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CASE REPORT

Metastatic craniopharyngioma: case report and literature review

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Abstract
Background Distant spread of craniopharyngioma is a rare but important complication. Most cases are a result of spread along the surgical path. We describe a rare case of metastatic leptomeningeal craniopharyngioma as a result of dissemination along CSF pathways in a child. A review of previously described cases is provided.
Case presentation A 14-year-old male was diagnosed with metastatic craniopharyngioma on routine follow-up imaging after multiple surgeries and radiation for locally recurrent craniopharyngioma. The lesion was erosive through the right parietal bone, but had remained clinically silent. The lesion was distant from previous surgical paths. The patient underwent right parietal craniotomy and resection of the lesion. Duraplasty and cranioplasty were necessary for closure. Histopathology confirmed adamantinomatous craniopharyngioma. One-year follow-up demonstrated no recurrence.
Discussion A review of reported cases suggests that leptomeningeal implantation may be an important step in metastases of craniopharyngioma, although the mechanism is poorly understood. Attention to tumor spillage at the time of surgery may be important in preventing distant recurrences.

Keywords Craniopharyngioma · Meningeal neoplasms · Neoplasm metastasis · Neoplasm seeding · Secondary

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Introduction

Craniopharyngioma is the most common non-neuroepithelial intra-cerebral neoplasm in children. It is presumably derived from Rathke pouch epithelium and is histologically benign (World Health Organization Grade I). However, the clinical course is frequently not benign as complete surgical excision is difficult. There are two histologic types: adamantinomatous and papillary. The latter type occurs rarely and almost exclusively in adulthood; these tumors are generally well circumscribed and are rarely cystic. The former, adamantinomatous tumors, are usually lobulated and cystic containing a dark greenish brown fluid. Calcification, ossification, fibrosis, and cholesterol deposits are frequently present. Adamantinomatous tumors often demonstrate local brain invasion and may adhere to adjacent vessels and nerves. Distant spread is rare in both types of craniopharyngioma [1].

Craniopharyngiomas generally occur in the suprasellar space. Common presentations include visual disturbances and endocrine dysfunction. Less commonly, cognitive impairment, personality change, and elevated intracranial pressure may be present. Prognosis is generally favorable with a 10-year recurrence-free survival rate of 60–93% [1]. Extent of surgical resection is the most significant predictor of recurrence [2–4]. Likewise, larger tumor size (>4 cm) is a poor prognostic factor [2].

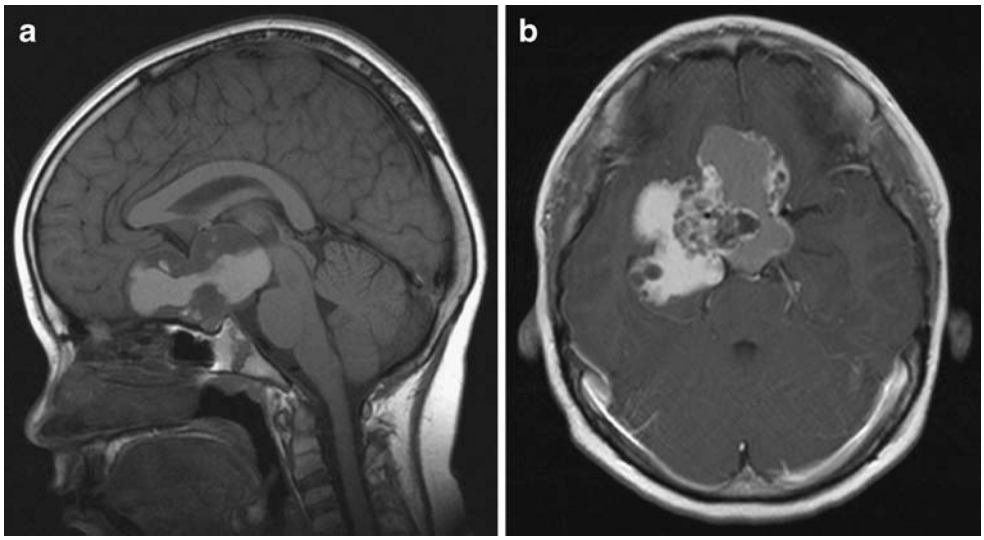

Fig. 1 **a** Sagittal T1 image delineating the heterogeneous mixed cystic and solid suprasellar mass with areas of heterogeneous hyperintensity suggestive of proteinaceous fluid or hemorrhage. **b** Axial T1 post-gadolinium image demonstrating a heterogeneous mixed cystic and solid suprasellar mass with enhancement of the solid component

