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Edema along the Optic Tract: A Useful MR Finding for the Diagnosis of Craniopharyngiomas

Morio Nagahata, Takaaki Hosoya, Takamasa Kayama, and Koichi Yamaguchi

BACKGROUND AND PURPOSE: **The pattern of edema caused by craniopharyngiomas and other common suprasellar masses could be useful for determining the differential diagnosis of lesions in this region. The purpose of this study was to ascertain whether the pattern of edema spread on MR images can be used in the diagnosis of craniopharyngiomas.**

METHODS: **The preoperative MR images in eight consecutive patients with craniopharyngiomas, 15 patients with large pituitary adenomas compressing the optic chiasm, and six patients with tuberculum sellae meningiomas were evaluated. All the patients were treated surgically at our hospital and a pathologic diagnosis was obtained. We analyzed the spread of edema surrounding the tumor on the coronal dual-echo fast spin-echo images and compared this finding with tumor location and size as seen on contrast-enhanced T1-weighted images.**

RESULTS: **Not only peritumoral edema but also edema spreading along the optic tracts was observed in five patients with craniopharyngiomas, one of whom also had edema within one optic nerve. The location of edema in the visual pathway was not always associated with the degree of visual disturbance. None of the patients with large pituitary adenomas or with tuberculum sellae meningiomas had such edema along the visual pathway.**

CONCLUSION: **Edema caused by craniopharyngiomas tends to spread along the optic tracts. It is a useful MR finding for distinguishing craniopharyngiomas from other common parasellar tumors.**

Although it is known that craniopharyngiomas are often associated with edema in the adjacent brain parenchyma, the pattern of edematous spread has not been described. We analyzed the pattern of edema as depicted on MR images, hypothesizing that craniopharyngiomas would frequently elicit edema, especially along the visual pathway, because they often occur in the suprasellar region and make contact with the optic chiasm or the anterior portion of the optic tracts during the early period of their growth. We also hypothesized that the pattern of edematous spread would be a useful MR finding in the diagnosis of craniopharyngiomas.

Methods

We reviewed the preoperative MR images for eight consecutive patients with craniopharyngiomas, 15 consecutive patients with pituitary adenomas that extended into the suprasellar cistern and were large enough to compress the optic chiasm, and six consecutive patients with tuberculum sellae meningiomas, all of whom were treated surgically at our hospital between July 1991 and December 1996. We selected patients with large pituitary adenomas and tuberculum sellae meningiomas because these are common extraaxial tumors in the parasellar region. All patients had undergone MR examinations on a 1.5-T system with the same imaging protocol. Before June 1996, we used fast spin-echo sequences with parameters of 3200/20/1 (TR/TE/excitations) for proton density–weighted images, 3200/100/1 for T2-weighted images, and 440/20/2 for T1-weighted images. Fat-suppressed contrast-enhanced T1-weighted images were also obtained after injection of 0.1 mmol/kg of gadopentetate dimeglumine. Three-millimeter-thick sections with 0.0- to 1.5-mm spacing between adjacent sections were obtained routinely in the coronal plane (proton density–, T2-, unenhanced T1-, and contrast-enhanced T1-weighted images) and in the sagittal plane (unenhanced T1- and contrast-enhanced T1-weighted images). The acquisition matrix was 256 × 192, with an 18-cm field of view. We obtained axial T2-weighted images in only one of the eight patients with craniopharyngioma using a fast spin-echo sequence with parameters of 3200/95/1, a 256 × 192 matrix, and a 220-mm field of view. We do not obtain axial MR images routinely because we believe that the best way to detect the fine structures in the parasellar region, such as the visual pathway, is to analyze serial coronal MR images in detail. After June 1996, we routinely used a fast spin-echo (3540/102/2) sequence for T2-weighted imaging, and a conventional spin-echo (440/10/1) sequence for

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TABLE 1: Clinical data for patients with craniopharyngiomas

