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Adrienne M. Laury, *Emory University*
Nelson M Oyesiku, *Emory University*
Costas G. Hadjipanayis, *Emory University*
John DelGaudio, *Emory University*
Sarah Wise, *Emory University*

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Incidental sinonasal findings identified during preoperative evaluation for endoscopic transsphenoidal approaches

Adrienne M. Laury, M.D.,[1] Nelson M. Oyesiku, M.D., Ph.D.,[2] Costas G. Hadjipanayis, M.D., Ph.D.,[2] John M. DelGaudio, M.D.,[1] and Sarah K. Wise, M.D., M.S.C.R.[1]

ABSTRACT

Background: *The endoscopic transsphenoidal approach (eTSA) to lesions of the sellar region is typically performed jointly by neurosurgeons and otolaryngologists. Occasionally, the approach is significantly altered by sinonasal disease, anatomic variants, or previous surgery. However, there are no current guidelines that describe which physical or radiological findings should prompt a change in the plan of care. The purpose of this study was to determine the incidence of sinonasal pathology or anatomic variants noted endoscopically or by imaging that altered preoperative or intraoperative management.*

Methods: *A retrospective review was performed of 355 consecutive patients who underwent combined neurosurgery–otolaryngology endoscopic sella approach from August 1, 2007 to April 1, 2011. Our practice in these patients involves preoperative otolaryngology clinical evaluation and MRI review. Intraoperative image guidance is not routinely used in uncomplicated eTSA.*

Results: *The most common management alteration was the addition of image guidance based on anatomic variants on MRI, which occurred in 81 patients (35.0%). Eight patients (2.9%) were preoperatively treated with antibiotics and surgery was postponed secondary to acute or chronic purulent rhinosinusitis; two (0.7%) required functional endoscopic sinus surgery for medically refractory disease before eTSA. Five patients (1.8%) required anterior septoplasty intraoperatively for severe nasal septal deviation. Two patients (0.7%) had inverted papilloma and one patient had esthesioneuroblastoma identified preoperatively during rigid nasal endoscopy.*

Conclusion: *This is one of the larger reviews of patients undergoing eTSA for sellar lesions and the only study that describes how intraoperative management may be altered by preoperative sinonasal evaluation. We found a significant incidence of sinonasal pathology and anatomic variants that altered routine operative planning; therefore, a thorough sinonasal evaluation is warranted in these cases.*

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It has been nearly a 100 years since Cushing introduced his sublabial transsphenoidal approach to the sella, which revolutionized the concept of pituitary surgery.[1] In the past several decades, a number of advances have been made to improve the safety and efficacy of pituitary adenomectomy. In the 1960s, Guiot introduced the endoscope in transsphenoidal evaluation of the sella, and by the late 1980s, endoscopic transsphenoidal adenomectomy (eTSA) surgery was first detailed.[2] In the past 20 years, the use of endoscopic surgery for excision of sellar tumors and skull-based lesions has rapidly expanded in its usefulness and acceptance. Compared with a transseptal approach, eTSA offers a superior view of vital structures surrounding the pituitary gland, including the carotid arteries and optic nerves. The endoscopic approach also avoids the possible complications that may result with the transseptal approach, such as nasal septal perforation, septal deformity, saddle nose deformity, and nasal obstruction.[3] Furthermore, it circumvents the complications most commonly associated with the sublabial approach as well, including incisor numbness, denture problems, and loss of nasal tip projection.[4] Overall, eTSA along with increasing accessibility to high-definition video imaging provides improved accessibility and anatomic visualization and strengthens the cooperation of otolaryngologists and neurosurgeons.[5,6] Based on this surgical collaboration, each patient must be analyzed from a neurosurgical perspective with respect to the tumor and surrounding structures, as well as from a rhinologic perspective with respect to the approach and closure. Occasionally, sinonasal disease, anatomic variants, or prior intranasal surgery can alter the surgical plan. However, no guidelines are available to describe which physical or radiological findings should prompt a change in the plan of care. The purpose of this study was to determine the incidence of sinonasal pathology or anatomic variants noted endoscopically or by imaging that altered preoperative or intraoperative management.

