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Operative Outcome Following Meningioma Surgery: A Personal Experience of 600 Cases

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Introduction

It has been well discussed in the medical literature that higher patient volume in a given medical center is associated with a more favorable outcome for surgical patients. In the study of Flood and colleagues in the 1980s, a study of 550,000 patients treated in over 1200 hospitals in 15 surgical and 2 medical (nonsurgical) categories, strong and consistent evidence was found suggesting that high patient volume was associated with a better outcome for surgical patients, although the evidence for the medical patients was not as strong [1]. Recently, volume-outcome association has been of interest to scholars from the neurosurgical community as well. Long and colleagues studied the outcome and the cost of tumor-related craniotomies in high- and low-volume medical centers [2]. In this study, the cutoff point for defining low and high volume centers was 50 craniotomies/year. Their results showed the mortality rates in high-volume centers as half of those at low-volume ones. In a more specific patient population, Curry and colleagues looked at the relationship between outcome and case volume in craniotomies for intracranial meningiomas [3]. In that study the cutoff for high and low-volume centers and high and low-volume surgeons was 24 cases/year/institution and 8 cases/year/surgeon, respectively. Their results showed lower mortality and morbidity rates for the high-volume hospitals.

However, although there are growing data in the literature suggesting a more favorable outcome in high-volume centers for various neurosurgical pathologies, there has not been much discussion and data on how to quantify experience throughout the carreer of any given surgeon. As Black points out in his comment for the study of Long and colleagues, the results favoring the outcomes in higher volume centers would not mean that the surgeons working in these centers are "better" than those working in lower volume centers or that these data do not define how many patients are truly necessary to provide surgeons with optimal experience [4]. The data available in the literature on surgical outcomes are mainly institutional, at times multi-institutional, but rarely reflective of the experience of a single surgeon.

In this context, we believe that analysis of the surgical outcome of a particular neurosurgical problem, in this case intracranial meningioma in the experience of a single surgeon, throughout his or her carreer would provide important information. This chapter focuses on the operative experience of the senior author with 600 consecutive cases of intracranial meningiomas over a 13-year period.

Methods

Medical records of 600 patients who were operated by the senior author between July 1993 and December 2006 were reviewed retrospectively. The overall outcome was reported using the Glasgow Outcome Scale (GOS) [5] at 6 weeks and at 1 year. Favorable and unfavorable outcomes were defined as GOS 4 and 5 and GOS 1–3, respectively. In addition, postoperative surgical (major neurologic, minor neurologic, nonneurologic) and medical complications within the first postoperative month were recorded. The impact of the surgeon's experience on the outcome was assessed by stratifying the patients into three groups of 200 successive patients each. Group I consisted of the first 200 patients, Group II the latter 200 patients, and Group III the most recent 200 patients.

Major neurologic complications consisted of new deficits of the following cranial nerves: 2, 3, 5 (V1 division), 7, 9, 10, as well as worsened level of consciousness, motor deficits, aphasia and pituitary insufficiency.

Minor neurologic complications consisted of new deficits involving the cranial nerves 4, 5 (Divisions V2, V3), 6, 8, 11, 12, as well as focal sensory deficits.

Nonneurologic complications included surgical complications such as meningitis, cerebrospinal fluid (CSF) leak either from the wound or in the form of rhinorrhea, wound dehiscence, and infection.

Results

At 6 weeks, 95.2% of the 600 patients had a favorable outcome (85.8% GOS 5, and 9.8% GOS 4) (Fig. 18-1): 92% of Group III patients had GOS 5, as compared to 83.5% of Group I and 82% of Group II ($p = 0.01$) (Fig. 18-2). Overall mortality was 0.6%. Data for 342 patients were available for 1-year review (Fig. 18-3). Of these, 95.9% showed a favorable outcome (92.7% GOS 5, and 3.2% GOS 4).

Early Outcome vs. Late Outcome

Of the 6 patients with a GOS of 2 at 6 weeks, 1-year follow-up was possible in 4. Of these, 3 died, and the remaining one patient had a GOS of 3.

Of the 19 patients with a GOS of 3 at 6 weeks, 13 patients had 1 year follow-up. Of these patients, 4 (30.7%) died, 4 (30.7%) remained at GOS 3, whereas 1 (7.7%) improved to GOS 4, and 5 (38.4%) improved to GOS 5.

