INTRODUCTION

Cerebrospinal fluid rhinorrhea implies a communication between subarachnoid space and the pneumatized portion of skull base. The most common cause of cerebrospinal fluid rhinorrhea is trauma, which is responsible for 81 to 90% of the cases. Cerebrospinal fluid rhinorrhea may be managed conservatively. Due to serious risks of complications, e.g. meningitis, brain abscess and pneumo-encephalocoele, etc., surgical treatment is required. The management of cerebrospinal fluid rhinorrhea has always been a major surgical challenge. Various surgical techniques have been described in literature for the closure of CSF leak. The first surgical repair of CSF leak was reported by Dandy, who closed craniofacial fistula using a frontal craniotomy in 1926. Then different intracranial approaches were used with success rate varying from 60-80% in all cerebrospinal fluid rhinorrhea. These procedures involved direct visualization of the defect, and the use of vascularized pericranial flaps. Due to increased risk of serious complications, namely frontal lobe retraction, intracranial hemorrhage, anosmia due to loss of olfactory tracts and olfactory filaments and finally a large surgical scar, the morbidity and mortality was high. In 1948, first extracranial approach to repair CSF leak was described by Dohlman using naso-orbital incision. Subsequently, a variety of extracranial approaches were employed including transmastoid and trans-septal sphenoid approaches, with higher success rate and comparatively less patients' morbidity. In 1981, Wigand was first to use nasal endoscope in the management of CSF leak. With the invent of Functional Endoscopic Sinus Surgery (FESS), it is now easy to diagnose as well as treat or close the defect by minimally invasive transnasal approach, without any increased morbidity and mortality and with high success rate ranging from 80 to 100%. It can be easily performed in recurrent cases or after failure of other conventional intracranial and extracranial procedures. However, local data about this mode of surgery in the CSF rhinorrhea treatment is lacking.

The objective of this study was to determine the etiology and site of leak of cerebrospinal fluid (CSF) rhinorrhea and the surgical efficacy of Functional Endoscopic Sinus Surgery (FESS), in closing the defect of CSF leak by different graft materials.

METHODOLOGY

The study was conducted by Department of ENT-Head & Neck Surgery, Dow University of Health Sciences, Department of ENT Head and Neck Surgery, Dow University of Health Sciences, Karachi. Correspondence: Prof. Muhammad Umar Farooq, D-109, Block 4, Federal B. Area, Karachi. E-mail: umar_entsurgeon@yahoo.com Received August 06, 2009; accepted June 10, 2011.
Karachi, from September, 2005 to December 2008. Some private patients from Mid-City Hospital Karachi, and National Medical Centre Karachi were also included in this study.

Patients who attended ENT clinic for the complaint of CSF rhinorrhea, were subjected to high resolution CT scan with intrathecal contrast (cisternography) to localize the site of leak. Those with neurosurgical problems, associated complications, or managed conservatively, were excluded. Data was collected regarding the cause and site of CSF leak, the graft material used, complications if any, and the success of closure as manifested by cessation of CSF rhinorrhea.

After obtaining detailed history and thorough clinical examination, a high resolution CT scan with intrathecal contrast (cisternography) was obtained for all patients to document the site of leak. All patients were operated under general anaesthesia. Intrathecal injection of 5% sodium fluorescein dye was injected through lumbar puncture, about 20 - 30 minutes before surgery. Dye leakage into the nose was confirmed and identified by using 0° and 30° rigid endoscope (Figure 1). Fat obtained from ear lobule or abdomen was then used to plug the defect in majority of the cases (Figure 2). In few cases, an additional layer of mucosa taken from middle turbinate was also used. Later, fibrin glue was applied to strengthen the seal in all cases. Results were assessed in terms of successful closure of the defect and absence of symptoms.

RESULTS

Among 23 patients, 13 were males (56.5%) and the male to female ratio was 1.3:1. Age of the patients ranged between 12 and 52 years, with mean age of 36.3 ± 11 years. Trauma was the most frequent cause of CSF leak accounting for 17 (74%) cases. Iatrogenic trauma, due to previous surgery was more common (n=9, 39%) than non-surgical trauma (n=8, 34.8%) cases. In 6 (26%) patients, there was no identifiable cause and CSF rhinorrhea were considered to be idiopathic or spontaneous.

Lateral lamella of cribriform plate in the region of fovea ethmoidalis was found to be the commonest site of leak in (n=10, 43.5%) followed by posterior ethmoid (n=5, 21.7%). Horizontal lamella of cribriform plate and sphenoid sinus were involved in 4 (17.4%) cases each. The leak was closed solely by fat in 15 (65.2%) cases, while in another 7 (30.4%) cases a combination of both fat and middle turbinate mucosa was used as a graft material to provide two layered closure. Only in one patient (4.3%), temporalis fascia was used as a graft material.