From the [1]Emory University Sinus Nasal and Allergy Center, Atlanta, Georgia, and [2]Department of Neurological Surgery, Emory University, Atlanta, Georgia

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Address correspondence and reprint requests to Sarah K. Wise, M.D., Emory University Sinus Nasal and Allergy Center, 550 Peachtree St., MOT 9th Floor, Atlanta, GA 30308

E-mail address: skmille@emory.edu

MATERIALS AND METHODS

After approval from the Emory University Institutional Review Board (no. 48520), three hundred fifty-five consecutive patients were identified who underwent combined neurosurgery–otolaryngology endoscopic transsphenoidal approach to the sella from August 1, 2007 to April 1, 2011. These patients were identified based on the ICD-9 diagnosis codes used by the primary endoscopic sinus and skull base surgeons at our institution. Endoscopic transsphenoidal approaches were performed by the two senior rhinology authors (S.K.W. and J.M.D.) and the tumor resection was performed by the two neurosurgery authors (N.M.O. and C.G.H.). After identification by ICD-9 diagnosis code, each patient's medical record was reviewed focusing on patient age, diagnosis, preoperative neurosurgery and otolaryngology evaluations, operative report, and postoperative outpatient follow-up evaluations. On initial screening, if any of these items were not accessible in the medical record, the patient was dropped from analysis. A total of 83 patients were dropped from analysis in this study because of incomplete available data.

After initial review, 272 patients were included in the study and their preoperative sinonasal evaluation was reviewed. This included current nasal symptoms, prior nasal surgery or trauma, sinonasal radiographic findings on preoperative MRI, sinonasal physical examination including rigid nasal endoscopy, and the subsequent plan based on these findings. On preoperative MRI, several specific criteria were noted including (1) nasal septal deviation; (2) paranasal sinus disease; (3) sphenoid sinus pneumatization pattern; (4) position and orientation of the sphenoid intersinus septum and any incomplete sphenoid septae; (5) presence of sphenoethmoid (Onodi) cells; and (6)

encroachment of tumor into the sphenoid cavities, third ventricle, or cavernous sinuses.

Findings on preoperative MRI scan and rigid nasal endoscopy were used to determine if intraoperative image guidance would be used for the otolaryngology transnasal endoscopic sella approach. It should be noted that image guidance systems are not routinely used for the uncomplicated eTSA in our practice.

Each patient's operative report was also reviewed to determine if any intraoperative changes were made based on sinonasal findings at the time of surgery. Finally, each patient's two initial otolaryngology postoperative follow-up notes (typically occurring within the first 6 weeks after surgery) were reviewed to determine the occurrence of any significant events altering the routine postoperative plan of care.

RESULTS

One hundred forty female and 132 male patients underwent eTSA over the 45-month study period and were included in this study. Mean patient age was 48.9 years (range, 13–85 years). Sellar-based pathology included 129 (47.7%) nonfunctional pituitary adenomas, 123 (45.2%) functional pituitary adenomas, 7 (2.6%) cases of pituitary apoplexy, 5 (1.8%) Rathke's cleft cysts, 5 (1.8%) craniopharyngiomas, and 1 (0.4%) each of meningioma, supersellar epidermoid, and arachnoid cyst.

Patients were typically evaluated in the otolaryngology clinic ~2 weeks before their surgery date. Fifty-three patients had a history of some form of previous nasal or sinus surgery. This included 30 patients who had undergone prior TSA including sublabial, transseptal, or endoscopic approaches. Ten patients had prior functional endoscopic sinus surgery, 7 had previous septoplasty, and 3 had undergone open rhinoplasty. Five patients had prior significant trauma to their nose resulting in a nasal fracture, none of which had operative intervention at the time.

Patients were also screened for nasal symptoms and nasal history on initial evaluation in the otolaryngology office. Twenty patients reported a history of sinus infections ranging from one per year to three to four per year. Eleven patients reported nasal congestion, eight bilateral and three unilateral. Ten had a history of allergic rhinitis and one had rhinitis medicamentosa. Finally, one patient reported complete anosmia, one reported a history of a cerebrospinal fluid leak after a previous TSA, and one reported a septal perforation requiring repair.

