The management of optic nerve meningiomas and gliomas

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A series of 63 patients with optic nerve meningioma or glioma is presented. The authors discuss the similarities and differences in the diagnosis and surgical treatment of these two neoplasms of the optic nerve.

KEY WORDS □ optic nerve □ brain neoplasm □ glioma □ meningioma

Optic nerve gliomas and meningiomas have been subjects of controversy for many years. Optic nerve gliomas grow inside the optic nerve sheath without infiltrating adjacent structures.⁸ Primary optic nerve meningiomas arise from the arachnoid sheath of the intraorbital portion of the optic nerve.⁹ These neoplasms have been called “optic nerve sheath meningiomas.” Clinically, it is difficult to differentiate an optic nerve glioma from a meningioma in adults.⁴,⁵

Opinions differ as to the management of optic nerve tumors. The two main approaches to treatment include 1) excision of the optic nerve together with the tumor at an early stage of the disease, even before complete visual deterioration has taken place,⁸ and 2) excision of the optic nerve with the tumor only in cases of progressive visual deterioration and proptosis.²,³,⁵,⁹,¹⁰ The efficacy of radiotherapy in the treatment of optic nerve gliomas is also a subject of controversy.¹,³,⁵ The aim of this study was to analyze the similarities and differences in the diagnosis and surgical treatment of optic nerve meningiomas and gliomas in 63 patients.

Summary of Cases

Patient Population

Between 1978 and 1986, 63 patients with benign optic nerve tumors confined to a single optic nerve without chiasmal expansion were examined and operated on. There were 28 patients with optic nerve gliomas, of these 20 were females and nine were males. Their ages at diagnosis ranged from 14 to 56 years. Of 35 patients with optic nerve meningiomas, 28 were females and seven were males. Their ages at diagnosis ranged from 14 to 60 years.

Computerized tomography (CT) was performed on all patients with optic nerve tumors. All 63 patients were operated on via the transcranial approach using microsurgical techniques. The anatomical relationships encountered during the transcranial approach to the orbital portion of the optic nerve have been discussed previously.¹

Preoperative Findings

Optic Nerve Meningiomas. At presentation, all 35 patients with optic nerve meningiomas had unilaterally decreased visual acuity, ranging from 0.9 to no light perception. Three patients had visual acuities of 0.9, 0.3, and 0.2, and the other 32 had visual acuity from 0.05 to no light perception.

Twenty-seven patients had proptosis ranging from 2 to 11 mm. In 23 patients the optic discs were pale and atrophic, and in 12 they were swollen. Oculomotor disorders were observed in all patients. X-ray films revealed increased bone density at the margins of the optic canal in eight patients. In two cases enlargement of the optic canal was visualized. Based on the clinical signs and CT findings, optic nerve meningiomas were divided into three groups as defined in Table 1 and Fig. 1.

Optic Nerve Gliomas. At presentation, all 28 patients with optic nerve gliomas had unilaterally decreased visual acuity, ranging from 0.5 to no light perception. Visual acuity was between 0 and 0.01 in seven patients and between 0.01 and 0.5 in 21. Vision was normal in the other eye in all cases. In seven patients progressive deterioration in vision of the affected eye had occurred over a period ranging from 6
TABLE 1
Clinical and computerized tomography findings in 35 patients with optic nerve meningiomas *

<table>
<thead>
<tr>
<th>Tumor Type</th>
<th>Clinical Findings</th>
<th>Computerized Tomography Findings</th>
<th>No. of Cases</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>progressive decrease in visual acuity (0-0.01); minimal degree of proptosis (2-4 mm); mild disorders of ocular motility</td>
<td>diffuse thickening of orbital portion of optic nerve from posterior pole of globe to optic canal (Fig. 1 left)</td>
<td>11</td>
</tr>
<tr>
<td>2</td>
<td>slow decrease in visual acuity (0.01-0.05); pronounced proptosis (5-9 mm); disorders of ocular motility</td>
<td>globular tumor in orbital apex with thickened optic nerve between posterior pole of globe &amp; tumor (Fig. 1 center)</td>
<td>21</td>
</tr>
<tr>
<td>3</td>
<td>slow decrease in visual acuity (0.1-0.9); slow progression of proptosis (4-7 mm); marked ocular motility disorders</td>
<td>infiltrative type of tumor without clear borders in orbit (Fig. 1 right)</td>
<td>3</td>
</tr>
</tbody>
</table>

