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First experience with transnasal and transseptal endoscopic and microscopic repair of anterior skull base CSF fistulae*

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SUMMARY

Currently, endoscopic endonasal surgery is a valuable and safe procedure routinely performed for treatment of paranasal sinus disorders. Since the endoscopic technique has become popular in this area, interest has been increased in its possible use for some other indications such as transsphenoidal pituitary and anterior skull base surgery.

In this paper, we present our experience in using the nasal endoscope for repair of anterior skull base cerebrospinal fluid (CSF) fistulae. Between 1994-1999, we observed 44 patients with CSF rhinorrhea. Out of 44 patients, 34 had improved with the conservative treatment in two weeks, in 10 patients endoscopic surgery was performed and in one patient endoscopic surgery failed and the defect was repaired with transsphenoidal microscopic surgery. The remaining 9 patients were doing well and no problem was encountered concerning the surgery.

Key words: anterior skull base, endoscopic repair, rhinorrhea, transnasal, trauma

INTRODUCTION

CSF leakage manifested with rhinorrhea is an important problem after anterior skull base fractures. Diagnosis and treatment of rhinorrhea may be difficult depending on the location, size and the aetiology of fistulae (Kelley et al., 1996; Lanza et al., 1996). Although some patients can be treated by conservative treatment, some cases are manifested with persistent CSF leak with or without recurrent attacks of meningitis or brain abscess (unresponsive to conservative treatment). In these cases, it is necessary to apply surgical treatment. The classical surgical approach is transcranial fistulae repair. Since the transcranial approach causes a high morbidity rate, some extracranial methods have been tried (Dohlman, 1948; Hirsch, 1952; Mattox et al., 1990; Lanza et al., 1996; Schick et al., 1998). One of these, rigid endoscopy used in paranasal sinus surgery, has also been tried for surgical repair of skull base fractures tusing a transnasal approach. Being a minor intervention not involving neural tissue, this technique decreases the operation time and the morbidity compared to the transcranial methods. In the ENT department of our hospital endoscopic sinus surgery has been performed since 1989. In the present study, the results of the endoscopic repair of cases with CSF fistulae are reported and special transseptal endoscopic surgical technique to sphenoid sinus is described.

METHODS AND PATIENTS

Between 1994 and 1999, a total of 44 patients who had rhinorrhea and/or meningitis and were administered to the ENT, neurosurgery and infectious disease clinics were included in the study (Table 1). Diagnostic modalities were through history taking (trauma, surgery, etc.), complete ENT examination including diagnostic nasal endoscopy, neurologic examination and a CT scan with the patient in coronal position with or without metrizamide. Initially all patients were prescribed conservative treatment including bed rest, head elevation, stool softener, broad spectrum antibiotics, acetazolamide (Diamox®) and lumbar punctures (LP) for at least 2 weeks.

Out of 44 patients, 34 were improved with the conservative treatment without any complication. In the conservatively treated group, patients were discharged from the hospital being ordered bed rest 2 weeks, oral broad spectrum antibiotics 2 weeks and stool softener for 1 month. Patients were followed for 2 years. For this retrospective study, patients were asked by telephone about evidence of recurrence of rhinorrhea and attacks of meningitis.

Ten patients did not respond definitively to the conservative treatment and were admitted with recurrent rhinorrhea and/or recurrent meningitis attacks.

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Table 1. Distribution of all cases
Abbreviations; CSFR: CSF rhinorrhea, P: Pneumocephalus

Age	4-56 years (26±3)
Sex	33 males, 11 females
Etiology	Traffic accident: 37, falling down: 3, prior surgery: 3, gun shot:1
Location of defect	Ethmoid roof 28, sphenoid sinus 11, frontal sinus 4, cribriform plate 1
Clinical presentation	CSFR: 29, CSFR+Meningitis: 4, P: 3, CSFR+P: 8
Follow-up period	10 months-5 years (33±3 months)

In all patients, the defect in the rhino-base was repaired by a transnasal or transseptal endoscopic approach. In one patient rhinorrhea began 3 months post operation and this case was reoperated with the transsphenoidal microsurgical technique.
Before the operation, all patients were re-evaluated by routine neurosurgical and ENT examination including nasal endoscopy.

