Unplanned Returns to the Operating Room Within 30 Days in Neurosurgery: Insights from a National Surgical Registry

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Introduction

In the modern, increasingly pay-for-performance era, unplanned ROR is gaining attention as a surgical quality metric. However, large-scale data on the appropriateness and utility of this measure in neurosurgery are scarce. Objective of the presented study is to provide a comprehensive description of all unplanned returns to the operating room (RORs) after neurosurgical procedures in a national surgical registry and identify factors associated with ROR.

Comparison of patients who returned to the operating room within 30 days compared to those who did not

Variable	No ROR within 30 days N = 186,964	ROR within 30 days N = 7,014	p-value
Age, median (IQR)	58.0 [47.0;68.0]	60.0 [49.0;69.0]	<0.001
Female sex, n (%)	90344 (48.5%)	3310 (47.2%)	0.039
Race, n (%)			<0.001
White	145535 (87.5%)	5100 (83.1%)	
Asian	3797 (2.28%)	160 (2.61%)	
African-American	15318 (9.21%)	794 (12.9%)	
Other	1727 (1.04%)	85 (1.38%)	
Hispanic ethnicity, n (%)	10251 (6.14%)	423 (6.84%)	0.026
BMI, median (IQR)	29.0 [25.4;33.5]	29.1 [25.2;34.3]	0.018
BMI WHO categories, n (%)			<0.001
< 18.5	2078 (1.13%)	103 (1.51%)	
18.5-24.9	39584 (21.6%)	1484 (21.8%)	
25-29.9	61956 (33.8%)	2165 (31.8%)	
30-34.9	44644 (24.3%)	1540 (22.6%)	
35-39.9	21540 (11.7%)	880 (12.9%)	
≥ 40	13638 (7.43%)	637 (9.36%)	
ASA Classification, n (%)			<0.001
I	7411 (3.97%)	132 (1.88%)	
II	80648 (43.3%)	1951 (27.8%)	
III	86716 (46.5%)	3785 (54.0%)	
IV	10742 (5.76%)	1038 (14.8%)	
V	461 (0.25%)	83 (1.18%)	
None assigned	467 (0.25%)	25 (0.36%)	<0.001
Inpatient procedure, n (%)	141334 (75.8%)	6321 (90.1%)	
Preoperative functional status, n (%)			<0.001
Independent	179612 (96.9%)	6514 (93.7%)	
Partially Dependent	5001 (2.70%)	357 (5.13%)	
Totally Dependent	710 (0.38%)	84 (1.21%)	
Wound class			<0.001
1-Clean	181739 (97.5%)	6608 (94.2%)	
2-Clean/Contaminated	2205 (1.18%)	114 (1.63%)	
3-Contaminated	676 (0.36%)	48 (0.68%)	
4-Dirty/Infected	1825 (0.98%)	244 (3.48%)	

Methods

We queried the ACS-NSQIP registry for patients undergoing neurosurgical procedures during 2012-2016. The incidence, timing and nature of 30-day unplanned ROR after major procedure groups were determined. Logistic regression was conducted to identify factors associated with 30-day unplanned ROR following the three most common cranial and spinal operations: craniotomy for intra-axial neoplasm, supratentorial meningioma or skull base tumors, anterior cervical discectomy and fusion, posterior lumbar decompression and posterior lumbar fusion.

Comparison of patients who returned to the operating room within 30 days compared to those who did not

