

Minimal Pleural Effusion Underreported on Radiology Reports: AI-Based Detection as a Potential Independent Prognostic Factor in NSCLC

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Introduction

Background

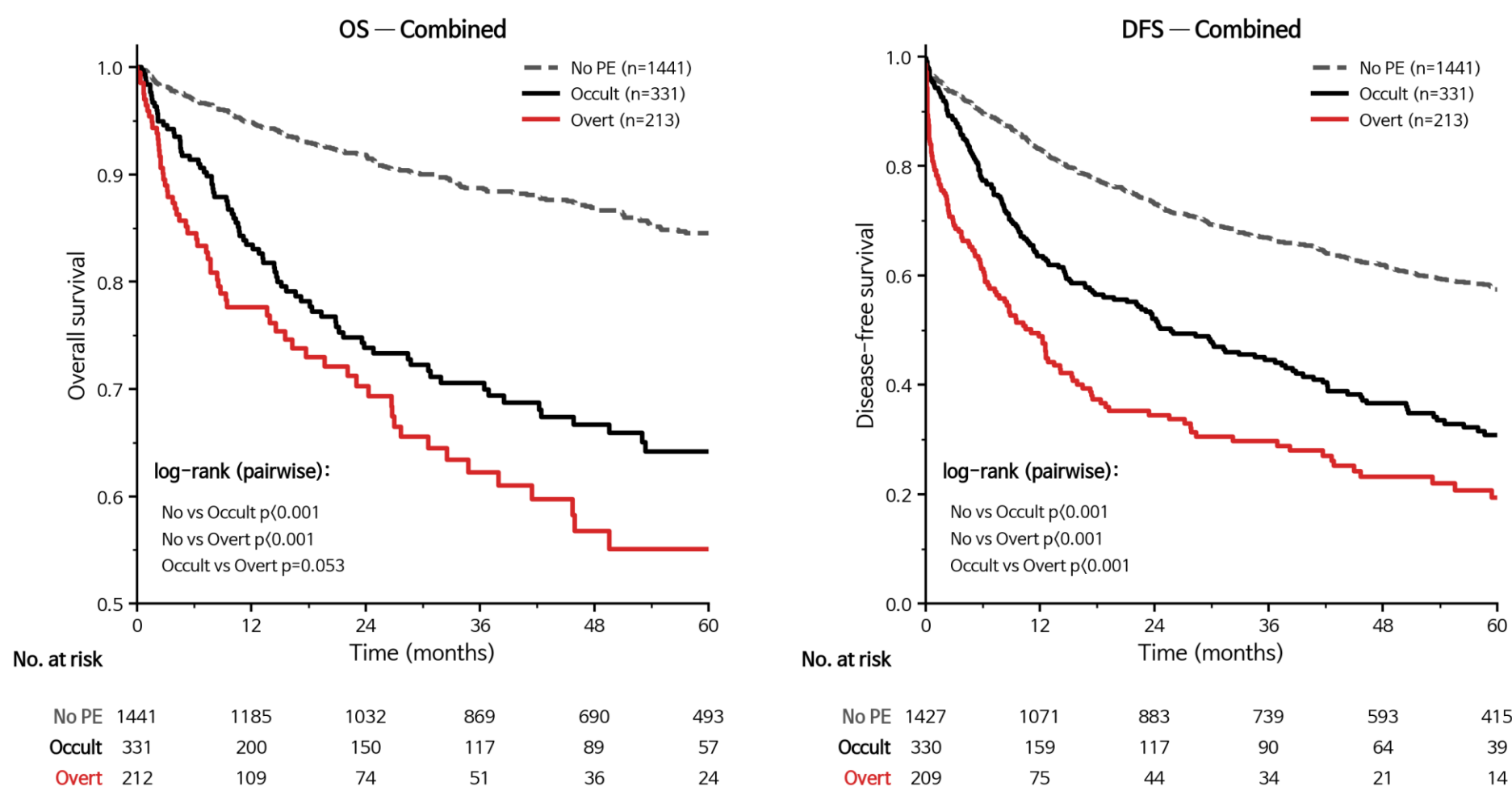
- Pleural effusion is a well-established adverse prognostic factor in NSCLC, and recent studies suggest that even minimal pleural effusion visible on CT may be associated with poor outcomes.
- However, existing evidence has largely been limited to effusions detectable on routine radiologic interpretation, and the clinical significance of sub-radiologic pleural fluid below the reporting threshold remains unclear.
- Recent advances in deep learning-based CT segmentation now enable quantitative assessment of such sub-radiologic pleural fluid.