SURGICAL TECHNIQUE

Paranasal sinus computed tomography with the patient in a coronal position with intrathecal contrast agent was performed to localize the defect. One ml 1% fluorescein was injected intrathecally one hour before surgery to visualize CSF leakage

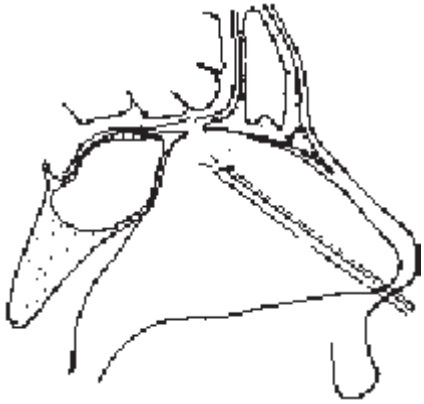

Figure 1. Localization of defect.

Figure 2. Insertion of fascia lata (underlay technique).

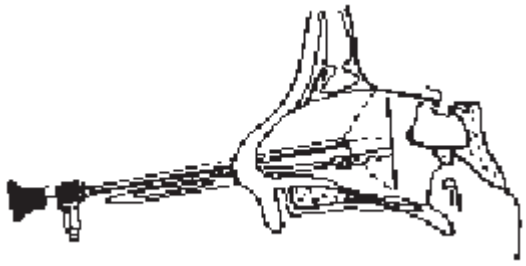

Figure 3. Presphenoidal septal mucosal incision.

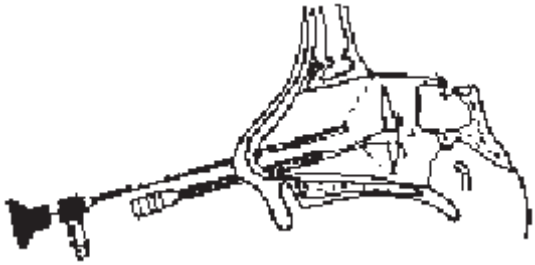

Figure 4. Elevation of mucoperiostium.

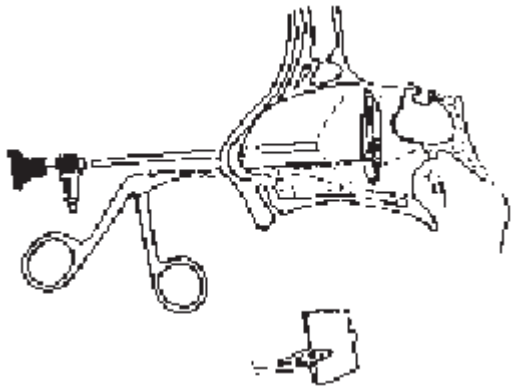

Figure 5. Removal of bony septum.

during the operation. After the application of endotracheal general anaesthesia, the nasal cavity was infiltrated with local anaesthetic agent (lidocaine 2% with adrenaline 1/100000). Zero° and 30° angled rigid endoscopes were used (Karl Storz Co., Tutlingen, Germany).
If the CSF leakage had resulted from an ethmoid roof defect, the operation was started as a complete ethmoidectomy endoscopically. Having localized the defect, mucosa and granulation tissue around the defect was removed (Figure 1). A piece of fascia lata was inserted between bone and dura (underlay technique) and using fibrin glue the cavity was filled with abdominal fat (Figure 2).
The CSF leakage originating from the sphenoid sinus was repaired via the transseptal route. Transseptal incision was done just 1,5 cm anterior to the sphenoid rostrum (Figure 3). Elevation of the mucoperiostium of the nasal septum was performed with the help of the suction elevator (Figure 4). Having transected the septal cartilage at the junction of the perpendicular plate of the ethmoid and cartilage septum, bilateral decollement of the septal mucosa was achieved and the bony septum was removed (Figure 5). Once the sphenoid rostrum was exposed, the sphe-

noid sinus of the side of the fistula was penetrated. In cases with bilateral defects the sphenoid sinus was opened through the same incision and the intrasinusal septum was removed (Figure 6). After resection of the mucosa around the defect, abdominal fat was placed into the sinus cavity together with fibrin glue (Figure 7). The operation was completed by replacing septal mucosa after reconstruction of the septum. Anterior nasal packing was applied at the end of the operation.

During the operation, presence of any potential leakage from the defect was eliminated by increasing intracranial pressure as a provocative measure. Hyperventilation consecutively causes increased intrathorasic pressure, decreased venous flow from the jugular system, and increased intracranial pressure. Postoperatively, it was tried to maintain the CSF pressure at a low level by serial LP's for 2 days. Nasal packing was removed on the second day and patients were discharged after a complete recovery. After discharge the patients were ordered bed rest for at least 2 weeks. The patients were followed by endoscopic examinations at 2 months intervals during one year.

