Is the chiasm-pituitary corridor size important for achieving gross-total resection during endonasal endoscopic resection of craniopharyngiomas?

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OBJECTIVE Craniopharyngiomas arise from the pituitary stalk, and in adults they are generally located posterior to the chiasm extending up into the third ventricle. The extended endonasal approach (EEA) can provide an ideal corridor between the bottom of the optic chiasm and the top of the pituitary gland (chiasm-pituitary corridor [CPC]) for their removal. A narrow CPC in patients with a prefixed chiasm and a large tumor extending up and behind the chiasm has been considered a contraindication to EEA, with a high risk of visual deterioration and subtotal resection.

METHODS A database of all patients treated in the authors’ center (Weill Cornell Medical College, NewYork-Presbyterian Hospital) between July 2004 and August 2016 was reviewed. Patients with craniopharyngiomas who underwent EEA with the goal of gross-total resection (GTR) were included in the study. Patients with postfixed chiasm or limited available preoperative imaging were excluded. Using preoperative contrast-enhanced T1-weighted sagittal midline MR images, the authors calculated the CPC as well as the distance from the chiasm to the top of the tumor (CTOT). From these numbers, they calculated a ratio of the CPC to the CTOT as a measure of difficulty in removing the tumors through the EEA and called this ratio the corridor index (CI). The relationship between the CI and the ability to achieve GTR and visual outcome were measured.

RESULTS Thirty-four patients were included in the study. The mean CPC was 10.1 mm (range 5.2–19.1 mm). The mean CTOT was 12.8 mm (range 0–28.3 mm). The median CI was 0.8; the CI ranged from 0.4 to infinity (for tumors with a CTOT of 0). Thirty-two patients had GTR (94.1%) and 2 had subtotal resection. The CPC value had no relationship with our ability to achieve GTR and no effect on visual or endocrine outcome.

CONCLUSIONS EEA for craniopharyngioma is generally considered the first-line surgical approach. Although a narrow corridor between the top of the pituitary gland and the bottom of the chiasm may seem to be a relative contraindication to surgery for larger tumors, the authors’ data do not bear this out. EEA appears to be a successful technique for the majority of midline craniopharyngiomas.

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KEY WORDS craniopharyngioma; optic chiasm; pituitary gland; suprasellar approach; endoscopic endonasal surgery; pituitary surgery

Craniopharyngiomas represent less than 1% of all primary central nervous system tumors and arise within the pituitary stalk from the remnants of Rathke’s pouch.8 They are histologically benign tumors, but their tendency to recur and their location within very close proximity to internal carotid artery (ICA), anterior cerebral arteries (ACAs), pituitary gland, hypothalamus, third ventricle, and the optic apparatus, make them challenging lesions to treat.

Craniopharyngiomas in adults are most commonly located posterior to the chiasm and extend behind the chiasm into the third ventricle. They may present with hydrocephalus, visual loss, pituitary dysfunction, and diabetes insipidus (DI). Surgical management aims to achieve either
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Iata onlay with Medpore wedged into the defect to achieve a gasket-seal closure, and covered with a nasoseptal flap and then Duraseal (Integra).10,22,26

Results

During the study period, 62 patients with craniopharyngiomas were operated upon using an EEA. The goal was GTR in 41 cases. Reasons for not pursuing a GTR were previous surgery and/or radiation (in 8 cases), pediatric age with likely hypothalamic invasion (in 2), goal of cyst drainage and biopsy in an attempt to preserve pituitary function (in 4), and goal of decompression of the optic apparatus (in 7). Patients with postfixed chiasm (1 patient) or limited available preoperative imaging (6 patients) were excluded. Thirty-four patients were included in the study.

The mean CPC was 10.1 mm (range 5.2–19.1 mm). The mean CTOT was 12.8 mm (range 0–28.3 mm). The median CI was 0.8, and the CI ranged from 0.4 to infinity (for tumors with a CTOT of 0). The median was chosen since the upper limit was infinity. Thirty-two patients had GTR and 2 had STR (CIs 1.1 and 0.6). GTR was achieved in 95% of patients. In the 2 patients with STR, the locations of residual tumor were ICA branches and the pituitary stalk (n = 1) and “diffuse” due to prior operations and radiotherapy (n = 1). The CPC and CI values had no statistically significant relationship with our ability to achieve GTR. New anterior pituitary dysfunction occurred in 44% of patients and new posterior pituitary dysfunction (DI) occurred in 29%, with a total new endocrinopathy rate of 44%. The presence of new endocrinopathy did not correlate with CI ratio. The visual outcome was stable or improved in 94% of patients and worse in 6%, which also did not correlate with the CI number.

