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Neurosurgery

A COMPARITIVE STUDY OF ENDOSCOPIC VERSUS TRANSCRANIAL REPAIR OF CEREBRO SPINAL FLUID RHINORRHEA

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ABSTRACT Surgical treatment of anterior cranial base traumatic cerebrospinal fluid (CSF) rhinorrhea is challenging and is fraught with complications. Whether a person should be offered open craniotomy or endoscopic endonasal repair is a dilemma faced by most surgeons. This study is one of the few to directly compare the two forms of management. **Methods:** Data were collected from two groups of 15 patients each who underwent transcranial CSF leak repair and endoscopic endonasal CSF leak repair in a tertiary care hospital over a 3-year period. Information including demographics, recurrence rates, complications, and hospital and intensive care unit (ICU) stay was recorded and analyzed. Outcome was assessed up to 6 months. **Results:** Recurrence was seen in 9/30 patients, 6 in the transcranial group and 3 in the endoscopic group. Hospital stay was longer than 1 week in all the transcranially operated patients and only in 73% of the endoscopically operated patients ($p = 0.439$) although ICU stay was reduced in the endoscopic group ($p = 0.066$). Complications were more common with transcranial repair (seven of eight patients who underwent transcranial repair, $p = 0.035$) with anosmia being the most common (33.3%, $p = 0.042$). **Conclusion:** The transcranial open repair is a reasonable choice especially for leaks that occur through the frontal sinus and extend backward into the frontoethmoidal region. However, this approach has the drawbacks of greater number of complications, higher recurrence rate, and longer ICU and overall hospital stay. The endoscopic endonasal repair enjoys a lower morbidity profile although it may not be an adequate treatment for leaks that are placed far laterally in the frontal sinus

KEYWORDS : CSF Rhinorrhea, Endoscopic and Craniotomy

INTRODUCTION

Duramater of the brain is an important barrier for any infection to ascend intracranially. It contains the cerebrospinal fluid present within the subarachnoid space and hence, a transdural event can cause breach in its integrity causing leak of the cerebrospinal fluid, as evident from watery nasal discharge.

CSF rhinorrhoea ensues when the breach involves the nasal mucosa , periosteum, bone forming the skull base in the region of nose and paranasal sinuses, endosteum, duramater and arachnoid mater. Transdural event can be due to trauma, nasal surgery, tumors invading skull base or may be spontaneous.

In each of these cases, the outcome is the same- CSF leak from the site of injury to dura and ascending infection through the defect causing meningitis and related complications.

In cases where the medical therapy fails, it is mandatory for surgical closure to prevent such complications. Surgical repair of CSF leak site can be either through an intracranial or an extra cranial approach.

Endoscopic approach is a type of extra cranial approach which has the advantage of being less invasive, no external surgical scar , excellent site localization with preservation of the surrounding anatomy and shorter hospital stay.

Unlike open surgical techniques, endoscopic approach avoids excessive mobilization of the brain and the dura and, offers wide and site specific view through a smaller exposure than that achieved through a microscope.

AIMS AND OBJECTIVES

Aim

Aim of this study is to ascertain the best effective surgical management for CSF Rhinorrhea.

Objectives

1. To study the influence of etiology, timing, graft used, and type of surgery on outcome.
2. To asses patients outcome at the end of 6 months following surgery

Patients and Methods

Study Design

The study included 31 patients with CSF rhinorrhoea arising from the anterior and midde cranial fossa not subsiding with medical management. .

It is an institutional based observational study done during the period of 2012to 2018 in, The Osmania Medical College and Hospital, Hyderabad. All the patients were evaluated for CSF rhinorrhoea using a battery of tests which involves the clinical examination for the reservoir sign, biochemical and microbiological analysis of the fluid , radiological investigations and diagnostic nasal endoscopy to assess the site of leak.

All patients were treated in a multidisciplinary approach. Some of them needed a neurosurgical intervention for head injury and were managed medically for CSF rhinorrhoea . Patients who didnot respond to the medical management and had a size of defect less than 2 cm were taken up for our study. In cases of spontaneous CSF rhinorrhoea, we worked in coordination with the neurologist to rule out intracranial causes for a raised CSF pressure and all patients were evaluated by ophthalmologist to rule out benign intracranial hypertension as a cause of CSF rhinorrhoea.

