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Endoscopic management of cerebrospinal fluid rhinorrhea from anterior skull base defects

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Abstract

Background: Over the past 20 years, the minimally invasive endoscopic approach has gained widespread acceptance. The study was performed to evaluate the diagnostic method and the success rate of endoscopically diagnosed and treated CSF rhinorrhea, and also investigations such as leakage site and etiologic factor.

Methods: This retrospective CSF leakage management review of patients experiencing CSF rhinorrhea made from 1999-2006 included data regarding leakage etiology, preoperative assessment, intraoperative techniques and postoperative follow-up.

Result: Sixty-five patients were managed endoscopically. CSF rhinorrhea etiology was traumatic in 30 cases, iatrogenic in 23 and spontaneous in 12. We used nasal endoscopy and high resolution computed tomography (HRCT) in all 65 cases while CT metrizamide cisternography was used in 5 specifically and magnetic resonance imaging for 5 others. Intrathecal fluorescein was used for intraoperative assessment without complications, and only one case of meningismus was noted.

Conclusion: Several imaging methods were effective in diagnosing CSF leakage sites. Endoscopic management and autografts were successful in repairing anterior skull defects in 90.76% of the cases.

Keywords: CSF leakage, skull base defects, diagnostic tests, endoscopic diagnosis and management.

Introduction

Otolaryngologists have a major role in the evaluation and management of anterior skull base defects that result in cerebrospinal fluid (CSF) leaks and meningoencephaloceles. Improved instrumentation for sinus surgery led to use of the endoscope for repair of CSF leaks by Wigand in 1981. Over the past 20 years, the minimally invasive endoscopic approach has gained widespread acceptance. As diagnostic aspects and surgical techniques have evolved, leading to higher success rates (approximately 90%) and lower morbidity than intracranial techniques for most leaks, the endoscopic approach has become the standard of care [1].

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The most common cause of CSF leaks is head trauma, and the remainder attributed to postoperative or spontaneous mechanisms [2]. In recent years, several authors have reported using endoscopic methods to repair leaks [3].

Some surgical care providers have used intrathecally-administered solutions of 0.5% to 5% (2.5-50 mg) sodium fluorescein through the lumbar space for detection and localization of skull base defects [4]. Recently, larger series have since demonstrated initial success rates of 76% - 94% with ultimate success rates ranging from 86% - 100%. [5]. Despite general agreement on treatment of CSF leak, the initial management, surgical indications, and the technique of repair are controversial [6].

This study was performed to evaluate the success rate of endoscopically diagnosed and treated CSF rhinorrhea, and also investigation of leakage site and etiologic factors.

Methods

Records of 65 patients who had undergone endoscopic repair of CSF rhinorrhea from 1999 through 2006 were retrospectively reviewed. Fine cut axial and coronal computed tomography (CT) scans were obtained in all patients before surgery. Magnetic resonance imaging (MRI) and CT cisternography with contrast was used in some patients. Intraoperative lumbar injection of fluorescein was used in 28 cases, by our policy. Approximately 9.5 cc of CSF was mixed with a solution of 0.25cc of 10% fluorescein and slowly reinjected. After 30 minutes, patients were examined with an endoscope and, if needed, with a blue light and a dark field. The sites of examination included the eustachian tube, cribriform plate, middle meatus and the osteum of the sphenoid. Examination was also done before and after anterior and posterior ethmoidectomy.

The surgical approach was made through a standard FESS technique. Complete ethmoidectomy is initially done to enable surgeons to precisely identify the location of the CSF leak. Secondly, if the leakage came from herniated dura, the leak should be observable. Thirdly, performing this technique helps to prevent subsequent mucocele formation after repair. Fourth and finally, if ethmoidectomy is not performed completely, in the instance that the leak has come from the frontal sinus, fluid will enter the ethmoid tissue cells and then the leak site will be mistakenly classified as an ethmoidal defect. To prevent secondary sinusitis in the maxilla and frontal sinus, the osteomeatal complex (OMC) must be widely opened. At the time of repairing the site of the defect, attention must be paid so that the osteum of these sinuses does not close down. These pertinent issues include: 1) accurately identifying the entire skull base defect area, 2) completely lifting the mucosa surrounding the defect, 3) performing a complete anterior and posterior ethmoidectomy in addition to a sphenoidectomy while opening the osteum of the maxillary and frontal sinus completely and 4) retracting the mucosal edges of the bone defect all around.

In cases when the defect is about 5 mm or larger, we attempt to use a piece of cartilage or bone as a support under the edges of the bony defect area to support the material used to cover the dural defect. The cartilage or bone graft is harvested either from the septum or from the lower or middle turbinate.