On rigid nasal endoscopy, 15 patients had scarring in and around their sphenoid ostia, all of which had undergone prior TSA (Table 1). Ten patients had moderate to severe septal deviation, five had an unidentified mass in their nasal cavity or sinuses, and six had significant crusting or purulence noted on exam. Two patients had a septal perforation and two had middle turbinate concha bullosa. Additionally, one patient had a prominent Kesselbach's plexus and one had fungal saprophytic elements on crusts seen at the entrance to the sphenoid sinus.

Furthermore, each patient in this series underwent an MRI or CT scan (if they could not undergo MRI) as part of their neurosurgical workup before evaluation in the otolaryngology office. The MRI/CT and history and physical findings were reviewed to determine if image guidance was required during surgery. Overall, 81 (35.0%) patients had findings that changed routine eTSA by prompting the decision to use image guidance for the endoscopic transsphenoidal approach. The use of image guidance for the endoscopic transsphenoidal approach was the most common alteration in routine eTSA management based on sinonasal findings in this study. Figure 1 categorizes the findings on MRI that leads to the use of intraoperative image guidance for the eTSA. Of note, several patients had multiple criteria on imaging that compelled the use of image guidance. Figure 2 shows a preoperative MRI with common findings prompting the use of image guidance—tumor encroachment into the sphenoid sinus, as well as significant extrasellar and cavernous sinus involvement of tumor.

Table 1 **Most common endoscopic findings on preoperative evaluation**

Endoscopic Findings	No. of Patients
Scarring around sphenoid	15
Severe septal deviation	10
Mass in nasal cavity or sinus	5
Crusting or purulence	6
Septal perforation	2
Fungal elements	1

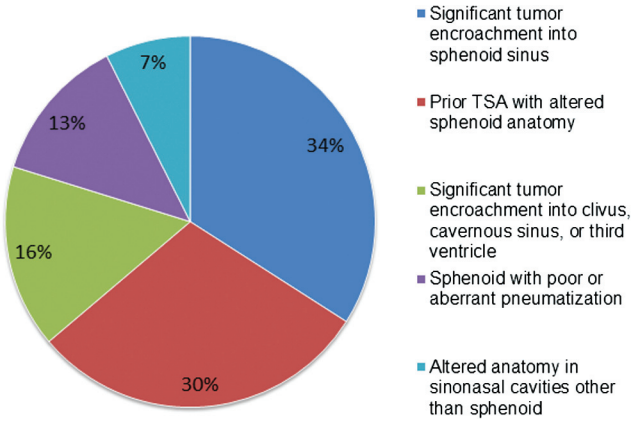

Figure 1. Pie chart depicting the various MRI findings that prompted the acquisition and use of intraoperative image guidance for the endoscopic transsphenoidal approach (eTSA) to the sella.

Beyond the addition of image guidance, other changes were made in preoperative management based on clinical and radiographic sinonasal findings. Eight patients (2.9%) were preoperatively treated with antibiotics for acute or chronic purulent rhinosinusitis identified on preoperative sinonasal endoscopy. In all cases, eTSA surgery was postponed until the infection had resolved on physical exam and/or radiographically. Two of these patients did require functional endoscopic sinus surgery for medically refractory purulent rhinosinusitis before eTSA. Five of the 10 preoperatively identified patients with moderate to severe septal deviation required formal anterior septoplasty intraoperatively. It should be noted that mild paranasal sinus mucosal thickening, most commonly seen in the alveolar recess of the maxillary sinus, did not alter the routine operative plan for eTSA.