This multidisciplinary approach guided us to decide upon further evaluation of a raised intracranial pressure if present and, to plan for the placement of lumbar drain. We evaluated the demographic data, CSF leak site and size, etiology, complications, surgical closure techniques, complications of surgery and recurrences and its management.

Inclusion Crieteria

- All patients who developed cerebrospinal fluid rhinorrhea due to various etiology and attended at Osmania General Hospital.
- Patients with CSF rhinorrhea who are willing for investigations and treatment

Exclusion Crieteria

- All patients who are treated by conservative management.
- CSF leaks with space occupying lesions in the brain
- All patients who did not come for follow up
- All patients who refused investigations and treatment

METHODOLOGY

Patients were evaluated, diagnosed and classified using the following methods,

- History
- Clinical examination
- Rigid nasal endoscopy
- Biochemical and microbiological analysis of CSF
- CT PNS – axial and coronal cuts CT – cisternogram / MR cisternogram

Following the investigations the leak site was classified into

- Cribriform plate
- Fovea ethmoidalis
- Sphenoid sinus
- Frontal sinus

Endoscopic closure of the leak site was done as described earlier (refer to surgical management) and the results were analysed.

RESULTS

1. Age Group Wise Distribution of Participants

Table-1: Percentage Distribution of Study Participants By Age Group

Age group (years)	Number	Percentage
1-10	6	19
11-20	4	12
21-30	10	32
31-40	8	25
41-50	3	12
Total	31	100

Among the study patients, Majority (32%) were in 21 – 30 years age group, followed by 31 – 40 years age group(25 %) and 1 – 10 years (19%). The median age of the patients was 24.5 years and mean age of the patients was 24.9 years.

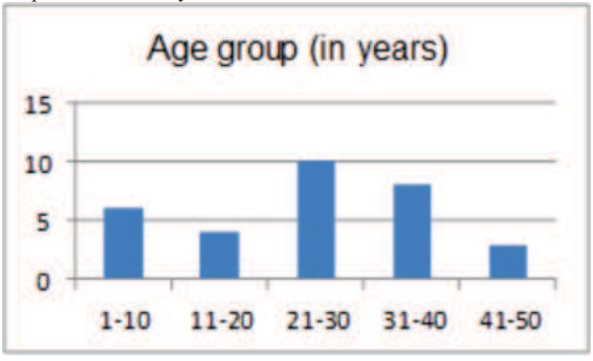

Fig-1: Percentage Distribution of Study Participants By Age Group

2. Sex Distribution of Participants

Table-2: Percentage Distribution of Study Participants By Sex

Sex	Number	Percentage
Male	24	77.4
Female	7	22.6
Total	31	100

Regarding sex distribution of participants, the males are more than that of females.

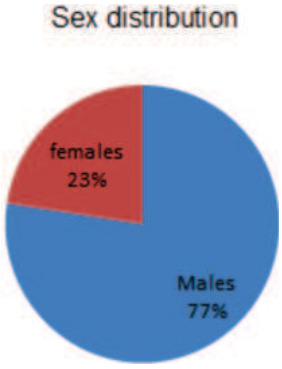

Fig-2: Percentage Distribution of Study Participants By Sex

3. Presence of Co-morbidities

Table-3: Percentage Distribution of Study Participants By Co-morbidities

Co morbidity	Number	Percentage
Diabetes	4	12.9
Hypertension	5	16.1
Meningitis	7	22.5
Neurofibromatosis	2	6.6
None	13	41.9
Total	31	100

Of the 31 patients, 7 (22.5 %) presented with meningitis . Two of them had traumatic CSF leak.

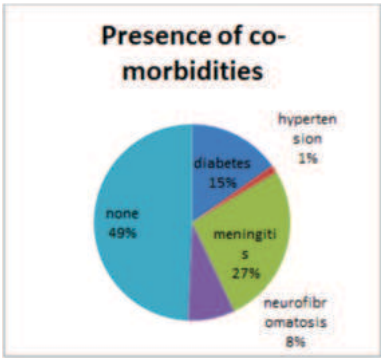

Fig-3: Percentage Distribution of Study Participants By Co-morbidities

4. Etiology of CSF Rhinorrhoea

Table-4: Percentage Distribution of Study Participants By Etiology of CSF Rhinorrhoea

Etiology	Number	Percentage
Spontaneous	9	29.1
Trauma	22	70.9
Total	31	100

Among the study subjects, 29.1% had spontaneous aetiology of CSF rhinorrhoea, and trauma was reported as cause in 70.9% subjects.

