Risk Calculation for Post-Discharge Venous Thromboembolism After Anatomic Lung Resection

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Introduction

Venous thromboembolism (VTE) is a common cause of perioperative morbidity and mortality after surgical treatment of lung cancer. VTE chemoprophylaxis has been shown to reduce the incidence of VTE, and recent guidelines have been established for extended post-discharge chemoprophylaxis for patients with resected lung cancer. However, specific risk factors associated with VTE are unknown.

Methods

The American College of Surgeons National Surgical Quality Improvement Program (ACS NSQIP) was used to identify patients who underwent anatomic lung resection between 2015 and 2018. Bivariate analysis and multivariable logistic regression were used to identify post-discharge VTE risk factors which were used to create a post-discharge VTE risk calculator. The cut-point with optimal sensitivity and specificity in predicting post-discharge VTE was calculated using Youden's J Index.

Results

The study included 18,476 patients who underwent anatomic lung resection. Overall, VTE was diagnosed within 30 days of surgery in 224 (1.2%) patients with 203 (1.1%) diagnosed in-patient and 21 (0.11%) diagnosed post-discharge. Older age, male sex, non-Hispanic Black race, higher body mass index (BMI), longer operative time, longer post-operative length-of-stay, transfusion, myocardial infarction, chronic obstructive pulmonary disease, post-operative pneumonia, mechanical ventilation >48hrs, renal failure, and open pneumonectomy were identified as risk factors for overall risk of VTE. Post-discharge VTE was associated with BMI (odds ratio 1.06, 95% confidence interval 1.03-1.10 per point increase), open pneumonectomy (odds ratio 4.62, 95% confidence interval 1.28-16.7), and post-operative pneumonia (odds ratio 14.3, 95% confidence interval 5.87-34.8). Twenty iterations of 10-fold cross-validation yielded a mean C-statistic of 0.84 indicating good model discrimination for post-discharge VTE risk calculation. Predicted risk of post-discharge VTE after anatomic lung resection ranged from 0.02% to 8.95%.

Factors Associated with Post-Discharge VTE

Increasing BMI
OR 1.06 (1.03-1.10) per point increase

Open Pneumonectomy
OR 4.62 (1.28-16.7)

Post-Operative Pneumonia
OR 14.3 (5.87-34.8)

Beta Coefficients for Post-Discharge VTE Risk Calculation

Parameter	Beta Coefficient	95% CI	P Value
BMI (per point increase)	0.06	0.03-0.10	<0.001
Open Pneumonectomy	1.53	0.25-2.81	0.02
Post-Operative Pneumonia	2.66	1.77-3.55	<0.001
Constant	-9.22	-10.39 to -8.05	<0.001

Method for Post-Discharge VTE Risk Calculation

To use for VTE risk calculation:

1. Identify the **beta coefficients** applicable to the patient
2. Sum those beta coefficients with the model intercept (constant) to generate a **log probability** (LP) of the outcome
3. Calculate the **predicted probability** of an event by using the following equation: event probability = exp (LP)/[1 + exp (LP)]

FIGURE 1A. Predicted Probability of Post-Discharge VTE After Anatomic Lung Resection