Previous reviews on the distant spread of craniopharyngioma propose two mechanisms of spread: (1) transplantation during surgery and (2) dissemination via cerebrospinal fluid (CSF) [5–13]. Some authors have suggested that the terms metastatic and ectopic be reserved for those lesions thought to have occurred via the latter mechanism [9]. We present a pediatric case of metastatic craniopharyngioma. To our knowledge this is only the third instance of CSF dissemination of craniopharyngioma in a child [5, 10]. A review of metastatic craniopharyngioma is also provided.

Case report

A 10-year-old male presented with decreased visual acuity. MRI revealed a suprasellar tumor measuring 3.4 cm × 6.3 cm × 6.0 cm. The mass elevated the third ventricle, compressed the right temporal lobe and was abutting the basilar artery. The lesion was lobulated and multi-cystic. The lesion demonstrated some enhancement and signal intensity was heterogeneous with high T1 and T2 signal intensities within the loculations (Fig. 1). He underwent a prolonged bifrontal craniotomy and attempted tumor resection. Post-operatively, a small volume of tumor remained in the right middle cranial fossa. Histopathology revealed adamantinomatous craniopharyngioma. Unfortunately, the patient developed a cerebrospinal fluid fistula that required surgical exploration and repair a few weeks later.

Approximately 6 months later the child presented with headache and emesis. MRI revealed regrowth of the residual tumor in the right temporal fossa. The patient was therefore taken for a right temporal craniotomy and tumor resection. A referral was made to radiation oncology

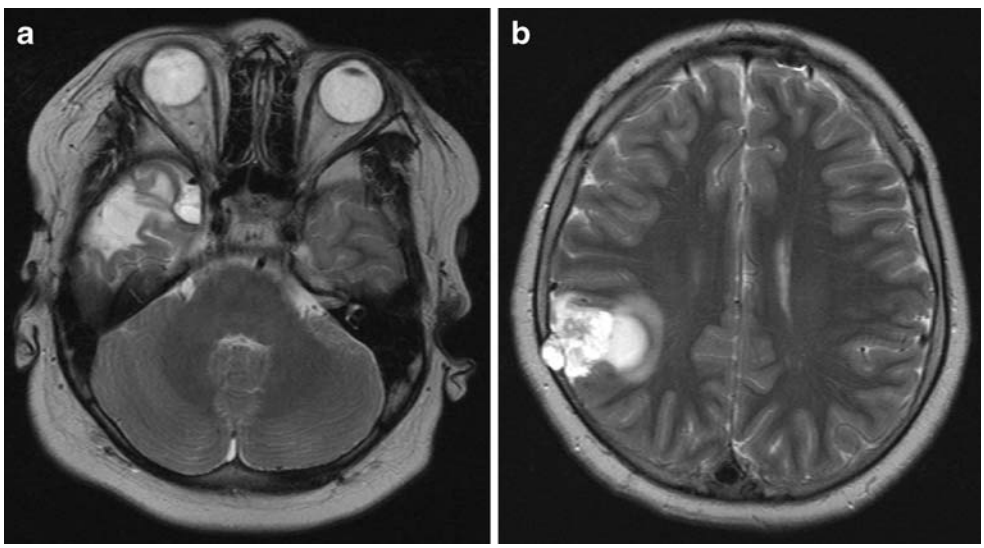

Fig. 2 Post-operative axial T2 images revealing abnormal hyperintensity in the right temporal lobe (**a**) and high right parietal lobe with calvarial extension (**b**), consistent with metastatic craniopharyngioma

