The incidence of meningioma is between 1 and 2.8 per 100,000 persons per year in the general population and 8.5 per 100,000 among elderly people. Given the increases in the average human life span, partly due to improved life conditions, indications for the surgical treatment of intracranial meningiomas have been broadened to include its use as a valid therapeutic option in the elderly population as a guarantee of longer survival and improved quality of life.

In a previous retrospective study, we evaluated and compared long-term outcomes in 34 patients older than 70 years of age who underwent surgery for intracranial meningiomas and 12 age-matched patients who did not undergo surgery. Taking into consideration different clinical and neuroimaging prognostic factors, we developed a grading system, the CRGS, which is summarized in Table 1 and is composed of different subset items including the size and the location of the tumor, the presence of peritumoral edema, the patient's neurological status, the preoperative KPS score, and the presence of concomitant diseases. We define the location of the tumor as critical if the lesion is close to major cerebral vessels, cranial nerves, or the brainstem and eloquent areas. The definition of a critical location actually is made by a combination of radiological and neuroimaging tools: CT scanning, MR imaging, angiography, and MR angiography with visualization of the venous sinus. Edema is considered moderate if it is only found to be perilesional and severe if there is a shift of midline structures. Neurological deficits are determined to be unrecoverable if they are stabilized and complete (for example, hemiplegia, amaurosis, or hearing loss) and recoverable if there is a progressive impairment of a certain neurological function (for example, hemiparesis, worsening of visual acuity, or hypacusia). Concomitant diseases are usually systemic diseases that potentially increase the anesthesiological risk to the patient and interfere with the postoperative course; examples are diabetes, cardiovascular diseases, and respiratory diseases. We define diseases as compensated when they are controlled by medical therapy and decompensated when they are uncontrolled despite medical therapy.

According to this scale, patients with a total score lower than 10 had a bad prognosis regardless of surgical treatment, those with a score between 10 and 12 had a prognosis positively influenced by surgery, and those with a score higher than 12 had a good prognosis regardless of surgical treatment. The authors performed a prospective cross-sectional study to validate further the use of the CRGS as a clinical tool to orientate surgical decision making in elderly patients and to explore prognostic factors of survival.

Methods. From 1990 to 2000 the authors consecutively recruited and surgically treated 90 patients 70 years of age or older with neuroimaging findings of intracranial meningiomas and a preoperative evaluation based on the CRGS. The surgical mortality rate, which covers deaths within 3 months after surgical intervention, was 7.8%, and the 1-year mortality rate was 15.6%.

Female sex and a higher CRGS score were associated with a higher probability of survival. Among the different subset items of the CRGS score, no peritumoral edema for surgical survival and no concomitant diseases for 1-year survival provide the strongest predictive contribution, even if not at a statistically significant level.

Conclusions. The CRGS score is a useful and practical tool for the selection of elderly patients affected by intracranial meningiomas as surgical candidates. A CRGS score higher than 10 and female sex are good prognostic factors of survival, whereas age is not a contraindication to surgery.

Key words • meningioma • elderly • clinical–radiological grading system
Surgery of intracranial meningiomas in the elderly

TABLE 1
Clinical–Radiological Grading System

<table>
<thead>
<tr>
<th>Factor</th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>size of lesion (cm)</td>
<td>&gt;6</td>
<td>4–6</td>
<td>&lt;4</td>
</tr>
<tr>
<td>neurological condition of patient*</td>
<td>unrecoverable</td>
<td>progressive</td>
<td>no deficits,</td>
</tr>
<tr>
<td>KPS score</td>
<td>≤50</td>
<td>50–60</td>
<td>60–80</td>
</tr>
<tr>
<td>whether location of lesion is critical†</td>
<td>highly</td>
<td>moderately</td>
<td>not critical</td>
</tr>
<tr>
<td>peritumoral edema‡</td>
<td>severe</td>
<td>moderate</td>
<td>absent</td>
</tr>
<tr>
<td>concomitant disease(s)§</td>
<td>decompensated</td>
<td>compensated</td>
<td>absent</td>
</tr>
</tbody>
</table>

* Unexpected deficits: deficits complete and stabilized (for example hemiplegia or amaurosis); progressive deficits: deficits incomplete or worsening (for example hemiparesis or impairment of visual acuity).
† A critical location is present if the tumor is attached to a primary vascular or nervous structure (such as the cranial base or an eloquent area).
‡ Peritumoral edema is classified as moderate (only peritumoral) and severe (with a shift of midline structures).
§ Concomitant diseases were evaluated as being compensated (controlled by medical therapy) or decompensated (uncontrolled despite medical therapy).

