

Endoscopic closure of the Eustachian tube orifice for refractory lateral skull base cerebrospinal fluid leak using autologous fat graft: illustrative case

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BACKGROUND Rhinorrhea due to lateral skull base cerebrospinal fluid (CSF) leaks can be a challenge to manage. Multiple strategies exist for treating CSF leaks in this region including direct repair, posterior Eustachian tube packing, and CSF diversion. Endonasal closure of the Eustachian tube has been reported using cerclage and mucosal flaps.

OBSERVATIONS We present the first reported case of endoscopic autologous fat packing of the Eustachian tube orifice to repair a CSF leak. In this case a 42-year-old woman who underwent middle fossa meningioma resection 20 years ago presented with refractory CSF rhinorrhea despite blind sac closure of the ear canal. This persisted after CSF diversion and only resolved after endoscopic endonasal Eustachian tube closure described herein.

LESSONS This technique is simple to perform with minimal risk of morbidity. Eustachian tube orifice fat packing may be particularly useful for patients with refractory CSF rhinorrhea with low CSF pressure.

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KEYWORDS CSF leak; endoscopic; Eustachian tube; fat graft; skull base

Recalcitrant lateral skull base cerebrospinal fluid (CSF) leaks can be difficult to manage. Typically, such leaks are simply repaired from a lateral approach, including direct repair or by blind sac closure of the external auditory canal and Eustachian tube packing via the middle ear space. Challenging leaks can also be treated using temporary or permanent CSF diversion techniques such as lumbar drainage or ventriculoperitoneal shunt placement. An alternative strategy of plugging the Eustachian tube orifice within the nasopharynx has also been suggested for CSF leak.¹⁻⁴ This has included cerclage of the Eustachian tube orifice (closure with a circumferential suture), creation of a local Eustachian tube mucosal flap, and use of a pedicled nasoseptal flap.

We have previously reported the use of endonasal autologous fat grafting for patients with a patulous Eustachian tube.⁵ This technique is technically simple and reproducible and requires less mucosal injury and repositioning than a flap. Here we present the first report of endoscopic autologous fat grafting of the Eustachian tube orifice for repair of a CSF leak.

Illustrative Case

We report the case of a 42-year-old woman who had undergone resection of a large middle cranial fossa meningioma 20 years ago. She presented with a large left middle fossa meningocele (Fig. 1), severe headaches, recent placement of a left myringotomy tube resulting in CSF otorrhea and rhinorrhea, and recurrent meningitis. She was admitted with severe confusion and meningitis and started on broad-spectrum antibiotics. Given the acuity and severity of her clinical presentation, and the urgent need for definitive repair, we recommended a blind sac closure of the external auditory canal and packing of the Eustachian tube. This was offered despite previously present but diminished hearing in her left ear. The potential for placement of an osseointegrated hearing aid at a later date was also discussed with the patient's family. After surgery, the patient's signs and symptoms of meningitis resolved, and CSF rhinorrhea abated.

Two months later she presented with recurrent intermittent CSF rhinorrhea and fluctuant swelling of the scalp over her previous

ABBREVIATION CSF = cerebrospinal fluid.

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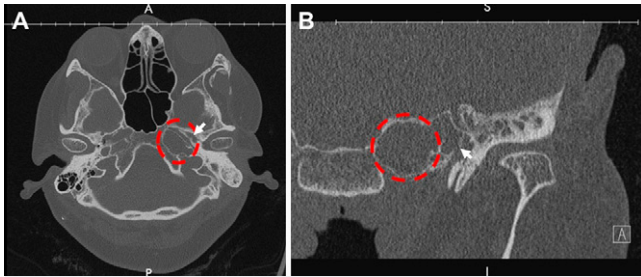


FIG. 1. High-resolution axial (A) and coronal (B) computed tomography demonstrates a region of bony dehiscence within the left petrous apex (red circle), adjacent to the bony part of the Eustachian tube (white arrow).