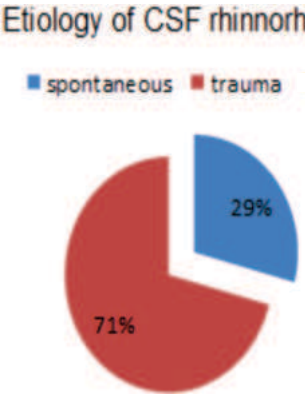

Fig-4: Percentage Distribution of Study Participants By Aetiology of CSF Rhinorrhoea

5. Site Of Leak

Table-5: Percentage Distribution of Study Participants By Site of Leak of CSF Rhinorrhoea

Site of leak	Number	Percentage
Cribriform plate	13	41.95
Frontal sinus	09	29.04
Fovea ethmoidalis	02	06.45
lateral recess of sphenoid	01	03.22
Cribriform plate and fovea ethmoidalis	02	06.45
Cribriform plate &frontal sinus	03	09.67
Fovea ethmoidalis & sphenoid sinus	01	03.22
Total	31	100

CSF leak was seen commonly, through Cribriform Plate (42%) followed by Frontal Sinus (29%) and rest through Fovea Ethmoidalis, Posterior Ethmoid, lateral recess of sphenoid and combination of those sites.

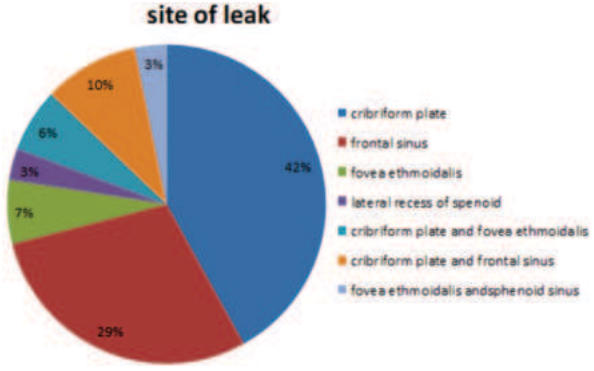

Fig-5: Percentage Distribution of Study Participants By Site of Leak of CSF Rhinorrhoea

6. Size of Leak

Table-6: Percentage Distribution of Patients By Size of Leak

Size(mm)	Number	Percentage
Less than 5	03	09.68
5-10	22	70.97
11-15	05	16.13
More than 15	01	03.22
Total	31	100

Out of 31 subjects, 70.97 % had 5 – 10 mm size of leak and 16.13 % had 11 – 15 mm size of leak. Three had leak size < 5mm and one had > 15mm size.

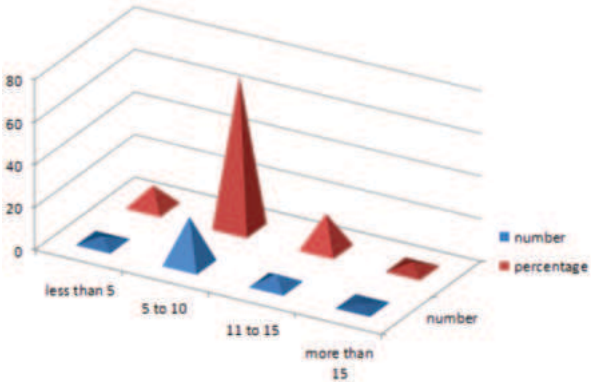

Fig.-6: Percentage Distribution of Patients By Size of Leak

7. Association With Meningoencephalocele

Table-7: Percentage Distribution of Patients By Association With Meningoencephalocele

Meningoencephalocele	Number	Percentage
Spontaneous etiology MEC	3	9.68
Traumatic etiology MEC	1	3.23
None	27	87.09
Total	31	100

Out of 31 patients four had meningoencephalocele, of which 3(9.68%) had spontaneous etiology and 1(3.23%) had traumatic etiology.

