Machine Learning Approach to Predict Venous Thromboembolism Among Patients Undergoing Spinal Posterior Instrumented Fusion

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Introduction

- Spinal fusion surgery is associated with increased risks for venous thromboembolism (VTE)
- Rates of VTE after lumbar fusion have not changed since 2011
- Relatively few risk stratification tools to mitigate VTE rates

- Study Aims:
  - Incorporate machine learning (ML) models to stratify risk factors for 90-day VTE in a large national database
  - Develop a simple predictive risk calculator for VTE

Methods

IBM MarketScan database queried for patients who underwent spinal posterior instrumented fusion 2009-2021
Excluded traumas, malignancies, or infections

90-day VTE collected w/ ICD codes

Demographics and patient comorbidities collected

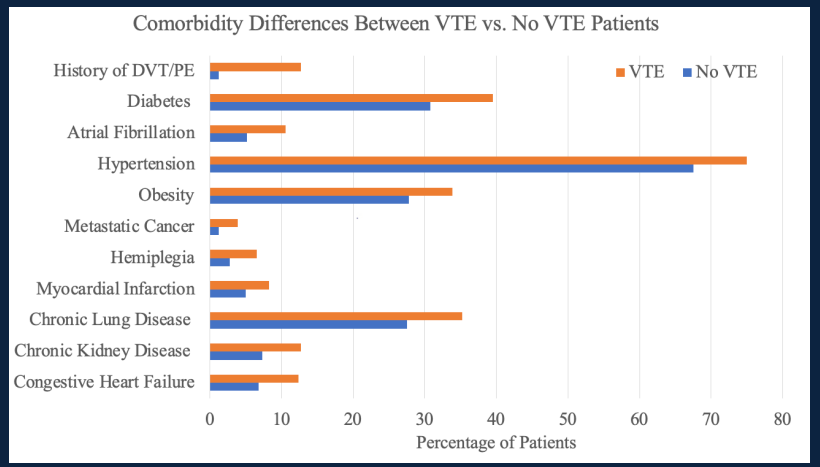
5 ML models w/ k-fold cross validation using 80-20% split

XGBoost Tree | Logistic Regression | Random Forest | Neural Networks | Linear Support Vector Machine

Results

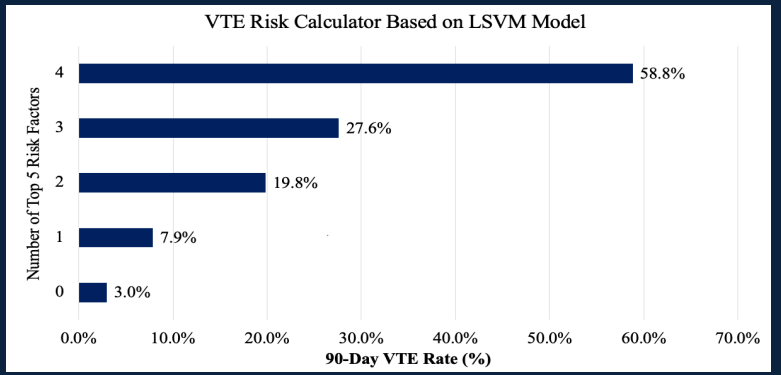
Table 1. Baseline Demographic Data by 90-Day Venous Thromboembolism (VTE) Cohort

	No VTE*	VTE	*P*-value
Total Patients (n, %)	136,297 (96.19%)	5,400 (3.81%)	
Age (avg, SD*)	58.31 (11.87)	61.75 (11.70)	<0.001
Female Patients (n, %)	72,827 (53.43%)	2,686 (49.74%)	<0.001
CCI* Score (avg, SD)	1.83 (2.25)	2.77 (2.87)	<0.001



Model	AUROC	Variable 1	Variable 2	Variable 3	Variable 4	Variable 5
Linear Support Vector Machine	0.68	History of DVT/PE	Chronic Hypercoagulability	Metastatic Cancer	Hemiplegia	Chronic Renal Disease

- **LSVM** performed the best compared to other models w/ AUC of 0.68
- Top 5 risk factors for VTE listed above according to the LSVM model



Discussion

- LSVM had the best prediction rates of VTE, stratified top 5 risk factors
- Patients with increasing # of risk factors had increased VTE rates
- Patients with increased risks for VTE may require more aggressive mechanical and chemoprophylaxis or increased monitoring
- ML models can also be utilized to build user interfaces for patients/physicians
- Advantages of study:
  - >140,000 patients incorporated
  - Large input of risk factors
- Limitations:
  - Lab values, operative notes unavailable, med adherence unknown

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