The recurrence of intracranial meningiomas after surgical treatment


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A study of 114 surgically treated patients with intracranial meningiomas was carried out to evaluate factors influencing recurrence. The date of the initial surgery extended over a 24-year period from January, 1956, to December, 1979. The patients ranged in age from 11 to 82 years. Seventy-one (62.3%) were females and 43 (37.7%) were males. The surgical procedure was graded according to Simpson's classification from 1 to 5 (Grade 1 = complete excision, Grade 5 = simple decompression). In this series, 33 procedures (28.9%) were Grade 1, 55 (48.2%) were Grade 2, seven (6.1%) were Grade 3, 18 (15.8%) were Grade 4, and one (0.9%) was Grade 5. There were eight (7%) postoperative deaths.

Approximately 60% of the tumors were located in the sphenoid wing (23.7%), convexity (21.1%), and parasagittally (14.9%). Histological diagnosis in 96% of the patients was transitional (42.1%), syncytial (34.2%), and fibroblastic (20.2%) meningiomas. Eight (7%) patients received postoperative radiotherapy. There was evidence of recurrence in 22 patients (19.3%). Twenty-one underwent a second surgical procedure. Using survival analysis, it was determined that 80% of the patients were free of recurrence 5 years after the initial surgery, and approximately 50% showed no recurrence 20 years after the initial surgery. Only the grade of the initial surgery had a statistically significant influence on recurrence. Sex of patients, site and histology of the tumor, and postoperative radiotherapy had no statistically significant influence on recurrence. Angioblastic and malignant meningiomas were rare (only four cases), and recurred relatively quickly.

Key Words: intracranial meningioma · surgical grading · recurrence · radiotherapy · brain tumor
Grade 4 excision denotes a partial removal, and Grade 5 a simple decompression. There is a consensus that the probability of recurrence is significantly influenced by the grade of the operation; the more radical the excision, the smaller the chance of recurrence. The role of radiation therapy, however, remains controversial. Most authors suggest postoperative radiotherapy in cases where excision is incomplete, where the tumor is malignant, or in cases of recurrent tumors. Preoperative radiotherapy, presumably for highly vascular tumors, and radiation therapy as the primary treatment, have few proponents.

We review our experience in the management of 114 patients surgically treated over a 24-year period. Postoperative radiotherapy was carried out in a few patients with malignant tumors and when apparently benign tumors exhibited histological characteristics suggesting rapid growth. Using survival analysis, we determined that only the grade of surgery significantly influenced recurrence.

**Clinical Material and Methods**

The records of all patients who underwent surgical treatment of intracranial meningiomas at University Hospital, Saskatoon (one of the two major neurosurgical centers in the Province of Saskatchewan, Canada) between January, 1956, and December, 1979, were reviewed. Patients whose first operation on a single tumor or on the first of multiple tumors was carried out elsewhere were excluded from the study. The site of the tumor was determined by results of radiological investigation and the surgeon's operative record. Pneumoencephalography, isotope brain scans, and angiography were the diagnostic tests until February, 1979, when they were superseded by computerized tomographic (CT) scans. The surgical excision was graded according to Simpson's grading system, and histological diagnosis was based on Russell and Rubinstein's classification.

Patients were followed in the outpatient department at regular intervals (ranging from 3 months to 1 year)
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### TABLE 3

<table>
<thead>
<tr>
<th>Surgical Grade*</th>
<th>Cases</th>
<th>Percent</th>
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<tr>
<td>1</td>
<td>33</td>
<td>28.9</td>
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<tr>
<td>2</td>
<td>55</td>
<td>48.2</td>
</tr>
<tr>
<td>3</td>
<td>7</td>
<td>6.1</td>
</tr>
<tr>
<td>4</td>
<td>18</td>
<td>15.8</td>
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<tr>
<td>5</td>
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<td>0.9</td>
</tr>
<tr>
<td>total</td>
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<td>100</td>
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</tbody>
</table>

* Surgical grading according to Simpson's classification.9

### TABLE 4

<table>
<thead>
<tr>
<th>Histological Diagnosis</th>
<th>Cases</th>
<th>Percent</th>
</tr>
</thead>
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<tr>
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<td>34.2</td>
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<tr>
<td>transitional</td>
<td>48</td>
<td>42.1</td>
</tr>
<tr>
<td>fibroblastic</td>
<td>23</td>
<td>20.2</td>
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<tr>
<td>angioblastic</td>
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<td>0.9</td>
</tr>
<tr>
<td>malignant</td>
<td>3</td>
<td>2.6</td>
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<tr>
<td>total</td>
<td>114</td>
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</tbody>
</table>

until they were discharged, died, were lost to follow-up review, or until recurrence of tumor was diagnosed. The follow-up period ranged from less than 1 year to 23 years. Most patients discharged were contacted yearly by mail. The data collected were subjected to statistical analysis.

**Summary of Cases**

**Results of Review**

**Sex and Age, and Site of Tumor.** There was a female preponderance representing 62.3% of all patients; males constituted 37.7%. The male to female ratio was 1:1.7 (Table 1). The age at first surgery ranged from 1 year 5 months to 82 years (mean 55 years), and showed a peak in the sixth and seventh decades of life (Fig. 1).

The sphenoid wing represented the single most common site of tumor (23.7%), followed in order of frequency by the convexity and parasagittal region; these three sites were involved in approximately 60% of the 114 cases studied (Table 2).

**Grade of Surgery and Postoperative Mortality.** Table 3 outlines the surgical operation by Simpson’s grading. Grades 1 and 2 constituted 77.2% of the operations, with Grade 2 excisions being performed in almost half of all the cases. Histological diagnosis revealed that syncytial and transitional forms of meningioma together accounted for 76.3% of all cases (Table 4). Only one angioblastic and three malignant forms were diagnosed. There were eight immediate postoperative (in-hospital) deaths, a surgical mortality rate of 7%.