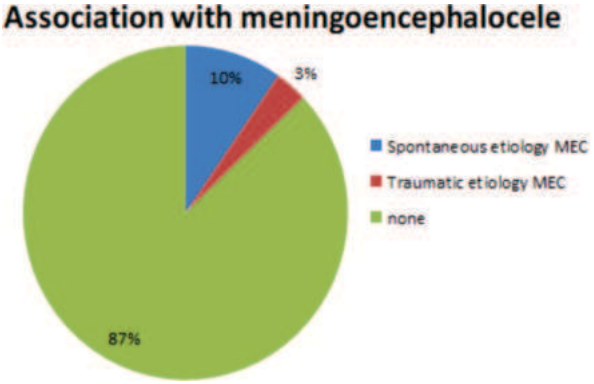

Fig-7: Percentage Distribution of Patients By Association with Meningoencephalocele

8. Type of Graft Used For Closure

Table-8: Percentage Distribution of Patients By Type of Graft Used For Closure

Type of graft	Number	Percentage
Tensor fascia lata & fat	26	83.87
Septal cartilage &tensor fascailata	3	9.67
Septal flap & middle turbinate	1	3.23
Septal flap & septal cartilage	1	3.23
Total	31	100

Regarding the type of graft used, majority (83.87 %) of the participants had Tensor fascia lata and fat. Septal cartilage and tensor fascia lata was used in 9.67% cases and septal flap with middle turbinate was used in 3.23% subjects.

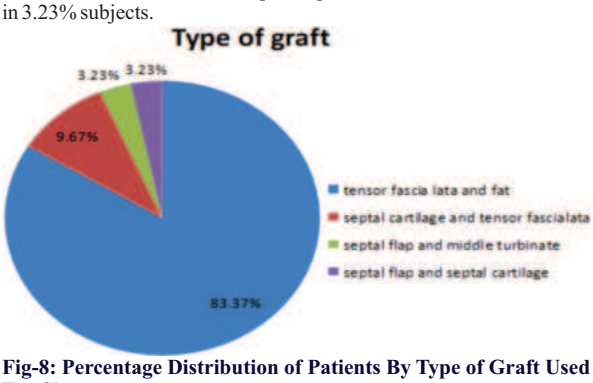

Fig-8: Percentage Distribution of Patients By Type of Graft Used For Closure

9. Lumbar Drain

Table-9: Percentage Distribution of Patients By Lumbar Drain Placement

Lumbar drain	Number	Percentage
No	30	96.77
Yes	1	3.23
Total	31	100

Lumbar drain was placed in only 3.23% cases and rest (96.77%) had no lumbar drain

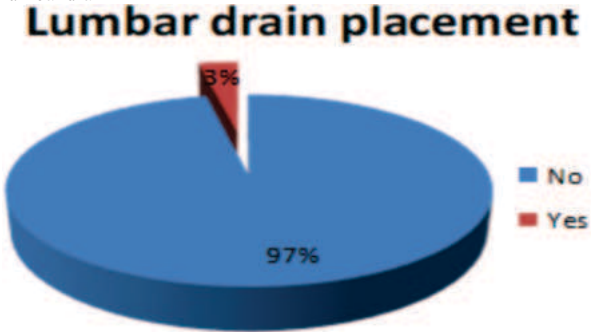

Fig 9: Percentage Distribution of Patients By Lumbar Drain Placement

10. Complications After Surgery

Table-10: Percentage Distribution of Study Participants By Complications

Complications	Number	Percentage
Reclosure	1	3.23
Sunkenflap syndrome	1	3.23
None	29	93.54
Total	31	100

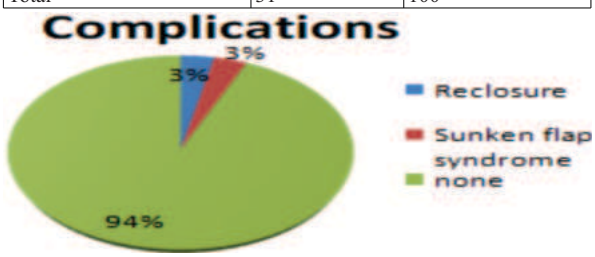

Fig-10: Percentage Distribution of Study Participants By Complications

Among the study participants, reclosure was done in 1 (3.23%) Patient and sunken flap syndrome was seen in one patient (3.23%). Cases without complications was about 93.54% while, successful endoscopic closure with no recurrence was seen in 96.77%

11. Treatment Groups

Table-11: Percentage Distribution of Study Participants By Type of Surgery

Type of Surgery	number	Percentage
Endoscopic Repair	10	32.3
Open (Craniotomy)	21	67.7

Out of 31 patients 10 (32.3%) undergone endoscopic repair and rest 21 (67.7%) undergone transcranial repair.

