Presentation Abstracts

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Validation of thoracic surgery mortality prediction models in a contemporary database

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Introduction: Currently, surgical resection is considered the best treatment available for early-stage lung cancer. In recent decades, minimally invasive procedures have revolutionized thoracic surgery, expanding the benefited patient population by reducing morbidity and mortality rates, incidence of complications, length of hospital stay and postoperative pain.[(1)] However, lung resections remain associated with significant morbidity and mortality, with national studies indicating a complication rate of 21.8% and an in-hospital mortality rate of 1.8% for video- assisted surgeries.[(2)] Concomitantly, various non-surgical approaches have emerged as effective therapeutic alternatives, such as stereotactic body radiation therapy. In this scenario, the importance of adequately evaluating patients and referring high-risk cases to other lines of treatment is evidenced. Mortality risk prediction models have been progressively applied as aids to this process. Recent guidelines, such as those from the British Thoracic Society and the National Institute for Clinical Excellence, advocate the use of these models as part of the selection criteria for patients undergoing elective surgeries.[(3)] Among the various models developed in the last 30 years, the most well- established are the European Society Objective Score, Brunelli, Thoracoscore, Modified Thoracoscore, Eurolung and Modified Eurolung. Although some of these models have been externally validated after their development, contemporary validations are lacking. Four out of these 6 models were developed using only data from patients operated before 2007 and, with current technological advances and improvement of surgical outcomes, these models are in a constant process of performance loss.

Objective: This study aims to evaluate the performance of six postoperative mortality prediction models (European Society Objective Score, Brunelli, Thoracoscore, Modified Thoracoscore, Eurolung, and Modified Eurolung) applied to a national and contemporary database.

Methods: For the analysis, data was extracted from the Brazilian Registry of Surgical Treatment of Lung Cancer, a multicenter database which currently includes data from 2,476 patients with lung cancer who underwent resection with curative intent between 2002 and 2023. Patients missing data for any essential variable ("sex", "age", "type of surgical access", "type of lung resection", "status at discharge" and "status at 30 days") or for more than 15% of other variables relevant to this study were excluded. For each model, the AUC-ROC was calculated and bootstrap technique was applied to establish confidence intervals.

Results: The database after the cleaning process included 1,832 patients. The mortality rates were 2.29% in-hospital, 3.28% after 30 days, and 4.48% after 90 days. The average survival was 35.90 months and the median survival was 26.84. Table 1 details a descriptive analysis of the study population regarding the variables applied by the benchmark models.

ROC curves with AUC and 95%-CI for each model are represented in figure 1. The AUC obtained were: 0.65 (±0.15) for Thoracoscore; 0.66 (± 0.23) for European Society Objective Score; 0.68 (±0.17) for Modified Thoracoscore; 0.74 (±0.11) for Brunelli; 0.77 (±0.08) for Modified Eurolung; and 0.79 (±0.08) for Eurolung.

Conclusion: Considering a prediction model with AUC of 0.50-0.69 as poor, 0.70-0.79 as acceptable and ≥0.80 as excellent, the only models with acceptable performance were Brunelli, Modified Eurolung and Eurolung. Furthermore, the two most recent models had the highest performances, which highlights the impact that recent advances in thoracic surgery have had on the predictive performance of older models. With these observations, the importance of developing more accurate mortality prediction models becomes evident. Machine learning is a promising tool for this purpose, to be addressed in future studies by this group, with the distinguishing feature of allowing continuous update and improvement of models as the database used is expanded.

Keywords: Lung neoplasms; Thoracic surgery; Postoperative mortality; Risk prediction

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Table 1. Description of the study population, considering frequency and percentage for nominal variables and median and IQR for numerical variables

		Total or median*	% or IQR**
Demographic data			
Age		65.5*	13.5**
Sex	Female	1008	55.02%
	Male	824	44.98%
Preoperative evaluation			
BMI		25.94*	6.30**
ASA	I	115	6.28%
	II	1201	65.56%
	III	332	18.12%
	IV	13	0.71%
ECOG	0	975	53.22%
	1	505	27.57%
	2	48	2.62%
	3	4	0.22%
MRC	0	919	50.16%
	1	317	17.30%
	2	115	6.28%
	3	20	1.09%
	4	3	0.16%
ppoFEV1%		66.32*	22.84**
Charlson score		5*	2**
Coronary artery disease	Yes	143	7.81%
	No	1689	92.19%
Cerebrovascular disease	Yes	60	3.28%
	No	1772	96.72%
Procedure			
Classification	Elective	1824	99.56%
	Urgent	6	0.44%
Access	RATS	319	17.41%
	VATS	773	42.19%
	Thoracotomy	740	40.39%
Resection	Nodulectomy	47	2.57%
	Segmentectomy	146	7.97%
	Lobectomy	1493	81.50%
	Bilobectomy	59	3.22%
	Pneumectomy	87	4.75%
Extended resection	Yes	302	16.48%
	No	1530	83.52%

* Frequency for nominal variables and median for numerical variables; ** Percentage for nominal variables and IQR for numerical variables.