Of the 56 patients with a GOS of 4 at 6 weeks, 30 patients had a 1-year follow-up. Of these, 6 (20%) remained the same, whereas 24 (80%) improved to a GOS of 5.

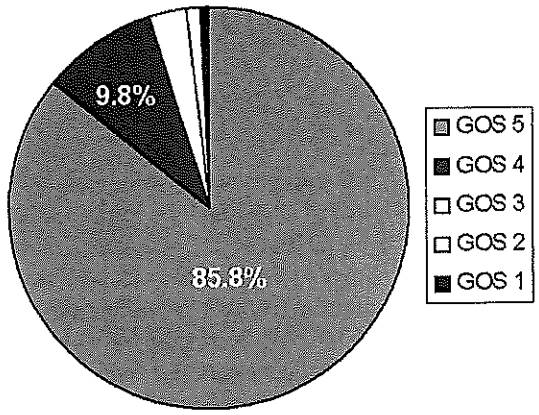

FIG. 18-1. Operative outcome in 600 meningiomas at 6 weeks. GOS, Glasgow Outcome Score

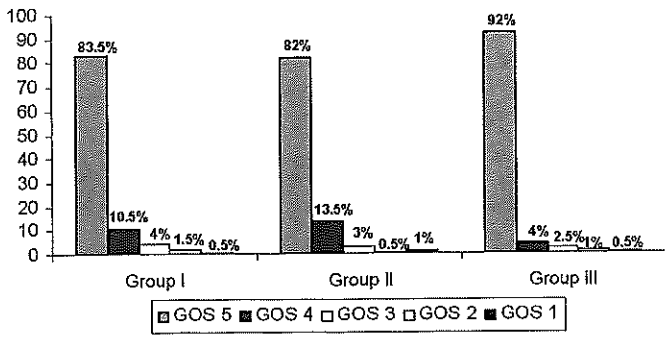

FIG. 18-2. Percentage of operative outcome at 6 weeks according to surgeon's experience in 600 patients. GOS, Glasgow Outcome Score

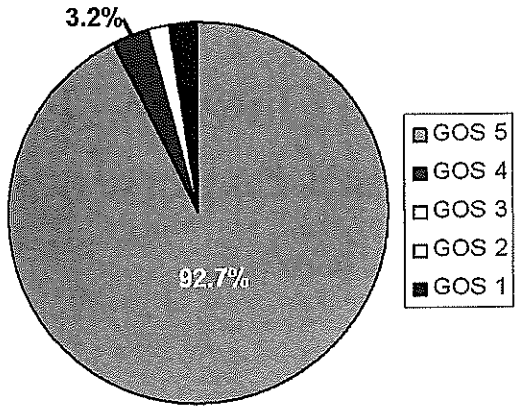

FIG. 18-3. Operative outcome in 342 patients at 1 year. GOS, Glasgow Outcome Score

Of the 294 patients, who had an early GOS of 5, and whose information was available for 1-year follow-up, 292 (99.4%) had still a GOS of 5, whereas 2 (0.6%) were dead at 1 year (1 late ischemic stroke, and 1 late pulmonary embolus).

Complications

Surgical complications were encountered in 17.7% of 600 patients: 22% in Group I, 18% in Group II, and 13.5% in Group III (Fig. 18-4). Medical complications were seen in 9.3%: 12% in Group I, 6.5% in Group II, and 9.5% in Group III (Fig. 18-4).

Further analysis of patients with surgical complications showed that major neurologic complications occurred in 12.5%, 11%, and 4%; minor neurologic complications in 7%, 4.5%, and 2.5%; and nonneurologic complications were seen in 2.5%, 2.5%, and 6.5% of Groups I, II, and II, respectively (Fig. 18-5).

Of the 333 patients whose 1-year following information was available, 31 had major and 18 had minor neurologic complications at their 6-week follow-up. The outcome of these complications during their 1-year follow-up is shown in Table 18-1.

