The utility of cerebrospinal fluid diversion in endoscopic endonasal pituitary macroadenoma resection

James Mamaril-Davis MD;[1] Ryan Juncker BS;[2] Reid Johnson MD;[1] Mark Damante MD;[1] Kara Parikh MD;[1] Kyle VanKoevering MD; [3] Ricardo Carrau MD;[3] Albert Sufianov MD;[4] Daniel Prevedello MD;[1] Kyle Wu MD[1]

[1]Department of Neurosurgery, The Ohio State University Wexner Medical Center, Columbus, Ohio

[2]College of Medicine, The Ohio State University, Columbus, Ohio

[3]Department of Otolaryngology, The Ohio State University Wexner Medical Center, Columbus, Ohio

[4]Federal Center of Neurosurgery Tyumen, Tyumen, Russia

THE OHIO STATE UNIVERSITY

Background and Introduction

- Large, and giant pituitary adenomas, can be challenging to resect given the limited, sagittal angle of attack provided from an endoscopic endonasal approach (EEA), subarachnoid invasion, and collapse of the walls of the tumor cavity during resection
- Historically, maneuvers to increase intracranial pressure (ICP) during microscopic resection were performed to push suprasellar tumor into the sellar resection cavity and therefore into the direct view of the surgeon
- However, in the case of large and giant adenomas, the diaphragma sellae can descend prematurely, thereby hiding residual tumor within the folds of the descended diaphragm and beyond—especially in cases where tumor has reached the subarachnoid space
- With the advent of EEA skull base surgery, the surgical team can employ expanded trajectories, angled endoscopic tools, and angled instruments to directly enter the surgical cavity to access suprasellar tumor without relying on the tumor to "fall" into the surgical field
- The use of lumbar drainage and/or mannitol to decrease ICP for tumors with significant suprasellar extension can be employed to facilitate these modern endoscopic techniques, by avoiding collapse of the diaphragma or walls of the resection cavity into the surgical field and preventing inadequate visualization of tumor

Clinical Presentation

- 53-year-old woman presenting to emergency department with altered mental status, hallucinations, chronic bitemporal hemianopsia
- Has known pituitary macroadenoma, lost to follow-up
- Last scan 4 years ago showing 2.2 cm at the greatest diameter
- Ophthalmology exam = right temporal optic nerve pallor; left diffuse optic nerve pallor
- Last optical coherence tomography (OCT) 1 year ago
  - Right eye = superior thickness showed abnormal thinning; all other areas normal
  - Left eye = superior thickness showed abnormal thinning; all other areas normal
- Pituitary labs = unremarkable; nonfunctional adenoma

Rationale for the Procedure

Procedure:

- EEA to anterior fossa for resection of large sellar/suprasellar macroadenoma with invasion of the bilateral cavernous sinuses
- Lumbar drainage intraoperatively (20 cc) and postoperatively (5 cc/hr for 2 days)

Rationale:

- Relief of optic nerve pressure, prevention of visual decline and vision complications
- Prevention of diaphragma sellae collapse to allow complete visualization of sellar resection cavity

Operative Video

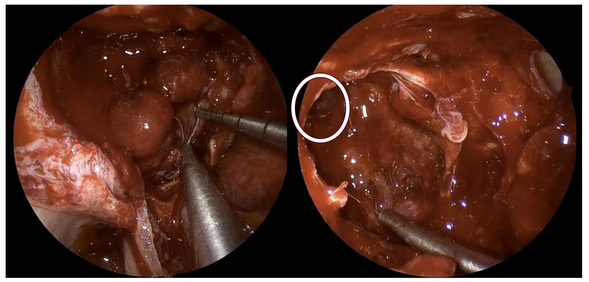

Figure 2: left shows a still endoscopic image showing an EEA for resection of a large pituitary macroadenoma (see **Figure 1** for radiographic reference); right shows the effect of lumbar drainage preventing collapse of the diaphragma sellae and allowing for adequate visualization of residual tumor behind the diaphragma (see white circle)

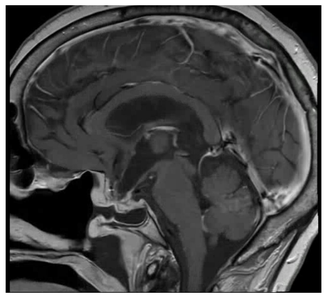

Figure 3: postoperative, post-contrast magnetic resonance image in the sagittal view showing complete resection of the large pituitary macroadenoma referenced in **Figure 1** without evidence of residual tumor

Conclusion

- Unlike other neurosurgical procedures where ICP is intentionally reduced to facilitate safe tumor resection, the use of ICP-reducing adjuncts has traditionally been avoided in patients with sellar and suprasellar pathology because of the need for tumors to descend into the direct surgical field of the operating microscope
- In the endoscopic era where instruments are used to travel further and wider into the surgical cavity, the use of ICP-reducing adjuncts should be revisited to allow practitioners to take full advantage of modern equipment and techniques, facilitating their ability to achieve a safe and complete resection.