Patient	Age (yr)/Sex	Tumor Location/Maximum Diameter (mm)	Edema in Visual Pathway	Visual Disturbances
C-1	3/F	Suprasellar/27	None	Decreased vision
C-2	31/M	Suprasellar/41	None	None
C-3	44/M	Suprasellar/28	Bilateral optic tracts, left optic nerve	Decreased vision (left eye) Inferior temporal defect (right eye), superior temporal defect (left eye)
C-4	2/M	Suprasellar/53	Right optic tract	Not examined
C-5	37/M	Suprasellar/41	Optic chiasm (right side), bilateral optic tracts	General constriction of the visual field (bilaterally)
C-6	32/M	Third ventricle/40	Bilateral optic tracts	None
C7	64/F	Suprasellar/38	Left optic tract (near the left lateral geniculate body)	Right homonymous hemianopsia
C-8	11/M	Suprasellar/34	None	Decreased vision (bilaterally), bitemporal hemianopsia

TABLE 2: Clinical data for patients with large pituitary adenomas compressing the optic chiasm

Patient	Age (yr)/Sex	Maximum Diameter of Tumor (mm)	Endocrinologic Function	Surrounding Edema	Visual Disturbances
A-1	17/M	44	GH	None	Bitemporal hemianopsia
A-2	24/F	30	PRL	None	None
A-3	19/M	37	NF	None	Bitemporal hemianopsia, decreased vision (left eye)
A-4	49/F	23	NF	None	Decreased vision (bilaterally), visual field defects (bilaterally)
A-5	54/F	48	NF	None	Decreased vision (right eye), temporal hemianopsia (right eye)
A-6	56/F	33	NF	None	None
A-7	69/M	27	NF	None	Bitemporal hemianopsia
A-8	39/M	32	PRL	None	None
A-9	51/F	23	NF	None	Visual field defects (bilaterally), decreased vision (left eye)
A-10	71/F	36	NF	None	None
A-11	41/M	38	NF	None	Temporal hemianopsia (right eye), decreased vision (right eye)
A-12	40/M	35	NF	None	Bitemporal hemianopsia
A-13	13/F	38	PRL	None	Decreased vision (left eye), bitemporal hemianopsia
A-14	65/F	30	NF	None	Decreased vision (bilaterally), temporal hemianopsia (left eye)
A-15	46/F	22	PRL	None	None

Note.—NF indicates nonfunctioning pituitary adenoma; GH, growth hormone; PRL, prolactin.

T1-weighted imaging, with a 512 × 256 matrix and a 240 × 180-mm field of view. All images were blindly reviewed by three neuroradiologists who focused on the presence of adjacent edema and tumor detection.

The cephalocaudal, anteroposterior, and side-to-side diameters of each tumor were measured on the hard copies of the MR images. The size of the tumor was recorded as the maximum diameter in each plane.

Results

Clinical data and information about the tumors and the pattern of edema for each of the patients with craniopharyngiomas, pituitary adenomas, and tuberculum sellae meningiomas are summarized in Tables 1, 2, and 3, respectively.

MR images in the patients with large pituitary adenomas or tuberculum sellae meningiomas disclosed varying degrees of optic chiasmal compression. On these images, neither large pituitary adenomas nor tuberculum sellae meningiomas were associated with edema surrounding the tumor (Figs 1 and 2). Of the eight patients with craniopharyngiomas, five had parenchymal edema adjacent to the tumor with spread along the visual pathways (Figs 3–6). The MR images for these five patients showed edema spreading posteriorly along the optic tracts. On the coronal MR sections, edema at the posterior portion of the optic tract appeared to be separate from the tumor and from the surrounding edema. One of these five patients also had edema spreading anteriorly to one optic nerve (Fig 3).

