

Original Article

Transmastoid Approach to Repair Iatrogenic Cerebrospinal Fluid Otorrhorrhea After Cerebellopontine Angle Tumor Resection

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BACKGROUND: The precise treatment of iatrogenic cerebrospinal fluid (CSF) otorrhorrhea has been poorly studied. The purpose of the study was to investigate the clinical manifestation, surgical results, and management of CSF leak.

METHODS: Electronic medical record database of iatrogenic CSF leaks after cerebellopontine angle (CPA) surgery from 2019 to 2022 was retrospectively analyzed. Three patients returned to the hospital with the complication of CSF leak. After failed attempts of conservative strategies or reverse surgical repair, adipose tissue was applied to the mastoid cracks repair.

RESULTS: With the techniques described above, the CSF leaks were successfully settled. The identified patients were observed for at least 10 months, and there was no recurrence or other complications.

CONCLUSION: Conservative treatment and initial surgical methods for occult postoperative CSF leaks are prone to delay effective results, particularly in patients with well-evaporated temporal bone. This complication can be minimized with transmastoid closure utilizing autologous fat.

KEYWORDS: Cerebellopontine angle tumor, CSF leak, skull base, transmastoid approach, autologous fat

INTRODUCTION

Iatrogenic cerebrospinal fluid (CSF) leaks result from the dura defects causing an anomalous communication between the surgical site and the airspace of the mastoid process. This condition is considered one of the most common complications found in postoperative CPA lesion surgeries.^{1,2} Early diagnosis is necessary because it can lead to prompt and adequate treatment, significantly reducing the incidence of serious complications such as meningitis, pneumocephalus, or even death.^{3,4}

The current management strategy is similar to that well-reported for spontaneous CSF leakages, which can be primarily conservative, such as a dehydrator, diuretic agent, or lumbar drainage.^{5,6} When conservative intervention does not work, surgical intervention is usually performed.^{3,7} Moreover, the consequences of such ineffective treatment include increases in hospital stays and costs.^{8,9} However, the precise management of iatrogenic CSF leakage is still lacking.

The purpose of this retrospective study was to recommend the right time for surgical intervention and present our preliminary experience with endoscopic transmastoid repair of iatrogenic CSF otorrhorrhea associated with CPA tumor removal. The study will provide an empirical reference for better management of postoperative iatrogenic CSF otorrhorrhea.

MATERIAL AND METHODS

Between April 2019 and January 2022, 3 cases of iatrogenic CSF otorhinorrhea were identified in 144 patients after CPA tumor resection. Demographics, surgical procedures, postoperative complications, clinical manifestations, review imaging, resolution of CSF rhinorrhea, postoperative outcomes, and follow-up data are all documented in Table 1. All procedures followed the ethical standards of the The First Affiliated Hospital of Fujian Medical University institutional research committee (Approval No: [2015] 084-1). Informed consent was obtained before conducting this study.

All these patients underwent craniotomy via retrosigmoid approach because of CPA tumors. One patient experienced recurrent postoperative hearing loss, which was misdiagnosed as otitis media and treated repeatedly without success. The diagnosis was finally confirmed by tympanic puncture to determine the nature of the effusion. One patient had postoperative CSF otorhinorrhea, which was managed by drainage and surgical repair by retrosigmoid approach,

MAIN POINTS

- Iatrogenic CSF leaks result from dura defects causing abnormal communication between the surgical site and the mastoid process airspace. It is a common complication in postoperative CPA lesion surgeries.
- Early diagnosis is crucial to prevent serious complications such as meningitis, pneumocephalus, or death.
- Management strategies is similar to that well-reported for spontaneous CSF leakages, which include conservative measures like dehydration, diuretic agents, or lumbar drainage, and surgical intervention if conservative measures fail.
- The study aims to recommend the right time for surgical intervention and present experiences with endoscopic transmastoid repair of iatrogenic CSF otorhinorrhea associated with CPA tumor removal. The study intends to provide an empirical reference for better management of postoperative iatrogenic CSF otorhinorrhea.

but both failed. One patient was accompanied by meningitis after failed lumbar drainage due to iatrogenic CSF otorhinorrhea. The 3 medical records described herein underwent successful closure for the mastoid cavity, Eustachian tube, and middle ear cavity with the endoscope-assisted transmastoid surgical technique and the implication of autologous fat. All of the surgical management was performed by senior otologists and neurosurgeons. The observation period ranged from 10 to 25 months. Since the number of cases was limited, only a descriptive analysis of the data was performed.

