



P2.076: Predictive Value of V/Q Lung SPECT and Chest CT for Postoperative Pulmonary Complications in Patients with Lung Cancer: A Preliminary Study



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INTRODUCTION

- Ventilation and perfusion (V/Q) lung SPECT and chest CT scans** are widely used for prediction of postoperative lung function and clinical staging in patients with lung cancer. However, their clinical value in predicting **postoperative pulmonary complications (PPCs)** remains unclear.

Objective

To investigate whether **incorporating predictive residual ventilation and perfusion using preoperative lung SPECT and radiologic variables improves the prediction of PPCs** after lung cancer surgery.

METHODS

Patients and Study Design

This retrospective study included 315 patients with lung cancer (mean age, 67.33 ± 10.09; 43.2% female) who underwent preoperative lung SPECT and chest CT scans followed by surgery between January 2020 and June 2025.

Imaging Variables (Figure 1)

- Lung SPECT: the predicted residual ventilation percentage and perfusion percentage after surgery were calculated as follows:
1 – fractional ventilation (or perfusion) of the lobe undergoing resection.
- Chest CT: the presence of centrilobular emphysema involving > 5% of the lung was visually assessed by a thoracic radiologist based on the Fleischner Society emphysema classification system.

Outcome

- PPCs were classified as Clavien-Dindo (CD) grade ≥ II.

Statistical Analysis

- Associations between patient characteristics and PPCs (CD grade ≥ II) were tested using Student's t-test or Chi-square test. Fisher's exact test was applied when the expected cell counts were less than 5.
- Predictors were grouped into demographic (D), clinical (C), thoracic surgery-related (TS), nuclear medicine-related (NM), and radiologic (R) variables (Table 1).
- Prediction model performance was compared using multivariable logistic regressions, and the area under the receiver operating characteristic curve (AUC), accuracy, F1 score, positive predictive value (PPV), negative predictive value (NPV), sensitivity, and specificity were calculated.

RESULTS

- Among 315 patients, 86 (27.3%) developed grade ≥ II PPCs. Compared with patients without PPCs, those with grade ≥ II PPCs were more likely to be male, have a smoking history, have chronic obstructive pulmonary disease, have lower predicted DLCO (%), undergo thoracotomy, and undergo a greater extent of resection (all $P < 0.05$, Table 1).
- In the multivariable logistic regression, compared with the baseline D+C model, **the integrated (D+C+TS+NM+R) model demonstrated better overall discrimination for the risk stratification of PPCs** (CD grade ≥ II) (Figure 2).

