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Main Article

Endoscopic repair of cerebrospinal fluid rhinorrhea – Manipal experience

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Abstract

Otolaryngologists play a major role in the management of cerebrospinal fluid (CSF) rhinorrhea. A thorough understanding of the underlying pathophysiology and the various treatment options available is essential to achieve the best possible results.

In this paper, we are highlighting the pathophysiology, diagnosis and surgical technique involved in the repair of cerebrospinal fluid rhinorrhea. A retrospective study conducted in the department of ENT and Head and Neck Surgery, Kasturba Hospital, Manipal is presented to highlight our experience with cerebrospinal fluid rhinorrhea.

Eleven patients were managed in the department of otolaryngology between 1999 and 2005. Seven had spontaneous CSF rhinorrhea, three were due to trauma and one iatrogenic, following surgery. Commonest anatomic site of leak was the cribriform plate in 4 cases. Other sites included sphenoid [2], lateral lamella [2], fovea ethmoidalis [2] and olfactory groove [1]. Onlay technique was performed in 10 out of 11 patients. Closure was successful in 10 out of 11 cases in the first attempt. One patient underwent revision surgery. Patients were followed up for a period ranging from 3 months to 3 years.

CSF rhinorrhea is a potentially fatal condition which requires precise and urgent treatment. The transnasal endoscopic repair of CSF leak has a high success rate with low morbidity when performed by experienced endoscopic sinus surgeons. Our experience in managing this condition is presented.

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Introduction

CSF rhinorrhea is a challenging condition to treat. Otolaryngologists have played a major role in its management ever since improved instrumentation for sinus surgery led to endoscopic repair of CSF leaks by Wigand in 1981. Over the past 20 years, the minimally invasive endoscopic approach has gained widespread acceptance.

The credit for the first surgical repair of CSF leak goes to Dandy who closed a cranionasal fistula using a frontal craniotomy approach in 1926 [1]. A success rate of 60 to 80% was achieved using this approach. It was Dohlman in 1948 who first described an extracranial approach using a naso-orbital incision to close the cerebrospinal fluid rhinorrhea. Wigand revolutionized endoscopic CSF rhinorrhoea management with his repair. Since then improved surgical techniques with better visualization have led to success rates of over 90% with lower morbidity when compared to more traditional intracranial techniques.

CSF leaks can be categorized into 3 main groups:

1) Traumatic 2) Non-traumatic 3) Spontaneous

Traumatic leaks are subdivided into accidental (blunt or penetrating) or surgical. 70–80% of CSF rhinorrhoea is caused by accidental trauma.

Non-traumatic CSF rhinorrhoea causes include high-pressure and normal-pressure leaks. High pressure CSF rhinorrhoea is mainly caused by tumour obstruction, other causes being benign intracranial hypertension or hydrocephalous. Normal pressure leaks result from bony erosion by tumour, tumour treatment with radiation, arachnoid granulations, infectious meningocoeles etc. Spontaneous CSF leaks are idiopathic or unknown in origin.

Preoperative studies should establish the diagnosis and localize the site of the leak. The presence of clear watery fluid dripping from the nasal cavity and the presence of a halo sign on tissue paper should arouse suspicion of CSF rhinorrhoea. Components of CSF such as glucose, protein and electrolytes can be measured [2]. The sensitivity and the specificity of these tests remain quite poor.

Beta-2 transferrin is a protein present only in CSF, perilymph and aqueous humour [1]. Testing nasal secretions for Beta-2 transferrin represents a much more specific and sensitive technique. False positives and false negatives are unlikely with Beta-2 transferrin testing [3]. Beta-2 transferrin provides an accurate, non-invasive method to establish the diagnosis of an active CSF leak but does not provide information on the location of the leak.

High resolution coronal and axial computed tomography (CT) is useful in all cases. It can detect skull-base defects but does not establish CSF leaks.

Radioactive cisternograms, where intranasal cotton pledglet placed endoscopically, pick up radioactive markers which have been injected intrathecally, can localize the site of leaks. Pledglets are commonly kept over anterior cribriform plate, middle meatus and sphenoethmoidal recess. The pledglets are removed after several hours and the amount of radioactivity on it is measured.

