Infrasellar Craniopharyngiomas: Case Report and Review of the Literature

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ABSTRACT

Although craniopharyngiomas account for a large percentage of pediatric intracranial tumors, there is a bimodal age distribution. Most of these neoplasms are suprasellar or sellar in location. In this report we describe an unusual case of an infrasellar craniopharyngioma in a child. Only four previous cases of infrasellar craniopharyngiomas with no sellar involvement have been described. Infrasellar craniopharyngiomas are part of the continuum representing intracranial craniopharyngiomas and ameloblastomas of the jaw. A transnasal endoscopic biopsy was performed with a preliminary diagnosis of craniopharyngioma. The patient then underwent a radical resection of the infrasellar tumor via a subfrontal transbasal approach. This case illustrates a rare and unusual location for a craniopharyngioma. Craniopharyngiomas should be considered in the differential diagnosis of infrasellar neoplasms. Infrasellar craniopharyngiomas compromise part of the spectrum of tumors originating from enamel-forming neural crest cells.

KEYWORDS: Ameloblastoma, craniopharyngioma, infrasellar region, nasopharynx, Rathke's pouch

Craniopharyngiomas represent 2.5 to 4% of all brain tumors. There is a preponderance of these tumors in children between 5 and 15 years, and this age group constitutes almost one-half of all craniopharyngiomas.¹ However, there is a bimodal age distribution with a second peak at 50 to 60 years of age. Unlike craniopharyngiomas, ameloblastomas most commonly present as a painless expansion in

the mandible of patients between 35 and 45 years of age. Craniopharyngiomas appear as calcified, often cystic, neoplasms arising from remnants of the pharyngeal hypophysis. This accounts for their sellar or suprasellar location. Occasionally, these neoplasms are found within the sella and the third ventricle. Children often present with endocrine and visual disturbances. An infrasellar location for

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craniopharyngioma is extremely rare and has only been described in case reports.²⁻¹² We report an infrasellar craniopharyngioma that did not involve the sella; we also discuss the management of this tumor.

CASE REPORT

An 8-year-old boy presented with right eye visual loss noted on a routine school physical. For 1.5 years, he had complained of headaches, for which he was treated with antibiotics for presumed sinusitis. The physical examination revealed normal development. The patient was at the 50th percentile for height and weight. Ophthalmologic examination demonstrated no light perception in the right eye. Visual acuity in the left eye was 20/20. Fundoscopic examination demonstrated marked optic nerve atrophy in the right eye. Two years earlier, his visual examination had been normal.

Radiologic examinations included computed tomography (CT) and magnetic resonance imaging (MRI). MRI showed a large lesion confined to the ethmoid and sphenoid sinus (Fig. 1). The mass included multiple cysts and compressed the right optic nerve. CT confirmed the cystic appearance and demonstrated extensive bone destruction (Fig. 2).

Surgery

The patient underwent a transnasal endoscopic biopsy that revealed columns of squamous epithelium consistent with the diagnosis of craniopharyngioma. The patient was referred for surgical management. A lumbar drain was placed to permit the brain relaxation. A bifrontal craniotomy and subfrontal transbasal approach to the tumor were performed. The anterior cranial fossa floor, which was elevated by the tumor, was removed; the tumor was visualized within the ethmoid and sphenoid sinuses. The sella appeared to be intact and not involved by tumor. The large cyst was decompressed. The tumor was then re-

moved in a piecemeal fashion. At the completion of surgery, the surgical cavity was continuous with the nasopharynx, and the roof of the soft palate was visible. The entire tumor was extradural. The surgical bed was packed with a fat graft, and the floor of the anterior fossa was reconstructed with a fascia lata graft and pericranium.

Postoperatively, the patient was neurologically unchanged. His visual acuity in the right eye remained poor with light perception only. MRI revealed radical removal of the tumor with residual in the cavernous portion of the right carotid artery. Because histologic analysis had shown that the bone was infiltrated, no attempt was made to remove the residual tumor. Instead, he underwent conformal radiation therapy to the residual tumor and skull base. At last follow-up, 13 months after surgery, the patient was clinically stable without evidence of disease progression. He still has light perception in the right eye.

Pathology

Pathologic examination demonstrated densely packed, well-differentiated epithelial cells arranged in a palisading pattern surrounded by fibrous tissue. Nodular foci of keratinization and cysts with calcification and cholesterol clefts were present. Although the microscopic appearance was consistent with craniopharyngioma, the tumor also exhibited several unusual features. It had invaded the bone aggressively (Fig. 3), and mitotic activity was more pronounced than typical of craniopharyngiomas.