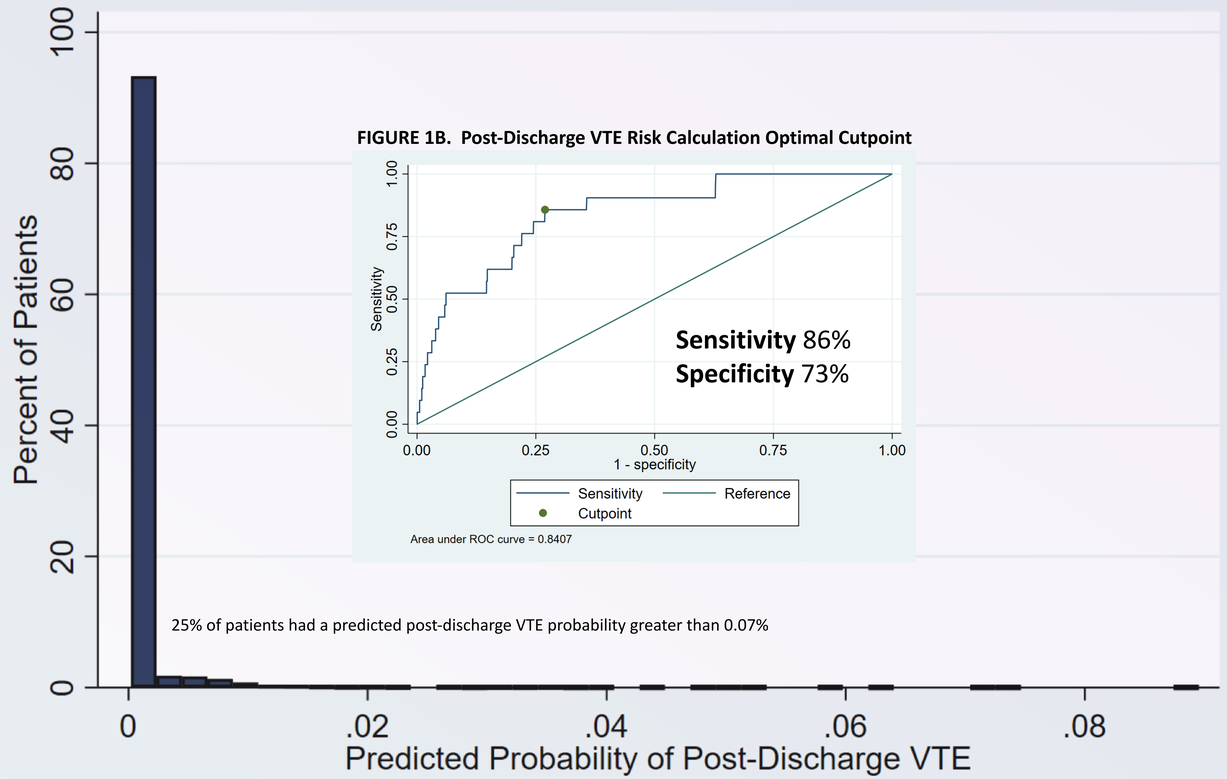

FIGURE 1B. Post-Discharge VTE Risk Calculation Optimal Cutpoint

TABLE 1. Characteristics of Patients Treated with Anatomic Lung Resection: 2015-2018

Parameter	N=18,476	%	P Value
VTE Rates			<0.001
Overall	224	1.2	
Inpatient	203	1.1	
Post-discharge	21	0.1	
Age at Diagnosis			0.18
<41	549	3.0	
41-60	4,484	24.3	
61-74	9,542	51.7	
>74	3,901	21.1	
Sex			<0.001
Female	10,255	55.5	
Male	8,221	44.5	
Race and Ethnicity			0.07
NHW	13,301	72.0	
NHB	1,316	7.1	
Hispanic	643	3.5	
AAPI	693	3.8	
Other/Unknown	2,523	13.7	
Body Mass Index			0.015
<18.5	480	2.6	
18.5-24.9	5,716	30.9	
25.0-29.9	6,410	34.7	
≥30	5,870	31.8	
Pre-operative Weight Loss			<0.001
No	18,085	97.9	
Yes	391	2.1	
Extent of Resection			<0.001
Segmentectomy	2,003	10.8	
Lobectomy	15,877	85.9	
Pneumonectomy	596	3.2	
Open Pneumonectomy			<0.001
No	17,956	97.2	
Yes	520	2.8	
History of COPD			<0.001
No	14,209	76.9	
Yes	4,267	23.1	
Post-operative Pneumonia			<0.001
No	17,528	94.9	
Yes	948	5.1	
Recent History of Smoking			0.664
No	12,173	65.9	
Yes	6,303	34.1	

Conclusions

VTE is an uncommon but potentially devastating complication after anatomic lung resection. Post-discharge VTE risk was associated with increasing patient BMI, open pneumonectomy, and post-operative pneumonia. Identifying patients at high risk for post-discharge VTE may help guide patient specific extended VTE chemoprophylaxis prescribing.