Edema was independent of tumor size (Fig 7). The location of edema in the visual pathway was not always associated with the type and degree of visual

TABLE 3: Clinical data for patients with tuberculum sellae meningiomas

Patient	Age (yr)/ Sex	Maximum Diameter of Tumor (mm)	Surrounding Edema	Visual Disturbances
M-1	64/F	30	None	Temporal hemianopsia (right eye)
M-2	82/M	24	None	Decreased vision (bilaterally), general constriction of visual field (right eye), temporal hemianopsia (left eye)
M-3	37/F	28	None	Bitemporal hemianopsia
M-4	66/F	42	None	Decreased vision (bilaterally), general constriction of visual field (left eye)
M-5	50/M	35	None	Blind (right eye)
M-6	41/F	26	None	Blind (left eye), decreased vision (right eye)

disturbance. For example, in patient C-3, the edema seen at the left optic nerve might have caused decreased vision of the left eye. However, the location of the visual field defects did not correspond with the edema. In patient C-5, the edema at the optic chiasm and along the optic tracts bilaterally was compatible with the general constriction of the bilateral visual field (Fig 4). In patient C-6, the absence of visual disturbance was consistent with the edema along the optic tracts (Fig 5); and in patient C-7, the edema seen near the left lateral geniculate body might have produced the right homonymous hemianopsia (Fig 6).

In all five patients, edema became less prominent on the postoperative MR images, a finding that was associated with improvement of the visual disturbances.

Discussion

Although it is well known that craniopharyngiomas are often associated with surrounding edema, the pattern of that edema has not yet been evaluated. By analyzing the pattern of edematous spread, we hoped to find a characteristic finding that would allow the correct diagnosis of craniopharyngioma and would be helpful in determining the differential diagnosis of suprasellar lesions.

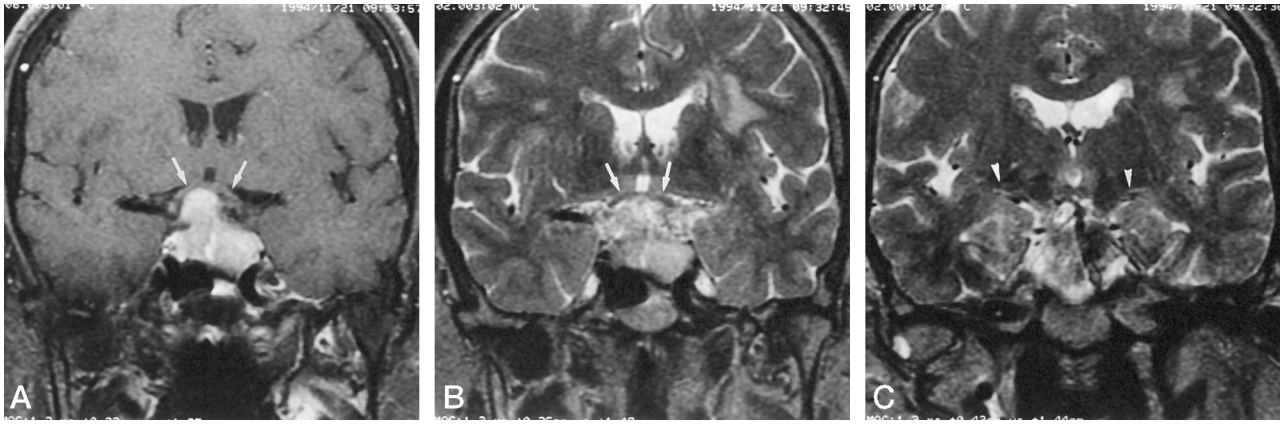


FIG 1. Patient A-6: 56-year-old woman with a large pituitary adenoma.
A and *B*, Coronal postcontrast T1-weighted (440/20/2) image (*A*) and T2-weighted (3200/100/1) image (*B*) show that the tumor is compressing the optic chiasm (*arrows*) superiorly. No edema is present.
C, Coronal T2-weighted image 6 mm more posterior also shows no edema along the optic tracts (*arrowheads*).

