



CT Derived Imaging Percolation Score for Nodal Status Prediction in Resected NSCLC: A Two Cohort Study

Presenting Author¹, S. Ors¹, K.C. Ceylan¹, S.G. Gök¹, E.A. Öztekin¹, Y.E. Bal¹, Y.E. Pek¹
¹Dr Suat Seren Chest Diseases and Surgery Education Hospital, Izmir/TR
Correspondence: Seyda Ors seyda1296@yahoo.com



IASLC 2026 World
Conference on Lung Cancer
SEPTEMBER 12 - 15, 2026
SEOUL, REPUBLIC OF KOREA

INTRODUCTION

Nodal status prediction in resected NSCLC depends on imaging features reflecting the interplay between tumor invasiveness and peritumoral tissue resistance. Percolation theory — a network physics framework for connectivity phase transitions — posits that dissemination is governed by a critical threshold (ψ_c): below it, physical barriers impede lymphatic spread; above it, a connected dissemination pathway emerges. No prior clinical study has applied this framework to CT-based nodal prediction in NSCLC. We hypothesized that a CT-derived ψ score integrating tumor invasive phenotype and peritumoral tissue density would predict nodal positivity across independent cohorts.

METHODS

Two retrospective cohorts were analyzed (339 total patients). Development cohort (n=150): STAS status, peritumoral HU density (peri-HU), solid tumor density, and emphysema grade. Validation cohort (n=329): peri-HU, solid density, and emphysema grade (150 patients overlap). Primary endpoint: nodal positivity (N+). $\psi = 0.30 \times \text{STAS} + 0.40 \times \text{peri-HU}_{\text{norm}} + 0.20 \times \text{density}_{\text{norm}} + 0.10 \times (1 - \text{emphysema}_{\text{norm}})$; higher ψ = reduced barrier + greater invasive capacity. Youden index determined optimal threshold. ROC-AUC, Mann-Whitney U, and chi-square tests applied. Disclosure: Three concurrent studies from the same institutional series are submitted to this meeting, forming a complementary program: (1) 150 development cohort patients overlap with a Bayesian STAS prediction study (STAS as outcome, nodal status as predictor — inverse analytic direction); (2) the 329-patient validation cohort overlaps with an emphysema-as-barrier study examining emphysema as the primary predictor of nodal negativity and hematogenous resistance (OR=1.92). Each study addresses a distinct scientific question within a mechanistic → quantitative → clinical framework.

DISCUSSION AND CONCLUSION

The first clinical percolation analysis of CT-based nodal prediction in NSCLC demonstrates a physics-derived ψ score identifying a dissemination phase transition across 339 patients: N+ rate 13% below versus 58% above threshold. Independently validated in a CT-only cohort (AUC=0.670), peritumoral HU density functions as a percolation resistance parameter. Within a three-study institutional program — emphysema as structural barrier, ψ as its physical quantification, and Bayesian STAS modeling as clinical application — these findings support prospective validation of ψ as a preoperative staging tool in resected NSCLC.

REFERENCES & ACKNOWLEDGEMENTS

Artificial Intelligence (AI) Use Disclaimer

Artificial intelligence (ChatGPT, OpenAI) was used for language editing. All scientific content, analyses, interpretations, and final presentation were reviewed and approved by the author.

RESULTS

Individual predictors: STAS (AUC=0.693, $p < 0.001$), solid density (AUC=0.610, $p = 0.032$), emphysema grade (AUC=0.597, $p = 0.042$), peri-HU (AUC=0.593, $p = 0.070$). Composite ψ score: AUC=0.786 (sens=0.74, spec=0.76, $p < 0.001$). Below threshold (n=91): N+ 13.2%; above threshold (n=59): N+ 57.6% ($p < 0.001$). Validation cohort (CT-only ψ): AUC=0.670 ($p < 0.001$); N+ 16.9% vs 46.9% below/above threshold. Threshold effect consistent across both cohorts. Performance metrics are summarized in Figure 1.

