Outcome of Endoscopic Cerebrospinal Fluid Rhinorrhoea Repair: An Institutional Study

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Abstract Cerebrospinal fluid Rhinorrhoea is caused by an abnormal open communication between the subarachnoid space and the nasal cavity. The most common anatomic sites of such abnormal communication are found in the anterior skull base, namely, ethmoid roof, olfactory groove, roof of the sphenoid sinus and the posterior wall of the frontal sinus. It can be classified into traumatic or spontaneous. Spontaneous leaks are associated with highest recurrence rates following surgical repair. The repair of CSF Rhinorrhoea has rapidly evolved over the past 30 years. Prior to the advent of the endoscopic approach, craniotomy was used for repairs which carried a variable success rate and morbidity. The purpose of our study was to ascertain the outcome after Transnasal Endoscopic Repair of spontaneous CSF leaks. This was a prospective study conducted at the Department of ENT at Safdarjung Hospital, New Delhi between January 2015 and June 2016. The study comprised of eleven patients who presented with the complaint of watery nasal discharge and were diagnosed to have spontaneous CSF Rhinorrhoea. Proper clinical examination, nasal endoscopy and biochemical and cytological analysis of nasal secretions of the patient was done. High Resolution Computed Tomography and MRI scans of the nose and paranasal sinuses were done to identify precise location of CSF leak and the size of fistula. CT cisternography was done wherever required. Fistula was repaired via Transnasal endoscopic approach in a multi layered underlay fashion. Out of all eleven patients with

spontaneous CSF leaks, most common site of leak was from left cribriform area. Four patients (36.36%) were found to have meningoencephalocele. No associated intracranial lesion was found and all patients did not have any benign intracranial hypertension. Our success rate of endoscopic repair on first attempt was 100% with recurrence in 1 patient after 4 months of repair. Endoscopic repair of CSF rhinorrhoea is safe and effective, with a very low complication rate. It has almost completely replaced the older open techniques. Accurate localization of leak site followed by multilayered closure of dural defect appear to be essential for successful endoscopic repair.

Keywords Cerebrospinal fluid rhinorrhoea · Cribriform plate · CSF leaks · Transnasal endoscopic repair · Meningoencephalocele

Introduction

Cerebrospinal fluid (CSF) Rhinorrhoea is caused by an abnormal open communication between the subarachnoid space and the nasal cavity. This communication or fistula must involve a breach of the arachnoid and dura mater, the bone of skull base, and the underlying mucosa [1, 2]. The most common anatomic sites of such abnormal communication are found in the anterior skull base, namely, ethmoid roof, olfactory groove, roof of the sphenoid sinus and the posterior wall of the frontal sinus. Persistent CSF leaks are usually divided into non-traumatic (tumour related, spontaneous or congenital) and traumatic [3]. Leaks with no identifiable cause are classified under spontaneous or idiopathic leaks and present both, a diagnostic and therapeutic challenge. They are associated with the highest recurrence rates following surgical repair attributable to

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various factors such as elevated intracranial pressure, presence of multiple skull base defects and high rates of meningo-encephalocele formation. Traumatic leaks are more common [4] and can be iatrogenic (or post-surgical) or due to non-iatrogenic skull base trauma.

The main symptom is the constant and uncontrollable unilateral watery rhinorrhoea exacerbated by bending over or performing a Valsalva maneuver. Appropriate surgical repair of CSF leaks is recommended to avoid serious complications such as meningitis, intracranial abscess or pneumocephalus [5]. Prior to the advent of the endoscopic approach, craniotomy was used for repairs, which carried a variable success rate and relatively high morbidity. Wigand described the first use of the endoscopic approach to repair CSF leak in 1981 [6]. Since then, there have been several case series and reports that describe various endoscopic methods and materials for repair, with success rates varying between 60 and 100%, averaging around 90% [7]. In this study, we report the surgical outcome in 11 cases of spontaneous CSF rhinorrhoea repaired via Transnasal Endoscopic Approach.