CT cisternograms are useful for identifying leaks. A coronal or axial CT is performed after injection of contrast material. It may be the only test required if it positively identifies contrast material within a specific paranasal sinus. Contrast agent includes iohexol and iopamidol. These agents have a low incidence of side effects compared with older compounds such as metrizamide [4].

Intrathecal fluoroscein endoscopy is most commonly used as an adjunct to intraoperative localization of a skull based defect. The process involves standard lumbar puncture followed by withdrawal of 10 cc of CSF, which is mixed with 0.2–0.25 cc of 5% Fluoroscein. After 30 minutes, a brilliant yellow fluid leaking into the nose is observed.

MRI & MR cisternography are non-invasive alternative to intrathecal contrast-enhanced high-resolution CT. This cannot define bony defects.

Most CSF leaks resulting from trauma heal with conservative measures, over the course of 7–10 days. Spontaneous leaks in which CSF rhinorrhoea develops days or weeks after trauma are less likely to heal. Initial management includes bed rest, head end elevation, avoidance of straining and the use of laxative. The use of antibiotics is controversial.

In 1981, Wigand described closure of CSF leaks using an endoscopic approach. Endoscopic intranasal fistula repair is now the preferred approach. Regardless of materials used success rate of 92–96% have been documented.

Generally a small defect can be closed with an overlay free mucosal graft or a free fascial graft. Free mucosal grafts can be acquired from the inferior turbinate or the septum. Fascia is harvested from the temporalis region or fascia lata. It is important that the mucosa surrounding a defect be removed prior to grafting to stimulate osteogenesis and to increase the channels of graft take up. Large bony defects are sealed with the help of bone grafts placed in an overlay fashion with a layer of fascia covering it in on overlay manner. Hydroxyapatite is the most commonly used alloplastic material.

Materials and methods

We retrospectively studied 11 patients with CSF rhinorrhea treated in our department between 1999 and 2005 (Table 1). Data collected included presenting signs and symptoms, site and size of skull base defect, surgical approach, repair technique and clinical follow-up. Pre-operative evaluation consisted of thorough history, physical examination, nasal endoscopic examination and radiographic images (Fig. 1).

To obtain adequate anterior exposure, any agger nasi cells or concha bullosa were excised and turbinectomies and ethmoidectomies were performed when needed for exposure.

The site of leak was identified using 0º and 30º endoscopes (Fig. 2). When no leak was visible intraoperatively, the anaesthetist was asked to hyperventilate inorder to increase the intracranial pressure.

After identifying the defect, the graft bed was prepared by removing a cuff of normal mucosa for 3–4 mm surrounding the defect. Larger bony defects were reconstructed by sealing with cartilage grafts taken from the septum (Fig. 3), shaped to the size of the defect and placed in an underlay fashion in the epidural space followed by an overlay soft tissue graft. Mucosa should not be entrapped in the epidural space as it may lead to an intracranial mucocoele. This was followed by surgicel, gelfoam and BIPP, (bismuth iodoform paraffin paste) packs. Adjuvant therapy included the use of acetazolamide.

Results

Eleven patients underwent endoscopic repair of CSF rhinorrhea. The age group ranged from 30–50 years. The follow up period extended from 3 months to 3 years. Etiologies included 7 spontaneous leaks, 3 post traumatic and 1 iatrogenic leak. The commonest sites of leak included the cribriform plate, the fovea ethmoidalis and the lateral lamella (Table 2).

Underlay technique was performed in one patient while all the others had overlay. Connective tissue grafts taken included temporalis muscle, temporalis fascia (Fig. 4), abdominal fat and septal bone graft as well as cartilage. KTP 532 laser was used in 3 patients to debride the defect of overlying mucosa.