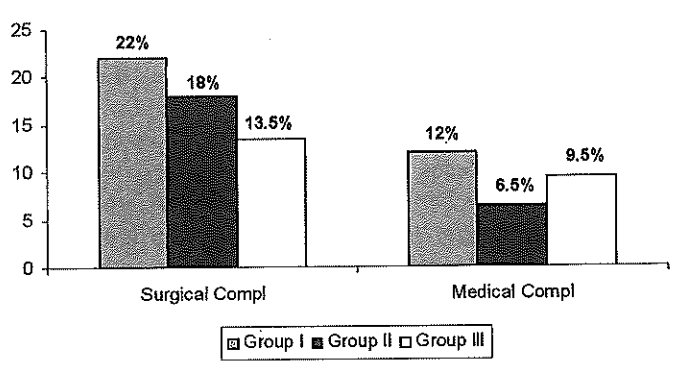

FIG. 18-4. Percentage of surgical and medical complications

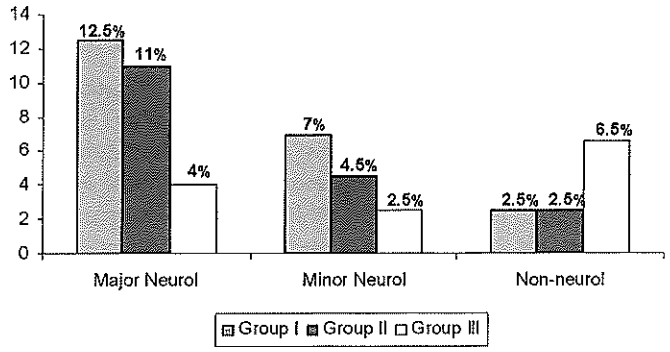

FIG. 18-5. Percentage of surgical complication subgroups

Composition of the Groups

The average patient age was 55 ± 14 for Group I, 56 ± 13 for Group II, and 54 ± 13 for Group III. Average tumor size was 36.5 ± 16.5 mm for Group I, 37.1 ± 18.7 for Group II, and 37.4 ± 18.2 for Group III. There was no difference among the groups with regards to the patient age or tumor size.

The composition of the groups with regards to the patient co-morbidities as defined by the American Society of Anesthesiology (ASA) [6], tumor location classified as high, moderate, or low risk as defined by the CLASS algorithmic scale (please refer to Chapter 20), as well as presence and severity of symptoms are detailed in Tables 18-2, 18-3, and 18-4, respectively.

Discussion

In the experience of the senior author, 85.8% of the patients had a GOS of 5 and 9.8% had a GOS of 4 at 6 weeks. Of the 600 patients, 342 patients were available for 1-year follow-up, and of these, 92.7% had a GOS of 5 and 3.2% had a GOS of 4. Patients who remained with a GOS of 2 or 3, or patients who were dead at 1 year, were mainly among the patients who had a GOS of 2 or 3 at 6 weeks. It was interesting to note that almost half of the patients (46.1%) who had a GOS of 3 at 6 weeks improved to GOS of 4 or 5. In the group of patients with a GOS of 4 at 6 weeks, 80% improved to GOS 5.

When the outcome was stratified according to the groups as outlined above, the overall favorable outcome was similar in all groups, but the incidence of GOS 5 (92%) was significantly higher in the most recent 200 patients (Group III) as compared to the first 400.

With regard to the types of complications, the incidence of major neurologic complications was significantly lower in Group III (4% in Group III vs. 12.5% in Group I and 11% in Group II). The incidence of minor complications also showed a constant decrease over the years (7% in Group I, 4.5% in Group II, and 2.5% in Group III). It was surprising to see that surgery-related nonneurologic complications such as CSF leak or infection showed an increase in Group III (6.5% in Group III vs 2.5% each for Groups I and II) and was the most common subgroup of surgical complications in this group.

The incidence of patients with meningiomas at high-risk locations was higher in Group I (38.5%) compared to 29.5% in Group II and 28% in Group III, which might have some role in the relatively higher neurologic complication rate in this group. The relatively lower incidence of high-risk location meningiomas in the latter 400 patients as compared to the first 200 can be attributed to the evolution in the management paradigm for such tumors, such as the more widespread use of adjuvant or primary radiation treatment, or to stringht patient selection criteria for surgery in there high-risk patients.

