2017

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SURGICAL NEUROLOGY INTERNATIONAL

OPEN ACCESS

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Editor: **James I. Ausman,** MD, PhD University of California, Los Angeles, CA, USA

SNI: Neurosurgery Concepts

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Neurosurgery concepts: Key perspectives on endoscopic versus microscopic resection for pituitary adenomas, surgical decision-making in tuberculum sellae meningiomas, optic nerve mobilization during resection of craniopharyngiomas, and evaluation of headache and quality of life after endoscopic transphenoidal surgery for pituitary adenomas

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Received: 09 January 17 Accepted: 30 January 17 Published: 05 April 17

Access this article online	
Quick Response Code:	Website: www.surgicalneurologyint.com
	DOI: 10.4103/sni.sni_17_17

How to cite this article: Germanwala AV, Hofler R, Lagman C, Chung LK, Khalessi AA, Zada G, *et al.* Neurosurgery concepts: Key perspectives on endoscopic versus microscopic resection for pituitary adenomas, surgical decision-making in tuberculum sellae meningiomas, optic nerve mobilization during resection of craniopharyngiomas, and evaluation of headache and quality of life after endoscopic transphenoidal surgery for pituitary adenomas. Surg Neurol Int 2017;8:52.
http://surgicalneurologyint.com/Neurosurgery-concepts:-Key-perspectives-on-endoscopic-versus-microscopic-resection-for-pituitary-adenomas,-surgical-decision-making-in-tuberculum-sellae-meningiomas,-optic-nerve-mobilization-during-resection-of-craniopharyngiomas,-and-evaluation-of-headache-and-quality-of-life-after-endoscopic-transphenoidal-surgery-for-pituitary-adenomas/

COMPARISON OF OUTCOMES BETWEEN A LESS EXPERIENCED SURGEON USING A FULLY ENDOSCOPIC TECHNIQUE AND A VERY EXPERIENCED SURGEON USING A MICROSCOPIC TRANSSPHENOIDAL TECHNIQUE FOR PITUITARY ADENOMA[5]

Study Question: Are there significant differences in the extent of resection and endocrine outcomes between pituitary adenoma patients undergoing an endoscopic resection by a less experienced surgeon compared to a microscopic resection by a very experienced surgeon?

To compare the resection rate and the need for postoperative hormonal replacement, the authors review a prospectively accrued single institution database of consecutive patients undergoing pituitary adenoma resections via an endoscopic approach by a less experienced surgeon and a microscopic approach by a more experienced surgeon. At the beginning of this study, the less experienced surgeon, utilizing an endoscopic binarial approach, is described to have performed 100 such cases; the more experienced surgeon, using a microscopic uninarial approach, has performed 1800 such cases. Extent of resection, using gross-total resection rate, percentage of tumor resected, and volume of residual tumor was calculated through formal volumetric analysis on magnetic resonance (MR) imaging. In addition, the incidence of hypopituitarism based on the need for hormonal supplementation at 6-months from surgery, tumor size, tumor location, history of prior surgery, length of stay, major perioperative complication rate, and unplanned readmissions were analyzed.

A total of 135 patients were included in this study from October 2011 to June 2014. Fifty-five patients underwent an endoscopic resection by the less experienced surgeon while 80 patients underwent a microscopic resection by the more experienced surgeon. Patient demographics were similar for both treatment groups. There was no significant difference in the extent of resection between the endoscopic and microscopic groups in all the three subcategories – gross-total resection rate (78.2% vs. 81.3%), percentage of tumor resected (99.2% vs. 98.7%), and volume of residual tumor (0.12 cc vs. 0.2 cc). There was a statistically significant lower rate of posterior gland dysfunction in the endoscopic group. There was no significant difference in anterior gland dysfunction, tumor size, preoperative degree of suprasellar extension or cavernous sinus invasion, history of prior surgery, and length of stay between the groups. Although there were no significant differences in individual perioperative complications, the overall rates of major complications and unplanned readmissions were significantly lower in the endoscopic group.

Perspective: In this well-organized study, extent of adenoma resection by a less experienced surgeon using an endoscopic binarial approach was demonstrated to be similar to that of a more experienced surgeon using a microscopic uninarial approach. A significantly lower rate of posterior pituitary gland dysfunction, overall rate of complications, and frequency of unplanned readmissions were seen in the endoscopic group. Recognized limitations include a lack of a randomized controlled study, relatively small number of patients in each treatment category, and inability to separate surgical approach and surgeon experience as covariates.