To confirm whether the CRGS scale is a good predictor of outcome, we performed a prospective cross-sectional study by including 90 consecutively recruited patients 70 years of age or older in whom neuroimaging studies had detected an intracranial meningioma and in whom the decision whether to operate was based on the CRGS score.

Clinical Material and Methods

From 1990 to 2000 we consecutively recruited and surgically treated 90 patients 70 years of age or older in whom neuroimaging studies had detected intracranial meningiomas. The preoperative CRGS score was greater than or equal to 10 in 87 patients. Three additional patients with CRGS Score 9 underwent surgery at the requests of their relatives and under the personal responsibility of their surgeons. Strict adherence to the scale was not mandatory.

Twenty additional patients with a CRGS score lower than 10, who had demographic and neuroimaging characteristics similar to those of the surgically treated patients, were excluded from surgery.

Most patients who underwent surgery had a newly diagnosed meningioma, although five patients had recurrent meningiomas and had undergone earlier surgeries when they were younger than 70 years of age. Seven patients harbored lesions in multiple locations and the other 83 had only one lesion. There were 60 women and 30 men in the study, ranging between 70 and 92 years of age (mean 74.2 years; median 74 years). Three patients (3.3%) were asymptomatic and the meningioma was an incidental finding. Among the other patients, the duration of symptoms was less than 1 month in 38 patients (42.2%); less than 3 months in 24 patients (26.6%); between 3 and 6 months in 12 patients (13.3%), and longer than 6 months in 13 patients (14.4%).

Most significant symptoms and signs experienced by the patients were the following: seizures (21 patients), motor deficits (22 patients), motor deficits and seizures (10 patients), language problems (eight patients), intracranial hypertension (seven patients), visual disturbances (eight patients), frontal lobe syndrome (six patients), and gait/cerebellar symptoms (five patients). The sites of the meningioma were the following: convexity (40 patients), falx (17 patients), parasagittal region (six patients), olfactory groove (one patient), presellar region (two patients), tuberculum sellae (five patients), sphenoid ridge (four patients), middle fossa (three patients), cavernous sinus (one patient), cerebellopontine angle (two patients), tentorial edge (six patients), falciotential region (two patients), and en plaque (one patient). Multiple meningiomas were discovered in seven cases. The histological features of the tumors were the following: meningothelial (49 patients), transitional (20 patients), fibroblastic (six patients), psammomatous (six patients), angiofibroblastic (one patient), atypical (seven patients), and anaplastic (one patient).

Statistical Analysis

We performed a logistic regression analysis by using two different outcomes: Model 1 and Model 1bis, in which the dependent variable was “surgical mortality” (defined as death within 3 months after surgery), and Model 2 and Model 2bis, in which the variable was “1-year mortality” (defined as death within 1 year postoperatively). Possible predictors of survival included demographic variables (patient age at the time of surgical intervention and sex) and disease-related variables (total CRGS score alone in Model 1 and 2, whereas the subset items in Models 1bis and 2bis). The associations of different variables with final outcomes were expressed as ORs and 95% CIs.

Results

The total CRGS score ranged between 9 and 16 (mean 11.6; median 11). In Table 2 we report the average values of the different subset items of the CRGS score in recruited patients; the majority of patients tended to cluster around the middle value of 2.

Radical tumor removal was obtained in 66 patients (73.3%). Six patients (6.7%) died within 30 days and one patient within 3 months after surgery, providing a surgical mortality rate of 7.8%. Five of the seven patients who died had undergone radical removal of the tumor. Figure 1 shows the frequency of surgery-related deaths across patients with different CRGS scores. In three of the deceased patients the lesion had been located along the convexity, in two at the tuberculum sellae, in one at the tentorium, and in one patient...
at the falx. The cause of death was attributed to pulmonary embolism in two cases, cardiac failure in three patients, and bronchopneumonia in two patients. All these patients were bedridden and presented with neurological worsening after surgery. The two patients who died of pulmonary embolism had CRGS Scores 10 and 12 and died before 1995. In 1995, we introduced routine screening for detection of deep venous thrombosis and embolism by performing ultrasonography and pulmonary scintigraphy; using these techniques we were able to diagnose eight cases of asymptomatic pulmonary embolism and no other death occurred. The follow-up review ranged from 2 to 13 years in the surviving 83 patients. All these patients were followed up for at least 1 year. Seven of 83 patients died within the 1st year; three of unrelated conditions (prostatic cancer, pancreatic tumor, and multiple myeloma) and the remaining four of worsening of their neurological conditions after surgery.