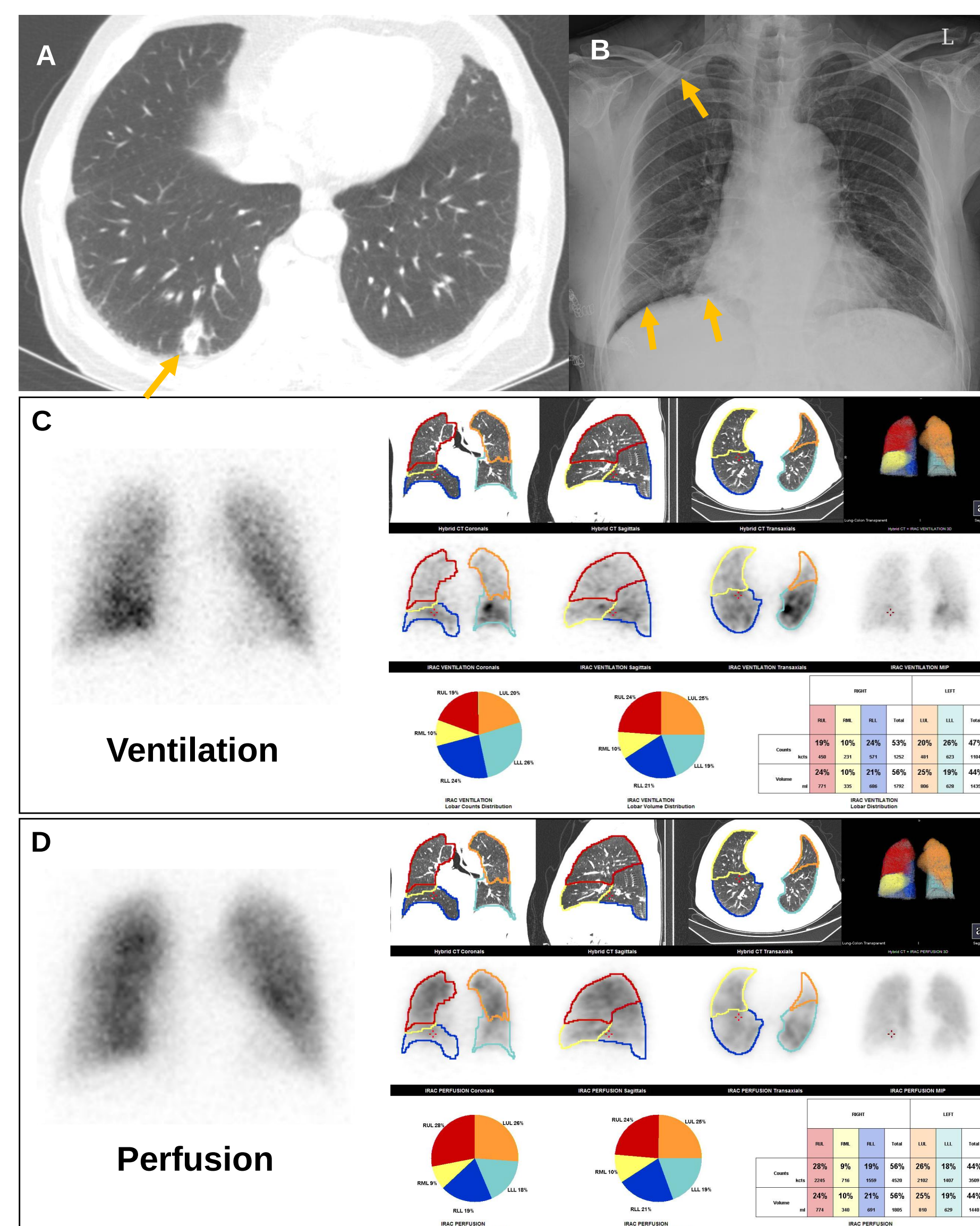


Figure 1. Perioperative evaluation of a 71-year-old male with stage I lung cancer. (A) Preoperative chest CT scan shows a 2 cm lung nodule in the right lower lobe (RLL) without underlying parenchymal lung disease. (B) Postoperative chest X-ray after RLL lobectomy shows a persistent pneumothorax (CD grade ≥ II). (C, D) Preoperative lung ventilation and perfusion scan and analysis showing lobar distribution. Predicted residual ventilation and perfusion ratios after surgery on SPECT scan were 0.76 and 0.81.