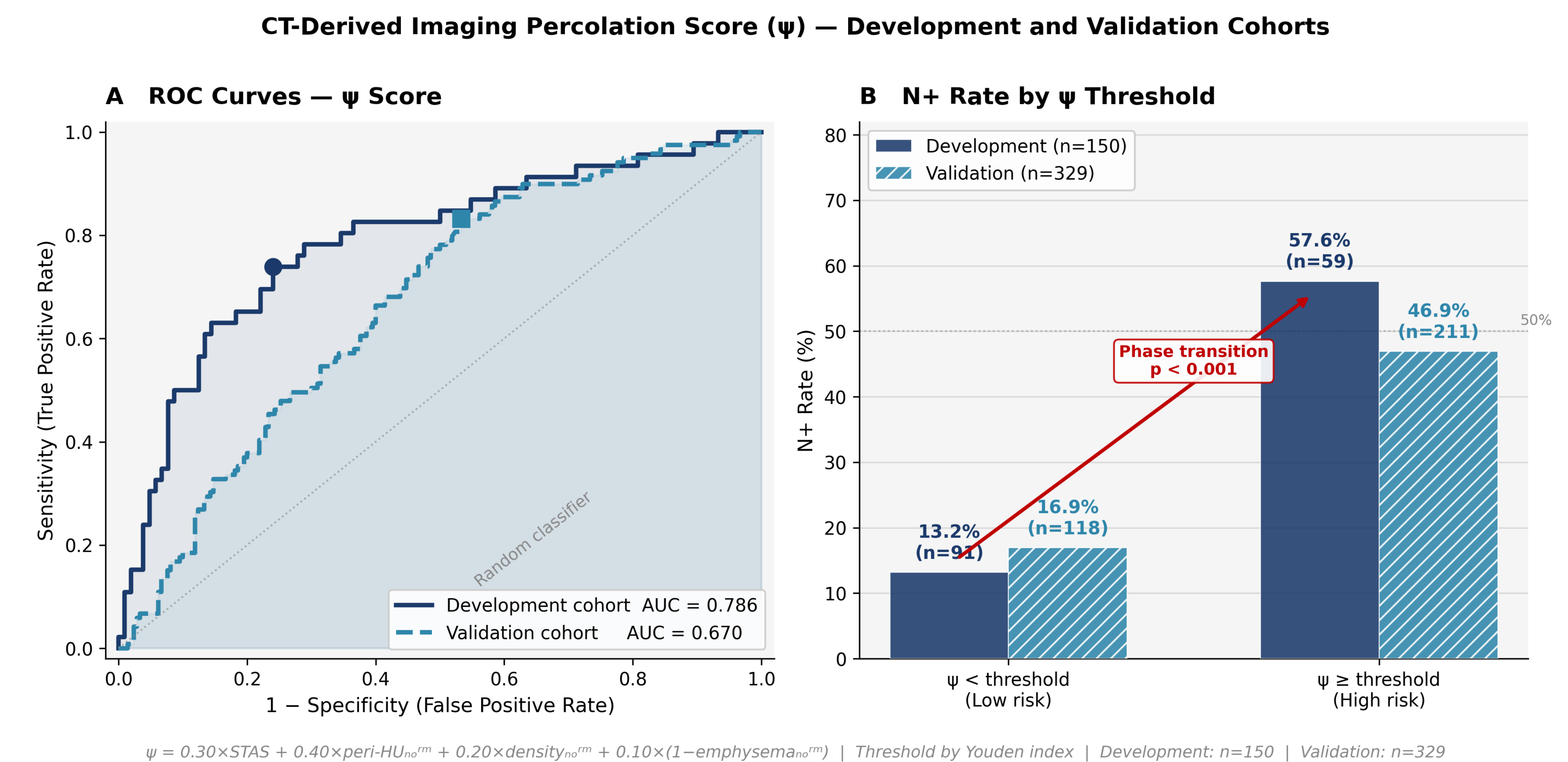


Figure 1