In the surviving 76 patients (84.4%) the mean KPS score was 69 at baseline, 70 at discharge from the hospital after surgical intervention, and 73 at the 1-year follow-up review. There was an improvement in KPS scores in patients with a baseline score equal to or lower than 70, and no change in patients with a higher score (Fig. 2). Six patients experienced recurrence of the meningioma, and underwent additional surgery between 1 and 8 years after the first procedure. The complete duration of follow up ranged from 2 to 11 years (median 5 years). Eight patients died after 3 years, six after 5 years, one after 7 years, three after 8 years, and three after 9 years. All these patients died of unrelated conditions. When we explored the potential role of different variables in the prediction of surgical and 1-year follow-up survival, female sex and a higher total CRGS score were associated with a higher probability of survival at 3 months and 1 year after surgery (Models 1 and 2, respectively; Tables 3 and 4). On the other hand, patient age at the time of surgery was not a statistically significant predictor of survival.

Considering the different CRGS score subset items in predicting survival, the absence of peritumoral edema and concomitant diseases is likely to provide the strongest contribution to survival following surgery and to 1-year survival, respectively, despite no statistically significant level in Models 1bis and 2bis (Tables 5 and 6).

**Discussion**

The literature of the last decade reflects a substantial discussion of the effectiveness of surgical treatment in elderly patients affected with meningiomas, even in patients older than 80 years of age. All these reports stress the importance of an accurate selection of patients to decrease the incidence of surgery-related deaths and morbidity; however, different scales were used, such as the American Society of Anesthesiology scale and the KPS grading alone, which unlike the CRGS include only a clinical evaluation. In only one study was the site of the lesion listed as an important prognostic predictor, and in no study was a composite outcome measure scale, such as the CRGS, used.

Our cohort of patients represents the second largest series of surgically treated elderly patients affected with meningiomas.

If we review mortality rates associated with other series

**Table 3**

<table>
<thead>
<tr>
<th>Variable</th>
<th>OR</th>
<th>95% CI</th>
<th>p Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>patient sex: female vs male</td>
<td>13.97</td>
<td>1.3–147.6</td>
<td>0.03</td>
</tr>
<tr>
<td>patient age</td>
<td>0.97</td>
<td>0.7–1.3</td>
<td>NS</td>
</tr>
<tr>
<td>total CRGS score</td>
<td>4.58</td>
<td>1.3–16.7</td>
<td>0.02</td>
</tr>
</tbody>
</table>

* NS = not significant.
Surgery of intracranial meningiomas in the elderly

of elderly patients with meningiomas (Table 7) the percentages are extremely variable, ranging from 1.8% to 29%. There are many different explanations for this discrepancy across series. 1) As reported in Table 7, the lower age limit of patients in studies has varied from 65 to 70 to 80. Nevertheless, it is worthwhile to mention that, according to our analysis, age is not a significant predictor of clinical outcome after surgery. 2) The clinical presentation of recruited patients varied across different studies. If we compare our group of patients with the one described by Black and colleagues, we find a comparable percentage of asymptomatic patients (5% compared with the 3.3% in our group), but our series had a higher percentage of patients who presented with motor deficits (22 patients with motor deficits and 10 with seizures and motor deficits; total 35.5%) than their series (21% of patients reported to have gait difficulty). 3) Another explanation lies in the characteristics of the lesions. No data on the size of the lesions were provided in the study conducted by Black and colleagues. Only Cormu and associates took into account the location of the tumor as a prognostic factor, concluding that a location at the base of the brain and the posterior fossa are associated with a poor outcome. 4) The extent of removal of the tumor is another factor to review. In the series of Mastronardi, et al., the tumor had been totally removed in the four patients who died and two of them had postoperative diffuse cerebral edema. No data were provided by Black and colleagues regarding the extent of tumor removal, even though they suggested that the best surgical approach should be to remove as much tumor as possible while minimizing the risk of new neurological complications.

The surgical mortality rate decreased from 12% within 30 days and 20% within 3 months in our previous retrospective study to 6.7% and 7.8%, respectively, in the present prospective study; it decreased further to 4.4% when the three patients who were recruited despite a CRGS score lower than 10 were excluded from the analysis. This seems to validate the assumption that only patients with a CRGS score equal to or higher than 10 are candidates for potentially successful surgery and that an accurate preoperative selection of patients is of major importance in achieving better results. Although we are aware that the inclusion of the three patients with CRGS Score 9 was a mistake, it should be considered that the strict application of the scale was not mandatory and individual surgeons were free to decide the surgical indication. In these particular cases although the total score contraindicated surgery, the surgeon involved in the case, after consultation with the family of the patient, decided to perform the operation. In our analysis of the results, we decided to report these cases because they provide a further confirmation of our findings and a warning that we should not surgically treat patients with a CRGS score less than 10.

