Complications in Neurological Surgery: Nationwide Trends in Morbidity from 2005-2010

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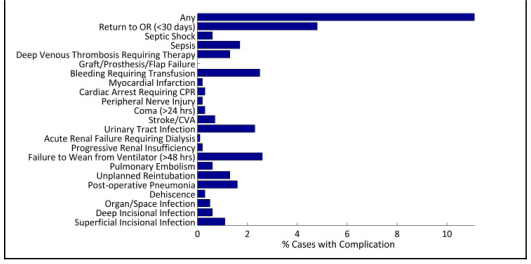
Fig. 1. Complications in Neurosurgical Procedures



Introduction

Medical errors lead to nearly 100,000 deaths and $6 billion in extraneous costs annually. Despite this impact, medical errors and complications have largely escaped investigation in neurological surgery. Here, we use the National Surgical Quality Improvement Program (NSQIP) database to quantify neurosurgical complications. The NSQIP database includes cases from >200 hospitals, collected by trained raters in an unbiased manner.

Methods

Data were acquired from the NSQIP database public use file. All procedures whose primary surgeon was identified as a neurosurgeon were extracted. Analysis was conducted using Matlab 2011b (Mathworks Inc., Natick, MA) and SPSS v20 (IBM Corp., Armonk, NY). Data are reported as mean ± SEM.

Results

Complications were reported in 11.1% of 20,564 cases studied. Complications were significantly more likely in cranial (20.2%) than spinal surgery (7.9%; RR 10.7, 95% CI 10.1 to 11.4). However, the ASA class of cranial patients significantly exceeded that of spinal patients (2.88 ± 0.01 vs. 2.40 ± 0.01, P < 0.00001). Fig. 1 and 2, and Table 1 show the frequency of each type of complication. Table 2 shows the results of a multivariate logistic regression model to determine significant predictors of complications.

Table 1. Complications in Neurosurgery

Complication	Cranial Surgery	Spinal Surgery	All Neurosurgery Combined	Relative Risk, Cranial vs. Spinal (95% CI)
Superficial Incisional Infection	40 (0.7)	175 (1.2)	215 (1.1)	0.634 (0.450, 0.892)*
Deep Incisional Infection	21 (0.4)	92 (0.6)	113 (0.6)	0.633 (0.394, 1.016)
Organ/Space Infection	51 (0.9)	42 (0.3)	93 (0.5)	3.366 (2.240, 5.058)*
Dehiscence	25 (0.5)	43 (0.3)	68 (0.3)	1.612 (0.986, 2.636)
Post-operative Pneumonia	225 (4.1)	108 (0.7)	333 (1.6)	5.776 (4.601, 7.250)*
Unplanned Reintubation	165 (3.0)	92 (0.6)	257 (1.3)	4.927 (3.860, 6.404)*
Pulmonary Embolism	71 (1.3)	47 (0.3)	118 (0.6)	4.188 (2.901, 6.047)*
Failure to Wean from Ventilator (>48 hrs)	438 (8.1)	104 (0.7)	542 (2.6)	11.676 (9.450, 14.426)*
Progressive Renal Insufficiency	14 (0.3)	17 (0.1)	31 (0.2)	2.283 (1.126, 4.628)*
Acute Renal Failure Requiring Dialysis	13 (0.2)	10 (0.1)	23 (0.1)	3.604 (1.581, 8.214)*
Urinary Tract Infection	217 (4.0)	247 (1.6)	464 (2.3)	2.436 (2.035, 2.915)*
Stroke/CVA	119 (2.2)	21 (0.1)	140 (0.7)	15.710 (9.889, 24.957)*
Coma (>24 hrs)	68 (1.3)	3 (0.0)	71 (0.3)	62.840 (19.781, 199.627)*
Peripheral Nerve Injury	8 (0.1)	24 (0.2)	32 (0.2)	0.924 (0.415, 2.056)
Cardiac Arrest Requiring CPR	29 (0.5)	24 (0.2)	53 (0.3)	3.350 (1.952, 5.748)*
Myocardial Infarction	13 (0.2)	25 (0.2)	38 (0.2)	1.442 (0.738, 2.816)
Bleeding Requiring Transfusion	172 (3.4)	332 (2.2)	504 (2.5)	1.436 (1.198, 1.722)*
Graft/Prosthesis/Flap Failure	3 (0.1)	5 (0.0)	8 (0.0)	1.663 (0.398, 6.958)
Deep Venous Thrombosis Requiring Therapy	143 (2.6)	115 (0.8)	258 (1.3)	3.447 (2.702, 4.398)*
Sepsis	216 (4.0)	122 (0.8)	338 (1.7)	4.908 (3.940, 6.115)*
Septic Shock	84 (1.5)	44 (0.3)	128 (0.6)	5.293 (3.680, 7.612)*
Return to OR (<30 days)	459 (8.5)	533 (3.5)	992 (4.8)	2.387 (2.116, 2.694)*
Any Complication	***1097 (20.2)***	***1181 (7.9)***	***2278 (11.1)***	***2.575 (2.386, 2.779)****