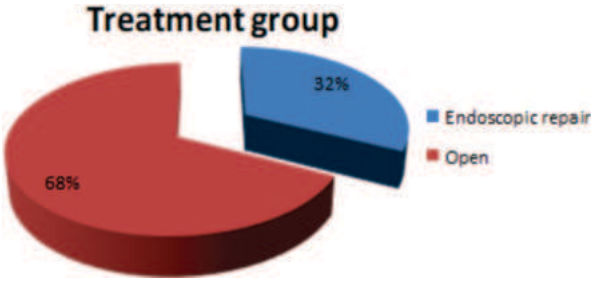

Fig-11: Percentage Distribution of Study Participants By Type of Surgery

12. Duration of Surgery

Table-12: Average Time Taken For Surgery in Each Study Group

Surgery	Average Duration of Surgery (in mins)	Mean Duration of Surgery (in mins)
Endoscpic	90-120	104.5
Open	110 -150	130

Among the endoscopic group average time elapsed in surgery is 90-120 with mean duration of surgery 104.5 minutes where as in craniotomy group it is higher ranging 110-150 minutes with mean duration of surgery 130 minutes.

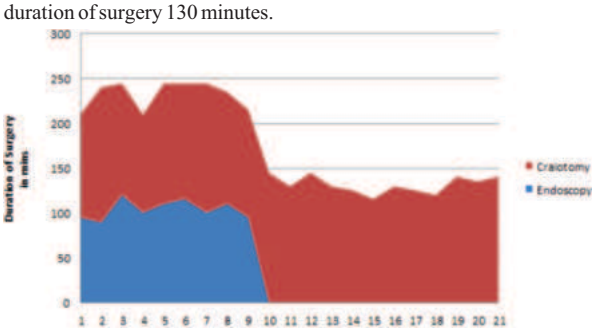

Fig-12.-a : Average Time Taken For Surgery in Each Study Group

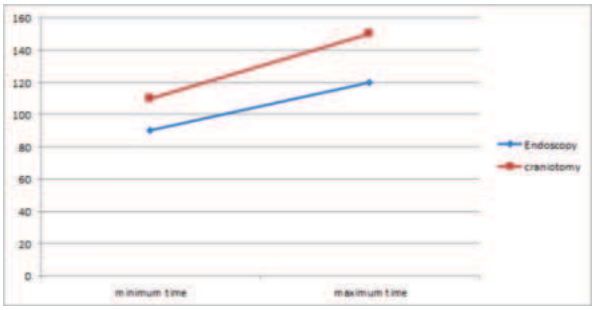

Fig-12.-b: Average Time Taken For Surgery in Each Study Group

13. Duration of Hospital Stay

Table-13: Average Duration of Hospital Stay in Each Study Group

Type of surgery	Average Duration of Hospital Stay	Mean Duration of Hospital Stay
Craniotomy	7-12 days	8.7 days
Endoscopy	3-5 days	4.3 days

Average duration of hospital stay in craniotomy group is 7-12 days with mean of 8.7 days where as in Endoscopy group average duration of stay is3-5 days with mean of 4.3 days

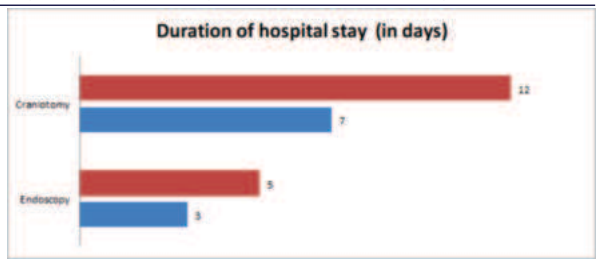

Fig -13: Average Duration of Hospital Stay in Each Study Group

14. Blood Loss

Table-14: Average Blood Loss in Each Study Group

Type of surgery	Average Blood loss in ml	Mean Blood loss in ml
Craniotomy	250-500	300
Endoscopy	100-250	168

In craniotomy group average blood loss was about 250-500 ml., with mean of 300 ml and in endoscopy group average loss of blood 100-250 ml with mean blood loss 168 ml.