Regarding the 1-year mortality rate, follow up stopped at 3 months in the series of Black and colleagues, at 4 months in the series of Maurice-Williams, et al., and at 30 days in the one of McGrail and Ojemann, making it impossible to compare our data with the findings of these series.

As to the prognostic factors, the better short-term and long-term outcomes of female patients have not been confirmed by other authors; instead, in the series of Mastronardi, et al., all patients who died were women and no study provided information on the relationship between patient sex and prognosis.

The role of the baseline CRGS score in predicting survival confirms the clinical validity of this scale in selecting elderly patients affected by meningioma as good candidates for surgical procedure. We think that a global evaluation of surgical risk rests on a combination of different factors, even if some of these are more important than others in a specific patient. Even if weighting of several factors may be not the same in particular cases, we found that the strongest contribution to predicting survival is provided by both the absence of a concomitant disease and the absence of peritumoral edema, which support the statement that “the old patient in good condition is at no disadvantage when it comes to elective surgery.”

Although not considered in the present study, in which the best score was 16, an issue can be raised about the selection of patients for surgery with the highest CRGS score, namely with small lesions, no peritumoral edema, no meningioma-related symptoms, and no concomitant medical diseases, given that meningiomas are generally believed to be benign, slow-growing tumors. Even for these patients (in which the policy of “wait and see” should be reasonable)

<table>
<thead>
<tr>
<th>Variable</th>
<th>OR</th>
<th>95% CI</th>
<th>p Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>patient sex: female vs male</td>
<td>8.91</td>
<td>1.4–56.9</td>
<td>0.02</td>
</tr>
<tr>
<td>patient age</td>
<td>0.94</td>
<td>0.8–1.1</td>
<td>NS</td>
</tr>
<tr>
<td>CRGS score</td>
<td>0.47</td>
<td>0.1–1.6</td>
<td>NS</td>
</tr>
<tr>
<td>size of lesion</td>
<td>1.22</td>
<td>0.3–4.8</td>
<td>NS</td>
</tr>
<tr>
<td>edema</td>
<td>3.85</td>
<td>0.6–22.4</td>
<td>NS</td>
</tr>
<tr>
<td>KPS score</td>
<td>0.7</td>
<td>0.1–3.7</td>
<td>NS</td>
</tr>
<tr>
<td>neurological condition</td>
<td>24.1</td>
<td>0.5–1228.6</td>
<td>NS</td>
</tr>
<tr>
<td>concomitant disease</td>
<td>9.71</td>
<td>0.8–107.0</td>
<td>0.06</td>
</tr>
</tbody>
</table>

TABLE 4: Results of the logistic regression analysis with Model 2: predictors of 1-year mortality

TABLE 5: Results of the logistic regression analysis with Model 1bis: predictors of surgery-related deaths (CRGS subitems)

TABLE 6: Results of the logistic regression analysis with Model 2bis: predictors of 1-year mortality (CRGS subitems)
we advocate the standard use of the CRGS scale to detect a modification over time of clinical and neuroimaging features of the tumor.

Radiotherapy and, especially, radiosurgery certainly could be good options in patients with a small tumor accompanied by deficits, but its indication in patients with low scores (poor general condition and large tumor) is controversial (radiosurgery is not indicated for large tumors and conventional radiotherapy is not very well tolerated). In any case, our personal experience was with a surgical series and we prefer not to enter into a discussion of radiotherapy, because our experience is limited.

Conclusions

The clinical results of the present study support the assertion that the CRGS is a practical and valuable grading system for use in the selection of elderly patients affected by intracranial meningiomas for surgery. On the basis of the statistical analysis, a score of 10 has been established to be the cutoff for the surgical indication; a patient with a score higher than 10 is the best candidate for surgery. Our data also indicate a strong correlation between female patients and a better prognosis. We agree with the statement that old age is not an absolute contraindication to surgery.

References


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Address reprint requests to: Manuela Caroli, M.D., Departments of Neurosurgery and Neurological Sciences, University of Milano, Ospedale Maggiore Policlinico, IRCCS, via Francesco Sforza 35, 20122, Milano, Italy. email: grwca@tin.it.