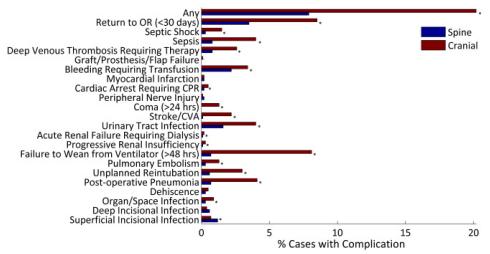
*Denotes a statistically significant difference.

Table 2. Significant Predictors of Complications

Characteristic	Odds Ratio (95% CI)
Race	
White	1 [reference]
Black or African American	1.18 (1.01, 1.39)*
Asian or Pacific Islander	0.95 (0.65, 1.39)
American Indian or Native Alaskan	0.38 (0.17, 0.88)*
Spinal vs. Cranial	
Spinal	1 [reference]
Cranial	1.24 (1.08, 1.41)*
Inpatient vs. Outpatient	
Outpatient	1 [reference]
Inpatient	1.84 (1.44, 2.35)*
Diabetes	
No	1 [reference]
Insulin-dependent	1.28 (1.06, 1.56)*
Not insulin-dependent	1.01 (0.86, 1.20)
Ventilator dependent prior to surgery	
No	1 [reference]
Yes	3.54 (2.49, 5.03)*
Altered mental status	
No	1 [reference]
Yes	1.63 (1.32, 2.02)*
Prior stroke with persistent neurological deficit	
No	1 [reference]
Yes	1.73 (1.40, 2.13)*
Prior stroke with no deficit	
No	1 [reference]
Yes	1.56 (1.18, 2.07)*
Paraplegia/paraparesis prior to surgery	
No	1 [reference]
Yes	1.56 (1.28, 1.90)*
Quadriplegia/quadriparesis prior to surgery	
No	1 [reference]
Yes	2.30 (1.58, 3.36)*
Open wound	
No	1 [reference]
Yes	1.61 (1.18, 2.19)*
Chronic steroid use	
No	1 [reference]
Yes	1.38 (1.14, 1.67)*
Transfused >4 units prior to surgery	
No	1 [reference]
Yes	3.64 (1.76, 7.52)*
Sepsis prior to surgery	
No	1 [reference]
SIRS	2.18 (1.71, 2.77)*
Sepsis	1.78 (1.17, 2.69)*
Septic Shock	0.97 (0.47, 2.00)
Emergency Case	
No	1 [reference]
Yes	2.69 (2.24, 3.22)*

*Denotes a statistically significant difference.

Fig. 2. Complications in Cranial and Spinal Neurosurgery



* indicates significance P < 0.001.

Conclusions

Reported complications are more common in cranial than spinal procedures, and this may relate to the lower ASA class found in cranial patients. Interestingly, the most common complication was prolonged intubation. Understanding the most frequent complications in neurological surgery will allow us to better counsel patients and better design targeted interventions to improve patient outcomes.

References

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