We attempt to use fascia lata or mucopericondrium as the first layer. If muscle is to be used, it is thoroughly crushed and then placed on the skull base defect along with Surgicel. Gelfoam is placed underneath this layer so the grafts do not pull off when removing the surgical packing.

If the leak is wholly within the sphenoid sinus, when MRI rules out any carotid anomalies, the entire sphenoid is demucosalized at first. The cavity is then packed with fascia, fat and muscle. In the final stage, a cartilage or bone graft is placed over them.

In cases of encephalocele bipolar electrocautery was first applied to the dural pouch and

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repair was done. Nasal packs as fixators were used on all patients to stabilize grafting materials and may have included Surgicel, Gelfoam and fibrin glue being placed during surgery. Patients were given parenteral antibiotics during the perioperative period and were placed on bed rest with the head of their bed elevated after surgery. Lumbar drainage was not used.

Results

From 1999 to 2006, 65 patients with CSF leakage underwent transnasal endoscopic diagnosis and repair of CSF leak procedures in our center. The study group consisted of 38 males and 27 females having an average age of 31.5 years. The cause of CSF rhinorrhea was determined to be traumatic in 30 cases (46.1%), spontaneous in 12, iatrogenic (35%) due to functional endoscopic sinus surgery (FESS) complications in 16 and iatrogenic from neurosurgical skull base procedures in 7. In 3 of the 16 FESS-related cases, the CSF leakage was encountered intraoperatively. The other 13 cases were referred from other institutions for subsequent repair.

Nasal endoscopy and high resolution computed tomography (HRCT) were used to identify the sites of the CSF fistulas in all of our 65 cases. In addition, CT metrizamide cisternography was used in 5, MRI in 5 and intraoperative intrathecal fluorescein in 28 patients. Meningoceles and/or encephaloceles were identified in 10. Sites of leakage was on the right side in 34 cases, on the left in 25 and both sides in 6 cases. CSF leaks occurred from the cribriform plate in 32 patients, fovea ethmoidalis in 23, sphenoid sinus in 5 and the frontal sinus in 5 respectively.

No major complications resulting from the use of fluorescein was seen with the exception of only one case of meningismus. Another method used on 5 of our patients was to pour a dilute solution of fluorescein on and/or inject the solution submucosally within the suspected site of CSF leakage. In the case of a positive detection result, the washing away of the fluorescein by CSF could be viewed.

Three cases had a past history of single craniotomy and 4 patients had a history of 2 craniotomies and all were repaired endoscopically. 5 failures in endoscopic repair happened. In 4 the site of leakage was the posterior wall of the frontal sinus and required repair via craniotomy and one was repaired by second endoscopic surgery.

However, five patients required a second endoscopic procedure to control leakage. Approximately 90.76 percent of cases were successfully treated with a single or two endoscopic surgical procedures, with 84.6 % on the first attempt.

The success rate for endoscopic diagnosis of CSF leak site was 90.2%. In 4 cases, the site of leak was the frontal sinus; however, the location was originally defined inaccurately as the fovea ethmoidalis.

Discussion

Since 1926 when Dandy described the first case using bifrontal craniotomy, this approach remained the mainstream surgical treatment until the Dohlman study later reported the first treatment using an extracranial nonendoscopic approach via a nasofrontal incision [1].

Wigand, in 1981, was the first to describe the use of an endoscope in treatment of CSF rhinorrhea occurring during FESS.

In 18.4% (12 cases) of the patients, we did not identify the exact etiology for CSF rhinorrhea. It is noteworthy, 9 of these 12 patients were obese females.

In 43% of the cases fluorescein solution was used to detect the leakage without any side effects other than in 1 case in which meningismus symptoms were observed.Utilizing fluorescein facilitated the rapid detection of the leakage site. This method also assisted in the detection of multiple leaks and ensured that no subsequent leaks would reoccur. Wax et al in their study suggested that fluorescein is relatively safe; complications ranging from lower extremity weakness to seizure and cranial nerve

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deficits have been described, but all complication were reversible without residual deficit [7].

The most common site for CSF leak in our patient group was the cribriform plate and, as is well known, it is the thinnest anatomic part of the skull base, and the most common site of CSF leakage in spontaneous and/or postoperative cases. However, in traumatic cases the most common defect is observed equally in the cribriform plate or fovea ethmoidalis.

In 5 cases, the site of leakage was the frontal sinus and was mistakenly assumed that the leak came from the fovea ethmoidalis, so we repaired that particular site. Whenever leakage reoccurred,we realized that the leak had actually come from the frontal sinus and subsequent patients underwent open frontal sinus surgery. Maybe the only instance in which endoscopic surgery is ineffective in repairing leakage that comes from the frontal sinusis is when the leak originates in the posterior wall of the nasofrontal recess where the fovea ethmoidalis and frontal recess intersect.

