

P1.085: Radiomics From 18F-FDG PET/CT for Non-Invasive Prediction of Histologic Subtypes and Tumor Grade in Lung Adenocarcinoma

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INTRODUCTION

Lung adenocarcinoma exhibits marked histologic heterogeneity, with significant implications for prognosis and treatment. However, accurate assessment of histologic subtype and tumor grade typically requires surgical specimens, limiting applicability in non-resectable or early decision-making scenarios. Radiomics has emerged as a promising approach to extract quantitative imaging features capable of capturing tumor phenotype non-invasively.

METHODS

Design: Retrospective, single-center study of resected lung adenocarcinoma with preoperative 18F-FDG PET/CT or chest CT.

- Radiomic features extracted from segmented tumor volumes using standardized pipelines; preprocessing included normalization, feature reduction, and ComBat harmonization for CT.
- Hierarchical classification strategy: (1) mucinous vs. non-mucinous tumors; (2) multiclass classification of non-mucinous subtypes; (3) prediction of tumor grade.
- Machine learning models developed: Random Forest, XGBoost, and GLMNET; performance evaluated by ROC-AUC, PR-AUC, accuracy, and F1-score on an independent test set.
- Additional models developed for predicting STAS, vascular invasion, and visceral pleural invasion.
- Survival analyses performed using propensity score matching and Cox regression.

DISCUSSION AND CONCLUSION

Key Message

- Radiomics derived from 18F-FDG PET/CT shows strong potential for non-invasive prediction of key histopathologic features in lung adenocarcinoma, particularly for distinguishing mucinous tumors and identifying extremes of tumor differentiation.
- Performance remains limited for intermediate subtypes and certain pathological features (STAS, vascular and pleural invasion), reflecting intrinsic biological overlap.

Future Direction for Research

- These findings support radiomics as a complementary tool for preoperative risk stratification in lung adenocarcinoma, alongside conventional histopathology.
- Larger, externally validated, multicenter studies are needed to improve generalizability before clinical implementation.

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Full methodology and results submitted as a manuscript to be published.

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RESULTS

A total of 255 patients with complete radiomic and pathological data were included.

- Mucinous vs. non-mucinous classification: excellent performance (AUC = 0.92; accuracy = 0.96), with high sensitivity for mucinous tumors.
- Multiclass classification of non-mucinous subtypes: moderate performance (accuracy = 0.393; balanced accuracy = 0.567); better discrimination for lepidic (AUC = 0.874) and solid/cirribriform (AUC = 0.793) patterns, with significant overlap among intermediate subtypes.
- Tumor grade classification: consistent performance (accuracy = 0.721; balanced accuracy = 0.600), with strong discrimination for well-differentiated tumors (AUC = 0.890); binary classification of poorly differentiated tumors improved performance (PR-AUC = 0.854).
- Models for STAS, vascular invasion, and pleural invasion: modest discriminative ability (AUC range: 0.62–0.65).
- Radiomic performance varied according to radiologic phenotype (solid vs. subsolid nodules), highlighting phenotype-dependent model behavior.

