Nasal endoscopic repair of cerebrospinal fluid rhinorrhea*

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SUMMARY

The surgical management of Cerebro-spinal Fluid (CSF) rhinorrhea has been modified these last years due to the improvement of endoscopic sinus surgery techniques allowing the treatment of selective dural tears by the endonasal route.

Over a period of 6 years , 27 patients with CSF rhinorrhea were operated on by the endonasal approach under optical guidance. CSF rhinorrhea was due, in 20 cases, to surgical iatrogenic trauma, in 4 cases to head injury, and in 1 case it was secondary to a conservative medical treatment of a pituitary adenoma. In 2 cases the cause was unknown. The average follow-up in this series was 24.7 months. The technique used was successfull in 22 patients (81,5%).

Considering these results and others reported in the literature, we think the use of the endonasal approach with optical guidance should always be considered as a valuable alternative to open surgery and should be discussed in all cases of CSF rhinorrhea with neurosurgeons.

Key words: cerebrospinal fluid rhinorrhea, endoscopic sinus surgery.

INTRODUCTION

Cerebrospinal fluid (CSF) rhinorrhea is the nasal discharge of CSF resulting from a bony defect located in the base of the skull. If not treated, it leads to an increased risk of meningitis necessitating a rapid surgical closure of this defect.

The intracranial repair of CSF leaks, as described by Dandy in 1926, is still widely used. Dohlman, in 1948, was the first to describe an extracranial naso-orbital approach for the repair of these defects using middle turbinate and septal flaps, thus avoiding the need for a craniotomy.

The wide use of endoscopic sinus surgery during the last decade has lead to an increased number of cases of iatrogenic CSF leaks (Castillo et al., 1996) that were dealt with by an immediate intraoperative sealing of the dural defect using the endoscopic telescopes (Dessi et al., 1994). The endonasal route has been widely used since then, to include delayed repair of unrecognized CSF leaks occurring at the time of endoscopic sinus surgery, or resulting from cranial base surgery or cranio-facial trauma.

We report, in this retrospective study, our results of delayed nasal endoscopic repair of CSF rhinorrhea based on a series of 27 patients presenting with CSF rhinorrhea at the ENT and Head and Neck surgery division of Pasteur Hospital in Nice, France.

MATERIAL AND METHODS

Between January 1992 and June 1997, 27 patients (17 women and 10 men), with an average age of 49.2 years (ranging from 27 to 79 years), where operated on, using a nasal endoscopic approach, for the repair of a CSF rhinorrhea.

The presenting symptom was an isolated CSF rhinorrhea in 19 patients, a CSF rhinorrhea associated to at least one episode of bacterial meningitis in 5 patients, 3 isolated episodes of bacterial meningitis in 1 patient, a frontal abscess in 1 patient, and brain seizures in 1 patient (Table 1).

Table 1. Presenting symptoms of the 27 cases of CSF fistulae.

Presenting symptoms	Number of cases
isolated CSF rhinorrhea	**19**
CSF Rhinorrhea associated to meningitis	**5**
isolated episodes of meningitis	**1**
frontal abscess	**1**
brain seizures	**1**

The CSF rhinorrhea had variable aetiologies. In 20 cases it was due to a surgical trauma: 8 cases occurred following transsphenoidal hypophysectomy, 8 cases following endoscopic sinus surgery, and 4 cases following surgical resection of an anterior

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cranial fossa meningioma. In 4 cases the CSF rhinorrhea was due to a cranio-facial trauma: 1 case was associated to a cranio-facial Lefort 3 fracture, 1 case occurred immediately following a frontal head trauma and 2 cases were associated to an old head trauma (after 4 and 7 years). In 1 case the CSF rhinorrhea was spontaneous following a medical conservative treatment of a prolactinoma with Bromocriptine. In the remaining 2 cases, the cause of the CSF leak was unknown (Table 2).

Table 2. Aetiology of the 27 cases of CSF fistulae.

Aetiology	Number of cases
surgical trauma	**20**
transsphenoidal hypophysectomy	8
endonasal sinus surgery	8
resection of meningioma	4
head trauma	**4**
cranio-facial fracture	1
frontal head trauma	1
old head trauma	2
conservative treatment of a pituitary adenoma	**1**
unknown	**2**

Coronal and axial Computed Tomography scans were performed in all but one case. In the last 5 cases, reconstructed sagittal cuts were performed. The bony defect was identified in 21 cases (80.7%).

Intrathecal fluorescein was administered to 9 patients. Under general anesthesia, 5 to 10 ml of CSF were withdrawn through a lumbar puncture, mixed with 0.2 to 0.5 ml of 0.5% fluorescein solution, and injected back slowly into the subarachnoid space. The patient was held in a tredelenbourg position for 30 minutes to allow the diffusion of the solution throughout the CSF. The passage of fluorescein into the nasal fossa was controlled endoscopically without the need for special light sources or filters. The fluorescein test was positive in 6 cases (66.7%).