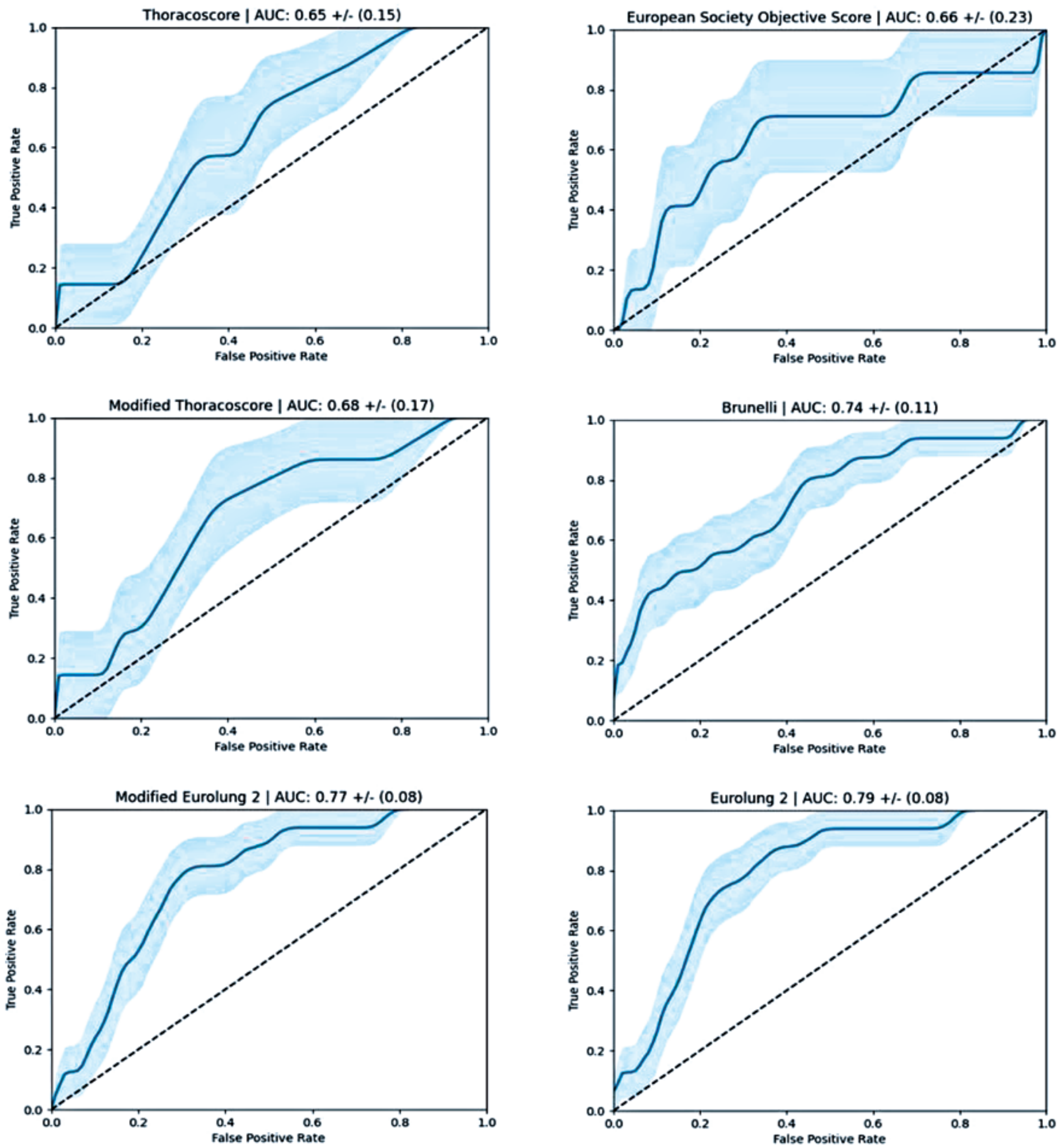

Figure 1. AUC-ROC and confidence intervals for each benchmark model