Table 1 Details of patients with CSF rhinorrhea studied between 1999 and 2005

Pt no.	Age (Yrs)	Sex	Etiology	Anatomical site	Technique	Graft material
1	58	F	Spont.	Rt. cribriform plate	TE (O)	Temp. muscle and fascia and septal cartilage
2	50	F	Traumatic	Rt.cribriform plate	TE (O)	Temp. muscle and fascia and septal cartilage
3	43	F	Spont.	Lt. lateral lamella	TE (U)	Temp. muscle and fascia and septal cartilage
4	55	F	Spont.	Lt. cribriform plate	TE (O)	Temp. muscle and fascia and septal cartilage
5	35	F	Traumatic	Olfactory groove	TE (O)	Temp. muscle and fascia and septal cartilage
6	38	F	Spont.	Rt. fovea ethmoidalis	TE (O)	Temp. muscle and fascia and septal cartilage
7	50	F	Spont.	Lateral wall of sphenoid	TE (O)	Temp. muscle and fascia and septal cartilage LASER
8	41	M	Spont.	Lt. fovea ethmoidalis	TE (O)	Temp. muscle and fascia and septal cartilage LASER
9	55	M	Traumatic	Rt. lateral wall of sphenoid	TE (O)	Temp. muscle and fascia and septal cartilage LASER
10	49	M	Spont.	Rt. cribriform plate	TE (O)	Temp. muscle and fascia and septal cartilage
11	36	M	Iatrogenic (skull base surgery)	Lt. lateral lamella	TE (O)	Temp. muscle and fascia and septal cartilage

M: Male, F: Female, Spont. : Spontaneous, TE (O): Technique employed (overlay), TE (U): Technique employed (underlay), Temp.: Temporalis muscle

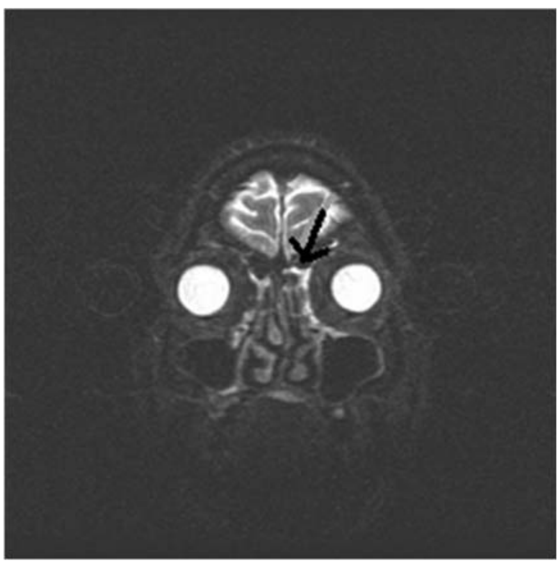

Fig. 1 MRI scan showing the site of CSF leak

Fig. 2 Endoscopic picture via transnasal route showing site of CSF leak

In our experience the leaks from fovea ethmoidalis were easy to manage whereas the leaks from lateral wall of the sphenoid were relatively difficult. The size of the leaks ranged from 2 mm to not more than 3 mm in our case series.

Out of 11 patients treated only 1 case of CSF leak from the lateral wall of sphenoid needed revision surgery.

Discussion

Endoscopic repair of CSF leaks is a challenging procedure. Surgical management now relies on an extracranial endoscopic approach where the success rate is over 90% when compared to intracranial approaches where the success rate is generally accepted as being 67–73% after the first procedure and upto 90% after multiple procedures. The main advantage of intracranial approach is the possibility of treating associated problems such as intracranial bleeding, or tumors and closing any associated dural defect. The main disadvantage of intracranial approach is loss of olfaction that occurs during mobilization of of the anterior cranial base. With advanced endoscopic and extracranial techniques, otolaryngologists can now close most CSF leaks and avoid the morbidity of a craniotomy.

The basic principle of endoscopic repair is positive identification of the leak site, meticulous preparation of the recipient bed and accurate placement of the graft material.

In our series of 11 patients who underwent repair of CSF rhinorrhoea, the success rate was 91%. One patient had to undergo revision surgery. This compares favourably with studies done in other parts of the world (Table 2).

Positive identification of the defect may be done through a series of investigations as outlined earlier but in our institute we rely on a combination of CT scan with intrathecal contrast injection. Thirty minutes after injection of contrast, CT scans taken in the coronal and axial planes will identify the leak.

The recipient bed is prepared by removing several millimetres of mucosa surrounding the bony defect. Exocrine mucous glands within sinus mucosa will continue to make mucous and may separate the graft from the recipient bed if it is not removed. Thus it is critical to thoroughly remove the mucosa to expose the underlying bone. A diamond burr or curette can be used to light abrade the recipient bed and stimulate the osteoneogenesis.