The use of the endoscope has become increasingly popular due to beliefs of improved visualization; however, there is little historical objective data comparing clinical outcomes between this newer tool and the more traditional microscope in skull base surgery. This study provides formal objective data with close clinical follow-up from a single institution. While provocative, the fact that a less experienced surgeon has similar to better resection and complication rates likely underscores the better visualization and surgical freedom afforded by a binarial endoscopic transsphenoidal approach. Larger, randomized, multi-institutional studies will be needed to provide stronger conclusions, and this study should serve as an impetus for additional investigation. Although endoscopic skull base surgery has a steep learning curve, with more neurosurgeons now receiving endoscopic experience in residency training, clinical outcomes should continue to improve globally and positively impact the field.

Summary Written by: Anand V. Germanwala, MD and Ryan Hofler, MD

SURGICAL DECISION-MAKING STRATEGIES IN TUBERCULUM SELLAE MENINGIOMA RESECTION[1]

Study Question: What criteria are most important when deciding between the transcranial route (TCR) and the endoscopic transphenoidal approach (ETSA) for the removal of tuberculum sellae meningiomas (TSMs)?

The authors of this study retrospectively reviewed TSMs resected by TCR and/or ETSA at their institution. A total of 22 (81.5%) of patients were managed with TCR and 5 patients (18.5%) with ETSA. Details of each procedure are provided, and 4 illustrative cases are included. Primary outcomes were extent of resection (EOR: gross-total [GTR] versus near-total resection [NTR]), complication, and recurrence.

Recurrence was observed (3-years postoperative) in one patient undergoing NTR via TCR. No recurrence was observed in the patients undergoing ETSA. With respect

to the latter, two had STR and have stable meningiomas at 3 and 7 years, respectively.

Perspective: Advances in microsurgical and neuroendoscopic techniques have diversified neurosurgical approaches to common brain tumors. However, modifications to traditional surgeries must be rationalized through comparative analyses such as this study. Evaluation of novel methods will be limited by sample size.

In the above study, the imbalance between patients managed with TCR ($n = 22$) versus ECM ($n = 5$) was not subtle. Moreover, the premise of this paper is to identify optimal patients for each respective approach. This has the potential to nullify future comparative analyses, as patients undergoing each procedure would have subtle, yet significant variances in tumor characteristics. The authors provided a comprehensive and descriptive analysis, which allows us to appreciate such variances.

Advantages of TCR include enhanced visualization of tumor (and adjacent critical neural structures), and feasible resection of the anterior clinoid and/or tumor located superior or lateral to the optic nerve. Disadvantages include retraction of the frontal lobe, nonideal approach for devascularization of meningioma, and limited resection. Recurrence was observed more often in the TCR group (versus ETSA). However, TCR patients included in this study greatly outnumbered the ETSA patients (by more than a factor of 4). The significance of this difference was not evaluated nor would we expect significance.

Advantages of ETSA include more favorable cosmesis, direct trajectory to the tumor, enhanced visualization with respect to the carotids, no brain retraction required, early decompression, decreased risk of olfactory nerve injury, safer dissection with preservation of the arachnoid plane, resection of hyperostotic bone (i.e., greater Simpson grade), and shorter recovery. Most importantly, the authors posit that this technique may potentially be more suitable to older patients with more comorbidities.

We applaud the authors for the efforts, but remain cognizant of the limitations of the study. We agree with the authors that the ETSA could be a viable option for a select group of patients, but would approach these tumors via the TCR. Enhanced visualization (and adjacent structures) should allow for safe, maximal resection, and higher Simpson grade. At our institution, we regularly perform preoperative embolization of meningiomas, and therefore, the limits of devascularization are not particularly concerning. Nevertheless, surgical decision-making should continue to be patient-specific and this study highlights the subtle variations in clinical presentation and tumor characteristics that must be considered in deciding between TCR and ETSA for TSMs.

Summary Written by: Carlito Lagman, MD and Isaac Yang, MD

OPTIC NERVE MOBILIZATIONTO ENHANCE THE EXPOSURE OF THE PITUITARY STALK DURING CRANIOPHARYNGIOMA RESECTION: EARLY EXPERIENCE[3]

Study Question: What is a surgical technique for craniopharyngioma resection when the pituitary stalk cannot be adequately visualized following tumor exposure?

