 10.0 mm was 9. The locations of the skull base defects were the fovea ethmoidalis (n=9), the sphenoid sinus (n=3), and the cribriform plate (n=6). Accompanying meningocele or encephalocele was present in 9 of the patients (Figure 1. A, B).

The two-layered fascial graft was used to repair the defect. The temporal muscle fascia (n=10) or fascia lata (n=8) was used as the first layer. The temporal muscle or fascia lata or middle turbinate mucosa (n=4) was used as the second layer of grafting. The absorbent materials were used to stabilize the graft and to create a barrier between the graft and the packing material in all the cases. Tissue glues were used at the edges of the graft in 5 patients, in addition to the absorbable hemostatic materials.

The postoperative radiological evaluation of the patients was done with MR cisternography. There were no signs of CSF leakage in any of the MR cisternographies (Figure 1B. and Figure 2B.). The areas of encephalomalasia were observed in 6 cases. Dural layer continuity was not well seen in 3 cases. No signs of encephalocele were observed in the coronal and sagittal section in any patient.

DISCUSSION

Endoscopic repair of CSF rhinorrhea is an effective method. Several authors recommend the transnasal endoscopic technique due to the low morbidity and high success rates for the repair of CSF rhinorrhea unassociated with other intracranial pathologies that would warrant a transcranial approach (11-13). Different types of grafting materials could be used, depending on the surgeons' experience and availability of the materials. It was shown that the choice of grafting materials used during repair does not seem to affect the success (5). In our series of patients, autologous tissue grafts such as temporal muscle fascia and fascia lata were preferred, for their durable nature and their easy engraftment.

The rigid graft was recommended for long-term results and lifelong prevention of delayed ascending meningitis (10). Schlosser et al. (10) recommended epidural bone graft due to a possible baffling effect of the rigid graft to the Valsalva or cough during graft healing, especially in the immediate postoperative period. The septal cartilage, the bones of the middle turbinate, vomer, and perpendicular plate of ethmoid are the most commonly used autologous rigid tissues for grafting. The rigid graft is recommended for the defects larger than 5 mm and in patients with an elevated CSF pressure (10, 14-16).

Although literature has been recommending rigid grafts for larger defects, the average size of the defect of patients included in our study was 8 mm. While the 72% (n=13) of cases had a defect equal or greater than 5 mm, half of the patients (n=9) had a defect with a diameter of 10 mm or greater. Although most of the patients included in our study had a defect larger than 5 mm and were operated on without a rigid graft, none of the patients have developed any complications such as meningitis or sagging at the level of the skull base during the follow-up period.

A bony defect, rupture of the dural/arachnoid membrane, and a pressure difference across the defect must be present for CSF rhinorrhea to develop. Defective areas of the bony structures at the skull base do not always lead to problems. We generally see this condition in the patients with an increased intracranial pressure. There are lots of defective and dehiscence areas at the bony structure of the skull base in these patients, but we do

