Occlusion of the Eustachian Tube for Lateral Skull Base Defect Pneumocephalus

Krupal B. Patel[1,2], Andre Beer Furlan[3], James Liu[3]

[1]Department of Head and Neck Surgery, City of Hope, Duarte, CA,
[2]Department of Otolaryngology- Head and Neck Surgery, University of South Florida, Tampa, FL,
[3]Department of Neuro-Oncology, H. Lee Moffitt Cancer Center, Tampa, FL

Abstract

Objective: The primary objective of this study is to describe and highlight a technique for endoscopic occlusion of the eustachian tube with an abdominal fat graft to resolve pneumocephalus.

Method: This study describes an endoscopic technique to occlude the eustachian tube using an abdominal fat graft as a minimally invasive approach to treat pneumocephalus.

Conclusion: Occlusion of the eustachian tube to treat lateral skull base defect pneumocephalus is a viable, relatively low risk procedure for patients at high risk of wound healing complications and meningitis.

Introduction

The tegmen tympanum and tegmen mastoideum form the tympanic cavity and mastoid. Tegmen defects occur in 20-30% of the population and while most cases are asymptomatic, may lead to temporal lobe encephalocele, meningitis, intracranial abscesses and cerebrospinal fluid (CSF) leak. [1] In addition, tegmen defects with an accompanied encephalocele can occasionally allow the entry of air into the cranial vault, resulting in pneumocephalus. [1] Clinical manifestations of pneumocephalus include hearing loss, tinnitus, middle ear effusion, imbalance and headaches. Acquired pneumocephalus is common following intracranial tumors, infections and head trauma.

This study describes an operative strategy comprising of an endoscopic technique to occlude the eustachian tube using an abdominal fat graft as a minimally invasive approach to treat pneumocephalus.

In this case, a 50-year-old woman with recurrent glioblastoma, previously treated with craniotomy, presented to urgent care with worsening headaches, nausea and vomiting. Serial CT head scans obtained over five days demonstrated progressive pneumocephalus with erosion of the right mastoid tegmen, which was suspected of being the source of the air entry. Preoperative CT neck imaging further revealed recurrent glioblastoma and pneumocephalus distribution along the right mastoid, posterior temporal surgical cavity and in the ventricles along the frontal horns. Although she was at risk for meningitis, her history of radiation and ongoing therapies placed her at high risk for wound-healing complications, making a traditional craniotomy unsuitable. Therefore, we discussed performing an endoscopic right eustachian tube occlusion using an abdominal fat graft to temporarily manage the pneumocephalus and its sequelae.

Methods and Materials

Method: A (2x2) Abdominal fat graft harvested first. Then, an endoscopic approach was undertaken next. Middle and inferior turbinates were lateralized. Once there was a clear view of the right eustachian use, this was explored with a curved suction and a 1x1 cm posterior inferior turbinate mucosa was harvested and kept in saline. The eustachian tube was then cauterized circumferentially using a needle tip monopolar cautery. The harvested abdominal fat graft was trimmed to proportion, wrapped in Surgicel and placed in the right eustachian tube. A J-curette, curved ball probe and curved suction were used to guide this further into the eustachian tube. 4-0 Vicryls were then used to do to approximate the cauterized edges of the eustachian tube. A total of 3 sutures were used. Then the previously harvested 1x1 cm posterior inferior turbinate mucosal graft was placed as a free mucosal graft to cover the right eustachian tube. Duraseal was then applied to secure the mucosal graft.

Results

Postoperative CT imaging at 10 days after the procedure demonstrated decreased pneumocephalus and ventriculomegaly. CT imaging at 3 weeks after the procedure demonstrated resolution of pneumocephalus. Endoscopic evaluation at two weeks confirmed successful occlusion of the right eustachian tube with stable graft placement. This suggests the procedure had successfully addressed the pneumocephalus and CSF leak.