DISCUSSION

Embryology

In 1904, Erdheim¹³ initially characterized the histologic features of craniopharyngiomas. He theorized that craniopharyngioma cells arose from embryonic squamous remnants of an incompletely

Figure 1 (A) Sagittal T₁-weighted MRI with gadolinium reveals a large multicystic infrasellar craniopharyngioma with elevation of the anterior cranial fossa. (B) Axial T₁-weighted image confirms the large infrasellar neoplasm. (C) Coronal T₁-weighted image demonstrates the infrasellar neoplasm without an intracranial component.

involuting hypophyseal-pharyngeal duct. This concept was later supported by the discovery of craniopharyngiomas along the path of development of Rathke's pouch from the pharynx to the

floor of the sella, as well as within and above the sella.

During the fourth gestational week, an ectodermally lined diverticulum develops in the roof of

Figure 2 (A,B) Axial CT scans demonstrate the cystic nature of the neoplasm and the extensive destruction of bone.

the stomodeum just anterior to the oropharyngeal membrane. This diverticulum is Rathke's pouch and it ascends to meet the neuroectoderm. The neuroectoderm diverticulum descends as an outgrowth from the floor of the third ventricle. Rathke's pouch differentiates into the anterior lobe of the pituitary, the adenohypophysis. Rathke's pouch remains as a solid cord of cells that involutes by the seventh gestational week. Theoretically, craniopharyngiomas arise from failure of the solid cord to involute adequately. Carmichael¹⁴ showed that remnants of the duct are present in 33% of autopsy cases as rests of squamous epithelial cells in the region of the pituitary gland. Craniopharyngiomas may originate along the obliterated duct, which accounts for the infrasellar location along the posterior aspect of the vomer and the junction of the soft palate and nasal septum.

Histologically, craniopharyngiomas are identical to ameloblastomas, tumors of enamel organ

cells.^{15,16} Immunocytochemistry staining confirms the similarity, and some craniopharyngiomas even display elements of primordial teeth formation.¹⁷ Craniopharyngiomas and ameloblastomas are only distinguished by their anatomic location. The extensive similarity between the two distantly located tumors has been perplexing and can be explained by their similar embryologic origin. Ameloblastomas are derived from oral ectoderm cells that migrate downward from the floor of the stomodeum to the tooth bud. Just as infrasellar craniopharyngiomas form along the embryologic path of development, only several case reports and one series of extragnathic ameloblastomas occurring in the maxillary sinuses or nasal cavity have been reported.¹⁸⁻²⁰ The existence of infrasellar craniopharyngiomas serves as evidence of the embryologic origin of craniopharyngiomas from the ectoderm stomodeum. The lines between extragnathic ameloblastomas and infrasellar craniopharyngiomas remain blurred.

Figure 3 Photomicrograph of a histologic section reveals squamous epithelial cells typical of craniopharyngiomas. The more aggressive features with infiltration into bone are evident. Hematoxylin and eosin, $\times 400$.

Diagnosis

The differential diagnosis of an infrasellar lesion is mostly the domain of otolaryngologists⁹ and includes encephaloceles, mucoceles, chordomas, squamous cell carcinomas, and sarcomas. The diagnosis is usually established via an endoscopic biopsy. Similar to osseous neoplasms, infrasellar craniopharyngiomas can demonstrate bone erosion on preoperative studies.

Most craniopharyngiomas occur in the sella-suprasellar area. Infrasellar craniopharyngiomas are exceedingly rare. A craniopharyngioma with sellar origin is unlikely to spread to the infrasellar region

because the sphenoid bone imposes a limitation on tumor expansion. Suprasellar growth is relatively unhindered. Only 25 cases of craniopharyngiomas with infrasellar involvement have been reported. In most of these cases, the tumor, despite being primarily infrasellar, has also extended into the sella. Others have questioned whether these tumors actually originated in the sella and extended into the pharynx. Only four cases of infrasellar craniopharyngiomas in which the tumor had no sellar involvement have been reported^{3,4,6,9} (Table 1). More extragnathic ameloblastomas, however, have been reported (Table 2).

