

Predictors of Complications After Clipping of Unruptured Intracranial Aneurysms: A National Surgical Quality Improvement Program Analysis

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Introduction

The goal of this study was to create a predictive scale to risk-stratify patients before surgery for intracranial aneurysms.

Methods

Patients who underwent craniotomy for clipping of an unruptured aneurysm were extracted from the prospective National Surgical Quality Improvement Program registry (2007-2014). Multivariable logistic regression evaluated predictors of developing a complication within thirty days; predictors screened included patient demographics, comorbidities, American Society of Anesthesiologists classification, functional status, and preoperative laboratory values. Independent predictors were utilized to build a predictive scale, which was validated using the Nationwide Inpatient Sample (2002-2011).

Table 1: Predictors of developing any complicationafter clipping of unruptured aneurysms in NSQIPPopulation

	Odds Ratio	95% CI	P-value
Age, years			
18-50	Ref.		
51-60	2.54	1.30-4.97	0.006
61-70	4.08	2.10-7.93	< 0.001
> 70	4.91	2.21-10.91	< 0.001
Cardiac Disease			
No	Ref.		
Yes	2.67	1.09-6.52	0.03
Missing	0.77	0.49-1.23	0.28
Diabetes mellitus	2.08	1.10-3.94	0.03
Body Habitus			
Non-Obese	Ref.		
Obese	0.85	0.47-1.54	0.60
Morbidly Obese	2.07	1.15-3.73	0.02
Preoperative WBC Count			
≤12,000/µL	Ref.	-	
>12,000/µL	3.84	1.51-9.75	0.005
Not Obtained	0.39	0.15-10.27	0.57
Preoperative Hematocrit			
≥36%	Ref.	•	
<36%	2.05	1.12-3.72	0.02
Not Obtained	1.12	0.04-29.39	0.95
Operative Time			
<270 minutes	Ref.	÷	
270-330 minutes	2.05	1.22-3.44	0.007
>330 minutes	3.13	1.77-5.52	< 0.001
C-Statistic		0.76	
Hosmer-Lemeshow Test		0.24	

Results

A total of 626 patients were included in the study population, in whom 19.4% (n=119) developed any complication and 13.7% (n=84) a major complication. The NSQIP-unruptured aneurysm scale was constructed by incorperating independent predictors of adverse events (Table 1) into a scoring system assigning points based on the odds ratio of multivariable logistic regression (Table 2). Increased score was associated with higher odds of a major complication in the study (odds ratio (OR): 1.42, 95% confidence interval (CI): 1.28-1.57, p<0.001, C: 0.74) and the validation (OR: 1.21, 95% CI: 1.17-1.25, p<0.001, C: 0.62) populations (Table 3). Greater score was also associated with increased odds of mortality, any complication, stroke or coma, cardiac complications, postoperative mechanical ventilation, venous thromboembolism, infectious complications, reoperation, extended length of stay, and nonroutine hospital discharge in both the study and the validation populations (p=0.04) (Figure 1).

Table 2: Components of the NSQIP & craniotomy: unruptured aneurysm scale score

Points	Variable	Stratification	Prevalence NSQIP	Prevalence NIS	
2	Patient Age	51-60 Years	32.1%	32.6%	
2	Comorbidity	Cardiac: Coronary Artery Disease or Congestive Heart Failure	9.1%*	8.7%	
2	Comorbidity	Diabetes Mellitus	10.6%	9.5%	
2	Body Habitus	WHO Class II or III Obesity (BMI > 35 kg/m ²)	14.9%	1.7%	
2	Laboratory Value	Anemia (Hematocrit < 36%)	12.3%	6.8%	
2	Operative Time	240-330 Minutes	33.1%		
3	Laboratory Value	Leukocytosis (WBC Count >12,000/µL)	4.1%	1.8%	
3	Operative Time	> 330 Minutes	21.2%		
4	Patient Age	61-70 Years	29.1%	24.0%	
4	Patient Age	>70 Years	10.1%	7.3%	
18	Maximum Potential Score				

Table 3: Use of the NSQIP unruptured aneruysm scale score to predict complications

Outcome	Odds Ratio	
Mortality	1.41 (1.14-1.75)	
Any Adverse Event	1.45 (1.32-1.59)	
Stroke or Coma	1.49 (1.30-1.69)	
Cardiac Complications	1.51 (1.02-2.23)	
Mechanical Ventilation	1.30 (1.14-1.49)	
VTE	1.45 (1.15-1.84)	
Infectious Complications	1.17 (1.04-1.31)	
Reoperation	1.38 (1.16-1.63)	
Extended Hospitalization	1.30 (1.20-1.41)	
Nonroutine Discharge	1.35 (1.21-1.52)	
Unplanned Readmission	1.23 (1.07-1.41)	

Conclusions

The NSQIP-unruptured cerebral aneurysm scale is predictive of several different complications and outcomes after clipping of unruptured aneurysms, and identifies patients with the greatest odd of an adverse event.