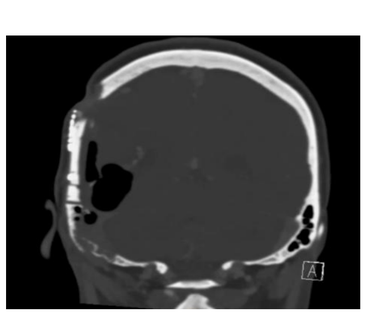

Figure 1. Preop Imaging

Figure 2. During the surgical procedure

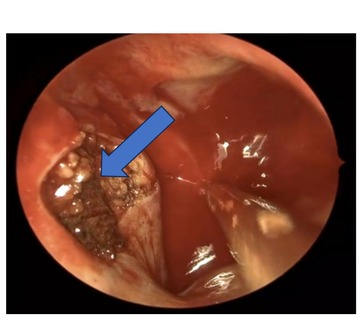

Figure 3. Fat graft wrapped in Surgicel

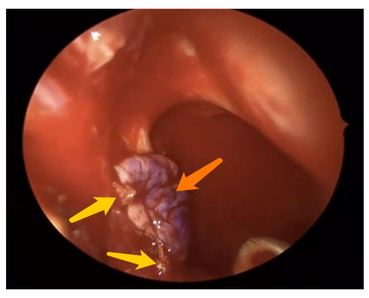

Figure 4. Mucosal graft and sutures

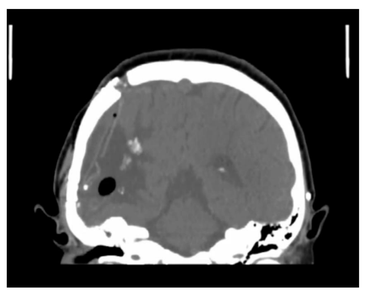

Figure 5. 10 days after the procedure pneumocephalus is decreasing

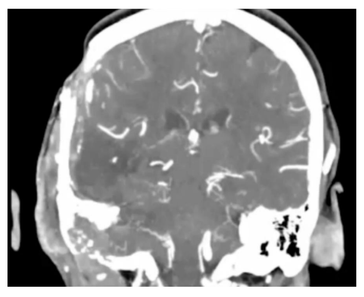

Figure 6. 3 weeks after the procedure no evidence of pneumocephalus

Discussion

Pneumocephalus, the accumulation of intracranial air, most found in the epidural, subarachnoid, intraventricular, intracerebral, or subdural spaces. In a study of 295 patients, 74% of pneumocephalus cases were attributed to trauma, while 9% resulted from infection.[2]

Clinical management of pneumocephalus often comprise of drilling burr holes, closure of the dural defect and needle aspiration, exenteration of the mucosa sinus packing with abdominal fat or temporal muscle, then covering it with frontal fascia.[3] Additionally, a supraorbital keyhole craniotomy is another viable surgical approach for pneumocephalus.

In this study, we described endoscopic eustachian tube occlusion using an abdominal fat graft offers a viable, as a lower-risk option for managing CSF leak related pneumocephalus in a patient with limited wound-healing capacity. This procedure may be utilized for patients who may be poor candidates for alternative interventions including a craniotomy due to elevated risks of wound-healing complications and meningitis.

Although long-term risks associated with the procedure may include middle-ear effusion, hearing loss, and potential cholesteatoma, it's important to consider this approach provides an effective immediate solution for life-threatening pneumocephalus when standard surgical strategies are contraindicated.

Surgical procedure link here. To access the corresponding surgical video, please scan the QR code

Conclusions

Ten days after the procedure, CT scans showed decreasing pneumocephaly and decreased ventriculomegaly. These findings suggest, endoscopic eustachian tube occlusion with abdominal fat graft provides a viable, relatively-simple procedure and lower-risk option for managing CSF leak related pneumocephalus in patients who are at high risk for wound healing complications and meningitis.

Contact

Krupal Patel
City Of Hope
1500 E Duarte Road Duarte, CA, 91010
kruppatel@coh.org
626-218-7100

References

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