

Predictors of deep vein thrombosis and pulmonary embolism in neurosurgery: preliminary evidence from the National Surgical Quality Improvement Program

Andrew Karl Rock MHS; Emmy Miller; William C. Broaddus MD
Department of Neurosurgery, Virginia Commonwealth University
Corresponding Author: Andrew Rock (arock@vcu.edu)



Introduction

Patients undergoing neurosurgery are at risk for venous thromboembolism (VTE)

Preventive medical therapies reduce the incidence of deep vein thrombosis (DVT) and pulmonary emboli (PE), but may increase risk for bleeding

Understanding the prevalence of VTE and its predictors are imperative for better identifying those who may benefit from preventive therapeutic intervention

This study utilizes data from the National Surgical Quality Improvement Program (NSQIP) between 2005 and 2014 to estimate the prevalence of VTE and identify predictors of VTE in neurosurgery

Methods

Data on 3,723,797 patients during 2005-2014 was obtained from the NSQIP database

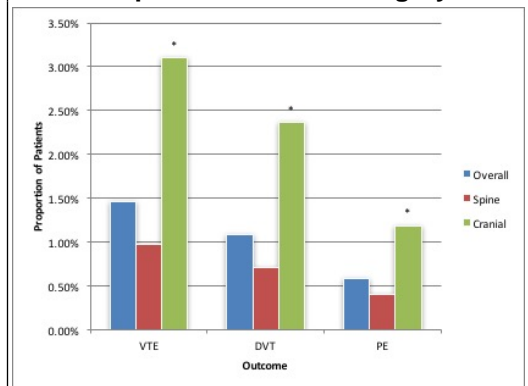
Current procedural terminology (CPT) codes classified cases as spine or cranial

VTE was defined as presence of either post-operative DVT or PE

Descriptive statistics estimated demographic and preoperative variables

Univariate analysis was performed for VTE, DVT, and PE

Proportion of Post-Operative Outcomes in Spine and Cranial Surgery



Chi-square analysis between proportion of outcomes across spine and cranial surgery, * <0.05

Multivariate Predictors for Venous Thromboembolism

Variable	Overall	Spine	Cranial
Age	1.02 (1.02-1.03)***	1.03 (1.02-1.04)***	1.02 (1.01-1.02)***
Height			1.02 (1.00-1.04)*
Weight	1.01 (1.01-1.01)***	1.01 (1.01-1.01)***	1.01 (1.00-1.01)***
Race		0.90 (0.83-0.97)**	
Ethnicity		0.99 (0.99-1.00)**	
Tobacco Use	0.69 (0.60-0.78)***	0.73 (0.61-0.88)**	0.77 (0.64-0.93)**
Diabetes	0.91 (0.84-1.00)*		
Ventilator Dependent	2.83 (2.23-3.59)***	5.09 (2.87-9.05)***	2.11 (1.61-2.75)***
COPD	1.25 (1.03-1.52)*		1.35 (1.02-1.78)*
Esophageal Varices	0.05 (0.02-0.13)**	0.05 (0.02-0.15)**	
CHF		1.87 (1.08-3.22)*	
Prior PCI	0.66 (0.44-0.99)*		
Peripheral Vascular Disease			0.22 (0.14-0.34)***
Impaired Sensorium			1.57 (1.16-2.11)**
Hemiplegia	1.66 (1.25-2.20)***		1.65 (1.23-2.21)**
Prior Stroke w/ Persistent Neurologic Deficit	1.41 (1.03-1.92)*		
Prior Stroke w/o Persistent Neurologic Deficit	1.78 (1.13-2.81)*	2.00 (1.00-3.99)*	
CNS Tumor	2.95 (2.41-3.61)***	3.21 (2.05-5.04)***	1.78 (1.40-2.26)***
Quadriplegia	2.51 (1.37-4.59)**	2.93 (1.52-5.64)**	
Disseminated Cancer	2.09 (1.77-2.44)***	3.75 (2.89-4.85)***	
Wound Infection	1.71 (1.30-2.26)**	2.18 (1.53-3.10)**	
Steroid Use	1.88 (1.63-2.17)***	1.57 (1.24-1.99)***	1.66 (1.39-1.98)***
Recent Weight Loss	1.52 (1.09-2.13)**	1.85 (1.16-2.96)**	
Bleeding Disorder		1.52 (1.11-2.07)**	
Transfusion within 72 hours	1.99 (1.34-2.94)**		1.86 (1.07-3.24)*
Pre-Op Sepsis	1.01 (1.00-1.02)**	1.01 (1.00-1.02)**	
Emergency Surgery	2.49 (2.14-2.90)***	2.85 (2.26-3.60)***	1.43 (1.16-1.76)**

