Stratifying Risk Stratification Tools: Predicting Adverse Perioperative Outcomes Among Patients with Lung Cancer Treated With Anatomic Lung Resection

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Introduction

Numerous methods have been developed to risk stratify surgical patients. However, it is unknown which method is best for predicting adverse events in patients treated with anatomic lung resection. Therefore, the purpose of this study is to evaluate three risk-stratification methods for prediction of adverse perioperative events following anatomic lung resection.

Methods

The National Surgical Quality Improvement Program (NSQIP) was used to identify patients who underwent anatomic lung resection between 2015-2018. The American College of Surgeons Surgical Risk Calculator (ACS-SRC), Risk Analysis Index (RAI-Rev), and the Modified Frailty Index (5-mFI) were used to predict 30-day perioperative mortality, morbidity, unplanned readmission, and unplanned reoperation. Differences in model receiver operating characteristics (ROC) were evaluated with DeLong's test.

Results

Overall, 19,069 patients treated with anatomic lung resection between 2015-2018 were included. The cohort was 55.5% female with a median age at diagnosis of 67 (IQR 60-73) years. Among the patients, 7.2% were Non-Hispanic Black or African American (NHB), 3.7% were Asian American or Pacific Islander (AAPI), 3.5% were Hispanic ethnicity, 72.0% were non-Hispanic White (NHW), and 13.5% had unknown or not reported race or ethnicity. Smoking within one year of surgery was reported by 34.0% of patients. In total, 19.9% were diagnosed in 2015, 24.8% in 2016, 27.5% in 2017, and 27.8% in 2018. Cardiothoracic surgeons performed 91.6% and General surgeons performed 7.7% of the total operations.

Perioperative morbidity and mortality rates were 9.1% (n=1,734) and 1.3% (n=247), respectively. 7.2% (n=1,377) of patients had unplanned readmissions while 4.6% (n=879) received unplanned reoperations within 30 days of the index surgical resection (Table 1).

ACS-SRC had the highest predictive discrimination for all measured outcomes including perioperative mortality (ROC 0.80, 95% CI 0.77-0.82) versus RAI-rev (ROC 0.66, 95% CI 0.62-0.69) or 5-mFI (ROC 0.61, 95% CI 0.58-0.65)(p<0.001; Figure 1). RAI-rev and 5-mFI had similar predictive discrimination for perioperative morbidity and unplanned readmission or reoperation (Table 2).

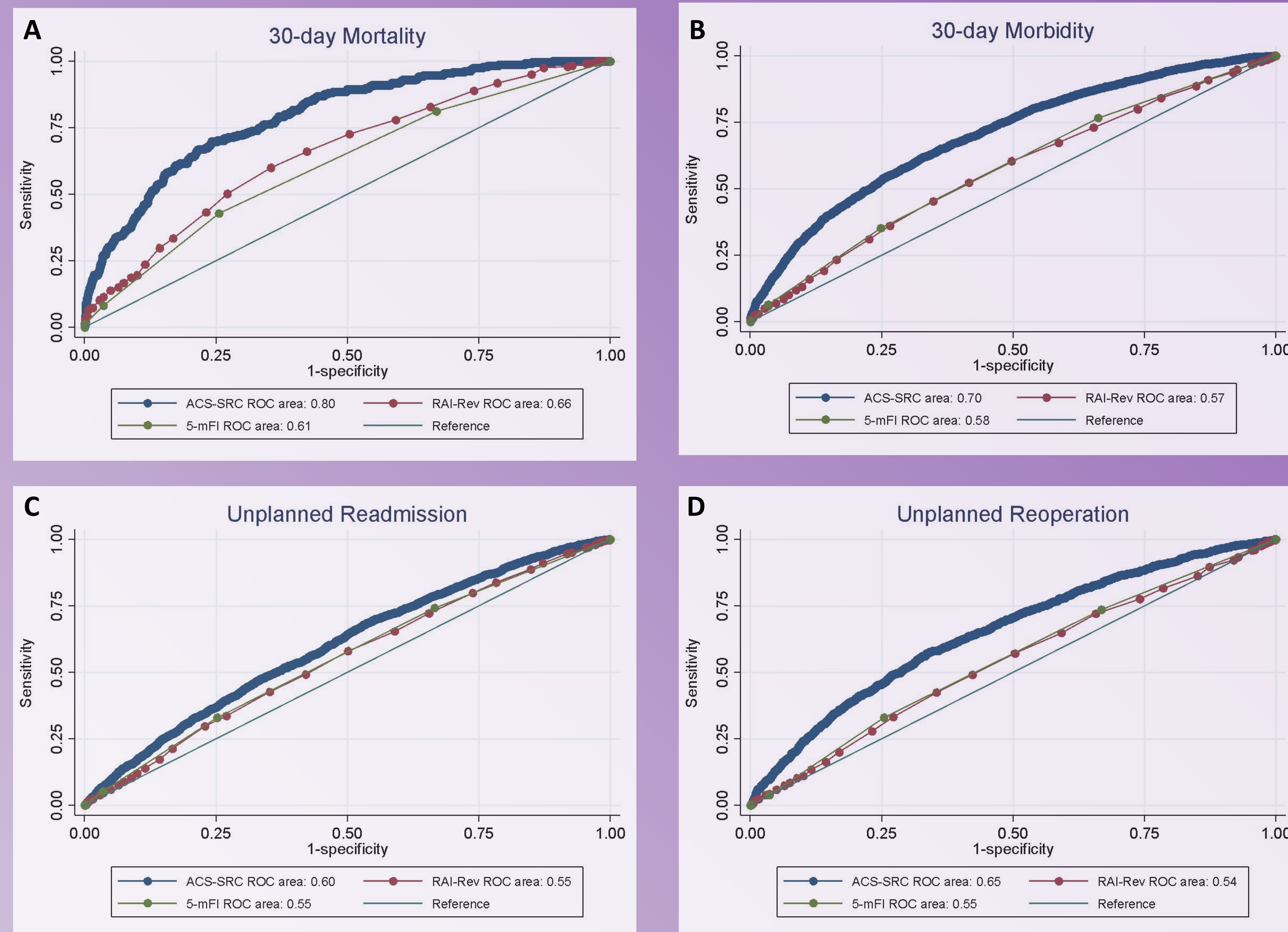## Figure 1. ROC Comparisons of Predicted Adverse Perioperative Outcomes