Two patients were confirmed to have sinonasal inverted papilloma at the time of surgery, both of which were identified preoperatively. One patient had a papillomatous mass in the sphenoethmoid recess. The second patient had a mass in the sphenoid sinus on imaging as well as a remote history of four previous surgeries for inverted papilloma. Both patients with sphenoid inverted papilloma underwent endoscopic surgical resection of their disease—one was performed in conjunction with eTSA because of significant visual compromise from pituitary adenoma compression of the optic chiasm, and one was performed separately from the eTSA procedure. Additionally, one patient was diagnosed with an esthesioneuroblastoma during preoperative evaluation. Figure 3 depicts MRI and CT scan images of the patient with incidental finding of esthesioneuroblastoma on preoperative rhinology evaluation for eTSA. On endoscopic evaluation this patient was found to have a nonpolypoid, nonpulsatile, firm mass medial to the middle turbinate. At that time, the mass was biopsied. The patient subsequently underwent endoscopic resection of her esthesioneuroblastoma followed by postoperative radiation therapy. Her pituitary adenoma is currently being clinically reevaluated.

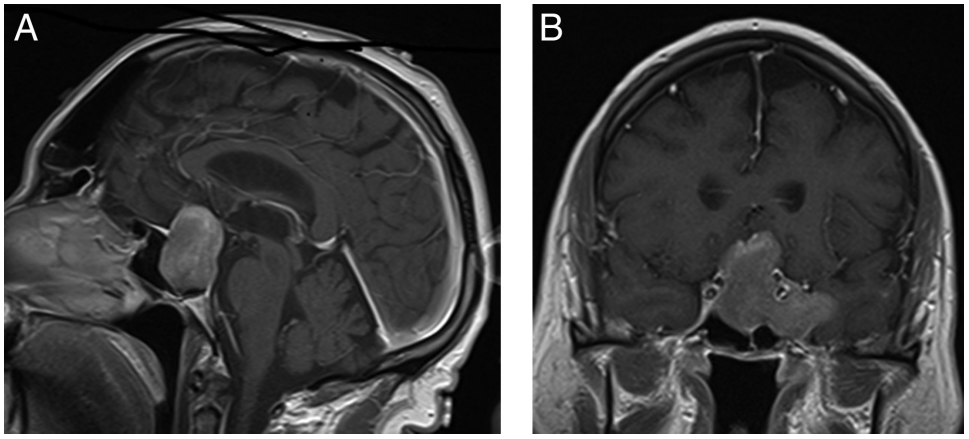

Figure 2. Gadolinium-enhanced (A) sagittal and (B) coronal T1 MRI scans of large pituitary macroadenoma in which image guidance was used for endoscopic transsphenoidal approach. These scans reveal significant tumor encroachment into the sphenoid cavities, as well as clear extrasellar tumor extent.

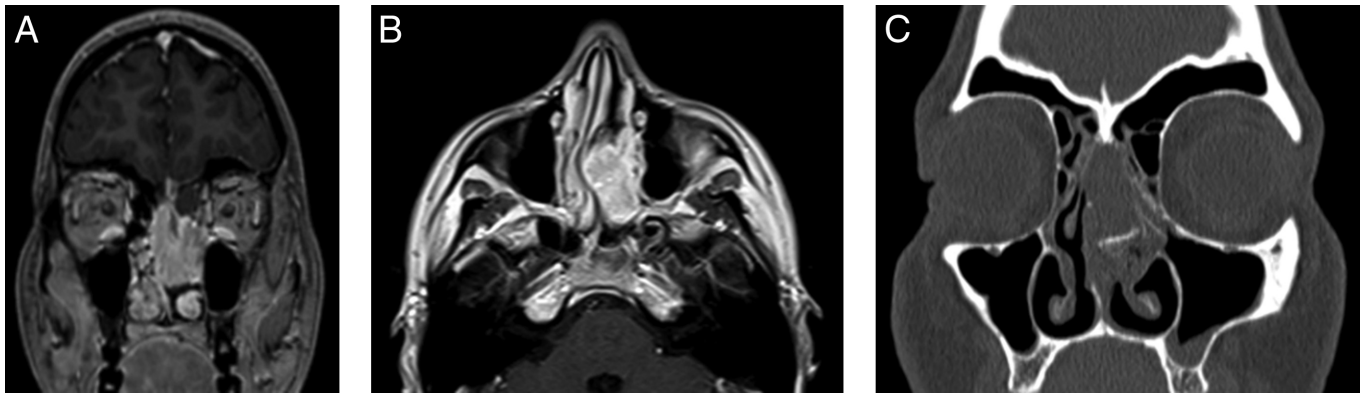

Figure 3. Gadolinium-enhanced T1 MRI (A) coronal and (B) axial views of a patient with incidental finding of left nasal mass on preoperative rhinology evaluation before endoscopic transsphenoidal approach (eTSA). (C) Coronal CT scan in bone window algorithm is also shown. Biopsy of this mass revealed esthesioneuroblastoma. This finding significantly altered the operative plan before proceeding with eTSA.