In the subgroup of 49 patients who initially had a neurologic complication at 6 weeks and with available follow-up at 1 year, outcomes of the neurologic functions were diverse. All of the patients who suffered from decreased level of consciousness and two thirds of the patients with hemiparesis improved.

TABLE 18-1. Outcome of Neurologic Complications at 1 Year.

	Outcome at 1 year	
Complication at 6 weeks	Improved	Not improved
Decreased LOC ($n = 6$)	6 (100%)	—
Hemiparesis ($n = 6$)	4 (67%)	2 (33%)
Cranial nerves		
CNIII ($n = 5$)	3 (60%)	2 (40%)
CNV ($n = 10$)	2 (20%)	8 (80%)
V1 ($n = 8$)	2 (25%)	6 (75%)
V2-3 ($n = 8$)	2 (25%)	6 (75%)
CNVI ($n = 10$)	5 (50%)	5 (50%)
CNVII ($n = 8$)	5 (63%)	3 (37%)
CNVIII ($n = 9$)	—	9 (100%)
CNIX-X ($n = 8$)	3 (37%)	5 (63%)
Other ($n = 8$)	1 (13%)	7 (87%)

LOC, level of consciousness; CN, crania nerve.

TABLE 18-2. Medical Co-morbidity of Patients in Each Group Stratified According to the American Society of Anesthesiology (ASA) Scale.

	ASA I	ASA II	ASA III- IV
Group I ($n = 200$)	92 (46%)	84 (42%)	24 (12%)
Group II ($n = 200$)	88 (44%)	95 (47.5%)	17 (8.5%)
Group III ($n = 200$)	82 (41%)	93 (46.5%)	25 (12.5%)

TABLE 18-3. Tumor Location in Each Group According to the CLASS Algorithmic Scale.

	Low risk	Moderate risk	High risk
Group I ($n = 200$)	52 (26%)	71 (30.5%)	77 (38.5%)
Group II ($n = 200$)	55 (27.5%)	86 (43%)	59 (29.5%)
Group III ($n = 200$)	54 (27%)	90 (45%)	56 (28%)

TABLE 18-4. Presence of Symptoms in Each Group.

	Asymptomatic	Mild	Severe
Group I ($n = 200$)	48 (24%)	50 (25%)	102 (51%)
Group II ($n = 200$)	83 (41.5%)	39 (19.5%)	78 (39%)
Group III ($n = 200$)	76 (38%)	25 (12.5%)	99 (49.5%)

Among the cranial nerve deficits, facial, oculomotor and abducens nerves had the highest incidence of subsequent improvement (63%, 60%, and 50%, respectively). None of the patients with postoperative hearing loss improved at 1 year.

The incidence of medical complications were slightly less in Group II (12% in Group I, 6.5% in Group II, and 9.5% Group III), which may be a reflection of the patient population, since the incidence of high risk (ASA III-IV) patients were also relatively less in Group II (8.5% vs. 12% in Group I and 12.5% in Group III).

In the study of Curry and colleagues, in which they retrospectively reviewed the Nationwide Inpatient Sample for the period of 1988–2000, mortality and adverse hospital discharge rates for resection of intracranial meningiomas were significantly lower for high-volume hospitals and surgeons [3]. Interestingly, the number of coded neurologic complications was higher in these groups also. As the authors also point out, these can result from dealing with higher-risk tumors in high-volume centers. This may also result from the fact that the definition of highest volume quintile was only ≥24 intracranial meningioma cases/year for hospitals and ≥8 cases/year for surgeons in their study. In addition, the annual number of craniotomies for meningioma ranged between 1 and 39, with a median of 3 for the surgeons. In this context, it would be questionable whether 8 cases of intracranial meningiomas per year is a high enough number for a single surgeon to be regarded as a "high-volume" surgeon.

Summary

In the experience of the senior author with over 600 intracranial meningiomas, the incidence of favorable outcome increased and postoperative complications decreased over time. The heterogeneity and varying degrees of complexity of intracranial meningiomas constitute a challenge for the surgeon wishing to master the principles of surgical management of these interesting tumors. Our data clearly demonstrate the existence of a learning curve of at least 400 operative cases in meningioma surgery in achieving optimal outcome with minimal surgical complications further, many patients with immediate postoperative neurologic deficits at 6 weeks showed subsequent improvement at 1 year postoperative follow-up.

References

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