Aggressive surgical management of craniopharyngiomas

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ABSTRACT

Surgical treatment of craniopharyngiomas is challenging and despite advancements it continues to pose a challenge. Proponents of subtotal resection in conjunction with radiotherapy argue that this less aggressive approach can yield appropriate results with the lower morbidity. On the contrary, other argument is that gross total resection is superior. Though surgical management of craniopharyngioma is challenging due to its location and important surrounding neurovascular structures, optimal surgical results can be expected following radical surgical excision. Radical excision of craniopharyngiomas is associated with excellent long-term recurrence free survival. Radiation induced long-term complications can be altogether avoided by excising these tumors completely.

Key words: Craniopharyngioma, radical excision, surgical management of craniopharyngioma

INTRODUCTION

Craniopharyngiomas are histologically uncommon benign tumors, which constitute 1.2-4% of all intracranial tumors.[1,2] In the pediatric age group, craniopharyngiomas are the third most common tumors after gliomas and medulloblastomas and constitute 3-9% of all brain tumors.[3] In adults, these are fifth most common suprasellar lesions. Craniopharyngiomas arise from the remnants of Rathke's pouch and occur around the infundibulum. These tumors can also arise in sella or suprasellar region and compress visual pathways. These can grow up further to compress hypothalamus and third ventricle, thereby producing hydrocephalus. Though these are histologically benign tumors, but the outcome is unpredictable due to their location and attachment to surrounding neurovascular structures. These tumors have variable consistency, which can be solid, cystic and can have dense calcification. As the tumor grows, small tumor papillary projections into the brain surface may falsely give the impression of tumor invasion.[4] Though, histologically benign, many patients deteriorates progressively regardless of treatment modality. There is controversy regarding the ideal mode of treatment in these patients. Total excision of the tumor is believed to have promising results with low recurrence rate, but the location of the tumor and its relation to surrounding vital structures makes it difficult, resulting in subtotal excision and high recurrence rate.

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Craniopharyngiomas are unique in their clinical presentations. These can present with growth retardation in kids, hormonal disturbances, visual impairment and raised intracranial pressure due to large tumor size or associated hydrocephalus. Multimodal therapeutic options are available, which include radical surgical excision, conservative tumor decompression followed by radiation therapy (RT), gamma knife radiosurgery (GKRS) and stereotactic cyst puncture with intracavitary instillation of chemotherapeutic agents or radioactive isotopes. If we compare conservative surgery followed by RT that improves the recurrence free survival, but this does not match the results of gross total radical excision of the tumor, where tumor free survival of 92.5-100% has been reported in the literature.[5,6] However, due to intimate relation to important neurovascular structures predisposes these patients to serious endocrine dysfunctions and visual impairment in case total excision is attempted.

Tumor recurrence is the most common problem. This can even happen after total excision and has a strong effect on overall survival. Recurrence rates of 5-50% have been reported in the literature.[7-9] Critical time of recurrence is 3-5 years after radical excision, ranging from 1 to 27 years. Two different histological types of

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craniopharyngiomas, i.e., papillary and adamantinous have a different outcome. In some studies, papillary variety has been reported to have a better outcome.

CLINICAL PRESENTATION

In western literature, two peaks of age incidence for craniopharyngiomas are described. First peak occurs in the first and second decade of life and second peak is seen in fifth and sixth decade.[10-12] Almost equal sex distribution has been described by Yaşargil *et al.*[13] in 144 patients. Headache and visual impairment are the two most common presentations. Headache may be due to local dural stretching or raised intracranial pressure due to large tumor size or hydrocephalus.

A substantial number of craniopharyngioma patients present with hormonal deficits. Van Effenterre and Boch[14] reported pituitary hormone deficiency in 85% of their patients. In most series, 60-70% of patients are reported to have endocrine deficiencies.[15-17] Craniopharyngiomas may be associated with moderate hyper-prolactinemia. However, the prolactin levels are usually less than 150 ng/ml. Reported incidence of hyperprolactinemia is between 40% and 55%.[18,19] Incidence of post-operative diabetes inspidus ranges from 43% to 78%.[18,20,21]

SURGICAL MANAGEMENT

Surgery for craniopharyngiomas has three goals. First, it should confirm the diagnosis. Second it should decompress the neural structures and third, it should prevent recurrence.