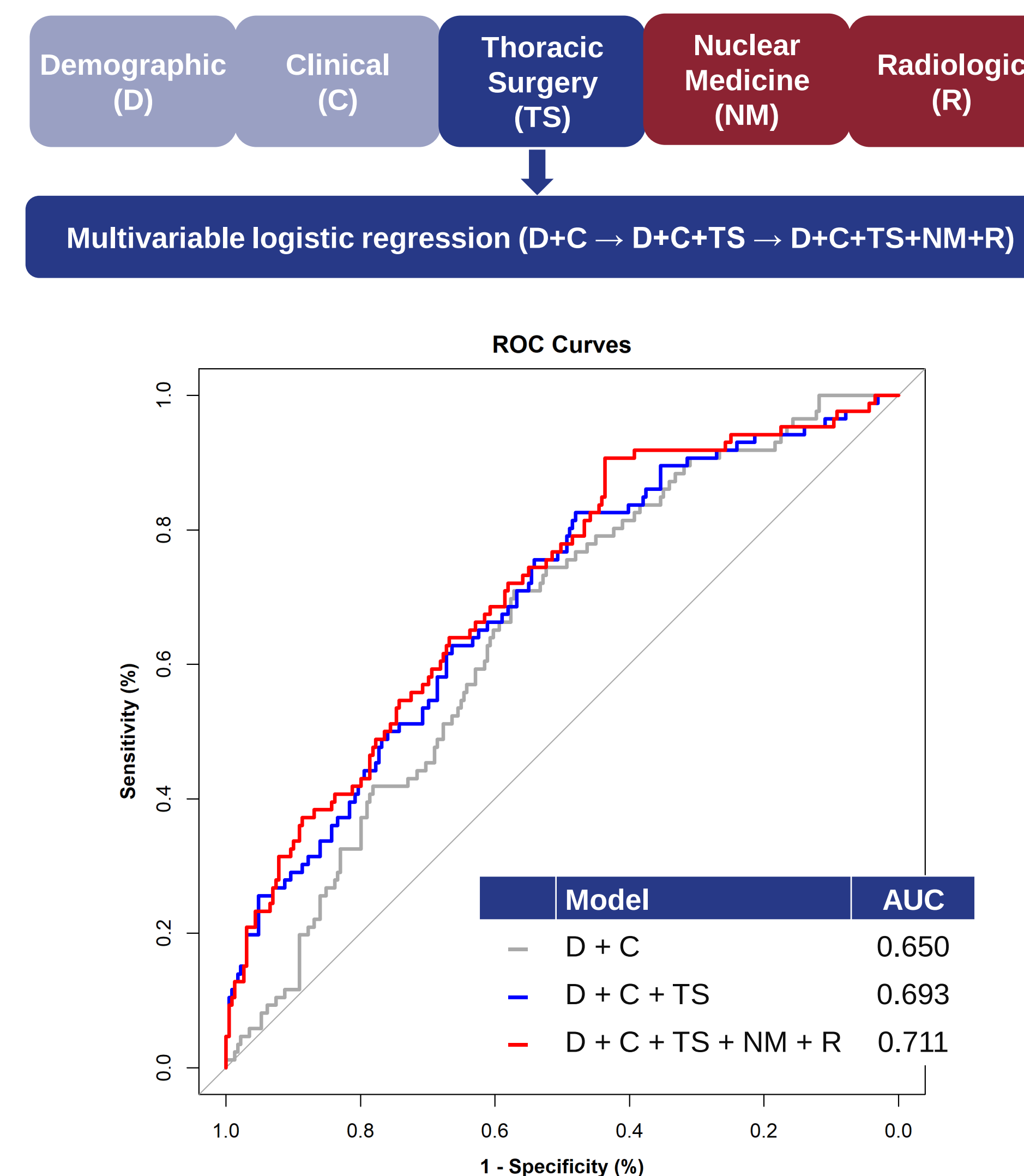


Figure 2. ROC curves and model performance (AUC). The baseline model including demographic and clinical variables (D+C) yielded an AUC of 0.650. The addition of thoracic surgery-related variables (D+C+TS) improved the AUC to 0.693. Ultimately, the model incorporating radiological and nuclear medicine parameters (D+C+TS+R+NM) achieved the highest discriminative performance, with an AUC of 0.711.

Table 1. Characteristics of data sets (n=315)