In all cases, the CSF rhinorrhea was treated using a video-assisted nasal endoscopic approach under general anesthesia.

Depending on the site of the CSF fistula, two different surgical procedures were used. When the defect was located in the ethmoid roof or the cribiform region, a complete ethmoidectomy was initially performed. The cleaning of the mucosa away from the entire roof of the ethmoidal sinus along with the resection of the middle turbinate have allowed a broad exposure and a precise identification of the site of the leak. When the size of the bony defect was greater than the diameter of the telescope (4mm), a bony fragment, taken from the middle turbinate, was sledded through the bony defect into the endocranium and positioned between the dural tear above and the bony defect below, thus sealing both.

Then, the bony defect was covered with a piece of middle turbinate mucosa (the mucosal side facing the nasal fossa) fixed with fibrin glue, and held in place by a Surgicel nasal pack. Finally, an Ultracel nasal pack was placed in the nasal fossa for 72 hours. When the bony defect was less than 4 mm, only turbinate mucosa was used to close the defect in the same way described above.

When the dural defect was located in the sphenoid sinus, it was sealed with abdominal fat, after removal of the mucosa of the sphenoid roof, when the leak was localised on the sphenoidal roof. A wide access to the spheno-ethmoidal recess required a resection of the tail of both middle and superior turbinates. The sphenotomy was performed by puncture of the sphenoid ostium followed by a progressive infero-medial enlargement of the anterior wall of the sinus until the bony defect was clearly visible. Then, the sinus was filled with previously harvested abdominal fat fixed with fibrin glue and held in place by a Surgicel nasal pack. The nasal fossa was again packed with Ultracel for 72 hours. The average hospital stay was 4 days.

RESULTS

The average follow-up in this series was 24.7 months (ranging from 8 to 60 months). Results were considered successful whenever CSF rhinorrhea was controlled in the absence of meningeal complications. The absence of CSF rhinorrhea was evaluated by routine endoscopic examinations of the nasal cavity for at least 6 months following surgery.

Accordingly, in this series, CSF leaks were considered to be successfully treated in 22 (81.5%) of the 27 cases (Table 3).

Table 3. Success of the Endonasal repair of CSF rhinorrhea according to the site of CSF leak.

Site of the leak	number of cases	\cell success	failure
posterior ethmoid	5	5	0
anterior ethmoid	4	4	0
cribiform plate	3	3	0
ethmoid-cribiform plate	5	2	3
sphenoid roof	10	8	2
	27	**22**	**5**

CSF rhinorrhea recurred in 5 cases (18.5%). In 2 cases, CSF rhinorrhea recurred after removal of the nasal packing 72 hours following surgery. In the first case, the initial CSF rhinorrhea was due to a bifrontal craniotomy approach with resection of an anterior cranial fossa meningioma. In the second case, the bony defect was due to a cranio-facial trauma with an anterior skull base fracture. In 3 cases, the CSF rhinorrhea recurred 10, 25, and 28 days following surgery. In the first 2 cases the initial rhinorrhea was due to a transsphenoidal hypophysectomy and in the last case it was due to an endoscopic sinus surgery for a nasal polyposis. In all cases the CSF rhinorrhea was successfully treated, at a later stage, by a conventional intracranial approach performed by the hospital neurosurgical team.

COMMENT

A unilateral watery nasal discharge with history of rhinologic or cranial base surgery, or following head trauma must always suggest the diagnosis of a CSF rhinorrhea.

Endoscopic examination of the nasal fossa coupled with maneuvers raising intracranial pressure, like bijugular compression or coughing, may aid to diagnose and sometimes locate the CSF leak (middle or superior meatus, Eustachian tube ostium).

Glucose and chloride concentrations in the nasal discharge may help indicate its origin. False positive results occur in 45% to 75% of the cases (Calcaterrat, 1985). Only the presence of ß2-transferrine, a specific CSF protein identified by electrophoresis, can confirm the intracranial origin of the rhinorrhea (Neurman et al., 1979 ; Oberascher, 1988). These screening methods have not been used in this series.

The next step is to locate the site of the leak. According to Dodson (1994), nasal endoscopic examination, by itself, may exactly locate the leak in 50% of the cases. Coronal and axial computed tomography (CT) scans, 1 mm wide, provide the best method for the identification of the bony defect. Reconstructed coronal images from axial cuts are often too coarse to identify small defects. According to several series, CT scans were reported to be able to identify the defects in 35% to 75% of the cases. In this series, we were able to draw conclusions in 80.7% of the cases.