Materials and Methods

The study comprised of eleven patients who presented to the Department of ENT at Safdarjung Hospital, New Delhi between January 2015 and June 2016 with the complaint of watery nasal discharge and were diagnosed to have spontaneous CSF rhinorrhoea. A thorough pre-operative evaluation was performed for each of them starting with a detailed history which included duration of leak, mode of onset, symptoms of raised ICT and history of intracranial complications. This was followed by clinical examination, nasal endoscopy and biochemical and cytological analysis of the nasal secretions of the patient. We were able to identify the precise location of CSF leak and the size of the fistula in all the cases with the help of High- Resolution Computed Tomography (HRCT) and MRI scans of the nose and paranasal sinuses. Figures 1 and 2 depict the sites of CSF leaks in the areas of cribriform plate and fovea ethmoidalis respectively. All patients were vaccinated against pneumococcus (Fig. 3).

All patients were operated via transnasal endoscopic approach under hypotensive general anaesthesia and were given intravenous antibiotic prophylaxis with ceftriaxone. 0° and 30° rigid 4 mm endoscopes were used. After achieving adequate local decongestion by infiltration with 1:100,000 adrenaline and nasal packing, the site of leak was approached. Uncinectomy, anterior ethmoidectomy and middle turbinectomy was performed in all cases to obtain adequate exposure. The site of leak was identified and its margins freshened to facilitate closure. Repair was performed in a

Fig. 1 Defect in cribriform plate area with encephalocele

Fig. 2 Defect in fovea ethmoidalis

multi-layered underlay or overlay fashion using fat, temporalis fascia or fascia lata, cartilage (septal or tragal) and occasionally, Hadad flap. Tissue glue, a prepared fibrin sealant, was used between each layer of repair. The repair was supported by Merocele standard nasal packs.

Post-operatively, the patients received broad-spectrum antibiotics for 1 week and were advised bed rest for 48–72 h, with the head elevated 30°–45°. The non-absorbable nasal packing was removed on 5th postoperative day. Stool softeners, antihistamines, and diuretics (Acetazolamide 250 mg/day) were administered for 2 weeks to reduce intra-abdominal pressure and intracranial pressure. Patients were also instructed to avoid blowing their nose. Patients were discharged on 5th postoperative day after pack removal. All the patients were followed up for a period of 6 months thereafter.

Fig. 3 Images showing meningo-encephalocele preoperatively followed by localization of defect intraoperatively

Table 1 Location of CSF Rhinorrhoea

Location	Number of patients
Cribriform plate	7
Fovea ethmoidalis	3
Cribriform + fovea ethmoidalis	1

Results

A total of 11 patients underwent endoscopic CSF rhinorrhoea repair during the study period. Out of these, 7 were females and 4 were males. Most of the patients were in 3rd or 4th decade, youngest being 8 year old female child and the oldest being 45 years old female patient. 8 out of 11 patients had leak from left side. Most common site of leak was the cribriform plate (63.6%), followed by fovea ethmoidalis (27.3%) (Table 1).

Maximum size of the defect was 12 mm and minimum size of the defect was 2 mm. A total of 4 patients were found to have meningo-encephalocele with size ranging from 0.5×1 cm to 1.5×2 cm. No associated intracranial lesions were found on imaging. Lumbar drain was not used in any of the cases.

All except one patient had successful cessation of the Rhinorrhoea after a single procedure with post-operative leak free periods ranging from 4 months to 1.5 years. No major complications occurred secondary to surgical management. One patient had a successful outcome after primary closure but came with recurrence after 4 months of repair. The site of leak was identified in the fovea ethmoidalis on revision surgery. Our study showed overall success rate of 90.9% as one of the patient came with recurrence after 4 months. After revision surgery, the patient attained successful cessation of Rhinorrhoea and is under follow up till now with no recurrence.