One patient was diagnosed with a sphenoid fungus ball during preoperative evaluation. Preoperative MRI revealed a defect in the posterior superior sphenoid sinus communicating with the sella, consistent with her history of a prior TSA. Rigid sinonasal endoscopy identified saprophytic elements overlying the healed sphenoid ostium. This required a separate operative intervention for removal of the sphenoid mycetoma. Finally, one patient was identified with an antrochoanal polyp preoperatively and had resection of this lesion in conjunction with eTSA.

Finally, all patients in this series were also seen for a minimum of two postoperative visits in the rhinology clinic, allowing for analysis of the most frequent rhinology-related (or potentially rhinology related) issues that altered routine postoperative management. Twenty patients were diagnosed with some degree of acute rhinosinusitis after eTSA, varying from increased mucoid drainage to frank purulence overlying the sphenoidotomy. Although antibiotics are not routinely prescribed beyond standard intraoperative therapy, a low threshold is adopted for initiating antibiotic therapy in the early postoperative period for suspicion or confirmation of acute rhinosinusitis. If possible, endoscopically guided cultures are obtained and antibiotics are culture directed. Seven patients had postoperative cerebrospinal fluid leaks, with one of those patients subsequently developing meningitis. Two patients had mild episodes of epistaxis, one that resolved spontaneously and one was treated with silver nitrate cautery in the office. One patient had severe epistaxis requiring embolization and nasal packing, one complained of postoperative hyposmia, and one had a new onset of sinonasal polypoid edema treated successfully with steroids (Figure 4).

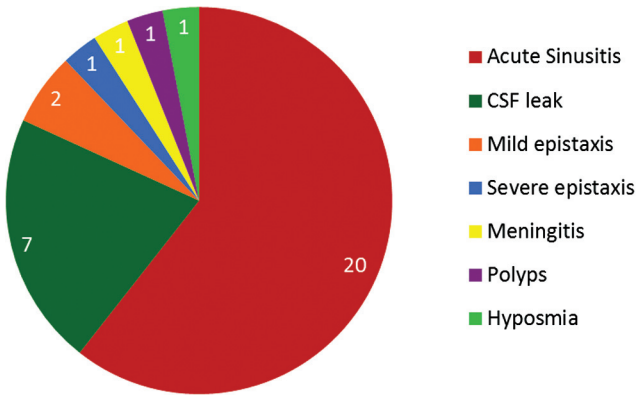

Figure 4. Chart depicting the most common rhinology-related postoperative issues.

DISCUSSION

Since the first description of endoscopic transsphenoidal approach for the resection of a sellar lesion in the late 1980s, several institutions have adopted it as their primary means of pituitary tumor resection.[7] Gondim states that the first principle in understanding and successfully achieving good results with the endoscopic endonasal approach is close collaboration between neurosurgeons and experienced sinus and skull base otolaryngologists.[2] Although the targets are more familiar to the neurosurgeon, the corridors are the territory of the

otolaryngologist, and therefore participation in the preoperative, intraoperative, and postoperative care of these patients is essential.

Despite the progress in acceptance of the endoscopic technique for pituitary adenomectomy, literature pertaining to preoperative otolaryngology assessment is sparse. In one case series, Lubbe advocates for preoperative assessment of eTSA patients based on intraoperative discovery of two significant sinonasal findings: purulent rhinosinusitis and hemorrhagic hereditary telangiectasia.[8] However, as of now, no source has defined what should be included in the otolaryngologist's preoperative assessment and which clinical findings may change the treatment plan.