Metrizamide CT scans were reported, in some series, to locate the bony defects in as high as 90% of the cases (Schaefer et al., 1980). When in doubt regarding the nature of the tissue, the MRI could distinguish between cerebral tissue and retention material in the sinus close to the bony defect. Cisternographies using radioisotopes (Krasnow et al., 1980) have been abandoned because of the increased incidence of false positive and false negative results.

With the improvement of endoscopic techniques, the use of intrathecal fluorescein dye has lately shown a regain of interest. This procedure was first described by Kirchner et al. (1960). Messerklinger (1972) combined the use of fluorescein to that of endoscopic telescopes in order to diagnose and locate the CSF leak.

The occurrence of meningeal complications (Mahaley et al., 1966 ; Mosheley et al., 1978) has resulted in abandoning this technique for many years. These complications were mainly due to the use of highly concentrated fluorescein solutions. However, no permanent neurologic damage has ever been reported.

According to many authors, the new methods of dilution and intrathecal instillation of fluorescein have proven to be safe and satisfactory. Reck et al. (1984), on 45 cases, reported no side effects resulting from fluorescein injection. Charles et al. (1979) reported only one case of a minor meningeal irritation in a patient to whom a tenfold amount of the initial fluorescein dilution was accidentally administered.

If properly done, this procedure is often successful in locating the CSF leak: Persky et al. (1979) reported a successful identification in 8 out of 10 cases (80%); Dodson et al. (1994), in 3 out of 3 cases (100%).

The major advantage of fluorescein injection, besides providing a positive diagnosis and a precise localization of the CSF leak, is the timing of the procedure which is performed immediately before surgery, thus allowing an easier scheduling of logistics and a more efficient repair of the defect.

In this study, the fluorescein test was performed in 9 patients. It was positive in 6 (66.7%) of them. No meningeal complications were reported.

The next step following diagnosis and localization of the leak is the choice of the surgical approach: intracranial or extracranial.

Among the extracranial approaches, the transethmoidal and transfrontal routes (Bremond et al., 1984; Vaneecloo et al., 1991) are being progressively abandoned in favor of the nasal endoscopic approach.

The intracranial approach using a bifrontal craniotomy is still widely used. It is actually the best method when large bony defects are present and in cases where repair of the posterior frontal sinus wall is required. This approach permits a broader exposure of the anterior cranial base allowing a more efficient repair of the large bony defects and a more sophisticated closure of the associated dural tears. In addition to the substantial morbidity of the craniotomy, the intracranial approach may cause a permanent anosmia resulting from the sectioning of the olfactory filaments at the level of the cribiform plate. Moreover, recurrence rates of CSF rhinorrhea after a craniotomy approach ranged, depending on the series, between 10% and 40% (Brunon et al.,1976 ; Derome et al.,1980 ; Marchal et al.,1980 ; Rousseaux et al.,1981 ; Park et al., 1983).

The nasal endoscopic repair of CSF rhinorrhea presents, in many cases, a valuable alternative to the intracranial approach. Wigand (1990) and Stanckiewicz (1991) were the first to perform a nasal endoscopic repair of CSF leaks occurring accidentally during endoscopic sinus surgery. Many authors confirmed later the efficiency of this approach (Papay et al.,1989; Mattox et al.,1990; Levine,1991). More recently, Dodson (1994) reported his results using endoscopic closure of CSF leaks based on a series of 29 patients with variable aetiologies and indications. The CSF leak was successfully treated in 22 patients (75.8%). Three recurrences where successfully reoperated using the same method, thus raising the successfully treated cases to 25 out of 29 cases (82.6%). The success rate in our series was 81.5% (22 out of 27 cases). The five recurrences where treated successfully by a craniotomy approach at a later stage.

The material used in the repair of the defect varies according to authors' habits. The use of fibrin glue is almost universal. Mucosa may be harvested from the nasal septum, middle or inferior turbinate. The use of muscle aponeurosis and abdominal fat may also be indicated (Papay et al., 1989). The results do not seem to be correlated to the material used. When the dural defect is located in the sphenoid sinus, the use of abdominal fat is advocated by all the authors. When the defect is located elsewhere, the choice of the material depends again on authors habits. We advocate the use of disposable material such as the middle or inferior turbinate.

Success rates reported in the literature concerning the nasal endoscopic repair of CSF rhinorrhea go beyond 85%. These good results depend on a careful selection of the cases, keeping in mind that complex cranial base fractures are counter-indications for the use of this technique. These encouraging results are yet to be confirmed by studies based on a long-term follow-up.

CONCLUSION

The positive diagnosis of a CSF rhinorrhea raises the matter of choosing the adequate surgical approach for its repair. Defects located in the posterior wall of the frontal sinus and those associated with intracranial complications are still a definite indication for a conventional intracranial approach. Other dural defects may constitute a good indication for the nasal endoscopic approach with high success rates and low morbidity.

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