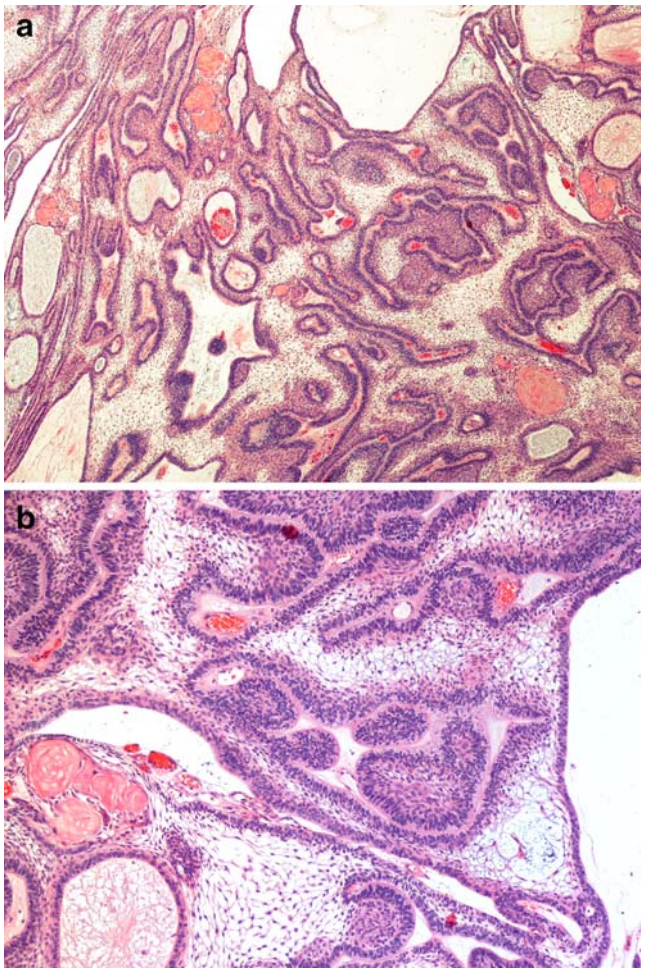

Fig. 3 Histologically typical adamantinomatous craniopharyngioma, with cellular anastomosing trabeculae of epithelial cells with peripheral palisading, loosely textured "stellate reticulum" tissue, cystic spaces and nodules of necrobiotic squames ("wet keratin"). H&E original magnification ×40 (**a**) and H&E original magnification ×100 (**b**)

but before the onset of treatment, the patient presented anew with lethargy and vomiting. This was found to be related to tumor recurrence in the temporal fossa. He underwent right temporal craniotomy and tumor resection for a third time. Follow-up imaging revealed a minute recurrence of tumor and the patient underwent a course of radiation therapy. Following this, the patient experienced radiographic resolution of the recurrence. However, 2 years later, during routine follow-up, MRI demonstrated recurrence in the right temporal fossa and a new right parietal mass. This second lesion was remote from the previous surgical paths and appeared to be extra-axial with erosion through the overlying skull (Fig. 2).

The patient underwent repeat right temporal craniotomy and a separate right parietal craniotomy for removal of both lesions. Grossly, the parietal lesion was both solid and cystic with abundant calcifications. The cysts contained a yellowish fluid. The appearance was consistent with adamantinomatous craniopharyngioma. The lesion had invaded through the skull and dura. There was no gross evidence of invasion into brain parenchyma and an obvious plane was present at the tumor–brain interface. Histopathology confirmed typical adamantinomatous craniopharyngioma at both surgical sites. Features were very similar to those of the previous resection specimens, with epithelial lobules having stellate myxoid regions centrally and palisaded cells peripherally (Fig. 3). Small cystic spaces lined by palisaded cells were also present, along with scattered microcalcifications, necrobiotic squames, collections of collagenous connective tissue, and lymphocytes. An occasional mitotic figure and variable, but generally small, numbers of MIB-1 (Ki67) immunopositive tumor cells were present; these were most commonly seen in the palisaded areas, and were similar in frequency to those present in the earlier resection specimens. The patient recovered from surgery without complication and at 1-year follow-up there was no evidence of recurrence.

Materials and methods

The Pubmed database was queried using the search terms "metastatic craniopharyngioma" and "ectopic craniopharyngioma." Article titles and abstracts were scrutinized for relevance. Additional reports were identified using the Pubmed "related articles" function and by inspecting the references of selected articles. Reports were classified by type of spread (transplantation versus CSF dissemination). Cases of CSF dissemination were of particular interest for review.

Discussion

Ectopic recurrence of craniopharyngioma is rare [1]. In fact, to our knowledge there are only 11 reported cases of craniopharyngioma recurrence at sites remote from the original occurrence or surgical path, with the inclusion of the present case (Table 1) [5–8, 10–14]. Each of these was presumed to be the result of CSF dissemination. Two of these metastatic cases had concomitant spread along the surgical path [5, 6]. There are an additional 15 reported instances of tumor transplantation along the surgical path away from the original occurrence site [13, 15–26]. Also, there were a number of craniopharyngiomas presenting in ectopic sites prior to any surgical intervention although our search was not exhaustive in this regard [27–36].