middle fossa craniectomy site. Due to concern for a high-pressure CSF leak, a right frontal ventriculoperitoneal shunt was placed (Sophysa Polaris SPV-B set at 70 mm Hg). Despite initial relief, her CSF rhinorrhea recurred 1 month later. Her shunt was reprogrammed to 30 mm Hg. Again, she had no leak until 1 month later, when an intermittent rhinorrhea from her left nostril developed. Additionally, at this time, she presented with a sunken scalp flap and low-pressure headaches. Given the bony dehiscence along the entire length of the Eustachian tube, and based on this clinical picture, we recommended endoscopic endonasal closure of the Eustachian tube.

Operative Technique

After general anesthesia was induced and a periumbilical fat graft was obtained, nasal endoscopy was performed. A red rubber catheter was inserted into the nasopharynx to retract the soft palate. Angled instruments were introduced from the oropharynx and visualized by left nasal endoscopy. This allowed direct visualization of the left Eustachian tube up to the valve (Fig. 2A and B). Bovie electrocautery was then used to cauterize the orifice of the Eustachian tube and denude the mucosa up to the cartilage of the torus tubaris. Abdominal fat was then packed into this orifice to seal the valve. The edges of the Eustachian tube orifice were then cauterized gently to involute the tissue around the fat graft and adhere it to the mucosal edge (Fig. 2C).

The patient tolerated the procedure without difficulty and was discharged the same day. Nasal endoscopy 1 month after surgery showed good healing and mucosalization. She has had no further CSF rhinorrhea through 5 months of follow-up.

Discussion

Observations

CSF leak is a significant potential morbidity of lateral skull base surgery, particularly when it results in meningitis. In such cases, a leak may manifest as rhinorrhea, as CSF drains through the middle ear to the Eustachian tube into the nasopharynx. Lateral skull base surgical techniques can be used to directly repair the site of the leak, such as obliteration of open mastoid air cells after a retrosigmoid approach. Alternatively, in patients whom hearing preservation is not a priority and requiring a definitive repair, Eustachian tube obliteration and blind sac closure of the external auditory canal can be effective. Finally, CSF diversion can lower intracranial pressure and allow for otherwise refractory CSF fistulae to heal.

Prior reports have suggested Eustachian tube orifice closure as a method for treating CSF rhinorrhea. Kwartler and colleagues² reported a patient with refractory CSF rhinorrhea after translabyrinthine tumor resection. She underwent subsequent shunting, middle fossa repair, and middle ear packing, but continued to have CSF leak. She was then treated with endoscopic incision, inversion, and cauterization of the Eustachian tube orifice, resulting in resolution of the leak. Orlandi and Shelton³ described three cases of CSF rhinorrhea after lateral skull base surgery treated by endoscopic cerclage of the Eustachian tube orifice. In these cases, the authors cauterized the mucosa of the Eustachian tube orifice and sutured close the torus tubaris. There were no postoperative leaks. Taghi and colleagues¹ reported a patient who underwent retrosigmoid craniotomy, who had persistent CSF rhinorrhea despite attempted primary repair and middle ear obliteration. The patient first underwent endoscopic cauterization of the Eustachian tube resulting in a 75% reduction in the leak. This was followed by a second operation in which the Eustachian tube was plugged with cartilage and covered by a rotated local mucosal flap resulting in resolution of the leak. Finally, Lucke-Wold et al.⁴ described a patient who underwent translabyrinthine resection of a vestibular schwannoma complicated by CSF rhinorrhea. She underwent ventriculoperitoneal shunt placement followed by repeat mastoidectomy with placement of fat packing