Transmastoid Approach and Repair Technique

After induction of general anesthesia, a 3–4 cm retroauricular incision was made. The mastoidectomy was performed with a 0 degree 2.7 mm endoscope to expose the suspected defect, better discovering the concealed sites of the inner auditory canal (IAC). Cerebrospinal fluid leakage from the air cells of the mastoid process was obvious during the operation (Figure 1). Then, abdominal fat was used to fill the mastoid-aerated cells until no CSF was leaking under a more clear and direct view. In 2 cases of CSF leakage from the mastoid aerated cells, fat was used to close the mastoid to the tympanic sinus. In 1 case of fCSF leakage in both of the mastoid and tympanic air cells, the facial recess was opened for better closure of the mastoid and tympanic cavity.

RESULTS

Three cases reported here have successfully closed occult iatrogenic CSF leakages, with no concomitant complications or recurrences. The longest observation period was 2 years.

Illustrative Case (Case 2)

A 52-year-old male who had undergone resection of acoustic neuroma in the department of neurosurgery was present in detail. After surgery, clear fluid flowed from the front nostrils. He was then diagnosed with postoperative CSF otorhinorrhea. Lumbar drainage was done for the reduction of cranial pressure. But the symptoms had not yet improved. The suspected leak was then sealed with bone wax through the retrosigmoid approach, but the results were

Table 1. Summary of 3 Cases with Iatrogenic Cerebrospinal Fluid Otorhinorrhea

Case	1	2	3
Age (years)	51	52	55
Gender	Female	Male	Male
Mastoid type	Pneumatic type	Pneumatic type	Pneumatic type
Preoperative MRI	T1 iso, T2 iso 1.9 cm × 1.4 cm	T1 high, T2 high 2.0 cm × 1.8 cm	T1 high, T2 high 4.0 cm × 3.3 cm
Primary diagnosis	Meningioma on the right	AN on the left	AN on the left
Treatment	Resection/TS	Resection/TS	Resection/TS
Postoperative pathology	Fibrous meningioma	Both were schwannomas	Schwannoma
Postoperative symptoms	Hearing loss, tightness in the ear, runny nose	Runny nose	Runny nose
Review image	T2 high (the right MAC and tympanum communicate with the OA)	T2 high (the left MAC communicates with the OA)	T2 high (the left MAC communicates with the OA)
Postoperative complications	CSF otorhinorrhea	CSF otorhinorrhea	CSF otorhinorrhea, meningitis
Treatment measures	AFSR/TM	AFSR/TM	AFSR/TM
Progress	No recurrence	No recurrence	No recurrence

AFSR, autologous fat surgical repair; AN, acoustic neuroma; CSF, cerebrospinal fluid; MAC, mastoid air chamber; MRI, magnetic resonance imaging; OA, operative area; TM, transmastoid approach; TS, transigmoid approach.

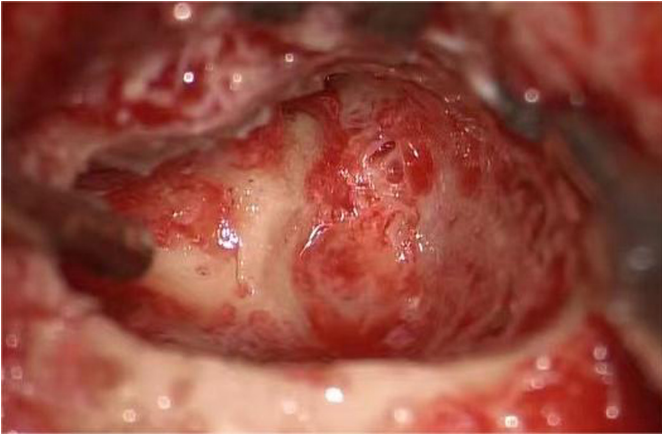


Figure 1. Cerebrospinal fluid could be clearly seen flowing from the mastoid air chamber.

disappointing. Thereafter, the patient was referred to the otolaryngology department for better recovery. Temporal bone High-resolution computed tomography (HRCT) scan showed high attenuation in the left mastoid and tympanic sinus areas (Figure 2). Cranial MRI showed that the left air-containing mastoid and the tympanic cavity communicated with the fluid-filled subarachnoid space of the occipital surgical field (Figure 3). Transmastoid surgical management was conducted to solve the problem. During the operation, it was found that the mastoid was well developed, and the lateral mastoid was partially missing. The autologous abdominal adipose tissue was chosen to obliterate the mastoid cavity and the tympanic sinus until there was no CSF outflow. After surgery, no symptoms of facial paralysis and no recurrence of CSF otorhinorrhea were found after follow-up for more than 1 year.