Successful closure of the CSF leak was achieved in 22 (95.6%) patients in the first attempt and only one (4.3%) patient required a second attempt.

DISCUSSION

There are numerous causes of CSF leak. The most common cause of CSF rhinorrhea is undoubtedly trauma, including both surgical or iatrogenic or non-surgical trauma. Oncologic skull base surgery and endoscopic sinus surgery are main causes of iatrogenic CSF leak. Other common causes of CSF rhinorrhea include, mucocoele, fungal sinusitis, osteomyelitis, brain cyst, primary and metastatic intracranial and extracranial tumours, high pressure hydrocephalus etc. High pressure hydrocephalus is not only among the common non-surgical cause, but it is also the main cause of surgical failure of CSF leak repair. But these different causes were not found in this study because of the selection criteria. Patients who were suffering from neurosurgical or other problems were referred to neurosurgical or other discipline for the management of their basic problems.

As in most other studies, the commonest cause of CSF leak in this study was trauma, including previous surgical and non-surgical trauma accounting for 17 (74%) cases. In only 6 (26%) patients the cause was not identified i.e. idiopathic or spontaneous.

This study showed that ethmoid (Figure 3) is the most commonly involved bone in CSF rhinorrhea in 82.5% patients, while sphenoid bone was involved in only 17.4% cases. In one large recent study, sphenoid bone was more commonly involved site (32%) than ethmoid (31%). In ethmoid bone, lateral lamella of cribriform
plate in the region of fovea ethmoidalis was found to be the commonest site of leak in 10 (43.5%) patients, followed by posterior ethmoid and horizontal lamella of cribriform plate.

The management of CSF rhinorrhea includes both conservative and surgical management.\(^4\) Conservative management to control CSF rhinorrhea includes rest in semi sitting position, repeated lumbar spinal taps, lumbar-spinal drain, and avoidance of straining, nose blowing, and forward bending.

The neurosurgical management of CSF rhinorrhea includes many different intracranial and extracranial approaches which were associated with not only increased morbidity and mortality, but comparatively less success rates.\(^5,16\) However, some studies claim equally good results.\(^17\) New transnasal endoscopic approach has revolutionized the management of CSF rhinorrhea, especially with the most modern Image Guidance Navigation System technique.\(^18\)\(^-\)\(^20\)

In this study, successful closure of the fistula in first attempt was achieved in 22 (95.6%) patients. Only one (4.3%) patient required revised endoscopic surgery. In this patient, leak appeared at a different site about 1 cm behind the repaired site. This patient might be having two sites of leakage simultaneously, one larger than the other. So, initially, the dye appeared only from the larger defect. After repairing of the larger defect, the leak then appeared from the smaller defect.

Results of this study are well comparable to other international studies.\(^14,15\)\(^,\)\(^21\) From this study, it appeared that the type of graft material used does not affect the outcome of results. Autologus fat, taken from ear lobule or abdomen, was used in almost all 23 cases. But in 7 (30.4%) cases, we supplemented fat graft with mucosa of the middle turbinate. In one case with large defect temporalis fascia was also used. All these graft material worked well. There was no difference in the results between different graft materials used. Other graft material used to repair CSF leak, reported in international studies, are middle turbinate bone, septal mucoperiosteal graft, acellular dermal graft, facia lata, lyophilized dura, allografts, hydroxyapatite etc.\(^20\)

Success rate depends upon the achievement of water tight seal. To confirm the effective water tight seal, the anaesthetist was asked to perform Valsalva maneuver to increase the intracranial pressure in the patient.

Although all these graft materials described in literature take well with high success rates, 90% to 100%, when applied by underlay technique. The graft is stabilized by fibrin glue and does not require suturing. Cukurova \textit{et al.} demonstrated repair of ethmoid roof by suturing the dura in their three patients with good results.\(^22\) The technique of suturing the dura is difficult and time-consuming without any added advantage. However, a large study is required to prove its effectiveness. On the other hand, Kirtane \textit{et al.} reported high success rate 96.63% in the first instance and 98.88% after revised surgery to repair the CSF leak using fascia lata and fat without the use of fibrin glue.\(^23\)

The main limitation of this study was small number of cases. Larger and comparative series are required to determine if there are significant differences with this and other modes of management of the condition.

**CONCLUSION**

CSF leaks from anterior and middle cranial fossa, which can be visualized by endoscopy are better repaired by endoscopic technique without any external incision and scar with less morbidity and mortality. Iatrogenic trauma is the commonest cause of CSF leak. The commonest site of leak is found in ethmoid, in the region of fovea ethmoidalis. Different graft materials can be used for closure of CSF fistula in single or multi layer with equally good results. Successful closure of the leak is independent of site of leak or graft material used.

**REFERENCES**


