



Predictors of 30-day perioperative morbidity and mortality of unruptured intracranial aneurysm surgery



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ABSTRACT

Introduction: Large-scale studies examining the incidence and predictors of perioperative complications after surgical clipping of unruptured intracranial aneurysms (UIA) using nationally representative prospectively collected data are lacking in the literature.

Methods: Using the American College of Surgeons' National Surgical Quality Improvement Program (ACS-NSQIP) dataset, we conducted a retrospective analysis of the complications experienced by patients that underwent surgical management of a UIA between the years of 2007 and 2013. The primary outcomes of interest were mortality within the 30-day perioperative period and adverse discharge disposition to a location other than home. Predictors of morbidity and mortality were elucidated using multivariable logistic regression analyses controlling for available patient demographic, comorbidity, and operative characteristics.

Results: 662 patients were identified in the ACS-NSQIP dataset for operative management of an unruptured aneurysm. The observed rates of 30-day mortality and adverse discharge disposition were 2.27% and 19.47%, respectively. A hundred and eight (16.31%) patients developed at least one major complication. On multivariable analysis, death within 30 days was significantly associated with increased operative time (OR 1.005 per minute, 95% CI 1.002–1.008) and chronic preoperative corticosteroid use (OR 28.4, 95% CI 1.68–480.42), whereas major complication development was associated with increased operative time (OR 1.004 per minute, 95% CI 1.002–1.006), age (OR 1.017 per year, 95% CI 1–1.034), preoperative dependency (OR 3.3, 95% CI 1.16–9.40) and diabetes mellitus (OR 2.89, 95% CI 1.45–5.75). Lastly, increasing age (OR 1.017 per year, 95% CI 1–1.034) as well as ASA Class 3 (OR 1.73, 95% CI 1.08–2.77) and 4 (OR 2.28, 95% CI 1.1–4.72) were independent predictors of discharge to a location other than home.

Conclusion: Our study yields morbidity and mortality benchmarks for UIA surgery in a representative, national surgical registry. It will hopefully aid in recognizing those patients at greater risk for post-operative complications following surgical management, leading to appropriate changes in treatment strategies for this selected group of patients.

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1. Introduction

Unruptured intracranial aneurysms (UIA) is a relatively common intracranial pathology, with an estimated prevalence in the US population between 2 and 3% [1,2]. Available modern imaging modalities have dramatically increased the ability to detect these lesions. Despite the continued advancement in endovascular techniques, surgical clip occlusion, although invasive, remains a viable

Table 1
Published studies on perioperative outcomes after surgical clipping of an unruptured intracranial aneurysm.

Study	Study Design	Sample Size	Mortality rate	Overall Complication rate	Discharge other than home
Suzuki et al, 2015	Single-institutional, retrospective	141	0%	Serious adverse event – 12.1% Total adverse event – 22.7%	N/A
Chen et al, 2015	Single-institutional, retrospective	150	0%	6.7%	N/A
Jalbert et al, 2015	Medicare Beneficiaries	7942	1.6%–3.2%	In-hospital complications: 25.0–28.9%	Acute Care: 1.0–12.3% Long-term care: 29.7%– 44.2%
Bruneau et al, 2015	International, multi-institutional, retrospective	183	0%	14.8%	N/A
Mahaney et al, 2014	International, multi-institutional Prospective (ISUIA)	1917	< 50 y/o: 0.6% 50–65 y/o: 1.2% > 65 y/o: 2.2%	N/A	N/A
Bekelis et al, 2014	NIS	3682	0.7%	N/A	15.26%
McDonald et al, 2013	Premier Perspective Database	1380	0.7%	N/A	17%
Brinjikji et al, 2011	NIS	29,918	1.2%	N/A	14.0%
Krisht et al, 2006	Single-institutional, prospective	116	0.82%	Permanent morbidity – 3.44% Transient morbidity – 7.7%	N/A
Wiebers et al., 2003	International, multi-institutional prospective (ISUIA)	1917	No Prior History of SAH – 1.8% Prior History of SAH – 0.3%	No Prior History of SAH – 12.2% Prior History of SAH – 10.6%	N/A

* NIS: Nationwide Inpatient Sample; ISUIA: International Study of Unruptured Intracranial Aneurysms; SAH: Subarachnoid hemorrhage.

