



Cranial Tumor Surgical Outcomes at a High-Volume Academic Referral Center

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Abstract

Objective: To determine adverse event rates for adult cranial neuro-oncologic surgeries performed at a high-volume quaternary academic center and assess the impact of resident participation on perioperative complication rates.

Patients and Methods: All adult patients undergoing neurosurgical intervention for an intracranial neoplastic lesion between January 1, 2009, and December 31, 2013, were included. Cases were categorized as biopsy, extra-axial/skull base, intra-axial, or transsphenoidal. Complications were categorized as neurologic, medical, wound, mortality, or none and compared for patients managed by a chief resident vs a consultant neurosurgeon.

Results: A total of 6277 neurosurgical procedures for intracranial neoplasms were performed. After excluding radiosurgical procedures and pediatric patients, 4151 adult patients who underwent 4423 procedures were available for analysis. Complications were infrequent, with overall rates of 9.8% (435 of 4423 procedures), 1.7% (73 of 4423), and 1.4% (63 of 4423) for neurologic, medical, and wound complications, respectively. The rate of perioperative mortality was 0.3% (14 of 4423 procedures). Case performance and management by a chief resident did not negatively impact outcome.

Conclusion: In our large-volume brain tumor practice, rates of complications were low, and management of cases by chief residents in a semiautonomous manner did not negatively impact surgical outcomes.

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Optimizing quality and efficiency while mitigating cost is a central tenet of modern health care. Assessing factors contributing to disparate health outcomes is necessary to consistently achieve high-quality care. Meaningful quality assessment requires benchmarks against which hospital systems and individuals can be compared. Neurosurgery has a modest framework for global assessment of complications compared with established mechanisms for several other high-risk surgical subspecialties.¹⁻⁴

Recent national health care policy trends have reinvigorated efforts to record complications and provide tools to reduce their frequency. Several prior studies addressing neurosurgical quality and cost relied on national databases to amass sufficient numbers

for statistical significance. For example, Wong et al⁵⁻⁹ authored a series of articles documenting adverse outcomes in neurosurgical subspecialties including treatment of intracranial neoplasms. Studies using pooled data from national databases have been of disparate quality, often lacking granular patient and institutional data. Information on volume-outcome relationships and the impact of resident involvement are controversial.¹⁰⁻¹⁵ For intracranial neoplasms, the trend suggests a reduction in perioperative mortality at centers with higher case volumes, resulting in a push for centralization to high-volume centers and surgeons.¹⁶⁻²³ “Higher case volume” has largely been defined as more than 10 to 24 annual cases per institution, depending on the specific tumor. Whether the improved outcome seen with such modestly

“high”-volume practices can be maintained at institutions with very high case volume is unknown. Institutions with very high case volumes could be at risk for declining quality if volume and resources are not balanced and/or portions of some cases are delegated to less experienced trainees.

In that light, resident impact on surgical outcome has also garnered considerable interest. A recently published study evaluated the impact of resident participation on surgical outcomes among 266,411 patients in the National Surgical Quality Improvement Program database undergoing general, cardiothoracic, vascular, and neurologic surgical procedures between 2008 and 2012.²⁴ Resident involvement correlated with higher composite morbidity and operative mortality, although mortality rates following perioperative complications were lower when residents were involved. Stratification by training level revealed improved surgical outcomes with senior residents but with an increase in resource utilization. To help clarify these issues, we present perioperative outcome data on patients with intracranial neoplasms treated at our very high-volume, academic referral center.

PATIENTS AND METHODS

All patients undergoing neurosurgical procedures between January 1, 2009, and December 31, 2013, were selected from a prospectively curated departmental database. Four case types were selected: stereotactic needle, endoscopic, or open biopsies; intra-axial intracranial lesions; extra-axial and/or skull base lesions; and transsphenoidal resections for sellar masses.

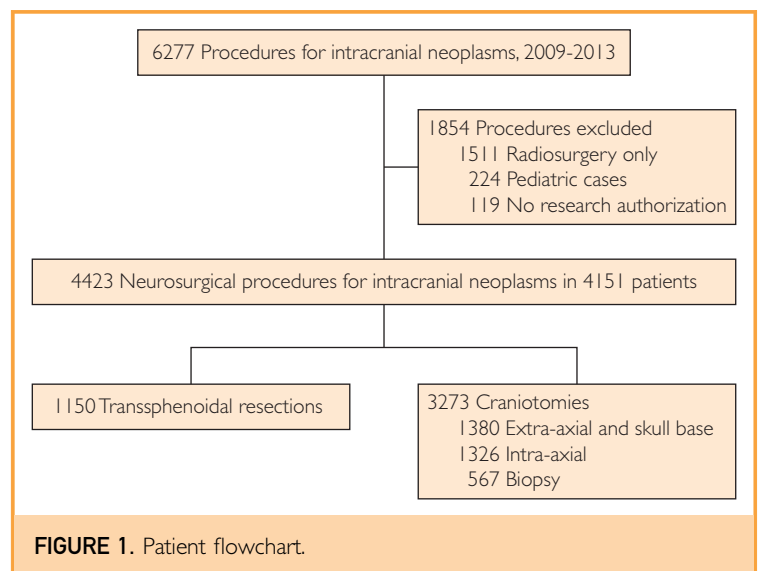
Thirty-day perioperative surgical complications were recorded as none, minor medical, major medical, minor neurologic, major neurologic, new seizures, wound complications, and perioperative mortality (all causes). We present the overall complication rates and compare outcomes in patients managed on consultant vs chief resident services. This study received preapproval by our institutional review board.

Statistical analysis was performed with JMP statistical software, version 10.0.0 (SAS Institute Inc). All ages are reported as mean and 95% CI. Contingency analysis was used to assess the impact of chief resident

involvement on outcomes. Likelihood ratios and Pearson tests of significance were used to determine statistical significance. Comparison of comorbidities was performed with the more parsimonious 1-way Fisher exact test. For all statistical tests, $P < .05$ was considered statistically significant.

RESULTS

Between January 1, 2009, and December 31, 2013, 6277 neurosurgical interventions for an intracranial neoplasm were performed at our institution. Procedures involving patients younger than 18 years (224), those undergoing radiosurgery only (1511), and patients who did not provide research consent (119) were excluded, leaving 4423 neurosurgical procedures performed in 4151 adult patients (Figure 1). All procedures were performed at a single hospital. There were 567 biopsies, 1326 intra-axial cases, 1380 extra-axial/skull base resections, and 1150 transsphenoidal resections in the 5-year period. Diagnoses in each category are provided in Supplemental Tables 1.1 through 1.4 (available online at <http://www.mayoclinicproceedings.org>). Low-grade astrocytomas and glioblastoma multiforme comprised 26.6% (353 of 1326) and 25.8% (342 of 1326) of all intra-axial neoplasms, respectively. In contrast, meningiomas and vestibular schwannomas comprised 50.8% (701 of 1380) and 19.8% (273 of



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