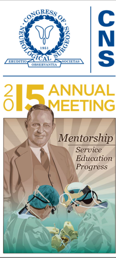



# Analysis of Venous Thromboembolism Risk in Patients Undergoing Craniotomy

Hanna Algattas; Kristopher T. Kimmell MD; G. Edward Vates MD, PhD; Babak S. Jahromi MD, PhD, FRCS(C)
Department of Neurosurgery
University of Rochester Medical Center

## Introduction

-In the current era of healthcare reform, there is a significant focus on outcome improvement and cost reduction.
-Postoperative venous thromboembolism (VTE) is a significant risk post-craniotomy and the decision to use prophylactic anticoagulation is unclear.
-Studies suggest the risk reduction of VTE may be matched by the risk elevation in intracranial hemorrhage when using anticoagulation.
-The National Surgical Quality Improvement Program (NSQIP) provides a wide array of data aimed at improving outcomes and records variables, including VTE.

## Objectives

1)Understand the factors associated with VTE post-craniotomy.
2)Develop a risk scoring system which is capable of delineating a subset of patients at highest risk for VTE.
3)Demonstrate the effectiveness of the VTE risk scoring model against previously analyzed data.

## Methods

-10,477 adult craniotomy cases from 2011 -2012 NSQIP data set
-Univariate Chi-squared analysis and multivariate binary logistic regression model
-Risk score creation and receiver operating characteristics (ROC) curve
-Planned validation on previously analyzed NSQIP data sets which was completed prior to the release of 2011-2012 NSQIP data

## VTE events and mortality rate

| Group | Total Patients (%) | 30 Day Mortality Rate (%) |
|---|---|---|
| Overall Cohort | 10447 | 4.8 |
| No VTE | 10114 | 4.6 |
| VTE | 333 (3.2) | 9.6 |
| DVT | 246 (2.4) | 10.2 |
| PE | 131 (1.3) | 10.7 |

## Factors significant after univariate analysis

| Preoperative | Intraoperative/Postoperative |
|---|---|
| Ventilator dependence | Ventilator dependence > 48 hrs |
| Non-elective surgery | Unplanned reintubation |
| Estimated probability of mortality > 10% | Infection (PNA, UTI, sepsis, septic shock) |
| Estimated probability of morbidity > 10% | Return to OR |
| Admission to OR time > 4d | Bleeding transfusion |
| Emergency case | CVA |
| Dependent functional status | Impaired sensorium |
| Age > 60 | Cardiac arrest requiring CPR |
| Transfer from acute care facility | Progressive renal insufficiency |
| Hemiplegia | Coma > 24 hrs |
| Steroid use | ASA Class 4-5 |
| Inpatient | |
| BMI > 30 | |
| African-American race | |
| Hypertension | |

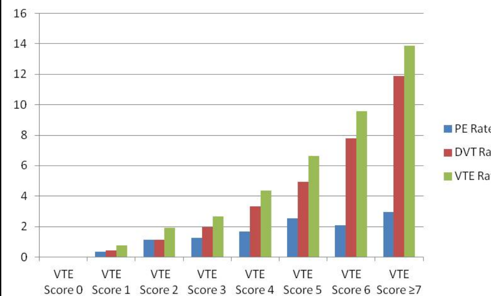
## Risk scores and associated VTE event rates, days to discharge, and mortality

| VTE Risk Score | No. Patients (% Total) | VTE Rate (%) | DVT Rate (%) | PE Rate (%) | Mean days from surgery to discharge* | Mean 30d mortality rate [n (%)]* |
|---|---|---|---|---|---|---|
| 0 | 129 (1.2) | 0.0* | 0.0 | 0.0 | 0.4 | 1 (0.2) |
| 1 | 2010 (20.5) | 0.7* | 0.4* | 0.3* | 3.3 | 5 (1.0) |
| 2 | 3117 (29.8) | 1.9* | 1.1* | 1.1 | 4.1 | 26 (5.2) |
| 3 | 2419 (23.2) | 2.6 | 1.9 | 1.2 | 5.3 | 67 (13.5) |
| 4 | 1379 (13.2) | 4.4* | 3.3* | 1.7 | 7.6 | 100 (20.1) |
| 5 | 708 (6.8) | 6.6* | 4.9* | 2.5* | 11.2 | 96 (19.3) |
| 6 | 334 (3.2) | 9.6* | 7.8* | 2..1 | 12.6 | 82 (16.5) |
| ≥7 | 351 (1.9) | 15.7* | 13.7* | 3.1* | 16.9 | 121 (24.3) |
| Overall # | 10447 | 333* | 246 | 131 | 5.8 | 498 |

## Factors significant after multivariate analysis

| Factor | Odds Ratio (95% CI) |
|---|---|
| *Pre-operative* | |
| Ventilator dependence | 3.13 (2.23-4.38) |
| Non-elective surgery | 2.04 (1.64-2.54) |
| BMI > 30 | 1.51 (1.21-1.88) |
| Age > 60 | 1.61 (1.30-2.01) |
| Steroid use | 1.76 (1.35-2.31) |
| African-American race | 1.85 (1.33-2.58) |
| Inpatient | 9.13 (2.27-36.78) |
| Impaired Sensorium | 2.57 (1.78-3.72) |
| Admission to OR > 4d | 2.00 (1.50-2.66) |
| *Intra-operative* | |
| ASA 4-5 | 2.37 (1.87-3.02) |
| *Post-operative* | |
| On ventilator > 48 hrs | 5.89 (4.55-7.63) |
| Infection | 5.40 (4.04-7.22) |
| Return to OR | 4.64 (3.53-6.10) |

## Rates of VTE, DVT, and PE at each risk score




## Results

-Rate of VTE in cohort was 3.2% (PE=1.3%; DVT=2.4%)
-VTE is significantly associated with increased time from operation to discharge and mortality rate
-13 variables were associated with VTE after multivariate analysis
-VTE risk scores ranged from 0 to 11 (median score=2) and increasing scores were indicative of increasing VTE rate, mortality rate, and time from operation to discharge
-VTE risk score was capable of significantly predicting VTE in ROC analysis with area under the curve (AUC) of 0.719 (95% CI 0.691-0.747;p<0.001)

## Conclusions

-The risk of post-op VTE after craniotomy is influenced by pre-operative comorbidities and post-operative complications. This risk can be quantified by a simple risk score, with increasing risk factors conferring increased risk of VTE. Based on risk scoring, a subset of patients may be identified that would benefit from anticoagulation post-craniotomy.

## References

4.Camden, R.; Ludwig, S., Prophylaxis against venous thromboembolism in hospitalized medically ill patients: Update and practical approach. American journal of health-system pharmacy : AJHP : official journal of the American Society of Health-System Pharmacists 2014, 71 (11), 909-17.
15.Hamilton, M. G.; Yee, W. H.; Hull, R. D.; Ghali, W. A., Venous thromboembolism prophylaxis in patients undergoing cranial neurosurgery: a systematic review and meta-analysis. Neurosurgery 2011, 68 (3), 571-81.
18.Ingraham, A. M.; Richards, K. E.; Hall, B. L.; Ko, C. Y., Quality improvement in surgery: the American College of Surgeons National Surgical Quality Improvement Program approach. Advances in surgery 2010, 44, 251-67.