Once the recipient site is prepared, the repair is performed by gently elevating the dura above the defect and then using bone grafts in an underlay fashion in the epidural space. The bone graft cut in the correct size and shape is soaked in an antibiotic solution before being placed in the defect.

A free graft helps wound healing by acting as a scaffold [5]. Free grafts are adherent to bone after 1 week and are replaced by fibrous connective tissue after 3 weeks.

A multilayered closure is recommended to provide structural support, (bone), and water-tight closure (fascia).

Small bony defects in the skull base would not require bone grafts as freshening and placing a bone in the epidural space could theoretically enlarge the bony defect [1].

In addition to bone and fascia grafts a number of authors include septal mucosa. We routinely use septal mucosa to cover the grafted area for additional support. Septal mucosa has advantages over middle turbinate mucosa because it is thicker and larger grafts can be harvested.

Packing material such as gelfoam and surgicel have all been used with success. There is no specific advantage of one over the other.

Conclusion

Otolaryngologists play an important role in the management of CSF rhinorrhoea. Endoscopic CSF rhinorrhoea repair has definite advantages over more traditional meth-

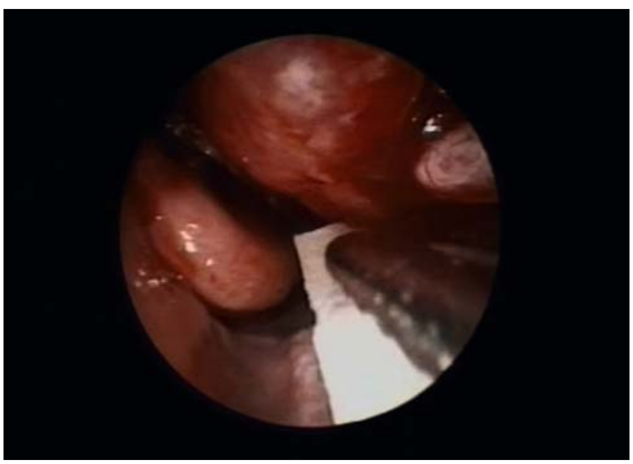

Fig. 3 A piece of cartilage is used to seal the leak

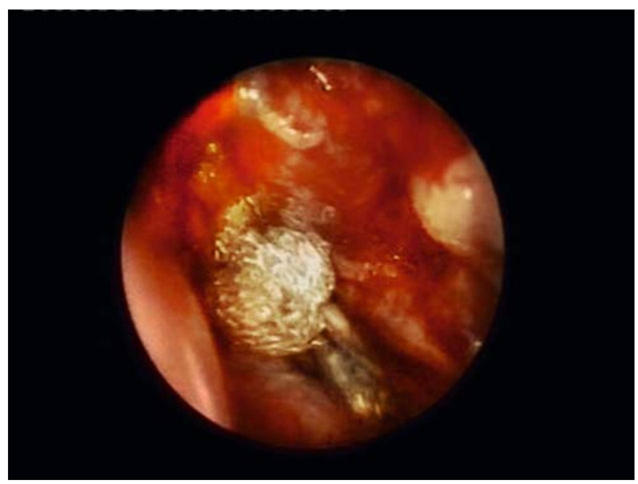

Fig. 4 Ethmoid cavity is packed with temporalis fascia and surgicel

Table 2 Success rate of CSF rhinorrhoea repair

Authors	No. of cases	First successful attempt	Second successful attempt	Craniotomies
Papay et al. 1999	04	4 (100%)	-	0
Mattox et al. 1990	07	6 (86%)	7 (100%)	0
Stankiewich 1995	06	6 (100%)	-	0
Kelly et al. 1996	08	7 (88%)	8 (100%)	0
Burns et al. 1996	42	35 (83%)	38 (90%)’	0
Lanza et al. 1996	36	34 (94%)	37 (97%)	3

ods. Most series point to a 90% success rate. A thorough understanding of the pathophysiology, diagnosis and treatment is critical for the proper treatment of this condition. Endoscopic CSF rhinorrhoea repair has had a high success rate and low morbidity when performed by experienced endoscopic sinus surgeons.

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