Clinical Presentation

Infrasellar craniopharyngiomas occur in both children and adults, with a range from 8 to 32 years^{3,4,6,9} (Table 1). Tumors not arising from the sella typically present with nasal obstruction and attain a larger size before presentation. Nasal airway obstruction is a prominent feature of infrasellar craniopharyngiomas not encountered with the suprasellar location. Truly infrasellar lesions do not manifest with endocrine dysfunction. If the tumor invades the optic canals, some patients may have visual disturbances. Two patients have been described as presenting with epistaxis.^{6,9} Extragnathic ameloblastomas have a presentation

Table 1 Infrasellar Craniopharyngioma Reported in the Literature

Author, Year	Age/Sex	Symptoms	Location	Surgical Approach
Cooper and Ransohoff, 1972 ³	32/M	Visual disturbance, nasal stuffiness	Sphenoid	Lateral rhinotomy
Akimura et al., 1989 ⁴	12/F	Visual disturbance, sinus obstruction	Sphenoid, left ethmoid	Lateral rhinotomy
Byrne and Sessions, 1990 ⁶	29/M	Difficulty breathing, epistaxis	Left maxillary, posterior ethmoid, sphenoid sinus	Lateral rhinotomy
Jiang et al., 1998 ⁹	7/M	Epistaxis	Left ethmoid	Endoscopic transnasal resection
This report	8/M	Visual disturbance, headache	Sphenoid, ethmoid	Subfrontal transbasal

Table 2 Extragnathic Ameloblastomas Reported in the Literature

Patient	Age/Sex	Presentation	Location	Follow-up Time (Years)	Recurrence
1	43/F	Nasal obstruction and epistaxis	Left nasal cavity and maxillary sinus	44	Yes
2	47/M	Nasal obstruction	Right maxillary sinus	23	Yes
3	50/F	Epistaxis	Left posterior nasal cavity	—	No
4	65/M	Nasal obstruction and sinusitis	Left nasal cavity	23	No
5	66/M	Nasal obstruction and sinusitis	Right nasal cavity	7	No
6	62/F	Nasal obstruction	Left nasal cavity	16	No
7	57/M	Nasal obstruction and sinusitis	Left nasal cavity	10	Yes
8	63/M	Epistaxis	Right nasal cavity	10	No
9	61/M	Epistaxis	Left nasal cavity and maxillary sinus	14	Yes
10	70/M	Nasal obstruction and sinusitis	Left nasal cavity, ethmoid, and maxillary sinus	11	No
11	55/M	Nasal obstruction and epistaxis	Right nasal cavity, ethmoid, and maxillary sinus	11	No
12	62/M	Nasal obstruction and epistaxis	Left nasal septum, ethmoid, and maxillary sinus	9	No
13	72/M	Sinusitis	Right maxillary sinus	6	No
14	61/M	Sinusitis	Right nasal cavity and maxillary sinus	24	Yes
15	81/M	Nasal obstruction	Right nasal cavity	3	No
16	50/M	Sinusitis and headache	Left maxillary and sphenoid sinus	2	No
17	58/M	Nasal obstruction and epistaxis	Left nasal cavity and maxillary sinus	2	No
18	62/M	Sinusitis	Left nasal cavity	2	No
19	53/M	Facial swelling	Right ethmoid and maxillary sinus	2	No
20	45/F	Nasal obstruction	Left maxillary sinus	2	No
21	45/F	Eye tearing	Left nasal cavity, ethmoid and frontal sinuses	2	No
22	59/M	Nasal obstruction	Left nasal cavity and maxillary sinus	1	No
23	71/M	Nasal obstruction, epistaxis and sinusitis	Left maxillary and frontal sinus	1	No
24	74/M	Polypoid mass	Right nasal cavity	1	No

From Schafer et al.²⁰

similar to that of infrasellar craniopharyngiomas (Table 2). Typically, extragnathic tumors present in the late 6th decade of life (59.7 years), in contrast with younger patients with oral cavity ameloblastomas.

Radiology

Infrasellar craniopharyngiomas demonstrate radiologic characteristics similar to intracranial craniopharyngiomas. The CT appearance of infrasellar

craniopharyngiomas is often a mixed pattern of high-density calcified areas, low-density cysts, and isodense noncystic solid components.⁴ The incidence of cysts is about 50%. On both T₁- and T₂-weighted MRI, cysts have a high signal intensity, indicating a rich water and protein content. The solid components demonstrate high signal intensity on T₂-weighted images but variable intensity on T₁-weighted images.

Management

Several surgical approaches have been described for infrasellar craniopharyngiomas. The surgical approach is determined by the anatomic location of the tumor. A lateral rhinotomy or a transpalatal approach may be used for tumors confined to the nasopharynx. An endoscopic approach has been used for tumors confined to the ethmoid sinus.⁹ We elected to perform a bifrontal craniotomy because the tumor in our patient was extensive.