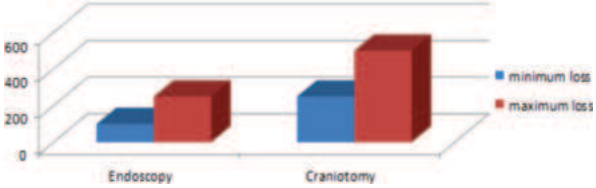

Fig -14: Average Blood Loss in Each Study Group

15. Infection

Table-15: Infection Rate in Each Study Group

Type of surgery	Meningitis
Endoscpy	1(3.23%)
Open	2(6.46%)

In craniotomy group 2 patients (6.46%) had meningitis and in endoscopy one had meningitis (3.23%).

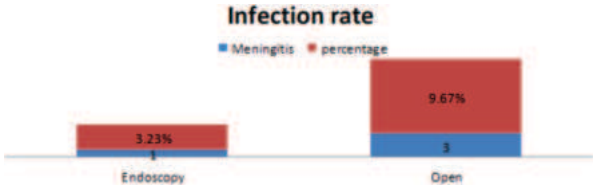

Table-15: Infection Rate in Each Study Group

16. Recurrence Rate

Table-16: Infection Rate in Each Study Group

Type of surgery	Number of patients with recurrence
Endoscpy	Nil (0%)
Craniotomy	2 (6.46%)

In craniotomy group 2(3.23%) had recurrence and in endoscopy none had recurrence.

- In the above institutional based observation study conducted at the department of NEUROSURGRY, OSMANIA Government General Hospital , 31 patients who were treated through surgical approach after a failed medical therapy were included .The sociodemographic and clinical data were studied and analyzed to determine the common sites of CSF leak presenting under the various etiology.
- Further, this study also analyses the various methods of the defect closure elucidating our experience in managing the CSF leak intraoperatively and post operatively, and the efficacy of endoscopic closure of these skull base defect.
- Among the study group, majority of patients belong to the age group of 21-30 years followed by 31-40 yrs. Our study included an high proportions of male over female patients.
- Of the total 31 patients, 9 (29.03%) presented with spontaneous CSF rhinorrhoea and 22 patients (70.9 %) presented with post traumatic CSF rhinorrhoea.
- Based on the age distribution of the cases, traumatic CSF rhinorrhoea is seen more commonly in younger age groups<40 yrs while spontaneous CSF leak is seen in older age groups which is

statistically significant.