The extent of tumor resection depends upon the following factors:

1. Brain invasion
2. Tumor location and its extensions
3. Size and consistency of the tumor.

Brain invasion is the limiting factor for complete excision of the tumor as it will not allow dissection of the tumor from the brain interface. The brain invasion cannot be predicted preoperatively. Location of the tumor in relation to the optic chiasm is another important factor deciding complete tumor excision. When the tumor is retro-chiasmatic, it is not visible through the inter-optic space. The surgery of retro-chiasmatic craniopharyngioma is difficult and these tumors cannot be easily excised. Van Effenterre and Boch[14] reported 31% total resection in such locations. Fahlbusch *et al.*[22] reported 11.5% total excision in these tumors in comparison with 45.7% at other locations. In third ventricular tumors, Fahlbusch *et al.*[22] reported 20.8% total resection.

Size of the tumor also determines the extent of resection. Yaşargil *et al.*[13] reported 87.5% mortality in tumors greater than 6 cm in size. Fahlbusch *et al.*[22] also reported that total excision couldn't be performed in tumors greater than 5 cm. In general, it is unlikely to witness any improvement in endocrine status and those with partial deficiency of hypothalamic pituitary axis frequently worsen after surgery.[20]

Craniopharyngiomas may have intimate attachments to critical structures such as the hypothalamus, optic nerves, pituitary stalk and vessels. Tumor dissection may be difficult due to dense arachnoid adhesions.[23-25] Complete microsurgical resection of the craniopharyngiomas leads to most favorable patient outcome.[26-28] Operative strategies depend largely on the size, location and extent of the tumor and additional factors may be the cystic or solid type and whether it is first or redo surgery.[29] Various transcranial approaches allow visualization of the optic nerves, the optic chiasm, the relationship of the tumor to these structures and carotid arteries and IIIrd cranial nerve. For small tumors predominantly in the sella, the transsphenoidal approach may be adequate.

DISCUSSION

Due to the critical location posing surgical challenge and post-operative complications such as hypothalamic dysfunction and endocrinal imbalance, total excision of the craniopharyngioma remains a challenge. Due to surgical challenges, many authors have opined against total excision and favored conservative surgical approach in conjunction with adjuvant RT for tumor control.

Though RT lowered risk of recurrence, but it carries significant adverse events.[30-32] Chemotherapy along with brachytherapy also had a high rate of complications.[33] Apart from this, in small children, RT following subtotal excision of craniopharyngioma is not safe and has long-term consequences. Keeping all this in view, complete surgical excision should be attempted whenever possible to avoid the complications of adjuvant therapy. Subtotal excision should be planned only when the tumor is involving hypothalamus and cannot be dissected free.

Di Rocco *et al.*[30] in a series of 54 children reported gross total excision in 78% cases. Overall surgical mortality was 3.7%. Patients who underwent complete excision fared well. Di Rocco opined that total excision of craniopharyngiomas should be attempted to prevent recurrence.

Dhellemmes and Vinchon[34] in their series of 37 patients of craniopharyngiomas achieved total excision in 65%

of cases. There was no surgical mortality. They noticed tumor progression in 93% of cases after subtotal excision versus 43% after total excision. Best oncological results were obtained with gross total resection. They reported visual deficits often improved or stabilized following surgery. Hypothalamic damage was seen with intraventricular extension of the tumor. Jo *et al.*[35] concluded that surgery should be the treatment of choice to prevent recurrence. If the tumor is located near critical structures or n case of recurrence, subtotal resection may be combined with RT or GKRS.