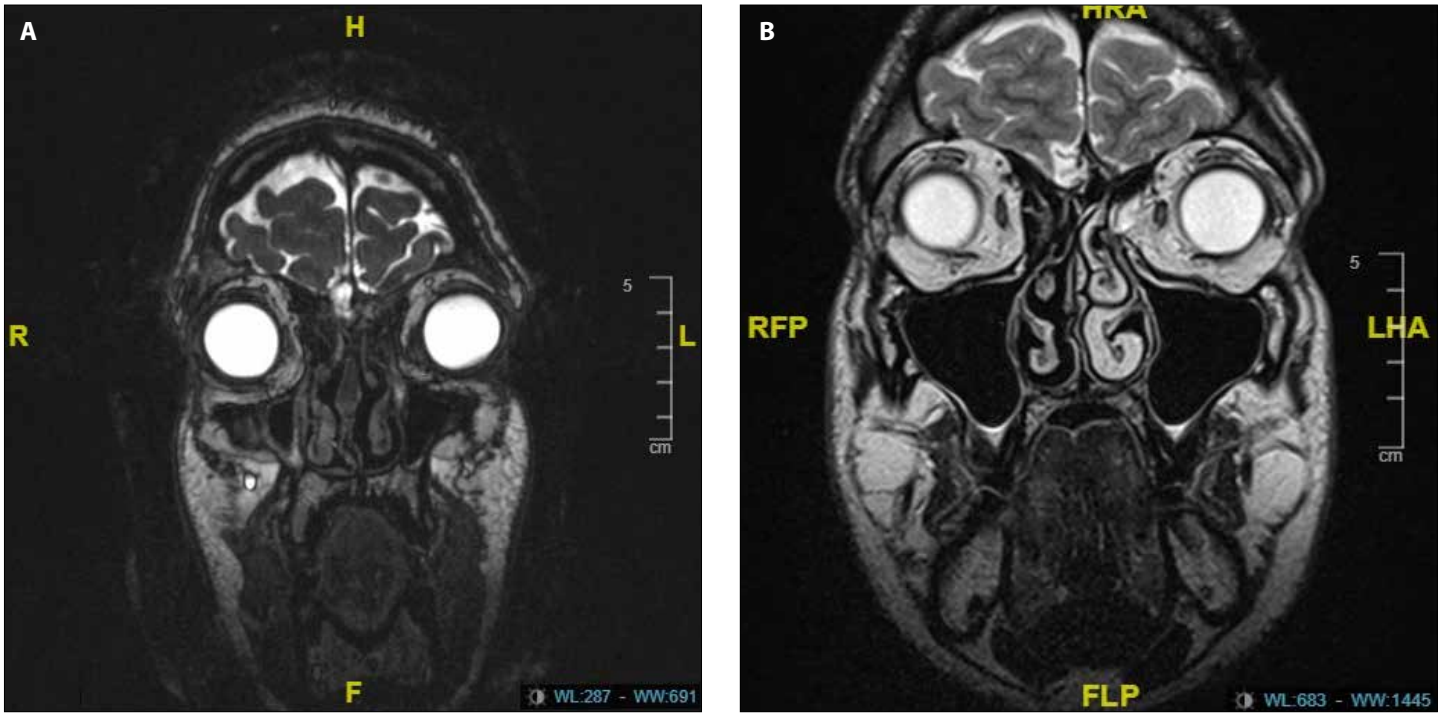

Figure 2. A, B. Preoperative scan with coronal (A) sequence demonstrates a dural defect at the right cribriform plate just lateral to the crista galli. The coronal (B) from the postoperative MR imaging reveals postoperative changes at the right olfactory groove

not encounter CSF rhinorrhea from all these sites. Dehiscence at the level of the skull base is not an uncommon condition. Ohnishi showed dehiscence sites at the ethmoid roof in 14% of cadaver skull base (17). These observations have shown that the closure of the bony structure is not needed for the treatment of the CSF fistula.

In the study by Carrau et al., in which the authors tried to ascertain possible factors affecting the endoscopic CSF rhinorrhea repair success rate, the septal cartilage was used in 5 cases and middle turbinate bone in 5 cases among the 53 rhinorrhea repair surgical procedures. They did not find any factors, which can positively affect the surgical success rate. However, the presence of hydrocephalus had a negative effect, whereas the graft type and surgical technique had no effect. While the authors define the conditions in which the rigid graft should be used, they confess to the information, which is not related to any clinical study (18).

We can say that not using rigid grafts will not lead to any problems in patients who have a defect up to 20 mm. Since the number of patients with a defect larger than 20 mm was insufficient, we could not make up an exact conclusion about the necessity of the rigid graft use in these patients.

The MRI using T2-weighted sequences is an ideal tool to locate the site of CSF rhinorrhea and evaluate the dural layer at the skull base. Demonstrations of the high-signal intensity fluid extending into the adjacent paranasal sinuses, or herniation of the brain into a sinus through a bone defect, has been the principal diagnostic criteria (19-20). Since the MR imaging can distinguish inflammatory tissues from meningoencephalocele and show any changes, such as sagging at the dural layer, the MR cisternography sections passing through the anterior skull base level were performed.

The literature also recommends the use of tissue glue to stabilize the graft. According to the medical records of our patients, although we used tissue glue in 5 of our cases, there would not be any problems if we had not used it. As a matter of fact, when the principles of this surgery are not accomplished, tissue glue will not guarantee the success. There is a need for comparative studies to demonstrate the necessity of the tissue glue in the CSF rhinorrhea repair.

CONCLUSION

Endoscopic transnasal CSF rhinorrhea surgery is a procedure with a high success rate. We have to examine the importance of every step in this operation for the possible roles of each. All the practice about the use of rigid grafts in the CSF rhinorrhea repair depends on the theoretical acceptance and beliefs. Neither the defect size nor used graft material has an effect on the surgical success rate of the endoscopic CSF rhinorrhea surgery. This study has shown that the use of a rigid graft is not obligatory in the CSF rhinorrhea surgery, especially in small and medium-sized defects. This study has shown that the use of a rigid graft is not a must for the reconstruction of the skull base, and treatment of a CSF fistula without a rigid graft would not lead to any problems. Endoscopic treatment of the CSF fistula with and without a rigid graft has a high success rate, and to recommend the use of a rigid graft during this surgical procedure, new clinical studies showing the necessity of rigid grafts are needed.

Ethics Committee Approval: Ethics committee approval was received for this study from the ethics committee of Hacettepe University (15.07.2015/241-15).

Informed Consent: Written informed consent was obtained from the patients who participated in this study.

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