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Tension Pneumocephalus after Endoscopic Sinus Surgery: A Technical Report of Multiportal Endoscopic Skull Base Repair

Randall A. Bly, MD^{1,*}, Ryan P. Morton, MD^{2,*}, Louis J. Kim, MD², and Kristen S. Moe, MD^{1,2}

¹Department of Otolaryngology, University of Washington, Seattle, Washington, USA

²Department of Neurological Surgery, University of Washington, Seattle, Washington, USA

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Tension pneumocephalus after endoscopic sinus surgery is a rare but life-threatening complication. While open repair is the historical standard, more recent reports have described efficacious transnasal endoscopic repair of not only cerebrospinal fluid (CSF) leak¹ but also pneumocephalus² and even tension pneumocephalus.³ Transorbital neuroendoscopic surgery (TONES) for CSF leak repair was described by our group.⁴ We now report a case of combined transorbital and transnasal (intradural and extradural) repair of bilateral anterior cranial fossa skull base defects with CSF leak and tension pneumocephalus using AlloDerm (LifeCell Corp, Branchburg, New Jersey) and Duragen (Integra, Plainsboro, New Jersey).

Technical Case Report

History

An 89-year-old man underwent bilateral endoscopic sinus surgery at an outside institution for chronic rhinosinusitis. Once at home, he developed headache and altered mental status. Paramedics were called and he was intubated. A non-contrast head computed tomography

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Corresponding Author: Randall A. Bly, MD, Department of Otolaryngology—Head and Neck Surgery, University of Washington School of Medicine, 1959 NE Pacific Street, Box 356515, NE-306, Seattle, WA 98195-6515, USA., randbly@uw.edu.

*These authors contributed equally to this work.

Author Contributions

Randall A. Bly, study design, data collection and analysis, manuscript writing and preparation; **Ryan P. Morton**, study design, data collection, manuscript revisions; **Louis J. Kim**, study design, data collection, manuscript revisions; **Kristen S. Moe**, study design, data collection and analysis, manuscript revisions.

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(CT) scan at the outside facility revealed tension pneumocephalus with the “Mount Fuji sign.” In the sagittal view, stretched subdural veins were apparent (Figure 1D, arrowheads).

The patient was airlifted to our institution. On arrival, he opened his eyes to voice and localized to painful stimuli. An emergent right frontal burr hole was placed to relieve the intracranial hypertension. Concomitant nasal endoscopy demonstrated bubbling along the ethmoid roof when irrigation fluid was flushed through burr hole—confirming a substantial communication to the intracranial space. The patient’s nose was packed and a right frontal ventriculostomy catheter was placed. He was then taken to surgery for emergent skull base repair through endoscopic transnasal and transorbital approaches.

Operation

Rigid nasal endoscopy revealed bilateral large (1×3 cm) defects in the ethmoid roof (Figure 1B). Advancing the endoscope through the defects revealed that the brain was approximately 2 cm off the skull base such that the bridging dural veins were under tension as the CT scan had suggested (Figure 1C).

Middle cranial fossae and orbital roof access was obtained through bilateral superior lid crease incisions as described previously (Figure 1A).¹ Neuroendoscopy through the orbital portals permitted intradural visualization of the skull base defect from above as well as the falx and dural bridging veins (Figure 1E).

For the repair, a “brain sling” was fashioned in which a piece of 3×7 -cm AlloDerm of medium thickness, with a cutout for the falx cerebri, was placed transorbitally using Takahashi forceps and Cottle instruments to span the entire width of the anterior cranial fossa as well as portions of middle fossae (Figure 2). Duragen was then transorbitally placed on the cranial side to bolster the repair and secured with fibrin glue (Figure 1F, asterisk). Another layer of AlloDerm was placed extradurally via the transnasal port and Nasopore sponges were placed in the superior nasal cavity to further buttress the repair (Figure 2). In this instance with prior septoplasty, the decision was made to not use a nasoseptal flap. Nasal trumpets were placed. Operative time was 4 hours.

Postoperative Course

The patient was extubated and had no signs of CSF leak. He was maintained on bed rest with head of bed at 30 degrees for 3 days. The ventriculostomy catheter was removed on postoperative day 1. His pneumocephalus progressively resolved and his mental status improved to the point where he was following commands. Over the subsequent weeks, however, unrelated to the surgical repair, he developed pneumonia and acute respiratory distress syndrome requiring reintubation. Ultimately, the family withdrew care as per the patient’s previously voiced advanced directive due to persistent respiratory failure.

Discussion

Large anterior skull base CSF leaks are challenging to repair. For large defects that would traditionally be considered for craniotomy, we prefer the multiportal TONES technique when possible. In this instance where the defect was bilateral and adjacent to the crista galli,

the TONES technique provided adequate visualization for reconstruction. Furthermore, this approach preserves the olfactory nerves compared with some transnasal approaches. For small defects (<1 cm), our group still prefers stand-alone transnasal repair. We consider open craniotomy after failure of standard transnasal or multiportal endoscopic approaches. This case demonstrates a successful multiportal transnasal and transorbital technique to repair large iatrogenic bilateral anterior cranial fossa defects with resultant tension pneumocephalus. This method of repair should be considered for the reconstruction of large skull base defects of any etiology as it provides excellent access and visualization.

Institutional review board approval was obtained from the University of Washington.

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Figure 1.

(A) Superior lid crease (blepharoplasty) incision. (B) Initial transnasal endoscopy and cerebrospinal fluid leak (arrows). (C) Stretched bridging veins demonstrated on sagittal head CT (arrows). (D) Intracranial transorbital endoscopy with subdural veins (arrows). (E) Transnasal instrument (*) through skull base defect; “F” indicates falx cerebri. (F) AlloDerm reconstruction (*).

Figure 2.

(A) Skull base approach for repair of bilateral ethmoid roof defects through transnasal and transorbital endoscopic portals (arrows). (B) Schematic and coronal section (C) of the “brain sling” technique. Intradural reconstruction was performed with a large single piece of Alloderm with a Falx cutout (2B,C, green) bolstered with Duragen via the transorbital ports. Additional Alloderm was placed extradurally via the transnasal port (2C, blue) to enhance the repair. (Reprinted with permission, University of Washington Creative Services ©2014. All rights reserved.)