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Letter to the Editor

Assessment of postoperative complications in craniopharyngioma patients: An approach based on the heterogeneous tumor-hypothalamus relationship

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A careful scrutiny of the long-term consequences of craniopharyngioma (CP) surgery is more necessary now than ever. Despite CPs being acknowledged as one of the most challenging intracranial tumors, most surgical series published in the past two decades share similar optimal results, with very low morbidity rates and almost negligible mortality. This is even more surprising when considering the generalized use of the endoscopic endonasal approach, a particularly complex surgical technique requiring a high degree of training and expertise, only achievable in a limited number of pituitary centers with a very large caseload. Aside from the paucity of CP patients, what hinders the efforts to monitor the real impact of surgery on this rare, highly complex pathology is the extreme clinicopathological heterogeneity of these tumors. Which factors do substantially influence the surgical risk for a given CP patient? Is patient outcome mainly determined by the surgeon's hands, or is it intrinsically linked to specific tumor features? Gathering objective data to answer these questions should be given a high priority.

In this context, attention should be drawn here to a recent study by Rock *et al.*, from the Department of Neurosurgery at Virginia Commonwealth University in Richmond, VA, USA, that analyzed the incidence of surgical complications in 143 CPs operated on in different centers in the United States.[7] This article focused on the set of information related to the occurrence of intra- and/or post-operative complications in CP surgery, a matter of special concern at a time when unsatisfactory surgical results are not generally the subject of open discussion. As an initial approach to this subject, Rock *et al.* analyzed common unsatisfactory neurosurgical results, such as unexpectedly prolonged ventilation, reoperation, and/or readmission within the 1st month following surgery.[7] Nevertheless, and despite their commendable effort, this type of analysis provides little insight into the nature of surgical complications in CP patients, as the postoperative variables selected are insufficient to truly grasp the intricacies of these lesions. Contrary to other neurosurgical conditions, CPs are extremely heterogeneous regarding their topography, gross morphology, and, most importantly, their degree of hypothalamic involvement. Any study aimed at defining CP postoperative outcomes should correlate these fundamental variables with the long-term quality of life for every case, in addition to, the specific surgical details, to recognize risky tumor patterns and potentially hazardous surgical maneuvers.[2,4]

Actually, one major problem with most analyses of modern CP surgery is a lack of reliable information regarding long-term postoperative hypothalamic disturbances such as obesity, hypersomnolence, neurocognitive deficits, and/or mental alterations.[4] An additional drawback

of many studies is that the endocrinologists who usually perform the follow-ups of CP patients are generally unaware of both the tumors' gross pathological features and the particulars of the surgical procedure, including unexpected intraoperative events. This prevents the formulation of well-founded hypotheses regarding the real causes of clinical sequelae after CP surgery. Worse still, there is no possibility of shedding light on the specific clinicopathological and neuroradiological features that may be predictive of high surgical risk.

Over the last decade, we have conducted research into the determinants of poor postoperative outcomes after CP surgery. Our methodology is based on thoroughly correlating the clinicopathological variables with surgical data in well-reported individual CP cases from a database, including more than 5000 patients. We found that the CP origin site along the pituitary-hypothalamic axis has a major influence on the likelihood of surgical complications, as it determines the type of tumor-hypothalamus relationship as well as the type of CP adhesion to the hypothalamus [Figure 1]. The hypothalamus has a very high chance of being seriously damaged during surgery in those CPs originated within the infundibulo-tuberal area and in suprasellar tumors that invaded the third ventricle after breaking through the third ventricle floor.[1] In our cohort of CPs treated in the magnetic resonance imaging (MRI) era, we found a poor outcome/death rate as high as 21.5% in these topographies primarily involving the hypothalamus [Figure 1a-c], in contrast to only 5.6% when the hypothalamus was not invaded by the tumor [Figure 1d].[3] Such a difference was related to the presence of strong and extensive CP-hypothalamic adherences which precluded a safe radical tumor resection [Figure 1e and f].[6] CP shape and the type of pituitary stalk distortion, two variables easily identifiable on preoperative MRI scans, were additional features indicating the potential surgical danger to the hypothalamus [Figure 1g-l].[5] For example, tumors with an elliptical shape, or those that "amputate" the upper portion of the pituitary stalk, associated a higher surgical risk of hypothalamic injury [Figure 1h and k]. Accordingly, further studies attempting to identify the source of complications in CP surgery should contemplate a more detailed analysis of the heterogeneous tumor-hypothalamus relationships to effectively predict surgical risk on an individual basis.