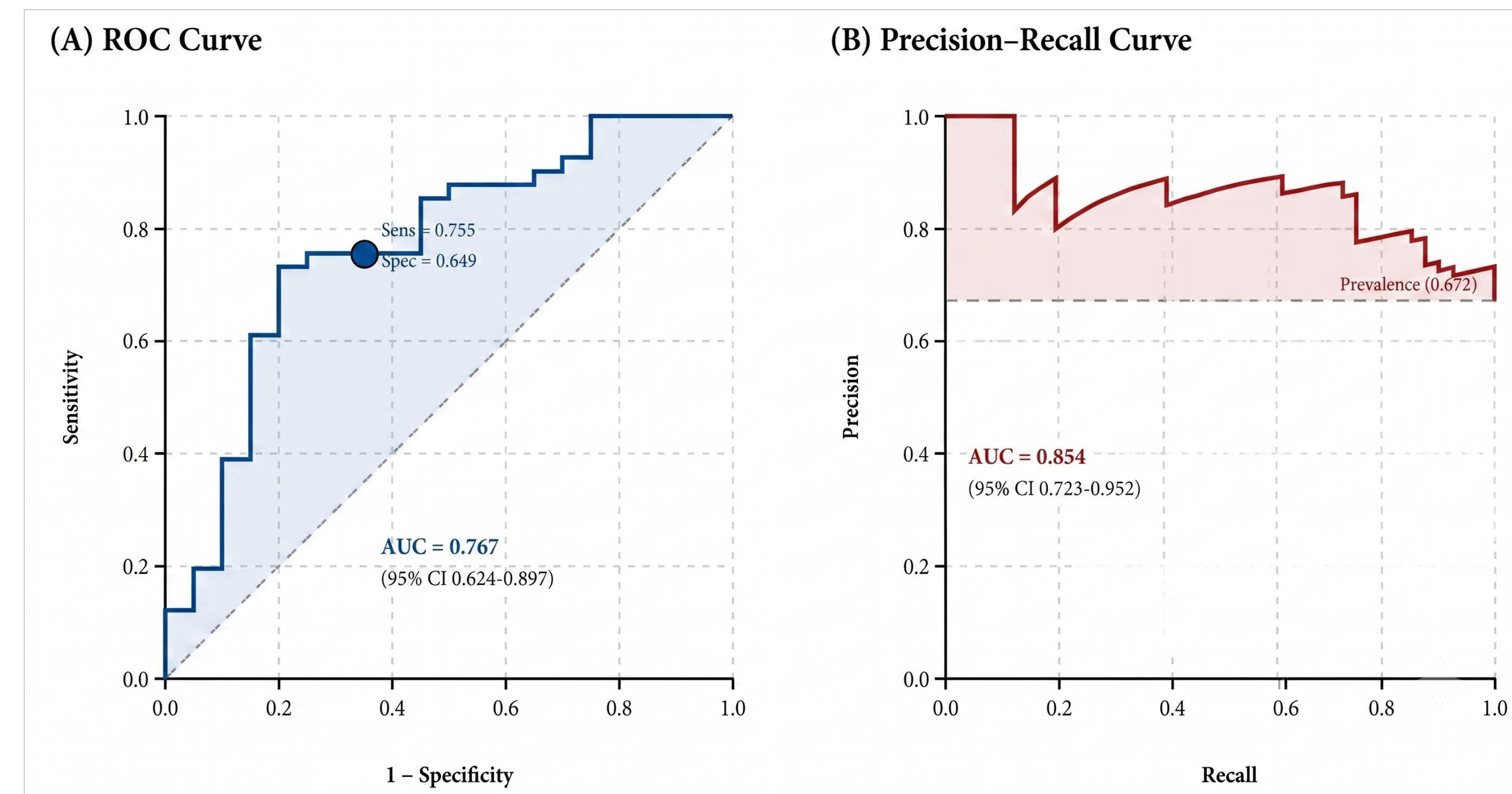


Figure 1. Performance of the binary grade classifier (grade 3 [poorly differentiated] versus grade 1–2) in the independent test set ($n = 61$). (A) Receiver operating characteristic (ROC) curve. The filled circle indicates the operating point at the Youden-optimised threshold (0.527), corresponding to sensitivity 0.755 and specificity 0.649. (B) Precision–recall (PR) curve. The dashed horizontal line represents the no-skill baseline (prevalence of grade 3 = 0.672). Both curves are derived from individual predicted probabilities. AUC values reported with 95% bootstrap confidence intervals ($B = 1000$).

Figure 2. Probabilistic performance of the binary grade classifier (grade 3 [poorly differentiated] versus grade 1–2) in the independent test set ($n = 61$). (A) Calibration curve across five equal-width probability bins. Each point represents the mean predicted probability versus the observed event fraction within the bin; point size is proportional to the number of observations. The dashed diagonal represents perfect calibration. (B) Distribution of individual predicted probabilities by true class ($n = 61$ observations). The dashed vertical line indicates the Youden-optimised threshold (0.527). Brier Score = 0.170; Brier Skill Score = 0.230.