The authors of the study describe an operative technique for mobilizing the optic nerve during craniopharyngioma resection. In some patients, a narrow subchiasmatic or opticocarotid window prevents direct visualization of the pituitary stalk during a frontolateral approach. Without proper exposure of the pituitary stalk, tumor dissection can lead to increased traction on the optic nerve and decreased postoperative outcomes from incomplete tumor resection or pituitary injury. As a proof-of-concept, the authors describe a surgical technique for optic nerve mobilization that involves unroofing the optic canal superiorly, incising the falciform ligament, and drilling the lateral aspect of the tuberculum sellae. The optic nerve can then be mobilized dorsally and medially to widen the opticocarotid triangle and allow for direct visualization of the superior and inferior portions of the pituitary stalk. By employing this technique in three patients, the authors were able to achieve complete tumor resection entirely under direct visualization when it would have otherwise been impossible. The pituitary stalk was reported to be anatomically preserved in all patients. Postoperatively, one patient experienced transient hyponatremia managed with fluid restriction. The two other patients experienced no new deficits following surgery. One patient had preoperative pituitary insufficiency which remained unchanged for 3 months postoperatively, after which she spontaneously recovered. None of the three patients experienced any degree of visual deterioration following tumor resection. Within this small patient series, the authors successfully demonstrated a safe technique for optic nerve mobilization that allows for craniopharyngioma resection from the pituitary stalk under direct visualization.

Perspective: Management of craniopharyngiomas is generally accomplished via gross-total resection, which results in increased local control rate and survival compared to subtotal resection alone.[2] However, achieving gross-total-resection increases the risk of hypothalamic dysfunction due to the potential for iatrogenic disruption of the pituitary stalk and its vasculature. Thus, identifying and preserving the pituitary stalk and its vascular structures is critical for achieving optimal postoperative outcomes, particularly for large

supradiaphragmatic craniopharyngiomas where dissection into the inferior portion of the pituitary stalk is required. The authors propose an operative technique of mobilizing the optic nerve medially by opening the optic canal and drilling the lateral part of the tuberculum sellae, allowing for direct visualization of the entire pituitary stalk without causing excessive traction on the optic nerve. The authors report that no visual or hypothalamic complications were caused as a result of this additional procedure.

When resecting craniopharyngiomas, the goal should always be safe, maximal tumor resection. Manipulation of neurovascular structures should be avoided when possible, with handling limited to the tumor instead. Thus, tumor exposure is critically important and may be accomplished by either altering the operative window or using a different surgical approach. This study presented a method of mobilizing the optic nerve to achieve a larger operative window. Optic canal decompression is well described for supraclinoid aneurysms; however, the literature describing this technique in the context of tumor surgery is limited. The authors should be praised for their efforts as manipulation of the optic nerve is technically challenging due to the possibility of injury to the ophthalmic artery. We believe that neurosurgeons unfamiliar with sellar and parasellar anatomy best avoid manipulating the optic nerve if possible. Furthermore, the drilling of the tuberculum sellae introduces the risk for cerebrospinal fluid leak if the integrity of the sphenoid sinus is compromised. Thus, an alternative surgical approach may be needed to maximize tumor exposure in certain patients. For example, a transphenoidal approach may be used if more of the tumor is intrasellar, which would limit the need for optic nerve manipulation. Although the authors report no complications as a result of optic nerve mobilization, the limited patient sample size raises concern for possible optic nerve or ophthalmic artery injury with this procedure. Continued investigation into new surgical techniques that improve patient outcomes should be commended, but we believe further evaluation should be completed before this procedure is routinely performed.

Summary Written by: Lawrance K. Chung, BS and Alexander A. Khalessi, MD, MS

QUANTITATIVE EVALUATION OF HEADACHE SEVERITY BEFORE AND AFTER ENDOSCOPIC TRANSPHENOIDAL SURGERY FOR PITUITARY ADENOMA[4]

Study Question: What is the impact of endoscopic transphenoidal surgery on headache severity and quality of life?

In this study, a prospective evaluation of overall quality of life and headache (as determined by the SF-26 and HIT-6 questionnaires, respectively) was performed in 79 patients undergoing surgical treatment for pituitary adenomas.

At 6 weeks and 6 months following surgery, a substantial proportion of patients experienced improvement from intense or substantial headache to mild or moderate headache. By 6 months, 70% of patients with moderate-to-severe headaches preoperatively reported improved headache in at least 1 category on HIT-6. Younger patients and those with lower preoperative quality of life showed the greatest improvement in headaches following surgery. Patients with postoperative CSF leaks (12.7%) were less likely to have headache relief at 6 months.

Perspective: This prospective study substantiates multiple retrospective clinical studies showing headache relief in patients with pituitary tumors and preoperative headaches. Similar retrospective findings have long been described in patients with Rathke Cleft Cysts. Limitations of this study include the small proportion of functional microadenoma patients and relatively high rate of postoperative CSF leaks for direct sellar approaches.

Although not an absolute indication for surgery, many patients with headaches and pituitary tumors will find some degree of relief by 6 months following endoscopic tumor resection. Data from this study can be used to advise patients regarding the risks and benefits of endoscopic tumor resection versus conservative therapy.

Summary Written by: Gabriel A. Zada, MD

Financial support and sponsorship
Nil.

Conflicts of interest
There are no conflicts of interest.

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