Figure 2. High-resolution axial temporal computed tomography images present the mature pneumatization of the mastoid and the petrous portion of the left temporal bone. Liquid shading is also visible in the figure.



Figure 3. Postoperative magnetic resonance imaging revealed the cerebrospinal fluid abnormal communication. The red arrow indicates a suspected leak site.

DISCUSSION

Recalcitrant iatrogenic CSF otorhinorrhea associated with CPA tumor resection is difficult to treat. This is a common complication after surgery for the CPA lesion using a retrosigmoid approach.¹⁰ In this study, conservative treatment of iatrogenic CSF otorhinorrhea not only has no obvious effect but also prolongs the treatment time. The decision to perform retrosigmoid repair may also fail due to incomplete occlusion of the airspace.

The retrosigmoid approach is the standard approach for tumor resection, which has the advantage of being straight and allows better visualization of the lesion area, but airspace preservation is often overlooked. The reason for this is poor vision in tumors of the IAC.¹¹ To better expose the IAC field during the operation, the posterior wall and the petrous bone are often removed. All of these measures can increase the likelihood of bony defects. In particular, patients with well-developed mastoids had a higher risk of postoperative CSF leakage, as confirmed by the well-developed temporal bone in the 3 patients in this study.¹² In particular, in case 2, retrosigmoid surgical repair combined with bone wax failed to identify a suspected space occlusion. However, the advantage of transmastoid surgery is that the mastoid chamber is completely sealed.

We recommend preoperative specialized analysis of the mastoid cavity and petrous bone in all patients.¹³ If the mastoid is well developed and the IAC bone is thin, postoperative CSF leakage should be prevented. Firstly, excessive abrasion of the IAC bone should be avoided. We then recommend endoscopic support for IAC tumors. The IAC cavity is narrow and difficult to observe under a microscope, but an endoscope has a better magnification and visualization system that facilitate tumor visualization and resection. Bone defects in the IAC and even exposure to mastoid air cells can be also corrected

in time. If bone destruction or air cell exposure is suspected, prophylactic repair of the leak is required to avoid postoperative CSF leakage. Bone wax stuffing may be effective against poorly gasified air chambers but may not reliably seal exposed air cells in well-gasified mastoids.¹⁰ The use of autologous fat is preferable in this case. This idea is also confirmed in case 2. Allogeneic materials are also at risk of dissolution, rejection, poisoning, and infection⁴ and even stimulate the facial nerve and affect its physiological function.¹⁴ Autologous fat rejection rate is low with a certain flexibility. As an excellent natural tissue sealant, it prevents CSF leakage through potential openings.¹⁵ This work used autologous abdominal fat as the main repair material and achieved good results.

Lumbar drainage has been reported to adversely affect patients with persistent CSF leaks over 2 weeks, intermittent leakage, and iatrogenic tumors and those associated with skull base tumors.¹⁶ Conservative therapy may be effective for traumatic CSF leakage but not for patients after the resection of the brain tumor.¹⁷ This is especially true in cases where intraoperative prophylactic repair measures have failed. Immediate surgical management through a transmastoid approach is critical. First, after brain surgery, patients often develop intracranial hypertension, and CSF leakage is difficult to treat. Second, iatrogenic CSF leakages tend to have larger bony defects, and well-developed air cells in the temporal bone often play a role in CSF drainage. Third, CSF leakage associated with brain surgery increases the risk of fatal meningitis. This approach also eliminates the need for craniotomy or lumbar drainage. In this study, 3 patients with iatrogenic CSF otorhinorrhea who failed conservative treatment underwent an immediate repair with abdominal fat through the transmastoid approach. In the end, it all yielded good results. Therefore, we strongly recommend that patients with good mastoid pneumatization require early transmastoid surgery to repair iatrogenic CSF otorhinorrhea.

Finally, our findings have important clinical references for better management of postoperative iatrogenic CSF otorhinorrhea. However, because of the strict inclusion criteria, the sample size was relatively small. Furthermore, this was a single-institution retrospective study, which may have the potential for selection bias. Therefore, more extensive clinical, multicenter-controlled studies are needed.

To avoid CSF leakage associated with the resection of tumors in the CPA area, the extent of pneumatization in the mastoid and the petrous bone should be assessed preoperatively. Once iatrogenic CSF otorhinorrhea happens, the endoscopic transmastoid approach combined with the autologous adipose tissue should be selected immediately for repair. The technique described in this article is a good option for satisfactory results.

Ethics Committee Approval: This study was approved by the Ethics Committee of Fujian Medical University (Approval No: [2015]084-1, Date: May 31, 2022).

Informed Consent: Informed consent was obtained from the patients who agreed to take part in the study.

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