Discussion

Non-traumatic CSF Rhinorrhea can be spontaneous, caused by a bony defect. The causes of spontaneous CSF Rhinorrhea are variable and not very well understood. Overweight increases intra-abdominal and intra-thoracic pressure and may effect blood circulation in cranial venous collectors and lead to development of permanent benign intracranial hypertension [8]. Spontaneous CSF leak might also occur secondary to focal atrophy of the olfactory nerve in the region of the cribriform plate. Additionally, defective development of the bony skull base could allow the arachnoid and brain tissue to protrude through the nose [9]. Arachnoid granulation in region of floor of middle cranial fossa is devoid of venous connection. Arachnoid sacs filled with CSF pulsate and gradually erode bone causing spontaneous CSF leak.

In cases of suspected CSF leaks, clinical presentation and office-based endoscopic nasal examination are of primary importance to demonstrate its presence. Also of great diagnostic advantage are laboratory tests of nasal secretions with special regard to β -trace protein testing which is highly sensitive and offers advantages with respect to β -2 transferrin testing: it is faster, has a higher specificity (98–100%) and is much less expensive [10].

An important part of the diagnostic process is also the definition of the exact location of the leak. HRCT is able to identify even the smallest bone defect along the skull base and providing the surgeon with important information regarding anatomical bone variations and landmarks for correct planning of the surgical intervention. In this study, MRI has been performed only in those cases in which parenchymal or meningeal herniation was suspected following endoscopic examination or HRCT.

Kljajić et al. [11] reported that male patients outnumbered female ones in the group of traumatic CSF leaks, while most of the patients with spontaneous CSF leaks were female ones. Our study confirms that spontaneous

leak patients are more commonly middle-aged females. This may be due to the fact that traffic injuries are more common among males, as well as occupational injuries of male workers whose job includes hard physical labour. They reported a high success rate of 97% after endoscopic CSF leak repair. Virk et al. [12] have also reported 2/3 of the study sample to be women.

The anatomical site of the defect corresponded well with a case series for spontaneous leaks, with the commonest site being the cribriform plate [12, 13].

The controversy lies in the technique of graft placement. Onlay and underlay techniques are used depending on the size of the fistula, and both have similar results when used properly [14]. In our study, we used underlay technique in more number of patients. Onlay technique was used only when there was a risk of neural injury.

Postoperatively, there is no clear consensus on the use of lumbar drains, although high success rates have been shown without their use [15]. In our study, lumbar drains were not used and we achieved a high success rate after endoscopic repair of CSF leaks but lumbar drain placement in cases of benign intracranial hypertension (BIH) and revision cases is recommended. One patient with recurrence of CSF leak underwent revision surgery where defect was found to be very small of around 2 mm. A successful outcome was achieved and no lumbar drain was used in this case too.

Presutti et al. [16], in their study used a septal mucoperichondrial graft with no lumbar drain and fluorescein tests. They reported a success rate of 88.5% on the first attempt. Banks et al. [17], in their 21-year retrospective study of 193 patients with endoscopic closure using intrathecal fluorescein localization of site of leak had an initial success rate of 85–90% and an overall success rate of 98%. Ye et al. [18], reported a success rate of 89% on the first attempt with an endoscopic multilayer reconstructive technique. In our study, we achieved overall success rate of 90.9% after endoscopic CSF rhinorrhoea repair with a recurrence rate of 9.1%; and 100% success on the second attempt. It is possible that the recurrence was due to larger size of defect or co-morbid condition of the patient. Other causes could be non-identification of the site, multiple sites of leak and associated conditions such as chronic cough.

Conclusion

The control of CSF leakage has been significantly improved through the development of the Endoscopic surgery. The excellent exposure of the anterior skull base by endoscope offers the opportunity to identify the area of the fistula allowing an adequate treatment plan. The risk of

bacterial meningitis, with a significant mortality rate, is high enough to consider surgical closure of the fistula.

We recommend endoscopic multilayered closure of CSF leaks in cases of spontaneous CSF rhinorrhoea without placing any lumbar drain except in cases with raised intracranial pressure and revision cases. Endoscopic approach should be encouraged as it has low rates of complications and is highly effective and successful.