A 30-day Mortality
— ACS-SRC ROC area: 0.80 — RAI-Rev ROC area: 0.66 — 5-mFI ROC area: 0.61 — Reference

B 30-day Morbidity
— ACS-SRC area: 0.70 — RAI-Rev ROC area: 0.57 — 5-mFI ROC area: 0.58 — Reference

C Unplanned Readmission
— ACS-SRC ROC area: 0.60 — RAI-Rev ROC area: 0.55 — 5-mFI ROC area: 0.55 — Reference

D Unplanned Reoperation
— ACS-SRC ROC area: 0.65 — RAI-Rev ROC area: 0.54 — 5-mFI ROC area: 0.55 — Reference

Table 1. Adverse Perioperative Outcomes

NSQIP 2015-2018	Anatomic Lung Resections (n=19,069)	
	n	**%**
Perioperative Outcome		
30-day Mortality	247	1.3%
30-day Morbidity*	1,734	9.1%
Unplanned Readmission	1,377	7.2%
Unplanned Reoperation	879	4.6%

NSQIP, National Surgical Quality Improvement Program.
*30-day Morbidity including stroke, cardiac arrest, myocardial infarction, pneumonia, renal failure, urinary tract infection, deep wound infection, sepsis, liver failure.

Table 2. Predicted Adverse Perioperative Outcomes for Anatomic Lung Resections

	ACS-SRC	RAI-Rev	5-mFI
NSQIP 2015-2018	ROC (95% CI)		
Perioperative Outcome			
30-day Mortality	0.80 (0.77-0.82)*	0.66 (0.62-0.69)	0.61 (0.58-0.65)
30-day Morbidity	0.70 (0.69-0.71)*	0.57 (0.55-0.58)	0.58 (0.56-0.59)
Unplanned Readmission	0.60 (0.58-0.61)*	0.55 (0.54-0.57)	0.55 (0.54-0.57)
Unplanned Reoperation	0.65 (0.63-0.67)*	0.54 (0.52-0.56)	0.55 (0.53-0.57)

ACS-SRC, American College of Surgeons Surgical Risk Calculator.
RAI-Rev, Risk Analysis Index - revised.
5-mFI, Modified Frailty Index.
NSQIP, National Surgical Quality Improvement Program.
ROC, Receiver Operating Characteristics.
CI, Confidence Interval.
*ACS-SRC vs RAI-rev or 5-mFI statistically significant with p<0.001.

Conclusions

The American College of Surgeons Surgical Risk Calculator has higher predictive discrimination for adverse perioperative events for patients treated with anatomic lung resection compared with RAI-Rev or 5-mFI.

References

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