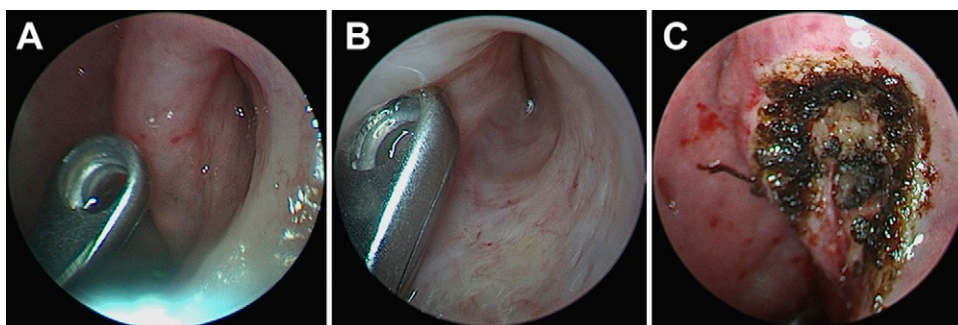


FIG. 2. Endonasal endoscopy demonstrates instrumented access to the Eustachian tube orifice via the oropharynx (A). This allowed visualization of the orifice up to the valve of the Eustachian tube (B). After cautery and demucosalization, autologous fat graft was used to pack the orifice and sealed in place using gentle cautery along the margins (C).

and a pedicled fascial flap but exhibited persistent rhinorrhea. The authors then endoscopically cauterized the Eustachian tube orifice, packed the orifice with acellular human tissue matrix, performed a cerclage, and then covered the orifice with a pedicled nasoseptal flap.

In previous study by Lemonnier et al.,⁶ endoscopic endonasal closure of the Eustachian tube was performed using acellular dermal graft. However, three patients (33.3%) developed CSF rhinorrhea, including one patient with meningitis, and underwent revision surgery. A previous study by Taha et al.⁷ among a large cohort of 1,581 cases demonstrated that the use of autologous fat is associated with a 1% complications rate and is widely applied technique for obliteration of dead space and reinforce dural closure during skull base reconstructions. Furthermore, it is known that acellular dermal graft is considered only septic and not sterile, therefore it is reported that infection rates is higher in cases using acellular matrices than in those who did not.⁸

Lessons

We have previously described a technique of endoscopic Eustachian tube orifice cauterization, abdominal fat packing, and cautery of the mucosal edge to seal the fat in place for patients with a patulous Eustachian tube.⁵ We report here that this technique can be effective for patients with CSF rhinorrhea after lateral skull base surgery. This strategy is technically simple and easily reproducible compared with cerclage. Compared with pedicled mucosal flap techniques, this procedure is less locally destructive with shorter operative time and lower risk of nasal complications such as crusting and dryness. Regardless of these advantages, some precaution should be taken in both patient selection and during surgery. First, ventriculoperitoneal shunts were present in most previously reported cases as well as the current case, suggesting this technique is particularly effective for low-pressure CSF fistulae. Second, during surgery, care must be taken to avoid injury to the internal carotid artery that runs superior to the torus tubarius. To prevent such morbidity, local anatomy should be carefully reviewed, and cautery should be limited to the interior and margins of the Eustachian tube orifice.

Endoscopic closure of the Eustachian tube orifice with autologous fat packing can treat CSF rhinorrhea after lateral skull base surgery. This simple and relatively low-risk procedure is an attractive option for refractory CSF fistulae and has a short recovery. This technique may be particularly useful in patients who already had shunts placed and have low intracranial pressure.

Acknowledgments

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Disclosures

The authors report no conflict of interest concerning the materials or methods used in this study or the findings specified in this paper.

Author Contributions

Conception and design: Lekovic, Mehta, Slattery. Acquisition of data: Lekovic, Mehta, Slattery. Analysis and interpretation of data: Lekovic, Fatima. Drafting the article: Lekovic, Mehta. Critically revising the article: Lekovic, Mehta, Fatima. Reviewed submitted version of manuscript: all authors. Approved the final version of the manuscript on behalf of all authors: Lekovic. Study supervision: Lekovic.

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