References

1. Locatelli D, Rampa F, Acchiardi I, Bignami M, De Bernardi F, Castelnuovo P (2006) Endoscopic endonasal approaches for repair of cerebrospinal fluid leaks: nine year experience. *Neurosurgery* 58(4):246–257
2. Zapalac JS, Marple BF, Schwade ND (2002) Skull base cerebrospinal fluid fistulas: comprehensive diagnostic algorithm. *Otolaryngol Head Neck Surg* 126:669–676
3. Ommaya AK, DiChiro G, Baldwin M et al (1968) Nontraumatic cerebrospinal fluid rhinorrhea. *J Neurol Neurosurg Psychiatry* 31:214–255
4. Hegazy HM, Carrau RL, Synderman CH, Kassam A, Zweig J (2000) Transnasal endoscopic repair of cerebrospinal fluid rhinorrhea: a meta-analysis. *Laryngoscope* 110:1166–1172
5. Marshall AH, Jones NS, Robertson IJA (2001) CSF rhinorrhea: the place of endoscopic sinus surgery. *Br J Neurosurg* 15:8–12
6. Wigand ME (1981) Transnasal ethmoidectomy under endoscopic control. *Rhinology* 19:7–15
7. Psaltis AJ, Schlosser RJ, Banks CA, Yawn J, Soler ZM (2012) A systematic review of the endoscopic repair of cerebrospinal fluid leaks. *Otolaryngol Head Neck Surg* 147(2):196–203
8. Badia L, Loughran S, Lund V (2001) Primary spontaneous cerebrospinal fluid rhinorrhea and obesity. *Am J Rhinol* 15:117–119
9. Casiano RR, Jassir D (1999) Endoscopic cerebrospinal fluid rhinorrhea repair: is lumbar drain necessary? *Otolaryngol Head Neck Surg* 121:745–750
10. Schnabel C, Di Martino E, Gilsbach JM, Riediger D, Gressner AM, Kunz D (2004) Comparison of beta2-transferrin and beta-trace protein for detection of cerebrospinal fluid in nasal and ear fluid. *Clin Chem* 50:661–663
11. Kljajić V, Vuleković P, Vlaški L, Savović S, Dragičević D, Papić V (2017) Endoscopic repair of cerebrospinal fluid rhinorrhea. *Braz J Otorhinolaryngol* 83(4):388–393
12. Virk JS, Elmieh B, Saleh H (2013) Endoscopic management of cerebrospinal fluid rhinorrhoea: the charing cross experience. *J Neurol Surg B* 74:61–67
13. Seth R, Rajasekaran K III, Luong A, Benninger MS, Batra PS (2010) Spontaneous CSF leaks: factors predictive of additional interventions. *Laryngoscope* 120:2141–2146
14. Platt MP, Parnes SM (2009) Management of unexpected cerebrospinal fluid leak during endoscopic sinus surgery. *Curr Opin Otolaryngol Head Neck Surg* 17(1):28–32
15. Psaltis AJ, Schlosser RJ, Banks CA, Yawn J, Soler ZM (2012) A systematic review of the endoscopic repair of cerebrospinal fluid leaks. *Otolaryngol Head Neck Surg* 147:196–203
16. Presutti L, Mattioli F, Villari D, Marchioni D, Alicandri-Ciufelli M (2009) Transnasal endoscopic treatment of cerebrospinal fluid leak: 17 years' experience. *Acta Otorhinolaryngol Ital* 29(4):191–196

17. Banks CA, Palmer JN, Chiu AG, O'Malley BW Jr, Woodworth BA, Kennedy DW (2009) Endoscopic closure of CSF rhinorrhea: 193 cases over 21 years. *Otolaryngol Head Neck Surg* 140(6):826–833
18. Ye H, Zuo J, Zhao H, Liu S, An H, Liu Y (2010) Endonasal endoscopic repair of CSF rhinorrhea in a series of 69 patients. *Br J Neurosurg* 24(3):244–248