Surgery of recurrent craniopharyngiomas may be difficult. Recurrent craniopharyngiomas should be operated at first instance.[35-37] Smaller tumors are easy to remove and rarely cause new deficits. Steňo *et al.*[38] reported no mortality in 16 patients. Only two patients had visual decline. In the same series, Steňo *et al.*[38] found recurrence rate of 42.8% following incomplete excision while it was 30% following complete excision. This finding has been reported in the literature by many other authors. Higher recurrence following subtotal removal versus compete removal has been reported by Choux *et al.* 56.6% versus 19.1%,[39] Duff *et al.* 22% versus 6%,[40] Lin *et al.* 100% versus 43%.[41]

The location of the craniopharyngioma has bearing on completeness of tumor excision. The tumors, which are retro-chiasmatic and have an extension into the 3rd ventricle, are difficult to remove and post-operative complications are high.[38] Steňo *et al.*[38] have also reported in their series that intrasellar and suprasellar craniopharyngiomas can be excised totally without much perioperative complication. While the craniopharyngiomas, which are in the suprasellar location extending into the ventricles, are difficult to excise and are associated with significant hypothalamic disturbances.

There is ample literature available to document that recurrence decreases considerably when RT is combined with incompletely excised craniopharyngiomas. On the contrary, others have reported no association between recurrence and RT.[42] In a series published by Zuccaro,[43] children who had undergone complete surgical excision of craniopharyngiomas without undergoing radiotherapy were performing excellently academically with a status not more than 1 year behind their peers. While the children who underwent subtotal tumor decompression and received radiotherapy, only 62% were doing well in their studies at school.

In the retrospective analysis of 268 patients, who were operated in our department at All India Institute of Medical Sciences in 8 years, 195 patients had follow-up of 1-5 years. Among these patients, recurrence was seen in 40 patients. Out of these 40 patients, 6 (15%) patients had undergone total excision while 34 (85%) patients had undergone subtotal excision. Though morbidity and mortality was higher in patients who underwent total excision, but recurrence was low and the quality-of-life was better. In our opinion, aggressive surgical approach should be adopted for the treatment of craniopharyngiomas. Multi corridor routes should be explored in every case to achieve total excision. Gentle tissue handling without much pulling of the tumor, along with the minimal use of coagulation and sharp tissue dissection can minimize complications and help in maximal tumor excision.

RECURRENCE

Many investigators studying the microscopic features of craniopharyngiomas have observed finger or islands of tumor in brain parenchyma.[4,7,17] It has been suggested that recurrent tumors might arise from these isolated foci. Tumor recurrence is the most common problem of the craniopharyngioma surgery.[1,5] In spite of gross total excision, recurrence rates of 5-57% have been observed.[7,9,35] In contrast to other central nervous system tumors, there is still controversy regarding the importance of histopathological features (calcification, tumor subtype) as a predictor of recurrence. At the same time, recurrence is much lower in patients with complete excision of tumors than in subtotal excision group.[13,21,22] Papillary tumors rarely show recurrence. Weiner *et al.*[44] reported overall recurrence rate of 17% after gross total excision and 63% recurrence after subtotal and RT. Maira *et al.*[45] reported 0% recurrence after total resection and 25% recurrence after partial resection. Keeping literature in view, the aim of surgery should be total excision.

CONCLUSION

Craniopharyngiomas are enigmatic tumors of the brain. The optimal treatment for craniopharyngiomas is debatable. Long-term survival is better following complete surgical excision than incomplete excision. Incomplete surgical excision associated with radiotherapy is also not free from complications, especially in children. Visual prognosis is also better in patients who undergo radical surgical excision. Tumors, which are extending both in suprasellar and intraventricular locations with hypothalamic involvement, should be dealt with conservative surgical approach. At the same time, intentional subtotal excision of craniopharyngiomas should be avoided and sincere efforts should be taken for radical surgical excision.