Our current practice, and the practice used during the time frame of this study, is for patients to undergo otolaryngology evaluation in the clinic prior to eTSA. During this visit, a sinonasal history is obtained, specifically including nasal symptoms and any history of nasal trauma or surgery. This evaluation may alter the preoperative plan or may lead to incorporation of intraoperative image guidance for the transnasal endoscopic approach. For example, if patients presented with symptoms and endoscopic or radiographic evidence of purulent rhinosinusitis, preoperative treatment with antibiotics, nasal irrigations, and sometimes steroids was initiated and surgery was often postponed.

Physical exam was essential for evaluation of sinonasal mucosa, leading in some cases to deferment of the planned eTSA. Rigid nasal endoscopy also allowed for identification of septal deviation that might restrict surgery and allowed for preoperative discussion of the risks and benefits of septoplasty.

Preoperative MRI was also evaluated independently by the otolaryngologist with respect to sinonasal structures and planned transsphenoidal approach. To date, there is only one study that evaluates MRI and the imaging characteristics predictive of successful TSA surgery, but this focuses solely on tumor characteristics that predict the likelihood of successful neurosurgical resection.[9] There are no studies describing MRI findings that may influence the success of the otolaryngologist in safely and effectively approaching the sella. We describe a total of 11 criteria that prompted the use of intraoperative image guidance for the transnasal endoscopic approach to the sella. The most common of these criteria in our practice were (1) pituitary tumor that significantly encroached into the sphenoid cavities and/or obliterated the sphenoid air space; (2) previous TSA with fat, tumor mass, or secretions filling the sphenoid sinuses; (3) poor or aberrant sphenoid pneumatization; and (4) tumor significantly encroaching on the clivus, cavernous sinus, or third ventricle. In an uncomplicated patient without those radiographic findings, history of prior TSA, or findings of chronic or acute rhinosinusitis, image guidance was not routinely used. There was no evidence that this practice compromised patient care in any way. Additionally, it provided significant reductions in preoperative and intraoperative costs as well as decreased radiation exposure.

This study proposes that the involvement of the otolaryngologist in the preoperative assessment of the eTSA patient is essential. Although the specific method of preoperative assessment may be different from practice to practice, in our institution, we find a preoperative clinical visit with eTSA candidates extremely useful. During this visit, we not only evaluate for sinonasal anatomic variations, but, additionally, review the operative plan and surgical risks. We also counsel the patient on the importance of postoperative sinonasal care, discuss various means of applying intranasal saline products for moisturizing and irrigating, and review the postoperative sinonasal office debridement procedures that will occur. We feel that the timing of this preoperative visit is best done within 2 weeks before surgery to minimize the chances of sinonasal infection developing and being undetected if there is an extended delay before surgery. Others may advocate alternative approaches to the otolaryngologist's involvement with eTSA patients in the preoperative period, such as close review of the patient's preoperative imaging to study the anatomy and determine if sinonasal pathology is present, or seeing only those eTSA patients with active sinonasal complaints for a clinical visit in the office preoperatively. Ultimately, the preoperative eTSA protocol must be one that works well for the neurosurgery–otolaryngology team and the patients involved.

Overall, this investigation provides an overview of the importance of preoperative imaging review in eTSA surgical candidates as well as further describes our practice's routine sinonasal evaluation of all patients undergoing eTSA at our institution. A limitation of this study that should be noted is its retrospective design. This fact, along with the established preoperative evaluation pattern at out institution, did not allow us to include a control group of patients who did not undergo preoperative rhinologic evaluation to determine if there were any significant differences in intraoperative or postoperative outcomes. Nonetheless, the incidence of sinonasal findings in this large patient group and the potential of these findings to alter the preoperative plan presents a compelling hypothesis.

CONCLUSION

This study is one of the larger reviews of patients undergoing eTSA and the only one that describes how operative management may be altered by preoperative sinonasal evaluation. We have identified specific benefits resulting from preoperative rhinologic evaluation focusing on nasal symptoms and history, rigid nasal endoscopic findings, and preoperative MRI assessment. In this series, preoperative rhinologic assessment resulted in relatively frequent findings of significant sinonasal pathology or aberrant anatomy that potentially altered the preoperative, intraoperative, or postoperative course.

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