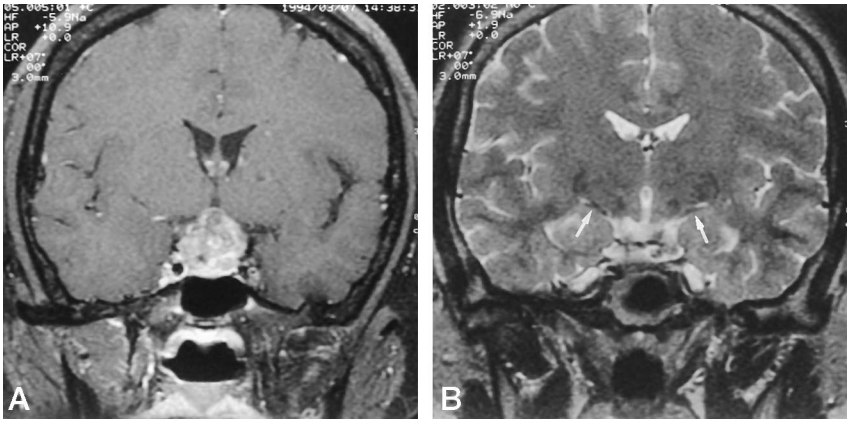


FIG 2. Patient M-3: 37-year-old woman with a tuberculum sellae meningioma.
A, Coronal postcontrast T1-weighted (440/20/2) image shows an enhancing tumor occupying the suprasellar cistern.
B, Coronal T2-weighted (3200/100/1) image 9 mm more posterior reveals no edema. *Arrows* indicate the optic tracts.

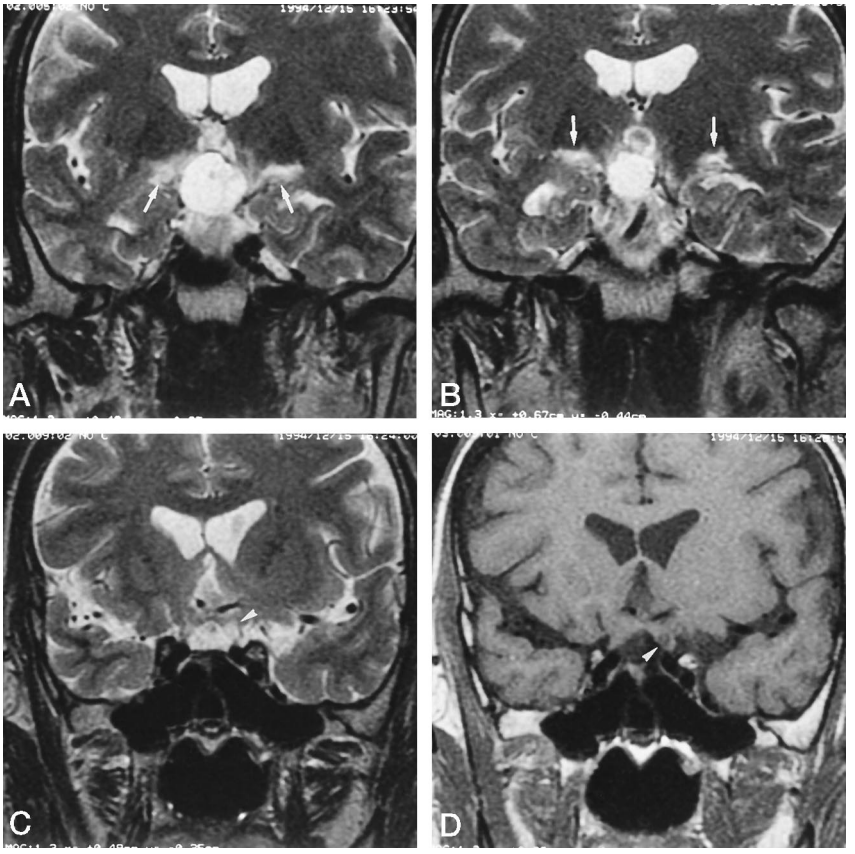


FIG 3. Patient C-3: 44-year-old man with craniopharyngioma.

