

A Prospective Study on Outcome of Transnasal Endoscopic Repair of Cerebrospinal Fluid Rhinorrhea

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Abstract

Background: Cerebrospinal fluid (CSF) rhinorrhea is the result of an osseous defect in the skull base coupled with a disruption of dura mater and arachnoid mater with a resultant pressure gradient, leading to CSF leak. CSF leak can be categorized into spontaneous (idiopathic), traumatic, and non-traumatic. Endoscopic transnasal approach is an extracranial approach which has the advantage of being less invasive, no external scar, excellent site localization with preservation of the surrounding anatomy, and shorter hospital stay.

Aim of the Study: The aim of the study was to assess the outcome of repair, cause, site of leak, and efficacy of materials used for the repair, elucidate the advantages of endoscopic approach.

Materials and Methods: A total of 25 patients with CSF rhinorrhea arising from anterior and middle cranial fossa not subsiding with medical management were included in this prospective study. Patients of all ages and gender were included in the study. Patients with recent history of meningitis were excluded from the study. All the patients were evaluated for CSF rhinorrhea using battery of tests including clinical examination for reservoir sign, biochemical and microbiological analysis of fluid, radiological investigations, and diagnostic nasal endoscopy to assess the site of leak. The demographic data, CSF leak site and size, etiology, complications, surgical closure techniques, complications of surgery, and recurrences and its management were observed and recorded. All the data were analyzed using standard statistical methods.

Observation and Results: Among the 25 patients, 14/25 (56%) patients were aged below 30 years followed by 11/25 (44%) patients who were aged between 30 and 60 years. The mean age was 34.20 ± 2.35 years. 16/25 (64%) patients were female and 9/25 (36%) patients were male. 22/25 patients (88%) had spontaneous leaks and 3 patients (12%) had traumatic leaks. In 18/25 (72%) of the patients, the site of leak was in the cribriform plate, 4/25 (16%) from fovea ethmoidalis, 2/25 (8%) from the sphenoid, and 1/25 (4%) from the frontal sinus. Immediate post-operative results were observed in 23/25 (92%) of the patients and there was no CSF leak. 2/25 (8%) patients had CSF leak for 10 days which later subsided.

Conclusions: The most common etiology of CSF rhinorrhea was spontaneous, most common site being the cribriform plate. Autologous fat graft was used as the first layer of underlay technique in most of the cases which act as a good sealant. The efficacy of transnasal endoscopic CSF leak repair in our study was found to be 100%, and it is a highly successful and safe procedure.

Key words: Cerebrospinal fluid, Cerebrospinal fluid rhinorrhea, Cisternogram, Spontaneous leak, Transnasal endoscopic repair

INTRODUCTION

Cerebrospinal fluid (CSF) is a clear, colorless fluid present in ventricles, cisterns, and subarachnoid space around the brain

and spinal cord. An average of 500 ml/day is produced mainly by choroid plexus and absorbed back through arachnoid villi.^[1] Any mismatch paranasal sinus leading between production and absorption leads to increased intracranial pressure and CSF pressure. CSF rhinorrhea occurs when an osseous defect in the skull base with a disruption of dura mater and arachnoid resulting a communication of subarachnoid space to nose and paranasal sinus, leading to CSF leak.^[2] CSF leak can be categorized into spontaneous (idiopathic), traumatic, and non-traumatic. Traumatic may be accidental or iatrogenic. Non-traumatic can be due to hydrocephalus, tumors, congenital

