Surgery for Cerebellar Hemorrhage: A National Surgical Quality Improvement Program Database Analysis of Patient Outcomes and Factors Associated with 30-Day Mortality and Prolonged Ventilation

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■ OBJECTIVE: **Primary cerebellar hemorrhage accounts for 10% of all intracranial hemorrhages. Given the confined space of the posterior fossa, cerebellar hemorrhage management sometimes necessitates suboccipital decompression and hematoma evacuation. In this study, we examine outcomes after surgery for primary cerebellar hemorrhage and identify risk factors associated with adverse outcomes.**

■ METHODS: **A retrospective review of the 2005–2014 American College of Surgeons-National Surgical Quality Improvement Program database was performed, with Current Procedural Terminology Code 61315 (suboccipital craniectomy or craniotomy for evacuation of cerebellar hemorrhage) queried between 2005 and 2014. Patient demographics, preoperative comorbidities, and 30-day outcomes were analyzed. Univariate and multivariate regression analyses were performed to identify predictors of mortality and adverse events.**

■ RESULTS: **A total of 158 craniotomies were studied, with a 30-day mortality rate of 26.6%. The most common adverse events included ventilator dependence after 48 hours (48.7%) and pneumonia (24.1%). Almost one quarter (24.7%) of patients required additional operations, with 8.5% of patients undergoing repeat craniotomy. Death was associated with premorbid dependent functional status ($P = 0.005$), American Society of Anesthesiologists class ($P = 0.010$), and history of congestive heart failure ($P = 0.031$). Prolonged ventilation was associated with premorbid functional status ($P = 0.043$) and ventilator dependence ($P = 0.007$) before surgery.**

■ CONCLUSIONS: **Cerebellar hemorrhage is associated with significant risk of mortality and ventilator dependence. In patients who require surgery, 30-day mortality risk remains high (26.6%), with functional status and American Society of Anesthesiologists class predictive of death.**

INTRODUCTION

Primary cerebellar hemorrhage accounts for 10% of all intracerebral hemorrhages.[1,2] Given the confined space of the posterior fossa, multiple studies[3-7] and current guidelines[8] recommend prompt evacuation of hemorrhages in patients with neurologic deterioration, brainstem compression, or hydrocephalus. To date, there have been several studies that compare surgery versus ventriculostomy and medical management,[3,6,7,9-14] with most studies recommending surgical decompression.

Although several papers have found patient outcome can be predicted based on initial presentation and Glasgow Coma Scale (GCS) score before surgery,[4,13,15-22] outcome data based on status

Key words
- Cerebellar hemorrhage
- Functional status
- Mortality
- NSQIP
- Posterior fossa
- Ventilator dependence

Abbreviations and Acronyms
ACS: American College of Surgeons
ASA: American Society of Anesthesiologists
CHF: Congestive heart failure
CI: Confidence interval
CPT: Current Procedural Terminology
GCS: Glasgow Coma Scale
NSQIP: National Surgical Quality Improvement Program
OR: Odds ratio

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after surgery have been sparse. The functional status of survivors, many discharged to long-term ventilator facilities, also has been less clear, with most studies reviewing mortality as an endpoint exclusively. To better predict outcomes, in this study we use the prospective National Surgical Quality Improvement Program (NSQIP) database to review a large population of patients who underwent surgery for primary cerebellar hemorrhage, and identify characteristics associated with adverse outcomes. Patient hospital course and discharge destination is also explored.

MATERIAL AND METHODS

A retrospective review of the prospectively-collected American College of Surgeons (ACS)-NSQIP database was performed.[23] Data from 2005 to 2014 were queried, corresponding to Current Procedural Terminology (CPT) code 61315 (suboccipital craniectomy or craniotomy for evacuation of intracerebellar hematoma). Patients with CPT code 61314 (primary extra-parenchymal hemorrhage: epidural or subdural) were excluded, as were patients with CPT or *International Classification of Diseases*, Ninth Revision (ICD-9) codes corresponding to a traumatic injury, vascular malformation, cerebral aneurysm, or tumor. Project approval was obtained through the university institutional review board. As data collection involved no risk to participants and all NSQIP data are anonymized, a waiver for consent was granted.

Data Collection

Patient demographics and medical comorbidities were reviewed. Body mass index was calculated with weight and height data, and obesity was defined as body mass index >30. Comorbidities were analyzed only if present in at least 5 patients and data points must have been available in at least one half of patients to be considered for statistical analysis. As complete data was not available for all cases, percentile values were calculated from the proportion of patients in whom information was available. Functional status before surgery was dichotomized into independent versus partially or totally dependent. The American Society of Anesthesiology (ASA) physical status classification was binned into groups 1–3 and 4–5 to classify patient fitness before surgery.

Outcome Measures

The primary outcomes measured were mortality and prolonged ventilation. Data for return to the operating room within 30 days, unplanned reoperation related to the primary surgery, length of hospital stay, discharge destination, and medical problems during admission also were recorded. When complete data was not available, percentile values were calculated from the proportion of patients in whom information was available. Adverse events needed to be present in at least 5 patients to be reviewed.

Statistical Analysis

Two-tailed Student t tests were performed for continuous variables and Pearson χ^2 tests or Fisher exact tests were used to compare proportions between categorical data. Univariate analysis of risk factors related to death or prolonged ventilation was performed for demographic variables, including age, sex, functional status, ASA class, and race, as well as for comorbidities. Statistically significant values were identified with a $P < 0.05$, and confidence intervals (CIs) were defined at 95%.

Multivariate logistic regression models were performed to evaluate predictors of mortality and prolonged ventilation. All demographic variables and comorbidities that were statistically significant on univariate analysis were included in regressions. Statistical analyses were performed with SPSS (IBM Corp., Armonk, New York, USA) and custom software.

RESULTS

Demographics and Preoperative Status

A total of 158 craniotomies for cerebellar hemorrhage were analyzed. Demographic data is illustrated in Table 1. The population included 96 male and 62 female patients, with a mean age of 60 years. Two-thirds of patients had an

Table 1. Demographic Data

	n (%)*
Total cases	158
Age, years	
18–60	71 (45.2%)
60–70	42 (26.8%)
70–80	34 (21.7%)
80+	10 (6.4%)
Sex	
Male	96 (60.8%)
Female	62 (39.2%)
Functional status	
Independent	105 (66.5%)
Partially dependent	14 (8.9%)
Totally dependent	34 (21.5%)
ASA class	
1	0
2	2 (1.3%)
3	41 (25.9%)
4	96 (60.8%)
5	18 (11.4%)
Race	
White	83 (52.5%)
Black	27 (17.1%)
Hispanic	13 (8.2%)
Asian	15 (9.5%)
Other/unknown	20 (12.7%)

ASA, American Society of Anesthesiologists.
*Of patients in whom data was available.