*N/A denotes that the rate (a) was not reported in the study or (b) could not be calculated using the data provided in the study.

therapeutic option for the treatment of UIA [3–6]. One of the keys to maximizing benefit from surgical clip ligation lies in identifying risk factors associated with *peri*-operative complications, thus facilitating the anticipation and potential prevention of these adverse events.

While many studies have examined risk factors associated with long-term morbidity and mortality after intracranial aneurysm surgery [7–10], there is a relative paucity of literature investigating predictors of post-procedural complications that may nevertheless significantly impact patient outcomes (Tables 1 and 2).

Herein, we performed an analysis of the complications experienced by patients that underwent surgical management of an UIA within the American College of Surgeons National Quality Improvement Program (NSQIP) surgical registry, with the aim of identifying predictors of both major and minor *peri*-procedural complications as well as factors associated with adverse discharge disposition and increased total length of stay.

2. Methods

2.1. Data source

The American College of Surgeons' National Surgical Quality Improvement Program (ACS-NSQIP) dataset between the years of 2007 and 2013 was queried for this retrospective cohort analysis. The NSQIP dataset contains more than 130 variables on patient preoperative risk factors, intraoperative data, and 30-day postoperative morbidity and mortality outcomes. The registry has grown significantly since its inception in 2004. By December 2008, almost 200 hospitals were contributing data and were receiving real-time, risk-adjusted feedback on their surgical outcomes [11]. Currently, it holds information on more than 1.7 million patients from more than 500 hospitals, 58% of which are large academic institutions. Moreover, 49% of all the enrolled hospitals have 500 or more licensed beds and 33% have 300–499 beds [11,12]. In addition, the majority of the data represent a random sample of all procedures performed by the various surgical subspecialties [11]. Data collectors are used at each participating institution to capture this information, which undergo extensive training on appropriate practices prior to the initiation of data collection. More importantly, quality control processes including inter-rater reliability audits by

Surgical Clinical Reviewers to ensure that data is collected and maintained with high fidelity.

2.2. Inclusion and exclusion criteria

Patients with unruptured cerebral aneurysms were identified in the NSQIP data registry using a postoperative *International Classification of Disease, 9th Revision (ICD-9)* code of 437.3. Exclusion criteria included: history of disseminated cancer, endovascular management, and surgery completed under emergent conditions.

2.3. Outcomes

The primary outcome of interest was mortality within the 30 day perioperative period. Secondary outcomes included adverse discharge disposition defined as discharge to a location other than home. Major or minor complication within the 30-day perioperative period were also evaluated. As defined in prior work using the NSQIP surgical registry [13], major complications included deep incisional surgical site infection, organ space infection, wound dehiscence, reintubation, pneumonia, pulmonary embolus, failure to wean ventilatory support within 48 h of surgery, renal failure, renal insufficiency, stroke, coma, nerve injury, cardiac arrest, myocardial infarction, sepsis, septic shock, or return to the operating room within 30 days of surgery. Minor complications included deep vein thrombosis (DVT), urinary tract infection (UTI), or superficial surgical site infection. Length of stay was also investigated and was measured as a continuous variable in days.

2.4. Covariates

Patient and operative variables available for analysis included: age, total operative time in minutes, patient functional status, ASA physical status classification category (Table 3), race, Body Mass Index (BMI) as defined by the World Health Organization Classification scheme, gender, smoking status, history of diabetes, hypertension requiring medication, history of congestive heart failure (CHF), history of severe chronic obstructive pulmonary disease (COPD), history of dyspnea either with activity or at rest, history of bleeding disorder, and history of chronic corticosteroid use within the 30 days of the operation.

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