A and *B*, Contiguous coronal T2-weighted (3200/100/1) images reveal a high-signal-intensity mass below the third ventricle associated with edema along both optic tracts (*arrows*).

C and *D*, Anterior coronal T2-weighted image (*C*) and T1-weighted (440/20/2) image (*D*) depict a small edematous area (*arrowheads*) in the left optic nerve. The shape of the optic nerves and the edema in the left optic nerve are depicted more clearly on the T1-weighted image.

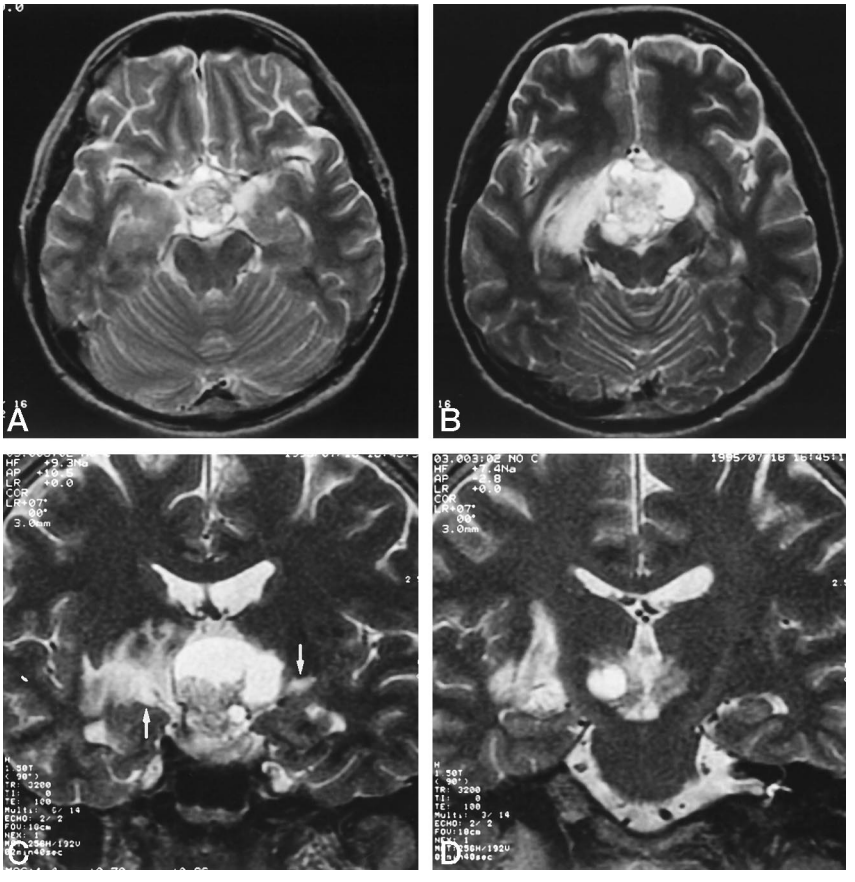
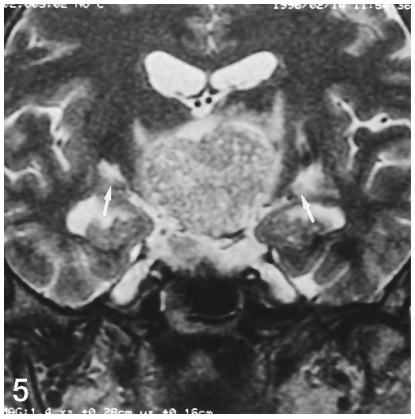


FIG 4. Patient C-5: 37-year-old man with craniopharyngioma.

A–D, Contiguous axial T2-weighted (3200/95/1) images (*A, B*), coronal T2-weighted (3200/100/1) image (*C*), and another image 13.5 mm more posterior (*D*) reveal a solid and cystic suprasellar tumor extending into the third ventricle. The tumor is so large that it is difficult to detect the optic tracts on the axial plane. On the coronal images (*C, D*), edema along the both optic tracts (*arrows, C*) is easily seen, especially on the right side. Parenchymal edema spreading to the right basal ganglia is also identified.