REFERENCES

1. Sami M, Tatagiba M. Craniopharyngioma. In: Kay AH, Laws ER Jr, editors. Brain Tumors: An Encyclopedic Approach. New York: Churchill Livingstone; 1995. p. 873-94.
2. Choux M, Lena G, Genitori L. Le craniopharyngioma de infant. Neurochirurgie 1991;37 Suppl 7:12-6.
3. Matson DD. Neurosurgery of infancy and childhood. 2nd Ed. Thomas, Springfield. 1969, p. 544-74.
4. Adamson TE, Wiestler OD, Kleihues P, Yaşargil MG. Correlation of clinical and pathological features in surgically treated craniopharyngiomas. J Neurosurg 1990;73:12-7.
5. Sami M, Sami A. Surgical management of craniopharyngiomas. In: Schmidek HH, Sweet HH, editors. Operative Neurosurgical Techniques. Philadelphia: W. B. Saunders; 2000. p. 489-501.
6. Crotty TB, Scheithauer BW, Young WF Jr, Davis DH, Shaw EG, Miller GM, *et al*. Papillary craniopharyngioma: A clinicopathological study of 48 cases. J Neurosurg 1995;83:206-14.
7. Carmel PW. Craniopharyngioma: Transcarnial approaches: Complication avoidance and management. In: Apuzzo ML, editor. Brain Surgery. New York: Churchill Livingstone; 1993. p. 339-57.
8. Cabezudo JM, Vaquero J, Areitio E, Martinez R, de Sola RG, Bravo G. Craniopharyngiomas: A critical approach to treatment. J Neurosurg 1981;55:371-5.
9. Dietze DD, Mickle JP. Recurrent craniopharyngioma. Contemp Neurosurg 1991;13:1-8.
10. Hoff JT, Patterson RH Jr. Craniopharyngiomas in children and adults. J Neurosurg 1972;36:299-302.
11. Sung DI, Chang CH, Harisiadis L, Carmel PW. Treatment results of craniopharyngiomas. Cancer 1981;47:847-52.
12. Pertuiset B. Craniopharyngiomas. In: Vinkin PJ, Bruyn GW, editors. Handbook of Clinical Neurology, Part III. Tumors of Brain and Skull. Amsterdam: North-Holland Publishing Co.; 1975.
13. Yaşargil MG, Curcic M, Kis M, Siegenthaler G, Teddy PJ, Roth P. Total removal of craniopharyngiomas. Approaches and long-term results in 144 patients. J Neurosurg 1990;73:3-11.
14. Van Effenterre R, Boch AL. Craniopharyngioma in adults and children: A study of 122 surgical cases. J Neurosurg 2002;97:3-11.
15. Banna M, Hoare RD, Stanley P, Till K. Craniopharyngioma in children. J Pediatr 1973;83:781-5.
16. Svolos DG. Craniopharyngiomas. A study based on 108 verified cases. Acta Chir Scand Suppl 1969;403:1-44.
17. Bruce DA, Schut L, Rorke LB. Craniopharyngiomas in a capsule? Concept Pedatr Neurosurg 1981;1:29-35.
18. Karavitaki N, Brufani C, Warner JT, Adams CB, Richards P, Ansorge O, *et al*. Craniopharyngiomas in children and adults: Systematic analysis of 121 cases with long-term follow-up. Clin Endocrinol (Oxf) 2005;62:397-409.
19. Ohmori K, Collins J, Fukushima T. Craniopharyngiomas in children. Pediatr Neurosurg 2007;43:265-78.
20. Honegger J, Buchfelder M, Fahlbusch R. Surgical treatment of craniopharyngiomas: Endocrinological results. J Neurosurg 1999;90:251-7.
21. Elliott RE, Hsieh K, Hochm T, Belitskaya-Levy I, Wisoff J, Wisoff JH. Efficacy and safety of radical resection of primary and recurrent craniopharyngiomas in 86 children. J Neurosurg Pediatr 2010;5:30-48.
22. Fahlbusch R, Honegger J, Paulus W, Huk W, Buchfelder M. Surgical treatment of craniopharyngiomas: Experience with 168 patients. J Neurosurg 1999;90:237-50.
23. Levy ML, Khoo LT, Day JD, Liker M, McComb JG. Optimization of the operative corridor for the resection of craniopharyngiomas in children: The combined frontoorbitozygomatic temporopolar approach. Technical note. Neurosurg Focus 1997;3:e5.
24. Symon L, Sprich W. Radical excision of craniopharyngioma. Results in 20 patients. J Neurosurg 1985;62:174-81.
25. Symon L, Pell MF, Habib AH. Radical excision of craniopharyngioma by the temporal route: A review of 50 patients. Br J Neurosurg 1991;5:539-49.