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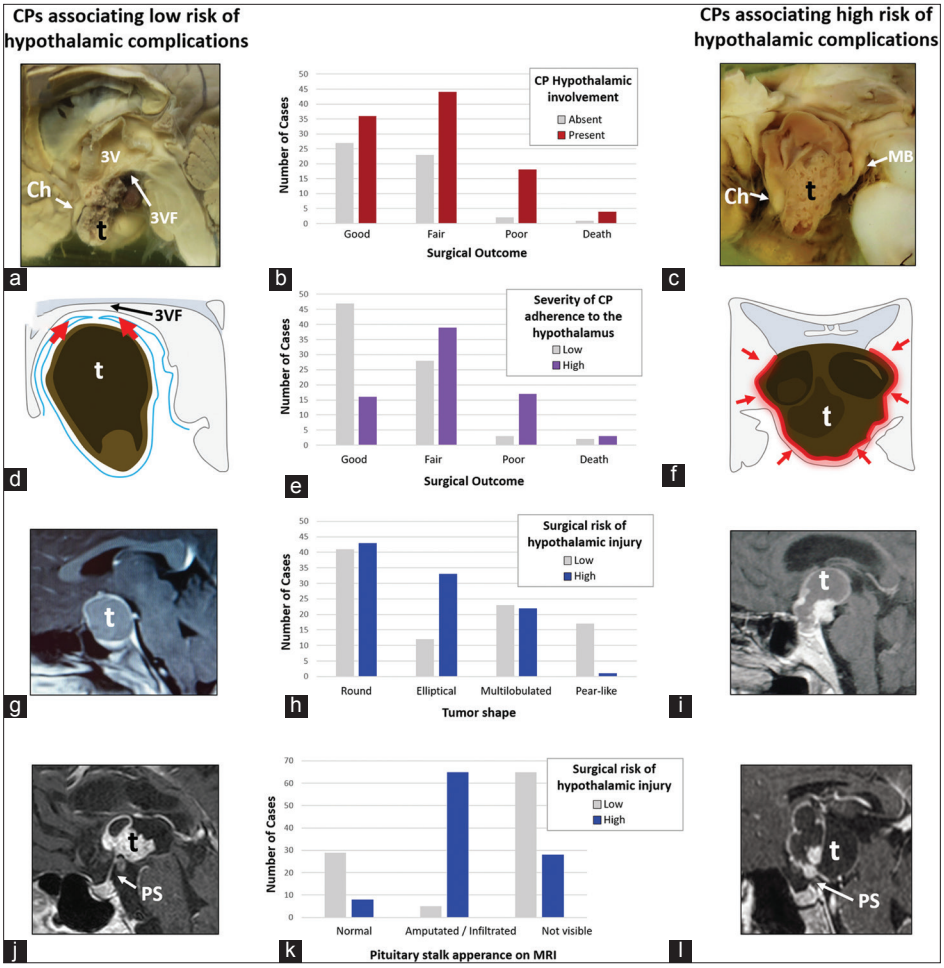