Discussion

The major finding of this report is that the size of the surgical corridor between the bottom of the optic chiasm and the top of the pituitary gland does not impact the likelihood of GTR in patients undergoing craniopharyngioma resection via EEA. Moreover, the amount of tumor extending up into the third ventricle above and behind the chiasm, even relative to the size of surgical corridor, is not a factor in GTR. Likewise, the size of this corridor has no effect on either visual or endocrine outcome. Our results of 6% visual worsening, 29% new DI, and 44% new hypopituitarism are better than the published transcra nial results of 11.3% visual worsening, 54.8% new DI, and 48.1% new hypopituitarism, and are comparable to transcranial and transsphenoidal results of 5.6% visual worsening and 49.8% new hypopituitarism.24 Although this could be considered a “negative” study, the results are important as they impact surgical decision making and case selection and serve to debunk a false contraindication to EEA for craniopharyngioma resection.

Craniopharyngioma treatment remains a controversial area of neurosurgical therapy. One area of continued discussion is the debate over radical versus conservative surgery. Although there is no Level I or Level II evidence favoring one or the other approach, retrospective literature review supports the conclusion that GTR provides an improved rate of progression-free survival.12,13,27,36 with the exception of cases involving tumors that invade the hypothalamus.9,27 A second area of debate is the preferred sur-
gical approach, transcranial versus EEA. Until recently, transphenoidal approaches have been thought to be only suitable for treatment of sellar craniopharyngiomas, and tumors with suprasellar or intraventricular extension were thought to require transcranial approaches. Traditional transcranial approaches generally entail brain retraction and manipulation of cerebrovascular structures that lie between the surgeon and the pathology. As the technology and experience with EEA improved, the limitations of EEA diminished and the applicability to midline craniopharyngiomas with suprasellar and intraventricular extension increased. Recent literature suggests that the results of EEA for craniopharyngioma resection are superior to transcranial approaches with respect to extent of resection and endocrine and visual outcomes. The Achilles’ heel of EEA, the CSF leak rate, has also dramatically diminished with use of the vascularized nasoseptal flap and multilayer reconstruction.

In this paper, we investigate another potential anatomical limitation to EEA, particularly for those craniopharyngiomas with extension behind the chiasm into the third ventricle. A narrow CPC with a large tumor extending up and behind the chiasm has been considered a contraindication to EEA, with a high risk of visual deterioration and consequent STR. Our review reveals that neither a narrow corridor nor a high-rising tumor behind the chiasm should be considered a contraindication for craniopharyngiomas. Although pituitary transposition has been described to increase the working corridor into the suprasellar cistern, this maneuver really only increases the view to the interpeduncular cistern, and it increases the rate of pituitary dysfunction and the rate of CSF leak. For this reason, we do not recommend this maneuver and prefer using an above-and-below approach or extradural posterior or clinoidectomy. We find that gentle upward pressure on the chiasm and downward pressure on the top of the pituitary gland can safely enlarge this corridor for removal of even craniopharyngiomas that extend up to the roof of the third ventricle. Our findings hold true regardless of whether the tumor is cystic or solid. Although one might think cystic tumors would be easier to remove than solid tumors, the opposite is the case. We find that the cystic tumors are slightly more difficult to remove completely than the solid tumors because the thin cyst wall sticks to the third ventricle roof more so than the solid tumor, which is more easily removed in one piece. The use of angled endoscopes and instruments is critically important to safely visualizing the superior extent of the tumor under the chiasm. Preservation of superior hypothalamic perforators to the chiasm is also important for preserving vision.

Conclusions

The location of the chiasm (prefixed or postfixed), the size of the corridor between the top of the pituitary gland and the bottom of the chiasm, or the superior extent of the tumor should not be considered an absolute contraindication to EEA for craniopharyngioma. Careful case selection and experience will always dictate the preferred approach in the hands of any given surgeon.

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**Disclosures**

Dr. Schwartz reports direct stock ownership in VisionSense.

**Author Contributions**

Conception and design: Schwartz, Omay, Anand. Acquisition of data: Omay, Almeida, Chen. Analysis and interpretation of data: Schwartz, Omay, Shetty, Liang, Ni. Drafting the article: Omay, Almeida, Chen. Critically revising the article: Schwartz. Reviewed submitted version of manuscript: Schwartz, Omay. Approved the final version of the manuscript on behalf of all authors: Schwartz. Statistical analysis: Omay. Administrative/technical/material support: Schwartz. Study supervision: Schwartz, Anand.

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