In this case, the tumor was radically removed. The craniopharyngioma involved the cavernous portion of the internal carotid arteries and the clivus. The histologically aggressive nature of this tumor suggests that residual neoplastic tissue is present in the surrounding bone. Subtotally removed intracranial craniopharyngiomas tend to recur within the first 3 years; radically removed tumors recur after a much longer time interval. Patients with subtotal removal of tumor likely require further therapy (either radiation therapy or reoperation). Craniopharyngiomas entirely confined to the infrasellar region may be removed completely and possibly offer a better prognosis. However, long-term follow-up information is unavailable in the literature. Extragathic ameloblastomas are associated with a recurrence rate of 22%, all within the first year of surgery. Patients with recurrent ameloblastomas underwent reoperation with no adjuvant therapy. The mean follow-up period was 9.5 years.²⁰

Because our patient's tumor was histologically more aggressive than typical intracranial cra-

niopharyngiomas, adjuvant radiotherapy was administered. Histologic aggressiveness was not a prominent feature noted in other case reports of infrasellar craniopharyngiomas or extragathic ameloblastomas.

CONCLUSION

Craniopharyngiomas with an infrasellar origin are rare lesions. Truly infrasellar lesions without sellar involvement are even less common. Histologically, craniopharyngiomas are similar to ameloblastomas and have a common embryologic precursor. These tumors often grow quite large before presenting with nasal obstruction and difficulty with breathing. Endocrine dysfunction is unusual with these infrasellar lesions. Skull base approaches offer the best possibility of complete resection. Tumors with aggressive features should be treated with adjuvant radiotherapy and close surveillance.

REFERENCES

1. Sanford RA, Muhlbauser MS. Craniopharyngioma in children. *Neurol Clin* 1991;9:453-465
2. Drummond WAD. Infrasellar adamantinoma. *Proc R Soc Med* 1938;31:200-207
3. Cooper PR, Ransohoff J. Craniopharyngioma originating in the sphenoid bone. *J Neurosurg* 1972;35:102-106
4. Akimura T, Kameda H, Abiko S, et al. Infrasellar craniopharyngioma. *Neuroradiology* 1989;31:180-183
5. Bret P, Beziat JL. [Sphenoido-nasopharyngeal craniopharyngioma. A case with radical excision by Le Fort I-type maxillotomy.] *Neurochirurgie* 1993;39:235-240
6. Byrne MN, Sessions DG. Nasopharyngeal craniopharyngioma. Case report and literature review. *Ann Otol Rhinol Laryngol* 1990;99:633-639
7. Graziani N, Donnet A, Bugha TN, et al. Ectopic basisphenoidal craniopharyngioma: case report and review of the literature. *Neurosurgery* 1994;34:346-349; discussion 349
8. Hillman TH, Peyster RG, Hoover ED, et al. Infrasellar craniopharyngioma: CT and MR studies. *J Comput Assist Tomogr* 1988;12:702-704
9. Jiang RS, Wu CY, Jan YJ, Hsu CY. Primary ethmoid sinus

- craniopharyngioma: a case report. *J Laryngol Otol* 1998; 112:403-405
10. Maiuri F, Corriero G, Elefante R, et al. Craniopharyngioma of the cranial base and nasopharynx. *Surg Neurol* 1987;27:191-194
11. Mukada K, Mori S, Matsumura S, et al. Infraselar craniopharyngioma. *Surg Neurol* 1984;21:565-571
12. Majlessi H, Shariat AS, Katirai A. Nasopharyngeal craniopharyngioma. Case report. *J Neurosurg* 1978;49:119-120
13. Erdheim J. Ueber Hypophysengangsgeschwulste und Hirncholesteatome. *Akad Wiss Wien* 1904;113:537-726
14. Carmichael HT. Squamous epithelial rests in the hypophysis cerebri. *Arch Neurol Psychiatry* 1931;26:966-975
15. Badger KV, Gardner DG. The relationship of adamantinomatous craniopharyngioma to ghost cell ameloblastoma of the jaws: a histopathologic and immunohistochemical study. *J Oral Pathol Med* 1997;26:349-355
16. Paulus W, Stockel C, Krauss J, et al. Odontogenic classification of craniopharyngiomas: a clinicopathological study of 54 cases. *Histopathology* 1997;30:172-176
17. Seemayer TA, Blundell JS, Wigglesworth FW. Pituitary craniopharyngioma with tooth formation. *Cancer* 1972;29: 423-430
18. Fitzgerald GW, Frenkiel S, Black MJ, et al. Ameloblastoma of the jaws: a 12 year review of the McGill experience. *J Otolaryngol* 1982;11:23-28
19. Wesley RK, Borninski ER, Mintz S. Peripheral ameloblastoma: report of case and review of the literature. *J Oral Surg* 1977;35:670-672
20. Schafer DR, Thompson LD, Smith BC, Wenig BM. Primary ameloblastoma of the sinonasal tract: a clinicopathologic study of 24 cases. *Cancer* 1998;82:667-674