However, in craniotomy-failed cases, endoscopic repair is usually easily and accurately performed.

Our success rate approximated 90.76 percent. Zweig et al had a success rate of 94.3% occurring in 48 patients with 53 CSF fistulas. Fifty fistulas were successfully repaired during initial endoscopic repair and 3 persistent leaks were resolved on the second attempt [6]. Kennedy et al, in a 36-patient series, had a success rate of 94.4% in 34 patients with 1 endoscopic procedure [8]. In the Gross et al's study of 42 patients, successful resolution of CSF rhinorrhea was achieved in 35 patients (83.3%) and 3 additional patients had successful closure in a second surgery [9].

In Dodson et al's study closure of leakage was successful in 75.5 percent in the first attempt and 100% in the 2nd repair [10].

Lindstrom et al identified 4 risk factors for surgical failure in their series: including leak location being the sphenoid sinus, elevated BMI (obesity), spontaneous CSF rhinorrhea, and massive skull base defect [11].

We did not use lumbar drainage methods on any of our patients. But Lee et al advise use of a lumbar drain in selected patients such as cases with meningocele or encephalocele and for those in whom the location of the defect is difficult to repair [12].

Conclusion

Based on retrospective studies on patients who were treated for CSF rhinorrhea, trauma has been the most common causes of leakage. Nasal endoscopy, HRCT, CT cisternography, MRI and intrathecal fluorescein injection has been used for diagnosis. The combined success rate of first and second endoscopic repair attempts was 90.76%, with 84.6% successful repair occurring on the first attempt. No lumbar drainage was used and no serious postoperative symptoms or complications were observed. Our patient follow-up period ranged from 6 months to 108 months (mean 60 months), indicating that the endoscopic approach provides a safe and effective means for repairing many skull base defects.

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References

1. Schlosser RJ, Bolger WE, Endoscopic management of cerebrospinal rhinorrhea. Otolaryngol Clin N Am, 2006; 39,523-538.

2. Buchanan RJ, Brant A, Marshall LA. Traumatic cerebrospinal fluid fistulas. In: Winn HR, Neurological Surgery, 5th ed. Philadelphia: Elsevier; 2004. pp. 5265-72.

3. Chin GY, Rice DH. Transnasal endoscopic closure

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of cerebrospinal fluid leaks. Laryngoscope 2003; 113: 136-38.

4. Keerl R, Weber RK, Draf W (FRCS Eds: Wienke A, Schaefer SD). Laryngoscope Feb 2004;114:266-72.

5. Mao VH, Keane WM, Atkins JP, Spiegel JR, Willcox TO, Rosen MR et al. Endoscopic repair of cerebrospinal fluid rhinorrhea. Otolaryngology-Head and Neck Surgery 2000; 122(1): 56-60.

6. Zweig JL, Carrau RL, Celin SE, Schaitkin BM, Pollice PA, Snyderman CH et al. Endoscopic repair of cerebrospinal fluid leaks to the sinonasal tract: predictors of success. Otolaryngology-Head and Neck Surgery 2000; 123(3):195-201.

7. Wax MK, Ramadan HH, Ortiz O, Wetmore SJ. Contemporary management of cerebrospinal fluid rhinorrhea. Otolaryngology-Head and Neck Surgery April 1997; 116(4): 442-49.

8. Kennedy DW, O'Brien DA, Lanza DC. Endoscopic repair of cerebrospinal fluid fistulae and encephaloceles. Laryngoscope 1996; 106(9 Pt 1):1119-25.

9. Gross CW, Dodson EE, Burns JA. Transnasal endoscopic repair of cranionasal fistulae: a refined technique with long-term follow-up. Laryngoscope 1996; 106(9 Pt 1); 1080-83.

10. Dodson EE, Gross CW, Swerdloff JL, Gustafson LM. Transnasal endoscopic repair of cerebrospinal fluid rhinorrhea and skull base defects: A review of twenty-nine cases. Otolaryngology-Head and Neck Surgery 1994; 111(5): 600-05.

11. Lindstrom DR, Toohill RJ, Leohrl TA, Smith TL. Management of cerebrospinal fluid rhinorrhea: The Medical College of Wisconsin experience. Laryngoscope 2004; 114: 969-74.

12. Lee TJ, Huang CC, Chuang CC, Huang SF. Transnasal repair of cerebrospinal fluid rhinorrhea and skull base defects: ten-year experience. Laryngoscope 2004; 114:1475-81.

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