Variable	No ROR within 30 days N = 186,964	ROR within 30 days N = 7,014	p-value
Smoker, n (%)	41847 (22.4%)	1629 (23.2%)	0.128
Comorbidities, n (%)			
CHF	802 (0.43%)	68 (0.97%)	<0.001
Diabetes mellitus	29878 (16.0%)	1390 (19.8%)	<0.001
On chronic steroids	10260 (5.50%)	619 (8.83%)	<0.001
Hypertension	89216 (47.9%)	3723 (53.1%)	<0.001
COPD	7988 (4.28%)	395 (5.63%)	<0.001
Ventilator dependent	1624 (0.87%)	357 (5.09%)	<0.001
Bleeding diathesis	4196 (2.25%)	388 (5.53%)	<0.001
Need of chronic transfusion	551 (0.30%)	88 (1.25%)	<0.001
Preoperative lab values			
Sodium < 135 mEq/L	10947 (6.63%)	723 (11.1%)	<0.001
Hematocrit < 35%	15874 (9.21%)	1165 (17.5%)	<0.001
Platelets < 150,000/	9830 (5.78%)	601 (9.10%)	<0.001
WCC ≥ 12,000/μL or ≤ 4,000/μL	19881 (11.7%)	1354 (20.5%)	<0.001
Albumin < 3 g/dl	3321 (4.40%)	405 (11.4%)	<0.001
INR ≥ 1,3	3003 (2.38%)	299 (5.63%)	<0.001
Estimated GFR			<0.001
Normal: eGFR <15	722 (0.44%)	79 (1.21%)	
CKD 2: eGFR 15-29	1177 (0.71%)	88 (1.35%)	
CKD 3: eGFR 30-59	18103 (10.9%)	769 (11.8%)	
CKD 4: eGFR 60-89	69108 (41.7%)	2394 (36.7%)	
CKD 5: eGFR >=90	76771 (46.3%)	3188 (48.9%)	
Operative time, median [IQR]	125 [80.0; 193]	157 [99.0; 249]	<0.001
Work relative value unit, median [IQR]	22.1 [15.4; 25.7]	24.6 [17.3; 30.8]	<0.001

Abbreviations: BMI: body mass index; CKD: chronic kidney disease; CHF: congestive heart failure; COPD: chronic obstructive pulmonary disease; GFR: glomerular filtration; INR: international normalized ratio; WCC: white cell count

Results

A total of 193,459 neurosurgical cases were identified, of which 7067 (3.7%) had at least one unplanned ROR within 30 days after the index procedure. Rates were 4.3% and 1.5% for inpatient and outpatient procedures, respectively. Median time [interquartile range] to ROR was 11 days [4-12]. Overall, the most common reasons were wound complication/surgical site infection (0.7%), hematoma evacuation (0.6%) and repeat surgery (0.5%). Within inpatient cranial cases, the three procedures with the highest 30-day unplanned ROR rates were craniotomies for intracranial infection/abscess (14.7%) followed by subdural hematoma (14.1%), and subarachnoid hemorrhage (12.2%). Within inpatient spinal cases, the highest reoperation rates were observed among thoracic fusions (6.9%), thoracic decompressions (5.6%) and "long" deformity fusions (5%). On multivariable analysis, the relative amount of variation in reoperation risk was found to be 1-25% for demographics, 1-22% for comorbidities, 1-6% for preoperative lab values and 2-46% for operative characteristics.

Conclusions

Significant variations in rates of 30-day unplanned ROR exist among neurosurgical procedures. The findings may inform stakeholders on the optimal parameters that need to be taken into account when crafting, endorsing and implementing quality metrics for neurosurgery that aim to assess surgical performance and reward or penalize hospitals and providers.

Contribution of composite variables for the variation in 30-day unplanned return to the operating room among the most common cranial and spinal procedures

Composite importance	CRANIAL			SPINAL		
Proportion of Chi Square	**Intra-axial neoplasm**	**Convexity/falx meningioma**	**Skull base tumors**	**ACDF**	**Lumbar decompression**	**PLF**
Full model Wald Chi-square	112.6	89.98	66.34	238.44	251.81	213.03
Demographics	1%	3%	1%	24%	3%	5%
Comorbidities	19%	12%	< 1%	12%	18%	9%
Preoperative lab values	6%	6%	2%	2%	< 1%	5%
Operative characteristics	29%	40%	58%	4%	20%	34%
c-statistic	0.64	0.69	0.68	0.72	0.67	0.63

*ACDF: anterior cervical discectomy and fusion; PLF: posterior lumbar fusion