TABLE 2
Clinical and computerized tomography findings in 28 patients with optic nerve gliomas *

<table>
<thead>
<tr>
<th>Tumor Type</th>
<th>Clinical Findings</th>
<th>Computerized Tomography Findings</th>
<th>No. of Cases</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>progressive decrease of visual acuity (0-0.01); minimal degree of proptosis (1-3 mm); mild disorders of ocular motility</td>
<td>diffuse thickening of orbital part of optic nerve from posterior pole of globe to the optic canal (Fig. 2 left)</td>
<td>7</td>
</tr>
<tr>
<td>2</td>
<td>decrease of visual acuity (0.01-0.5); pronounced proptosis (4-8 mm); marked disorders of ocular motility</td>
<td>fusiform thickening of orbital part of optic nerve (Fig. 2 right)</td>
<td>21</td>
</tr>
</tbody>
</table>

FIG. 1. Computerized tomography scans showing three types of optic nerve meningioma. See description in Table 1.

months to 1 year. Proptosis ranged from 4 to 8 mm in 21 patients and from 1 to 3 mm in seven. In 26 patients the optic disc was pale and atrophic, and in four it was swollen. Marked oculomotor disorders were observed in 21 patients. X-ray films showed enlargement of the optic canal in 25 patients. Based on the clinical signs and CT findings, optic nerve gliomas were divided into two groups as defined in Table 2 and Fig. 2.

Surgical Treatment
Several features are typical for both meningiomas and gliomas of the optic nerve. The intraorbital portion of an optic nerve tumor is usually surrounded by vessels and nerves penetrating the periorbital fat (Fig. 3). The ophthalmic artery and nasociliary nerve are usually
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displaced by the tumor in their superior and posterior aspects, and the superior ophthalmic vein is displaced in its superior and anterior aspects. The ciliary nerves, arteries, and veins are stretched on the surface of the tumor.

Different surgical techniques are necessary for the removal of optic nerve meningiomas and gliomas because of their histobiological features. An optic nerve meningioma infiltrates not only the optic nerve sheath but often the adjacent orbital nerves, vessels, muscles and fat, and the bone of the optic canal as well. An optic nerve glioma usually expands inside the optic canal as well. An optic nerve glioma usually expands inside the optic nerve sheath without infiltration of other orbital structures.

We approach optic nerve gliomas via a low frontal osteoplastic craniotomy, then remove the intracranial portion of the tumor by resection of the thickened optic nerve (Fig. 4) from the chiasm to the optic canal. Bipolar coagulation of the stumps of the optic nerve near the chiasm and in the optic canal is performed. The second step involves unroofing the orbit for a microsurgical approach to the intraorbital portion of the optic nerve glioma (Fig. 5) between the levator palpebrae and superior oblique muscles. The neoplasm is then removed by resection of the optic nerve from the posterior pole of the globe to the optic canal, with coagulation of the stumps near the globe and in the optic canal. From our experience, it does not appear necessary to open the optic canal. It is usually enough to coagulate the intracanalicular portion of the glioma through the optic canal from the orbit and cranial cavity with the use of a special tiny probe.

Fig. 4. Operative photograph of the intracranial portion of a right optic nerve glioma. 1: Arteria cerebri anterior; 2: arteria communicans anterior; 3: chiasm; 4: left optic nerve; 5: optic nerve foramen; 6: roof of the optic canal; 7: cystic right optic nerve; 8: arteria carotis interna; 9: arteria cerebri anterior (A1).

Optic nerve meningiomas are also approached via a low frontal osteoplastic craniotomy. The orbit is usually unroofed and the intraorbital portion of the neoplasm removed using microsurgical techniques (Fig. 6) with resection of the optic nerve between the anterior pole of the tumor and the globe when required. The need
for an additional surgical procedure depends on the extension of the neoplasm. When the tumor does not extend to the optic canal and is located in the orbit (as seen in six of our cases) the optic nerve affected by the neoplasm is resected between the visible posterior pole of the neoplasm and the optic canal. When the optic nerve meningioma extends into the optic canal (as found in 29 of our cases), the optic canal is unroofed, the anulus of Zinn dissected, and the intracanalicular portion of the neoplasm removed. In 13 cases the posterior pole of the meningioma was located in the optic canal. When there is intracranial expansion of the neoplasm through the optic canal (as exhibited by 16 of our cases) an intradural approach to the intracranial portion of optic nerve is used (Fig. 7) and the tumor is removed with resection of the optic nerve.