**Postoperative Radiotherapy.** Eight patients received postoperative radiation therapy. These included two patients with malignant tumors. The other six patients had benign tumors, with evidence of invasion of adjacent tissues, including skull, orbit, and temporalis muscle. Some of these excised specimens exhibited hypercellularity and/or numerous mitotic figures on histological study.

**Tumor Recurrence.** By survival analysis techniques, nearly 80% of all patients were free of recurrence at 5 years after the first surgery, about 70% at 10 years, and less than 50% at 20 years (Fig. 2). At the time of the analysis, 22 patients (19.3%) had shown evidence of recurrence. All but one underwent a second operation, with no postoperative mortality. Three patients were operated on a third time. In six cases, there was a change in the histology of the tumor with recurrence. The change most often noted was characterized by increased cellularity and an increase in mitotic figures.

**Factors Associated with Recurrence**

**Sex and Age, and Site of Tumor.** Although Fig. 3 suggests a higher proportion of females with recurrence from 6 years after surgery onward, this difference between the sexes is not statistically significant, by both Mantel-Cox and Breslow statistical testing. There was also no statistically significant difference in length of time to recurrence between patients under 50 years old at first surgery and those over 50 years.
(Fig. 4). No significant difference was found between the various sites in relation to the interval before tumor recurrence (Fig. 5).

Grade of First Surgery. Figure 6 shows the percentage of patients free of recurrence 5 years after first surgery categorized as Grades 1, 2, 3, and 4 to be 86%, 82%, 100%, and 48%, respectively. There was only one Grade 5 patient in this group. The number of Grade 3 patients was too few for the 100% to be useful for statistical purposes. The difference in results between Grade 1 and 2 surgery on one hand and Grade 4 surgery on the other attained statistical significance (p < 0.05). There was, however, no statistically significant difference between the results of Grade 1 and 2 surgery.

Histological Diagnosis. There was no significant difference in duration to recurrence between the three most common histological groups (Fig. 7). Although the 5-year result for the malignant and angioblastic groups was down to a dramatic 32%, the number of patients was too few for statistical significance.

Radiotherapy. Figure 8 suggests an improved duration to recurrence in patients who received radiotherapy, compared to those who did not; however, this difference is not statistically significant.

Discussion

Recurrence after complete removal of a tumor may be defined as the reappearance of symptoms after an interval of postoperative improvement, resulting from "regrowth" of the tumor. After incomplete removal, however, the term "recurrence" implies an interval of postoperative improvement in the syndrome of the tumor, which has proceeded to reestablish itself, representing in reality a "continuance" of the growth. These definitions imply that recurrence of symptoms would appear much earlier from "continuance" of growth, rather than from "regrowth."

Meningiomas have generally been regarded as benign. The classification as proposed by Russell and Rubinstein seeks to separate the hemangiopericytic variant of the angioblastic group from the more be-
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High cellularity was found more frequently among the recurring tumors by Skullerud and Løken, and this difference was statistically significant. Jellinger and Slowik also found a significantly high degree of cellularity and increased mitotic rate among recurrences. Six out of 19 recurrent meningiomas reported by Waga, et al., showed histologically malignant changes. Six of 21 recurrent tumors in our study exhibited a higher degree of cellularity and/or increased mitotic figures. These findings suggest a more aggressive nature of some of the recurring tumors, but the factors inducing this change are unknown.

We were unable to demonstrate any significant influence of sex, age, or site of the tumor on recurrence. A parasagittal location was cited by Simpson and Melamed, et al., as associated with the highest rate of recurrence. Waga, et al., found convexity tumors to recur the most frequently, but when they excluded forms diagnosed as malignant, falx tumors recurred most often.

The only factor that we found to have a significant influence on recurrence is the grade of first surgery. This correlation has been mentioned by most other authors in the past. We are, however, unable to compare our results because of differences in statistical analysis. Even at a low growth rate, which is characteristic of most histological types of meningiomas, it requires no depth of imagination to appreciate that incomplete removal would only lead to a short-lived improvement in symptoms but "continuance" of growth. Radical excision (Grade 1 or 2 surgery), whenever possible, remains the only uncontroversial safeguard against recurrence.

Local infiltration of bone, brain, and sinuses has not been addressed in our study. Simpson found infiltration of bone in 20% of cases, and of venous sinuses and brain in 15% and 3.7%, respectively. Microscopic or undetected macroscopic infiltration of surrounding tissue no doubt contributes to recurrence in cases where a gross total extirpation has been carried out.

Controversy still rages on the role of radiation therapy in the management of meningiomas. The study by Sheline suggested that radiation therapy at least increased the recurrence-free interval sufficiently to be of clinical significance in cases of incompletely resected meningiomas. Fukui, et al., indicated that irradiation is useful in tumors of the hemangiopericytic type, as an adjunct to surgery or for palliation in advanced stages. Waga, et al., were unable to establish whether prophylactic radiation therapy was effective in preventing repeated recurrence in benign meningiomas. Yamashita, et al., concluded that irradiation of recurrent meningiomas is of little value, although it might be beneficial occasionally. The practice of most neurosurgeons is, however, more in keeping with the contention of Carella, et al., that radiation therapy has an established role in the treatment of incompletely excised, recurrent, or malignant meningiomas. Whether or not radiotherapy has a significant influence in preventing recurrence of meningioma still remains open to question.

**Fig. 7.** Curves showing the cumulative proportion of patients free of recurrence by histological subtypes. No significant difference is observed.

**Fig. 8.** Curves showing the cumulative proportion of patients free of recurrence, comparing those receiving radiotherapy and those who did not. The difference observed is not statistically significant.
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References


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