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defects, etc. About 70–80% of CSF rhinorrhea is caused by accidental trauma.^[3] Due to adherence of dura mater to bone in the region of anterior skull base, fracture often results in dural tear and CSF leak, mostly in fovea ethmoidalis, and posterior wall of frontal sinus. Common sites of leak after sinus surgeries are cribriform plate and fovea ethmoidalis.^[4] The postulations regarding spontaneous leak are focal atrophy,^[1] persistence of embryonic lumen in the cribriform area, and intracranial hypertension. Hyperpneumatization of paranasal sinuses has a risk of spontaneous leak, particularly in lateral recess of sphenoid sinus.^[5] Spontaneous healing of dura mater is interfered by herniation of meninges (meningocele) or with brain (meningoencephalocele). Most traumatic leaks heal within 7–10 days with conservative measures such as bed rest, head end elevation, avoidance of straining, nose-blowing, and use of laxative.^[6] Antibiotics were also given to prevent meningitis and facilitate healing. CSF rhinorrhea developing few days or weeks after a trauma and spontaneous leaks is less likely to heal, so surgical closure is mandatory. Surgical management of CSF rhinorrhea can be intracranial or extracranial approaches. Endoscopic transnasal approach is an extracranial approach which has the advantage of being less invasive, no external scar, excellent site localization with preservation of the surrounding anatomy, and shorter hospital stay. Excessive mobilization and injury of brain and dura mater are avoided and offer wide and site-specific view through a smaller exposure than that achieved through a microscope. The aim of the present study was to assess the outcome of repair, cause, site of leak, and efficacy of materials used for the repair, elucidate the advantages of endoscopic approach.

MATERIALS AND METHODS

The present study included 25 patients with CSF rhinorrhea arising from anterior and middle cranial fossa not subsiding with medical management. This prospective study was done from January 2016 to June 2017 in the ENT Department of Government Medical College, Calicut.

Inclusion Criteria

1. Patients of all ages and gender were included
2. Patients with CSF rhinorrhea not responding to medical treatment were included
3. Patients with spontaneous CSF rhinorrhea were included.

Exclusion Criteria

1. Patients with recent history of meningitis were excluded
2. Patients with acute renal, cardiovascular, or hepatic dysfunctions were excluded. All the patients were evaluated for CSF rhinorrhea using battery of tests including clinical examination for reservoir sign, biochemical and microbiological analysis of

fluid, radiological investigations, and diagnostic nasal endoscopy (DNE) to assess the site of leak. Spontaneous cases were evaluated by neurologist and ophthalmologist to rule out intracranial causes and benign intracranial hypertension. Patients who did not respond with medical management for a period of 6 weeks and those with smaller defects were taken for surgery. The demographic data, CSF leak site and size, etiology, complications, surgical closure techniques, complications of surgery, and recurrences and its management were observed and recorded. All the data were analyzed using standard statistical methods.

OBSERVATION AND RESULTS

A total of 25 patients undergoing CSF rhinorrhea repair using transnasal approach for repair of the leak were included in this study. 14/25 (56%) patients were aged below 30 years followed by 11/25 (44%) patients who were aged between 30 and 60 years. The youngest patient was aged 3 years and the eldest patient was aged 84 years. The mean age was 34.20 ± 2.35 years.

16/25 (64%) patients were (64%) female and 9/25 (36%) patients were male [Table 1]. 15/25 (60%) patients CSF leak from the right side of the nasal cavity. 10/25 (40%) of the patients had a left-sided CSF leak.

All the patients were presented within a period of 6 months since the onset the leak. All patients had intermittent leaks and 20/25 (80%) patients had active leak during examination. 4/25 (16%) patients had hypothyroidism. 2/25 (8%) patients had dyslipidemia. 22/25 patients (88%) had spontaneous leaks and 3 patients (12%) had traumatic leak and one of these was iatrogenic in nature and not detected intraoperatively [Table 2].

Table 1: The age and gender incidence among the study sample (n=25)

| Age group (%) | Male-9(%) | Female-16(%) | Mean age in years |
|------------------------|-----------|--------------|-------------------|
| Below 30 years (14-56) | 5 (20) | 9 (36) | 24.70±1.40 |
| Above 30 years (11-44) | 4 (16) | 7 (28) | |

Table 2: The type of CSF leaks observed in the study (n=25)

| Observations | Male | Female |
|----------------------|------|--------|
| Spontaneous leak-22 | 7 | 15 |
| Traumatic leak-3 | 2 | 1 |
| Intermittent leak-20 | 8 | 12 |
| Active leak-5 | 1 | 4 |
| Iatrogenic leak-1 | 1 | 0 |

21/25 (84%) patients were evaluated with high-resolution computed tomography (HRCT) and magnetic resonance imaging (MRI). 4/25 patients (16%) were evaluated with computed tomography (CT) cisternogram. In 18/25 (72%) of the patients, the site of leak was in the cribriform plate, 4/25 (16%) from fovea ethmoidalis, 2/25 (8%) from the sphenoid, and 1/25 (4%) from the frontal sinus [Table 3].