Only significant predictors presented, * <0.05 ** <0.01 *** <0.001

Multivariate Predictors for Pulmonary Embolism

Variable	Overall	Spine	Cranial
Age	1.02 (1.01-1.02)***	1.02 (1.02-1.03)***	1.02 (1.01-1.02)***
Height	1.02 (1.00-1.04)*		
Weight	1.01 (1.00-1.01)***	1.01 (1.00-1.01)***	1.01 (1.01-1.02)***
Body Mass Index			0.95 (0.92-0.98)**
Tobacco Use	0.68 (0.55-0.84)***	0.66 (0.49-0.88)**	
Diabetes	0.80 (0.69-0.93)**	0.80 (0.66-0.97)**	
Ventilator Dependent	1.88 (1.22-2.91)**	3.59 (1.40-9.21)**	1.55 (1.01-2.38)*
COPD	1.44 (1.08-1.92)*	1.53 (1.03-2.27)*	
Esophageal Varices		0.31 (0.15-0.65)**	
Impaired Sensorium	1.71 (1.09-2.71)*		
Coma	0.23 (0.14-0.38)***		
CNS Tumor	2.55 (1.86-3.48)***	3.24 (1.55-6.77)**	
Disseminated Cancer	1.95 (1.52-2.51)***	3.40 (2.27-5.10)**	
Wound Infection	2.04 (1.34-3.10)**	2.76 (1.64-4.67)***	
Steroid Use	1.92 (1.54-2.40)***		1.98 (1.53-2.57)***
Emergency Surgery	2.23 (1.74-2.86)***	3.20 (2.26-4.53)***	

Only significant predictors presented, * <0.05 ** <0.01 *** <0.001

Multivariate Predictors for Deep Vein Thrombosis

Variable	Overall	Spine	Cranial
Age	1.02 (1.02-1.03)***	1.03 (1.03-1.04)***	1.02 (1.01-1.03)***
Weight	1.01 (1.01-1.01)***	1.01 (1.01-1.01)***	1.01 (1.01-1.01)***
Tobacco Use	0.68 (0.59-0.80)***	0.74 (0.60-0.92)**	0.76 (0.61-0.94)**
Ventilator Dependent	3.30 (2.57-4.23)***	4.75 (2.50-9.04)***	2.42 (1.81-3.22)***
Esophageal Varices	0.06 (0.03-0.13)**	0.04 (0.013-0.10)**	
Impaired Sensorium			1.53 (1.11-2.10)*
Hemiplegia	1.79 (1.34-2.40)***	2.53 (1.28-5.02)**	
Prior Stroke w/o Persistent Neurologic Deficit			0.37 (0.24-0.56)**
CNS Tumor	3.00 (2.39-3.77)***	3.23 (1.97-5.30)***	1.80 (1.38-2.35)***
Quadriplegia	3.08 (1.64-5.80)**	3.42 (1.72-6.82)***	
Disseminated Cancer	2.12 (1.77-2.54)***	3.92 (2.92-5.26)***	
Wound Infection	1.59 (1.16-2.19)**	2.00 (1.32-3.02)**	
Steroid Use	1.94 (1.64-2.28)***	1.72 (1.31-2.24)**	1.71 (1.40-2.09)***
Recent Weight Loss	1.65 (1.14-2.39)**	1.96 (1.16-3.30)**	
Bleeding Disorder		1.64 (1.16-2.31)**	
Transfusion within 72 hours	2.13 (1.40-3.24)**	1.96 (1.07-3.57)*	1.85 (1.01-3.41)*
Pre-Op Sepsis	1.01 (1.01-1.02)**	1.01 (1.00-1.02)**	1.01 (1.00-1.02)**
Emergency Surgery	2.84 (2.40-3.36)***	3.01 (2.31-3.91)***	1.68 (1.34-2.11)**

Only significant predictors presented, * <0.05 ** <0.01 *** <0.001

Results

A total of 132,063 neurosurgical cases (97,907 spine, 30,497 cranial) were identified

Overall, there were 1,922 (1.46%) cases of VTE comprised of 952 (0.97%) and 944 (3.1%) cases in spine and cranial surgery, respectively

Results Continued

Predictors of VTE included: age, height, weight, race, smoking, recent weight loss, diabetes, ventilator dependence, hemiplegia, paraplegia, quadriplegia, brain tumor, stroke, impaired sensorium, coma, COPD, CHF, PVD, PCI, esophageal varices, metastatic cancer, chronic steroid use, wound infection, transfusion, and sepsis

These predictors varied by type of surgery (overall, spine, cranial) and outcome of interest (VTE, DVT, PE)

Unique predictors for PE included: height, body mass index, diabetes, COPD, and coma

Unique predictors for DVT included: recent weight loss, hemiplegia, paraplegia, stroke, bleeding disorder, transfusion, and sepsis

Conclusions

VTE affects 1.46% of neurosurgical cases with roughly three times higher prevalence in cranial over spine cases

A variety of factors predict VTE, DVT, and PE

These predictors varied by surgery type and outcome of interest

This suggests different pre-operative predictors may uniquely identify patients at risk for VTE, DVT, and PE