References

1. Prevedello DM, Thomas A, Gardner P, Snyderman CH, Carrau RL, Kassam AB. Endoscopic endonasal resection of a synchronous pituitary adenoma and a tuberculum sellae meningioma: technical case report. Neurosurgery. 2007 Apr;60(4 Suppl 2):E401; discussion E401. doi: 10.1227/01.NEU.0000255359.94571.91. PMID: 17415151.
2. Prevedello DM, Ebner FH, de Lara D, Ditzel Filho L, Otto BA, Carrau RL. Extracapsular dissection technique with the cotton swab for pituitary adenomas through an endoscopic endonasal approach -- how I do it. Acta Neurochir (Wien). 2013 Sep;155(9):1629-32. doi: 10.1007/s00701-013-1766-1. Epub 2013 Jun 22. PMID: 23793961.
3. Mooney MA, Sarris CE, Zhou JJ, Barkhoudarian G, Chicoine MR, Fernandez-Miranda JC, Gardner PA, Hardesty DA, Jahnke H, Kelly DF, Liebelt BD, Mayberg MR, Prevedello DM, Sfondouris J, Sheehy JP, Chandler JP, Yuen KCJ, White WL, Little AS; TRANSSPHER Study Group. Proposal and Validation of a Simple Grading Scale (TRANSSPHER Grade) for Predicting Gross Total Resection of Nonfunctioning Pituitary Macroadenomas After Transsphenoidal Surgery. Oper Neurosurg. 2019 Nov 1;17(5):460-469. doi: 10.1093/ons/opy401. PMID: 30649445.
4. Rejane-Heim TC, Silveira-Bertazzo G, Carrau RL, Prevedello DM. Techniques and challenges of the expanded endoscopic endonasal sellar and parasellar approaches to invasive pituitary tumors. Acta Neurochir (Wien). 2021 Jun;163(6):1717-1723. doi: 10.1007/s00701-021-04805-3. Epub 2021 Apr 7. PMID: 33825972.

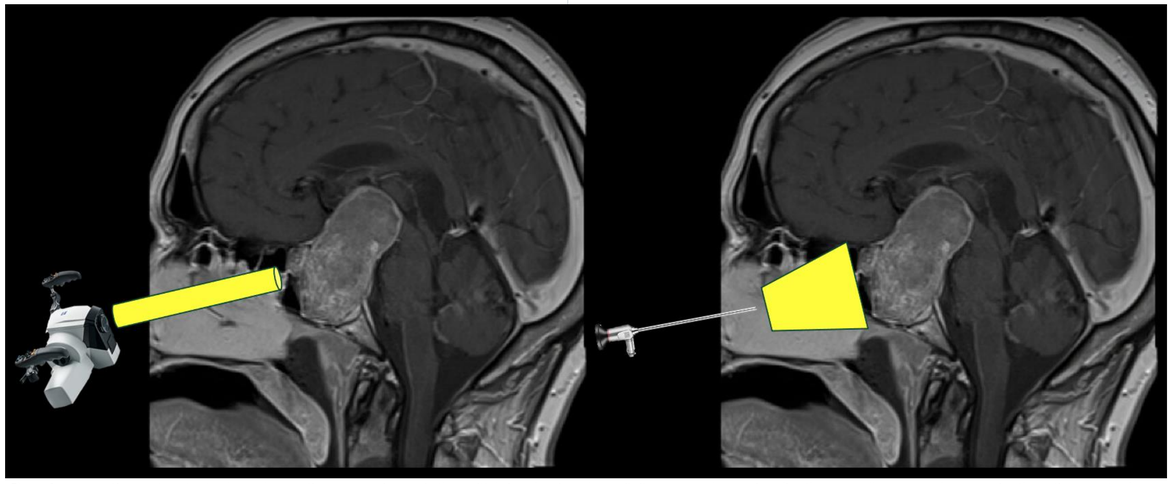

Figure 1: preoperative, post-contrast enhanced magnetic resonance images in the sagittal view showing a large pituitary macroadenoma invading the suprasellar space and compressing the optic apparatus (see clinical presentation for further details of the case); left image shows the limited vantage point of operating in the sellar area with a microscope view; right image shows the widened angle of attack to the sellar area with an endoscopic view

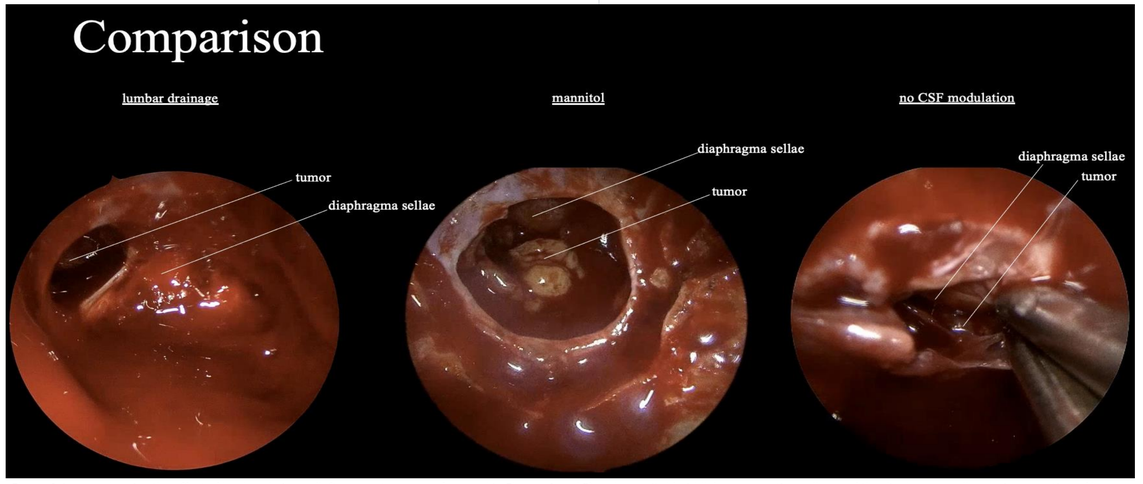

Figure 4: images showing the effect of lumbar drainage (left, present case as referenced in **Figures 1 and 2**) and mannitol (middle) on preventing collapse of the diaphragma sellae during resection of large pituitary macroadenomas when compared to utilizing no CSF diversion techniques (right)