26. Hoffman HJ, De Silva M, Humphreys RP, Drake JM, Smith ML, Blaser SI. Aggressive surgical management of craniopharyngiomas in children. J Neurosurg 1992;76:47-52.
27. Laws ER, Thapar K. Craniopharyngiomas in children and adults. In: Batjer HH, Loftus CM, editors. Textbook of Neurological Surgery. 1st ed. Philadelphia: Lippincott, Williams and Wilkins; 2002. p. 1400-5.
28. Raimondi AJ, Rougerie J. A critical review of personal experiences with craniopharyngioma: Clinical history, surgical technique and operative results. 1983. Pediatr Neurosurg 1994;21:134-50.
29. Kanno T. Craniopharyngioma. In: Kanno T, Kiya N, Karagiozov K, Agrawal A, Kumar S, Kato Y, *et al*., editors. Surgical Techniques in Brain Tumor Surgery. Tokyo: Neuron Publishing Co.; 2007. p. 181-96.
30. Di Rocco C, Caldarelli M, Tamburrini G, Massimi L. Surgical management of craniopharyngiomas – Experience with a pediatric series. J Pediatr Endocrinol Metab 2006;19 Suppl 1:355-66.
31. Rittinger O, Kranzinger M, Jones R, Jones N. Malignant astrocytoma arising 10 years after combined treatment of craniopharyngioma. J Pediatr Endocrinol Metab 2003;16:97-101.
32. Rutka JT, Hoffman HJ, Drake JM, Humphreys RP. Suprasellar and sellar tumors in childhood and adolescence. Neurosurg Clin N Am 1992;3:803-20.
33. Jiang R, Liu Z, Zhu C. Preliminary exploration of the clinical effect of bleomycin on craniopharyngiomas. Stereotact Funct Neurosurg 2002;78:84-94.
34. Dhellemmes P, Vinchon M. Radical resection for craniopharyngiomas in children: Surgical technique and clinical results. J Pediatr Endocrinol Metab 2006;19 Suppl 1:329-35.
35. Jo KW, Shin HJ, Kong DS, Seol HJ, Nam DH, Lee JI. Treatment outcomes of pediatric craniopharyngioma: A 15-year retrospective review of 35 cases. J Korean Neurosurg Soc 2012;52:37-41.
36. Konovalov AN. Operative management of craniopharyngiomas. In: Symon L, editor. Advances and Technical Standards in Neurosurgery. Vol. 8. New York: Springer; 1981. p. 281-318.
37. Sands SA, Milner JS, Goldberg J, Mukhi V, Moliterno JA, Maxfield C, *et al*. Quality of life and behavioral follow-up study of pediatric survivors of craniopharyngioma. J Neurosurg 2005;103:302-11.
38. Steňo J, Bízik I, Steňo A, Matejčík V. Craniopharyngiomas in children: How radical should the surgeon be? Childs Nerv Syst 2011;27:41-54.
39. Choux M, Lena G, Genitori L. Craniopharyngioma in children. Neurochirurgie 1991;37:1-172.
40. Duff J, Meyer FB, Ilstrup DM, Laws ER Jr, Schleck CD, Scheithauer BW. Long-term outcomes for surgically resected craniopharyngiomas. Neurosurgery 2000;46:291-302.
41. Lin LL, El Naqa I, Leonard JR, Park TS, Hollander AS, Michalski JM, *et al*. Long-term outcome in children treated for craniopharyngioma with and without radiotherapy. J Neurosurg Pediatr 2008;1:126-30.
42. Tena-Suck ML, Salinas-Lara C, Arce-Arellano RI, Rembao-Bojórquez D, Morales-Espinosa D, Sotelo J, *et al*. Clinico-pathological and immunohistochemical characteristics associated to recurrence/regrowth of craniopharyngiomas. Clin Neurol Neurosurg 2006;108:661-9.
43. Zuccaro G. Radical resection of craniopharyngioma. Childs Nerv Syst 2005;21:679-90.
44. Weiner HL, Wisoff JH, Rosenberg ME, Kupersmith MJ, Cohen H, Zagzag D, *et al*. Craniopharyngiomas: A clinicopathological analysis of factors predictive of recurrence and functional outcome. Neurosurgery 1994;35:1001-10.
45. Maira G, Anile C, Rossi GF, Colosimo C. Surgical treatment of craniopharyngiomas: An evaluation of the transsphenoidal and pterional approaches. Neurosurgery 1995;36:715-24.

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