**Postoperative Course**

In 32 patients with optic nerve meningiomas and visual acuity ranging from 0.05 to no light perception, the affected optic nerve was resected with the tumor, and the eye was blind after the operation. In three patients with optic nerve meningiomas and visual acuity of 0.9, 0.3, and 0.2, partial removal of the tumor was performed without resection of the optic nerve. After surgery, visual acuity in these patients decreased to 0.5, 0.2, and 0.05, respectively. In all cases of optic nerve glioma the affected optic nerve was resected and the eye was blind postoperatively.

In 24 cases of optic nerve glioma and 26 cases of optic nerve meningioma complete ptosis developed after the operation; in four cases of optic nerve meningioma the ptosis was partial. The disorders of ocular motility also increased in all cases. However, ptosis and disorders of ocular motility had considerably decreased 3 months after the operation. Swelling of the eyelids was observed in all cases after surgery but had usually disappeared 2 or 3 weeks later.

Optic nerve meningiomas recurred within 2 to 5 years in six cases. Recurrence of an optic nerve glioma was observed in only one case, 3 years after surgery; the source of the relapse was the stump of the optic nerve near the globe. The remaining 57 patients are in a satisfactory condition without symptoms of recurrence during the follow-up periods shown in Table 3.

**TABLE 3**

<table>
<thead>
<tr>
<th>Feature</th>
<th>Follow-Up Period (yrs)</th>
<th>Total Cases</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1-3</td>
<td>3-6</td>
</tr>
<tr>
<td>optic nerve meningioma</td>
<td></td>
<td></td>
</tr>
<tr>
<td>total cases</td>
<td>6</td>
<td>20</td>
</tr>
<tr>
<td>recurrence</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>optic nerve glioma</td>
<td></td>
<td></td>
</tr>
<tr>
<td>total cases</td>
<td>11</td>
<td>9</td>
</tr>
<tr>
<td>recurrence</td>
<td>1</td>
<td>0</td>
</tr>
</tbody>
</table>

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![Image](image-url)

**FIG. 7.** Operative photograph of the intracranial portion of a right optic nerve meningioma. 1: Basal portion of the right frontal lobe covered with moist cotton strips; 2: chiasm; 3: left optic nerve; 4: planum sphenoidale; 5: right anterior clinoid process; 6: optic nerve meningioma; 7: right optic nerve; 8: right arteria carotis interna.

**Discussion**

With the use of modern diagnostic techniques it has become possible to determine the type of growth of an optic nerve tumor and its relationship to the ocular globe, ocular muscles, and optic canal. Based on CT findings and clinical signs we have examined the similarities and differences of optic nerve meningiomas and gliomas. These are important because different surgical techniques are necessary for the removal of optic nerve neoplasms depending on their histological features. In cases of optic nerve meningioma, the optic nerve canal should be unroofed, the anulus of Zinn dissected, and the intracanalicular portion of the neoplasm removed. In cases of optic nerve glioma, however, it is enough to coagulate the intracanalicular portion of the tumor from the orbital and cranial cavities without unroofing the optic canal.

In the only recurrence of an optic nerve glioma, the source of tumor regrowth was the stump of the optic nerve near the globe. In three cases of recurrence of the optic nerve meningioma, the neoplasms had shown an infiltrative pattern of growth. In three other cases in which meningiomas recurred, the primary tumors had been partially removed without resection of the optic nerve.

From our microanatomical studies and microsurgical experience, a typical relationship between the orbital portion of optic nerve tumors and the orbital structures has been identified. We believe that knowledge of this relationship is useful in avoiding injury to orbital vessels and nerves during removal of the orbital portion of the optic nerve tumor. This may also reduce the danger of recurrence of tumor growth.

**References**

8. Sokolova ON, Volinskaya UN: *Tumors of Optic Nerve and Chiasma*. Moscow: Meditsina, 1975 (Rus)

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