RESULTS

Conservatively treated group

Of the 44 patients evaluated between 1994 and 1998, 34 patients had a spontaneous closure of their CSF leak. Of our patients the major cause was traffic accidents, followed by falling down, previous surgery, and gun shots by order of occurrence. All of the patients were free of rhinorrhea, meningitis or brain abscess for 5 months after their discharge from the hospital. In the follow-up period, 3 patients died due to other reasons without evidence of rhinorrhea recurrence. Nineteen out of 34 patients were able to be telephone-interviewed only.

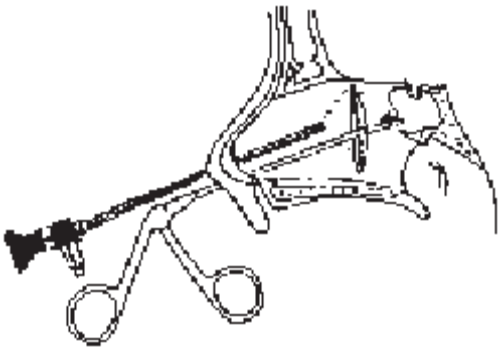

Figure 6. Penetration of sphenoid sinus.

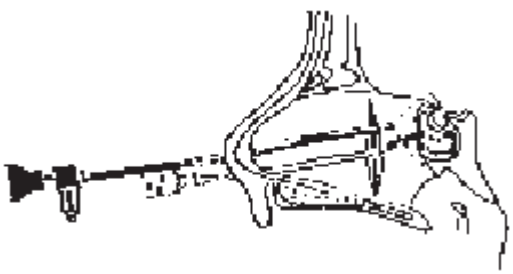

Figure 7. Obliteration of cavity.

Patients treated by surgical repair

Eight patients were male and 2 were female with an age range from 8 to 56 years. The cause of CSF fistulae was trauma in 8 patients, while one case resulted after transcranial hypophyseal surgery and one case on who endoscopic sinus surgery was performed, was consulted from another centre. In five patients the defect was located in the ethmoid sinus roof and the CSF was running down via ethmoid cells. In one patient the defect was located in the cribriform plate and CSF had no access to the paranasal sinuses. The defects have been found in the base of the sella in one patient, the sphenoid roof in 3 patients with CSF leakage through the sphenoid sinus. CSF was leaking through one nasal orifice in 9 patients and leaking bilateral in 1 patient who had the defect in the roof of the sphenoid sinus. The time-course of the transnasal surgical procedure was between 45 and 90 minutes. Nasal packing was removed on the second day. Two patients were discharged from the hospital on the third day, 3 patients were discharged on the fourth and the remaining were discharged on the fifth day. The patients were under follow-up between 14 months and 5 years (mean 32±5 months). In the follow-up period, the procedure was successful without any complication. Only in 1 patient who had recieved transcranial hypophyseal surgery, three months after the operation the plug composed of fascia and fibrin detached and he complained of rhinorrhea again. In this patient the defect was repaired by transcranial approach by neurosurgeons. Because of necessity of revision hypophyseal surgery, transnasal or transseptal revision duraplasty was not considered. The features of the patients and the results are summarised in Table 2.

DISCUSSION

Management of CSF fistulae is still controversial. Treatment options include both conservative and surgical repairs. CSF leakage through anterior skull base defects may highly respond to conservative treatment. Mincy reported an 85% closure rate within 7 days of bed rest (Mincy, 1966). In our series, this rate was 83%. In the patients not responding to the conservative treatment of at least 2 weeks, surgical treatment should be the choice. The chronology of the leak, site of the fistula, relative size of the fistula or amount of CSF leakage or both and the presence of an accompanying infection are the factors that influence the treatment plan. Bergman and Rockswold (1995) emphasize that larger leaks or leaks that are more chronic in nature are not likely to heal with conservative measures and may need operative intervention. Although the conservative treatment success rate is high there is the possibility of late complications of the spontaneous closure of CSF leakage without surgical repair (Samii and Draf, 1989). Among surgical methods besides classical frontal craniotomy, transnasal transeptal microsurgery and external nasal approach, the endoscopic repair was introduced as a novel technique. The extracranial approach was first introduced in 1948 by Dohlman by applying a nasoorbital incision in one patient with rhinorrhea (Dohlman, 1948).