- Males are more affected in the study group, this is an important observation relating to the social cause , where males are more commonly involved in road traffic accidents and other causes of accidental injury and related trauma.
- 70.9% of male patients had traumatic CSF leak which gives a p vale for association of etiology and sex distribution , a statistically significant value of p=0.0001.
- This is consistent with the study by Beckhardt et al in 1991. He observed spontaneous leaks to be more common in females (male: female ratio =1:2)[34]
- Females are more prone for spontaneous leaks, of which we have not encountered any cases of idiopathic intracranial hypertension as a reason of the leak. There were no known causes of CSF leak in these patients.
- Of the total spontaneous leaks, one female patient had a history of previous three endoscopic closure presenting with recurrence to us.
- Following all investigations, intracranial hypertension was ruled out and meningoencephalocele was identified to be the only conclusive finding for a non-healing dura and recurrence.
- Hence, she was taken up for revision endoscopic surgery with adjunctive medical therapy , without placement of lumbar drain. The patient was followed up for 1yr and did not have any recurrence.
- Regarding the sex distribution across the site of leak, 45.5% of male patients had leak from frontal sinus and 63.6% of females had leak from the cribriform area, though this difference was statistically not significant , p>0.05.
- In our study, the most common site of leak associated with spontaneous etiology is cribriform plate (41.95%) and frontal sinus leak is seen more with traumatic etiology (29.04%).
- In present study CSF leak was seen commonly, through Cribriform Plate (42%) followed by Frontal Sinus (29%) and rest through Fovea Ethmoidalis, Posterior Ethmoid, lateral recess of sphenoid and combination of those sites.
- According to Kennedy[33] site of CSF leaks among 27 patients found to be 17 patients with leak in ethmoids, while 6 patients in the cribriform plate and in the sphenoid in 4 patients.
- D.Richard Lindstrom et al. experience in Wisconsin Medical college is given in number of patients as, Cribriform plate -20; Anterior ethmoid-10; Posterior ethmoid- 5; Frontal-6; Sphenoid - 15
- During our study, we also encountered six cases presenting with two sites of leak. Of them one spontaneous and rest traumatic leak.
- The defects were closed independently after ruling out other intracranial pathology. These cases were also followed up and no recurrence was encountered.
- In every patient who undergoes imaging evaluation for a CSF leak, potential multiplicity of defects has to be borne in mind.
- Schlosser and Bolger[23] recognized multiple simultaneous skull base defects during surgery in 5 (31.25%) of 16 patients with nasal CSF leaks.
- Among the endoscopic group average time elapsed in surgery is 90-120 with mean duration of surgery 104.5 minutes where as in craniotomy group it is higher ranging 110-150 minutes with mean duration of surgery 130 minutes
- Average duration of hospital stay in craniotomy group is 7-12 days with mean duration of stay 8.7 days where as in Endoscopy group average duration of hospital stay was 3-5 days with mean hospital stay 4.3 days.
- In craniotomy group average blood loss was about 250-500 ml and in endoscopy group it is 100-250 ml with mean blood loss 300 ml and 167.5 ml respectively.
- In craniotomy group 2(6.46%) had recurrence and in endoscopy none had recurrence
- In craniotomy group 2 patients (6.46%) had meningitis and in endoscopy one had meningitis (3.23%) postoperatively.
- Three patients presenting with features of meningeal irritation were initially treated with third generation cephalosporins, T.Acetazolamide and T.Phenobarbitone before definitive surgical intervention was made. Lumbar drain was placed in one traumatic case were CSF pressure was needed. These cases had a bony defect of 1 cm or more and the drain was placed for 3-5 days . This case developed sunken flap syndrome or the motor trephine syndrome, wherein which, due to bifrontal craniotomy done previously, atmospheric pressure far exceeded the intracranial pressure , causing the forehead skin to retract into the cranium. This lead to slowness of motor activities. Lumbar drain was removed and the dose of T.Acetazolamide was reduced. Adequate hydration was provided , keeping in balance the intracranial pressure ,so as to avoid a raised ICP that would precipitate a CSF leak closure failure. Following this treatment , patient's neurological status improved; CSF leak well sealed , and planned for cranial flap reconstruction.
- Different methods of endoscopic leak closure were studied of which, the underlay and the sandwich techniques were preferred by the surgeons in larger defects and all these cases were successfully treated.
- Although the surgeons generally restrict the overlay technique to smaller defects, the success rate of different techniques studied were high(success rate of 95.45%).
- One out of the 31 patients developed recurrence and needed a revision closure within 3 weeks of the previous surgery. Intraoperatively, active CSF leak was not encountered in this patient, which we consider as the cause for the recurrence.
- The patient was advised a repeat CT – cisternogram and the site of leak indentified during the revision surgery and the result was successful immediately, as demonstrated by the Valsalva test done with the help of anesthetist Meta-analysis by Hassan et.al reported a 90%success rate[24] of endoscopic repair following first attempt , and a 97% success rate following revision surgery.
- The incidence of major complications such as meningitis, abscess, subdural hematoma were less than 1% each. Hence, it is considered to be less morbid than open surgical techniques.

CONCLUSIONS

- We conclude that, in our study, the most common site of leak associated with spontaneous etiology is cribriform plate (31.8%) and frontal sinus leak is seen more with traumatic etiology (22.7%).
- The method of closure may vary. But, the identification of the leak site and the plane between dura and the bone around the defect is important determinant of the success rather than the choice of material.
- For most of these cases, fat was used as the first layer of underlay technique which acts as a good seal.
- Additional procedures such as pedicled nasoseptal flap, rotation of middle turbinate, septal cartilage augmentation were used in larger defects of about 6 mm or more.
- The efficacy of endoscopic CSF leak closure in our study was 95.45%.
- Endoscopic repair of CSF rhinorrhoea involves lesser time for surgery with lesser blood loss.
- Endoscopic procedure is associated with lesser duration of hospital stay

Endoscopic procedure is associated with least infection rates and very less recurrence and of course without any surgical scar.

Endoscopic procedure is associated with least infection rates and very less recurrence and of course without any surgical scar.

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