Annual Meeting of the AANS/CNS Cerebrovascular Section
Held in conjunction with the 4th SNIS International Endovascular Stroke Conference (IESC)
February 10-11, 2014
Hard Rock Hotel
San Diego, CA

The Impact of Patient Age and Comorbidities on the Occurrence of "Never Events" in Cerebrovascular Surgery

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Introduction

As healthcare administrators focus on patient safety and cost-effectiveness, methodical assessment of quality outcome measures is critical. In 2008, the Centers for Medicare and Medicaid Services (CMS) published a series of "Never Events" which included 11 hospital acquired conditions (HACs), for which related costs of treatment are not reimbursed. Cerebrovascular procedures (CVPs) are complex and often performed on patients with significant medical comorbidities.

Methods

Admissions associated with CVPs were abstracted from the 2002-2010 Nationwide Inpatient Sample according to procedural and diagnosis ICD-9CM codes. HAC's were identified using diagnosis ICD-9CM codes provided by CMS. A multivariable logistic regression model using survey-adjusted generalized estimating equations was conducted to assess the relationship between patient age and medical comorbidities with the outcome of ever having a HAC (adjusting for gender, bed size, teaching status, region, CVP volume, and location). Additionally, We we fit multivariable logistic regression models to describe the relationship of the covariates to prolonged LOS and increased costs (both defined as at or above the 90th percentile), adjusting for HAC occurrence in addition to the aforementioned factors.

TABLE: HOSPITAL ACQUIRED CONDITIONS (HAC) ICD-9CM CODES, 2002-2010

Hospital Acquired Condition	Diagnosis Code
Air Embolism	999.1
Foreign Objects	998.4, 998.7
Blood Incompatibility	999.60-999.63, 999.69
Pressure Ulcers	707.23, 707.24
Catheter Associated Urinary Tract Infection	996.64
Vascular Catheter Associated Infection	999.31
Poor Glycemic Control	250.10-250.13, 250.20-250.23, 251, 249.10, 249.11, 249.20, 249.21
Falls/Trauma	800-829, 830-839, 850-854, 925-929, 940-949, 991-994

TABLE: CEREBROVASCULAR PROCEDURE ICD-9CM CODES, 2002-2010

Cerebrovascular Procedure	Diagnosis Code	Procedure Code
Aneursym clipping	430, 437.3	39.51
Arteriovenous Malformation Resection	747.81	01.59
Carotid Endartectomy	433.10, 433.11	38.12
EC/IC Bypass	437.3, 430, 433, 433.01, 433.11, 433.21, 433.31, 433.91, 434, 434.01, 435, 437, 437.01-437.09	39.28
Aneursym coiling	430, 437.3	39.79, 39.72, 39.52
Arteriovenous Malformation Embolization	747.81	39.72
Carotid Stenting	433.1, 433.11	00.63
Mechanical Thrombectomy	433.01, 433.11, 433.21, 433.21, 433.91 434.01 ,434.11, 434.91, 436, 433, 433.2, 433.1, 433.3, 433.9, 437, 437.1	39.74

Results

From 2002 to 2010, there were 1,290,166 admissions associated with cerebrovascular procedures. HACs occurred at a frequency of 0.49% (6,321 admissions had a HAC; 1.33% in the intracranial procedures and 0.33% in the carotid procedures). Falls/Trauma (n=4,610, 72.3% HACs, 357 HACs per 100,000 CVPs) and Catheter Associated Urinary Tract Infections (n=714, 11.2% HACs, 55 HACs per 100,000 CVPs) were the most common events. Younger age was associated with lower probabilities of incurring a HAC (p<0.01), while patients with two or more comorbidities were associated with two times increased odds of having a HAC (p<0.01). HAC occurrence negatively impacts both LOS and hospital costs. Patients with at least one HAC were ten times more likely to have prolonged LOS (>90th percentile) (p < 0.01), and seven times more likely to have high inpatient costs(>90th percentile) (p < 0.01) when adjusting for patient and hospital factors.

TABLE: CEREBROVASCULAR PROCEDURE (CVP) FREQUENCIES, 2002-2010

Cerebrovascular Procedure Frequency	N	% of all CVP	N with HAC	% with HAC
Aneursym clipping	88,551	6.8%	1157	1.3%
Arteriovenous Malformation Resection	10,816	0.8%	185	1.7%
Carotid Endartectomy	992,595	76.4%	3158	0.3%
EC/IC Bypass	1,649	0.1%	25	1.5%
Aneursym coiling	88,593	6.8%	1189	1.3%
Arteriovenous Malformation Embolization	14,919	1.1%	107	0.7%
Carotid Stenting	91,958	7.1%	396	0.4%
Mechanical Thrombectomy	10,532	0.8%	236	2.2%
Total	1,299,613			

TABLE: HAC OCCURRENCE PREDICTORS OF PROLONGED LOS AND HIGH COSTS, 2002-2010

	Prolonged Length of Stay			High Inpatient Costs		
HAC Occurrence	OR	95% CI	P-VALUE	OR	95% CI	P-VALUE
Yes	10.80	9.46, 12.33	< 0.0001	8.12	7.09, 9.31	< 0.0001
No	Reference			Reference		

TABLE: PATIENT AND HOSPITAL PREDICTORS OF HAC'S, 2002-2010

PATIENT PREDICTORS			
Comorbidities	**OR**	**95% CI**	**P-VALUE**
No comorbidities	Reference		
One	1.12	0.86, 1.45	0.3986
Two or more	2.24	1.79, 2.81	< 0.0001
Age Category	**OR**	**95% CI**	**P-VALUE**
60 years or younger	0.74	0.63, 0.86	0.0001
60-70 years old	0.41	0.34, 0.48	< 0.0001
70-80 years old	0.53	0.45, 0.62	< 0.0001
Over 80 years old	Reference		

Conclusions

Improved quality protocols focused on individual patient characteristics might help to decrease the frequency of HACs in this high-risk population. This data suggests that risk-adjustment according to underlying patient factors may be warranted when considering reimbursement for costs related to HACs in the setting of CVPs.

References

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Learning Objectives

Understanding cost and length of stay impact of hospital acquired conditions

Consideration of patient age and comorbidities on potential HAC occurrence