In 16/25 (64%) patients, the defect size was 2–5 mm, 7/25 (28%) of the patients had defect measuring <2 mm, and in 2/25 (8%) patients, the defect was measuring 5–8 mm [Table 4].

The graft materials used were as follows: Fat + fascia lata in 4/25 (16%) patient; fat + fascia + Hadad flap was used in 6/25 (24%) patients, underlay fascia + fat + overlay fascia in 2/25 (8%), fascia + Hadad flap was used in 2/25 (8%) of the patients, and fat + Hadad flap was used in 11/25 (44%) patients. Tissue sealant was used in all the patients to close the rent and to stabilize the graft [Table 5].

Immediate post-operative results were observed in 23/25 (92%) of the patients and there was no CSF leak. 2/25 (8%) patients had CSF leak for 10 days which later subsided. All the patients received post-operative IV antibiotics for 10 days. 2/25 (4%) of the patients received antibiotics for 15 days. Outcome of repair after 6 months follow-up by DNE showed no leak (0%), i.e., 100% success rate. No statistical significance among age group and etiology was noted. 14/25 (56%) of the patients with CSF leak were spontaneous type in females. 14/25 (56%) of the patients were of normal weight and body mass

Table 3: The site of cerebrospinal fluid leaks (n=25)

| Gender | Cribriform plate-18 | Fovea ethmoidalis-4 | Sphenoid -2 | Frontal sinus-1 |
|----------|---------------------|---------------------|-------------|-----------------|
| Male-16 | 15 | 1 | 0 | 0 |
| Female-9 | 3 | 3 | 2 | 1 |

Table 4: The size of defects in the bone in cerebrospinal fluid rhinorrhea patients (n=25)

| Gender | <2 mm-16 | 2-5 mm-7 | 6-8 mm-2 |
|-----------|----------|----------|----------|
| Male-9 | 3 | 4 | 2 |
| Female-16 | 13 | 3 | 0 |

Table 5: The types of flaps used in the study (n=25)

| Types of flaps used | Male-9 | Female-16 |
|--------------------------------------|--------|-----------|
| Fat+fascia lata-4 | 1 | 3 |
| Fat+fascia+Hadad flap-6 | 1 | 5 |
| Underlay fascia+fat+overlay fascia-2 | 2 | 0 |
| Fascia+Hadad flap-2 | 1 | 1 |
| Fat+Hadad flap-11 | 4 | 7 |

index (BMI), and 7/25 (28%) of them were overweight and BMI above 37 and all of them were found to have spontaneous leaks. The most common site of spontaneous leak was in cribriform plate which was correlating with the radiological findings.