Variable		Total (n=315)	Postoperative pulmonary complication CD grade ≥ II		P value
			No (n = 229)	Yes (n = 86)	
Demographic variables (D)					
Age		67.3±10.1	67.0±10.1	68.3±10.2	0.283
Sex					0.001
Male		179 (56.8%)	117 (51.1%)	62 (72.1%)	
Female		136 (43.2%)	112 (48.9%)	24 (27.9%)	
Comorbidities					
Smoking history					0.019
Never		172 (54.6%)	136 (59.4%)	36 (41.9%)	
Ex		88 (27.9%)	56 (24.5%)	32 (37.2%)	
Current		55 (17.5%)	37 (16.2%)	18 (20.9%)	
COPD history		99 (31.4%)	63 (27.5%)	36 (41.9%)	0.015
DM		105 (33.3%)	80 (34.9%)	25 (29.1%)	0.325
HTN		173 (54.9%)	126 (55.0%)	47 (54.7%)	0.953
Coronary heart disease		58 (18.4%)	41 (17.9%)	17 (19.8%)	0.704
Cerebral infarction		18 (5.7%)	11 (4.8%)	7 (8.1%)	0.279
Autoimmune disease		18 (5.7%)	13 (5.7%)	5 (5.8%)	1.000
Previous lung operation Hx.		3 (1.0%)	2 (0.9%)	1 (1.2%)	1.000
Histopathologic type and pathologic TNM stage					
Pathology type					0.011
Adenocarcinoma		240 (76.2%)	182 (79.5%)	58 (67.4%)	
Squamous cell carcinoma		52 (16.5%)	29 (12.7%)	23 (26.7%)	
Other type		23 (7.3%)	18 (7.9%)	5 (5.8%)	
TNM stage					0.058
Stage 0		3 (1.0%)	2 (0.9%)	1 (1.2%)	
Stage I		233 (74.0%)	179 (78.2%)	54 (62.8%)	
Stage II		36 (11.4%)	24 (10.5%)	12 (14.0%)	
Stage III		33 (10.5%)	19 (8.3%)	14 (16.3%)	
Stage IV		10 (3.2%)	5 (2.2%)	5 (5.8%)	
Clinical variables (C) – pulmonary function					
FEV1 (% predicted)		87.7 ±17.7	88.4 ±18.1	85.9 ±16.6	0.253
DLCO (% predicted)*		75.7 ± 20.2	77.2 ± 20.8	71.7 ±18.1	0.047
Thoracic surgery–related variables (TS)					
Surgical approach					0.001
VATS		250 (79.4%)	192 (83.8%)	58 (67.4%)	
Thoracotomy		65 (20.6%)	37 (16.2%)	28 (32.6%)	
Extension of resection					0.005
Wedge		26 (8.3%)	24 (10.5%)	2 (2.3%)	
Segmentectomy		73 (23.2%)	58 (25.3%)	15 (17.4%)	
Lobectomy		208 (66.0%)	144 (62.9%)	64 (74.4%)	
Bilobectomy		3 (1.0%)	2 (0.9%)	1 (1.2%)	
Pneumonectomy		5 (1.6%)	1 (0.4%)	4 (4.7%)	
Mediastinal lymph node dissection					0.528
None		23 (7.3%)	19 (8.3%)	4 (4.7%)	
Selective MLND		34 (10.8%)	25 (10.9%)	9 (10.5%)	
Systemic MLDN		258 (81.9%)	185 (80.8%)	73 (84.9%)	
Nuclear medicine–related variables (NM)					
Residual ventilation ratio after operation		0.77±0.10	0.78±0.10	0.75±0.11	0.083
Residual perfusion ratio after operation		0.78±0.20	0.79±0.22	0.77±0.13	0.471
Radiologic variables (R)					
Centrilobular emphysema		23 (7.3%)	15 (6.6%)	8 (9.3%)	0.403
Interstitial lung disease		29 (9.2%)	21 (9.2%)	8 (9.3%)	0.971

* n=276

CONCLUSION

- Our study demonstrates that V/Q SPECT and chest CT parameters provide incremental value when integrated with conventional demographic, clinical, and surgery-related factors for predicting PPCs after lung cancer surgery.**
- A key limitation is that our lung SPECT parameters were based on lobar counts, which may not fully reflect the specific functional loss in sublobar resections including approximately one-third of our study population.
- Nevertheless, this multimodal assessment improves preoperative risk stratification and further studies using segment-based functional analysis are needed to refine these predictive models.

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