In 1952, Hirsch described the intranasal sphenoid sinus approach (Hirsch, 1952) and Vrabec and Halberg reported the

Table 2. Distribution of surgically repaired cases.
Abbreviations; F: female, M: male, TA: traffic accident, CSFR: CSF rhinorrhea, Flr: failure, S: success, P: Pneumocephalus

Age Sex	Etiology	Period of complaint	Location of CSF leakage	Clinic presentation	Location of the defect	Hospital. Time	Out-come	Fallow Up time
37 M	TA	4 years	Left nose	CSFR meningitis	Left ethmoid	5	S	5 years
8 M	TA	1.5 years	Right nose	CSFR meningitis	Right ethmoid	5	S	5 years
36 M	TA	9 years	Left nose	CSFR meningitis	Left ethmoid	5	S	4 years
35 M	Surgery	3 years	Bilateral	CSFR meningitis	Right sphenoid	4	Flr	3 years
16 F	Falling Down	1 month	Right nose	CSFR	Floor of sella	4	S	3 years
27 M	Gun Shot	2 months	Left nose	CSFR	Left ethmoid	3	S	20 months
13 M	TA	3 months	Right nose	CSFR	Right sphenoid	5	S	18 months
28 M	Surgery	1 month	Left nose	CSFR+P	Left ethmoid	3	S	18 months
41 M	TA	2 months	Left nose	CSFR	Left sphenoid	5	S	15 months
56 F	TA	1 month	Left nose	CSFR	Left cribriform plate	4	S	14 months

intranasal approach for a leakage from the cribriform plate (Vrabec and Halberg, 1964). The transnasal endoscopic technique was first described by Wigand for treatment of rhinorrhea (Wigand, 1981). This approach was also applied in endoscopic hypophyseal surgery (Jankowski et al., 1992; Jho and Carrau, 1997; Yaniv and Rappaport, 1997). However the number of series are still limited because the technique is quite new.

Rigid telescopes provide a magnified and cleared view in a desired angle. These properties help for the recognition of the defect site and replacing the graft tissue under direct visualisation (Kelley et al., 1996; Lanza et al., 1996). By this method, the potential morbidity caused by other technique such as craniotomy, transseptal or external nasal approaches is decreased (Stankiewicz, 1989; Jankowski et al., 1992; Turgut et al., 1993; Kelley et al., 1996; Setti et al., 1996). The potential hazards for craniotomy are the prolonged time-course of the procedure, unwanted damages to neural tissue, anosmia and epilepsy (Bryant and Bird, 1982; Persky et al., 1991). The complications related to transseptal microsurgical and external nasal operations are septal perforation, facial numbness, and other nasal and orbital complications (Jankowski et al., 1992; Lanza et al., 1996; Yaniv and Rappaport, 1997). For the endoscopic method to be a succes it is important to define the exact localization of the defect. In our series localization of the defects was determined by means of cranial and paranasal CT with intrathecal contrast agent.

Additionally, for the intraoperative visualization of the defect intrathecal fluorescein was injected. Application of 5% fluorescein has previously been reported to cause some side effects such as meningeal irritation, loss of sense and power in the lower extremities and epilepsy (Charles and Snell, 1979; Bryant and Bird, 1982; Reck, 1984; Mattox and Kennedy, 1990). It has been suggested that dilution of fluorescein with 0.9% NaCl prevents the side effects (Moseley et al., 1978). Therefore we diluted fluorescein in NaCl solution to have a final concentration of 1% and sew no side effects related to the fluorescein application. This technique was succesful in 9 out of 10 patients. Generally, the reasons of failure obtained in this endoscopic procedure are as follows: improper localization of the defect, graft rejection or loosening, improper graft size, insufficient graft material, incompliance with the recommendations by the patients and poor wound healing. Nevertheless it is easier to detect the defect using the nasal endoscopic technique and the difficulties in manipulating within very small areas and possible complications related to other surgical procedures are decreased. With the improvement in endoscopic technology and increased surgical experience, repair of CSF fistulae in the anterior skull base has become more easy and safe. As a result, we suggest that the transnasal endoscopic procedure is preferable as the first choice of surgical treatment for repairing anterior skull base CSF fistulae if the site of the leakage can be determined. In addition this technique constitutes an alternative to the classical microsurgical methods for transsphenoidal hypophyseal surgery.

In conclusion, lower morbidity means:

1. Shorter operation time
2. Shorter hospitalisation time
3. No external incision
4. One septal incision in the sphenoid defects
5. The advantages of the transseptal approach to the sphenoid sinus is that the stabilization of the graft material is easier than that of the intranasal approach because of the intact anterior surface of the sphenoid sinus.

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