DISCUSSION

In this study, 25 patients with CSF rhinorrhea were treated by endoscopic surgical approach after failed medical management. The sociodemographic and clinical data were studied and analyzed to determine the common sites of CSF leak presented with various etiologies. The study also analyzed various materials used for the defect closure, elucidating our experience of CSF leak closure intraoperatively and postoperatively and the efficacy of endoscopic closure of skull base defects. Banks *et al.*,^[7] McMain *et al.*,^[8] Jain *et al.*,^[9] Lanza *et al.*,^[10] all similarly analyzed the etiology, site of leak, and graft material used. Majority were in age between 20 and 30 years. Twenty-two were spontaneous cases (similar to Singh *et al.*^[11] and Sanna Reddy)^[12] and three had a history of trauma, in which one was iatrogenic. In the present study, trauma was not common as the cause of CSF leak, they were conservatively for 6 weeks and only failed cases were selected for surgery. Among the spontaneous CSF leak patients, there were 14 females and 8 males. Virk *et al.*,^[2] in his study, also observed more females (75%) than males with spontaneous leaks. Regarding comorbidities, two patients with dyslipidemia and four with hypothyroidism and all are among spontaneous leaks. HRCT and MRI were the mainstay of radiological evaluation in this study in our institution as a protocol in 84% of patients. 4/25 (8%) patients were evaluated by HRCT and CT cisternogram as they were referred from other centers for management. The study by Ismail *et al.*^[3] and Lloyd *et al.*^[13] describes the use of combined CT and MRI quotes the sensitivity of detecting the CSF leak 97% using this modality. The use of CT cisternogram was reserved for cases with low flow leaks where the previous imaging has failed to localize site of leak as according to Psaltis *et al.*^[4] In two patients, it was observed on MRI that there were empty sellae in females presented with spontaneous leak. It was also observed that in all cases of trauma, the CSF leak was associated with meningocele through the defect which probably delayed and prevented spontaneous closure. Cribriform plate was the common site of leak (72%) seen closely associated with spontaneous etiology followed by fovea (16%). This observation was similar to data published by Virk *et al.*^[2] and Singh *et al.*^[11] In five cases, difficulty in locating the defect was encountered, where intrathecal fluorescein was injected to identify the site of leak, similar to Lanza *et al.*^[10] 16/25 (64%) of the patients had bony defect of the

size between 2 mm and 5 mm (mean value 3.2 mm) and the largest defect was 8 mm in posterior table of frontal sinus. A correlation was obtained intraoperatively with radiological findings of HRCT and MRI in 21/25 (84%) patients. All the 4/25 (8%) patients who underwent CT scan and cisternogram were also correlating with the operative findings. Fat was the most common material, placed in dumbbell fashion, and used in 16 (64%) cases reinforced by Hadad flap, tissue sealant, and surgical. Fascia lata was used as overlay in 14 cases. Gendeh *et al.*,^[14] Kirtane *et al.*,^[15] and Sannareddy *et al.*,^[12] all used mainly fat and fascia lata in their series. Fibrin sealant was also used in this study to seal the defect in the bone in addition to soft tissue, similar to the author Sannareddy *et al.*^[12] The largest defect in the posterior wall of frontal sinus was approached by a combined approach externally and transnasally with endoscope. It was closed by a sandwich technique of placing fascia lata as underlay, fat in between, and another fascia lata as overlay. None of the patients in this study had lumbar drain during the procedures. All patients were advised strict bed rest, propped position, and advised to avoid any form of strain. Intravenous antibiotics, anti-edema measures, and antiepileptic drugs were given for minimum of 7 days. Two patients had CSF leak on the 3rd post-operative day after removal nasal pack, it is assumed to be the collected fluid in nasal cavity or due to slight rise in intracranial pressure while the wound was still healing, and no leak was noticed after the 5th day. There were no complications during our follow-up period and none had any evidence of leaks in follow-up DNE after 6 months. Similar observations were reported by Hegazy *et al.*,^[6] who published a meta-analysis revealing that graft material type does not affect success rates when good surgical technique is employed. From literature, the results from endonasal endoscopic repair of CSF fistulas are exceptional, with published success rates ranging from 92% to 98% in large retrospective reviews.^[8,7,10,12,15] The success rate was 100% in the present study, but it might be due to the small number of subjects observed.

CONCLUSIONS

The most common etiology of CSF rhinorrhea was spontaneous, most common site being the cribriform plate. Autologous fat graft was used as the first layer of

underlay technique in most of the cases which act as a good sealant. The use of autologous fascia lata graft was also found equally effective. Both of the above materials were reinforced with a nasoseptal flap and tissue seal and supported by fascia. The method of closure may vary, but identification of the site of leak and plane between dura mater and bone around the defect is an important determinant of the success of procedure than the choice of materials. The efficacy of transnasal endoscopic CSF leak repair in our study was found to be 100%, and it is a highly successful and safe procedure.

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