Figure 1: Fundamental pathological features influencing the variability of surgical complications reported for craniopharyngiomas (CPs). The first column shows tumor pathological features associated with a low risk of hypothalamic complications and the third column displays the tumor features linked to an increased risk of postoperative serious complications derived from hypothalamic injury. The middle column shows significant bivariate relationships between the pathological features displayed in the adjacent panels in the same row and the surgical outcome, in a cohort of 200 CP patients treated in the magnetic resonance imaging (MRI) era ($P < 0.001$).[5,7] (a) Brain specimen of a CP (t) without hypothalamic involvement. Note the tumor is expanding in the sellar and suprasellar compartments, below an intact third ventricle floor (3VF). Ch: Chiasm; 3V: Third ventricle. (b) Bar graph showing the relationship between hypothalamic involvement and surgical outcome in CP patients. CPs with hypothalamic involvement (red group, formed by primary infundibulo-tuberal lesions, and tumors invading the third ventricle) have a significantly higher risk of poor outcome or death compared to CPs without hypothalamic involvement (grey group, formed by sellar/suprasellar lesions wholly developed beneath an intact 3VF). (c) Brain specimen of a CP with hypothalamic involvement. This infundibulo-tuberal tumor is predominantly expanding within the 3VF, close to the hypothalamic nuclei. The mammillary bodies are the only recognizable structures of the 3VF. (d) Sagittal scheme of a CP with a loose adherence to the 3VF. This sellar-suprasellar CP is separated from the 3VF by the arachnoid meningeal layer (red arrows), allowing the safe dissection of the tumor from the hypothalamus. (e) Bar graph showing the relationship between the severity of CP adherence and surgical outcome. A significantly worse outcome occurs in tumors presenting high severity adherence levels to the hypothalamus (purple group). (f) Coronal schematic view of a CP with wide and dense adhesions to the adjacent third ventricle floor and walls (red arrows). Lack of an identifiable meningeal cleavage plane between the tumor and the hypothalamus underlies a high risk of causing a hypothalamic injury during surgery. (g) MRI of CP displaying a pear-like shape. Such a tumor morphology is characterized by the presence of intervening meningeal layers (arachnoid and dura mater) between the lesion and the adjacent nervous tissue. (h) Relationship between CP shape and surgical risk of hypothalamic injury. A significantly higher risk of damaging the hypothalamus during surgery occurs in CPs with an elliptical shape (in 73% vs. 5.5% in CPs with the pear-like shape), as elliptical tumors usually expand within the third ventricle. (i) MRI of an elliptical CP that has invaded the 3V after breaking through the 3VF. (j) Preoperative midsagittal MRI of a strictly intraventricular CP developed above an intact 3VF. These CPs usually do not cause anatomical distortions of the pituitary stalk (PS) and typically present small patch-like attachments that can be easily removed without injuring the hypothalamus. (k) Relationship between the MRI appearance of the PS and the surgical risk of hypothalamic injury. A significantly increased risk of damaging the hypothalamus during surgery occurs in CPs that have amputated or infiltrated the stalk (93% vs. 21% in CPs sparing the PS). (l) Midsagittal MRI of an intraventricular CP that has amputated the upper portion of the PS. This finding occurs in CPs originated in the infundibulo-tuberal area of the 3VF which are characterized by their dense and wide adherences to the adjacent hypothalamus.

Declaration of patient consent

Patient's consent not required as patient's identity is not disclosed or compromised.

Ethical approval

This article does not contain any studies with human participants or animals performed by any of the authors.

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Conflicts of interest

There are no conflicts of interest.

REFERENCES

1. Pascual JM, Prieto R, Carrasco R. Infundibulo-tuberal or not strictly intraventricular craniopharyngioma: Evidence for a major topographical category. Acta Neurochir (Wien) 2011;153:2403-25.
2. Pascual JM, Prieto R, Castro-Dufourny I, Mongardi L, Rosdolsky M, Strauss S, *et al*. Craniopharyngiomas primarily involving the hypothalamus: A model of neurosurgical lesions to elucidate the neurobiological basis of psychiatric disorders. World Neurosurg 2018;120:e1245-78.
3. Prieto R, Pascual JM, Barrios L. Topographic diagnosis of craniopharyngiomas: The accuracy of MRI findings observed on conventional T1 and T2 images. AJNR Am J Neuroradiol 2017;38:2073-80.
4. Prieto R, Pascual JM, Castro-Dufourny I, Carrasco R, Barrios L. Craniopharyngioma: Surgical outcome as related to the degree of hypothalamic involvement. World Neurosurg 2017;104:1006-10.
5. Prieto R, Pascual JM, Rosdolsky M, Barrios L. Preoperative assessment of craniopharyngioma adherence: Magnetic resonance imaging findings correlated with the severity of tumor attachment to the hypothalamus. World Neurosurg 2018;110:e404-26.
6. Prieto R, Pascual JM, Rosdolsky M, Castro-Dufourny I, Carrasco R, Strauss S, *et al*. Craniopharyngioma adherence: A comprehensive topographical categorization and outcome-related risk stratification model based on the methodical examination of 500 tumors. Neurosurg Focus 2016;41:E13.
7. Rock AK, Dincer A, Carr MT, Opalak CF, Workman KG, Broaddus WC. Outcomes after craniotomy for resection of craniopharyngiomas in adults: Analysis of the national surgical quality improvement program (NSQIP). J Neurooncol 2019;144:117-25.

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