Table 1 Reported cases of metastatic craniopharyngioma

Author	Age/sex	Pathology	Primary site	Original surgeries	Recurrence site	Surgery for metastasis
Gupta et al. [14]	73/M	Adamantinomatous	Suprasellar	R frontal	L parieto-occipital, dural	Not reported
Lee et al. [11]	26/M	Papillary	Suprasellar	R fronto-temporal	Lumbar spine, intradural, extramedullary	Lumbar laminectomy
Ito et al. [8]	65/M	Adamantinomatous	Suprasellar	Bifrontal	R temporal, subdural	R temporal
Elmaci et al. [7]	62/F	Papillary	Suprasellar	R pterional	L temporo-parietal, leptomeningeal	L temporo-parietal
Nomura et al. [6]	19/F	Adamantinomatous	Suprasellar	Bifrontal, cyst aspiration, VPS	R temporal	R temporal + bifrontal
Novegno et al. [5]	6/M	Adamantinomatous	Suprasellar	L pterional (x2), VPS	Pons, basal ganglia	No repeat surgery
Yamada et al. [10]	17/F	Adamantinomatous	Suprasellar	R orbito-zygomatic	L frontal, mostly extra-axial	L fronto-temporal
Novak et al. [12]	67/M	Not reported	Suprasellar	Not reported	Posterior fossa, subarachnoid	Endoscopic
Bikmaz et al. [13]	52/F	Adamantinomatous	Suprasellar	Not reported	Pre-pontine	Petrosal
Bikmaz et al. [13]	29/M	Not reported	Suprasellar	Resection not reported, Ommaya inserted into cyst	Cerebello-pontine angle bilaterally	R retromastoid, bilateral gamma knife surgery
Frangou et al. (present study)	14/M	Adamantinomatous	Suprasellar	Bifrontal, CSF leak repair, R temporal (x2)	R Parietal, leptomeningeal	R parietal + R temporal

R right, *L* left, *VPS* ventriculoperitoneal shunt, *CSF* cerebrospinal fluid

Metastatic craniopharyngioma has been described in various locations including: cerebral hemispheres [6–8, 10, 14], posterior fossa [12, 13], lumbar spine [11], brainstem, and basal ganglia [5]. Most cases (including ours) appeared leptomeningeal in nature, residing in the extra-axial spaces [7, 8, 13, 14]. In fact, only one case was clearly intra-axial, although this report did not have confirmational histopathology [5].

The adamantinomatous subtype was present in seven cases, including ours [5, 6, 8, 10, 13, 14], the papillary subtype was reported twice [7, 11] and two cases did not report a histopathologic subtype [12, 13]. The present case is only the third reported instance of metastatic craniopharyngioma in the pediatric age group [5, 10]. All but one patient [5] underwent repeat operation to remove the metastasis. Patients undergoing repeat operation all required craniotomy at a new surgical site.

The proposed mechanisms of transplantation and CSF dissemination of craniopharyngioma at the time of surgery are generally accepted [5–8, 10–14, 20]. In fact, in one case of metastatic craniopharyngioma there is documentation of positive CSF cytology [6]. However, the details of how these vagrant cell populations establish themselves have yet to be elucidated. The extra-axial nature of these metastatic lesions may suggest that the meninges serve as a matrix for implantation disseminated cell populations. This is supported by the leptomeningeal and bony erosion demonstrated in the present case.

Leptomeningeal spread occurs in a wide array of tumor types [37], yet we remain in the infancy of our understanding of this process. Some authors have suggested an association between inflammation and tumoral adherence and invasion [7, 38]. The recent implication of vascular cell adhesion molecule 1 in leptomeningeal implantation of melanoma cells represents an important advance towards targeted therapy of leptomeningeal metastases [39]. However, until such molecular therapies are available to silence or eradicate neoplasia at a cellular level, we will continue to rely on sound surgical technique to improve the prognosis for patients. Thus, complete and safe surgical resection with particular attention to the possibility of tumor spillage and seeding remain of utmost importance in the treatment of craniopharyngioma.

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