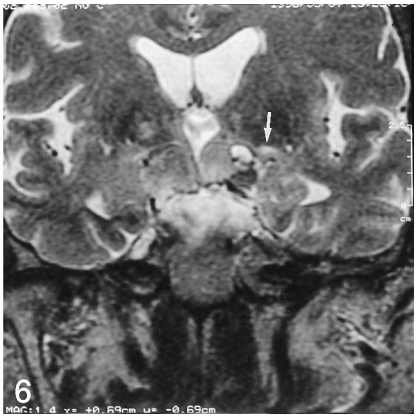


FIG 5. Patient C-6: 32-year-old man with craniopharyngioma. Coronal T2-weighted (3200/100/1) image discloses a large solid heterogeneous mass in the third ventricle. Edema along the optic tracts is present bilaterally (*arrows*), but is more prominent on the left.

FIG 6. Patient C-7: 64-year-old woman with craniopharyngioma. Coronal T2-weighted (3200/100/1) image shows a small edematous area along the left optic tract (*arrow*).

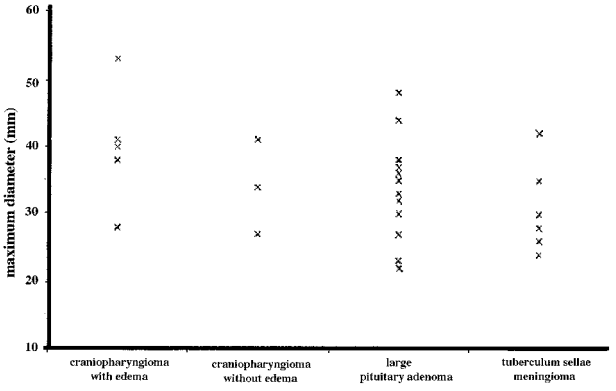


FIG 7. The distribution of maximum diameters (mm) of craniopharyngiomas with edema, craniopharyngiomas without edema, large pituitary adenomas, and tuberculum sellae meningiomas is in a nearly similar range. The adenomas and meningiomas were not associated with optic tract edema.

We found edema along the optic tracts in five of our eight patients with craniopharyngiomas, but could not find such edema on the MR images of patients with either large pituitary adenomas or tuberculum sellae meningiomas. If we were to use edema criteria only, this finding has a sensitivity of 63%, a specificity of 100%, and an accuracy of 90% for the diagnosis of craniopharyngioma. We realize, of course, that other imaging features would be used to arrive at a proper diagnosis. Actually, in patient C-6, the finding of edema was helpful for the diagnosis, whereas the third ventricular tumor was not suggestive of craniopharyngioma (Fig 5).

The cause of the edema associated with craniopharyngioma alone has not been clarified. In our study, the presence of edema was independent of tumor size (Fig 7). It is reasonable to consider that the invasive nature of craniopharyngiomas (1–3) may evoke regional inflammation, resulting in edema of the adjacent structures. Moreover, we speculate that microscopic leakage of cystic contents may evoke adjacent edema (4), because cystic contents often cause chemical meningitis when the craniopharyngioma ruptures into the subarachnoid space (5–7).

Craniopharyngiomas, which often occur in the suprasellar region, are probably in contact with the optic chiasm or the anterior portion of the optic tracts during the early period of their enlargement (8). The edema caused by direct contact with the tumor may then extend into the distant portion of the visual pathway along the neuronal fibers. The observation of edema along the optic tracts does not always suggest damage of the neuronal fibers. It may instead represent interstitial edema around the optic tracts, and perhaps for this reason the edema would likely spread posteriorly, and its distribution does not always correspond to the degree of visual disturbance.

Conclusion

Edema caused by craniopharyngiomas tends to spread along the optic tracts, and this may be a useful MR finding for distinguishing craniopharyngiomas from other common parasellar tumors.

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