Objective

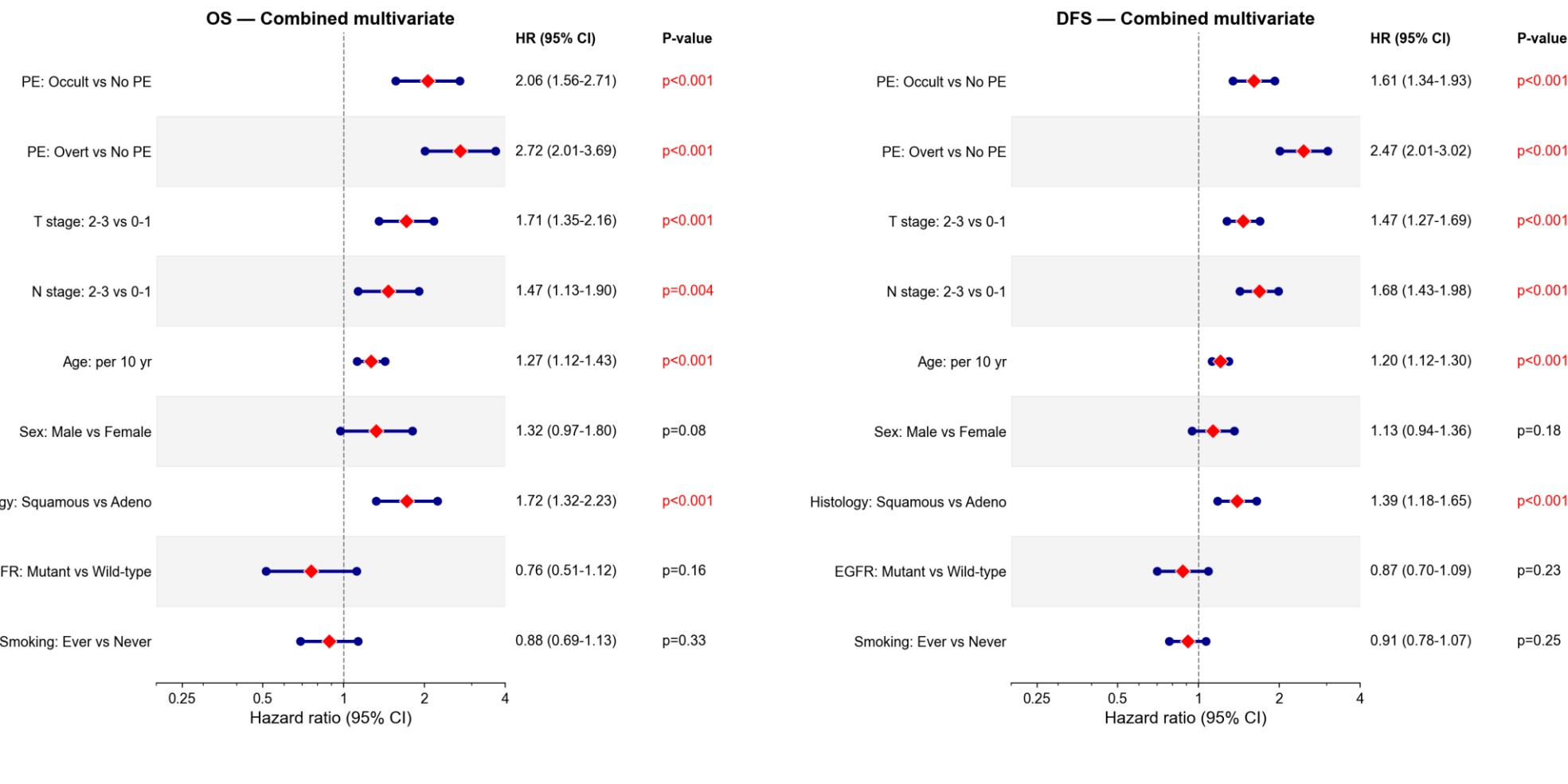
- To determine whether AI-detected occult pleural effusion (Rad–/AI+), not reported on routine radiologic interpretation, is associated with overall survival, disease-free survival, and subsequent progression to overt pleural effusion in patients with Stage I–III NSCLC.

Results

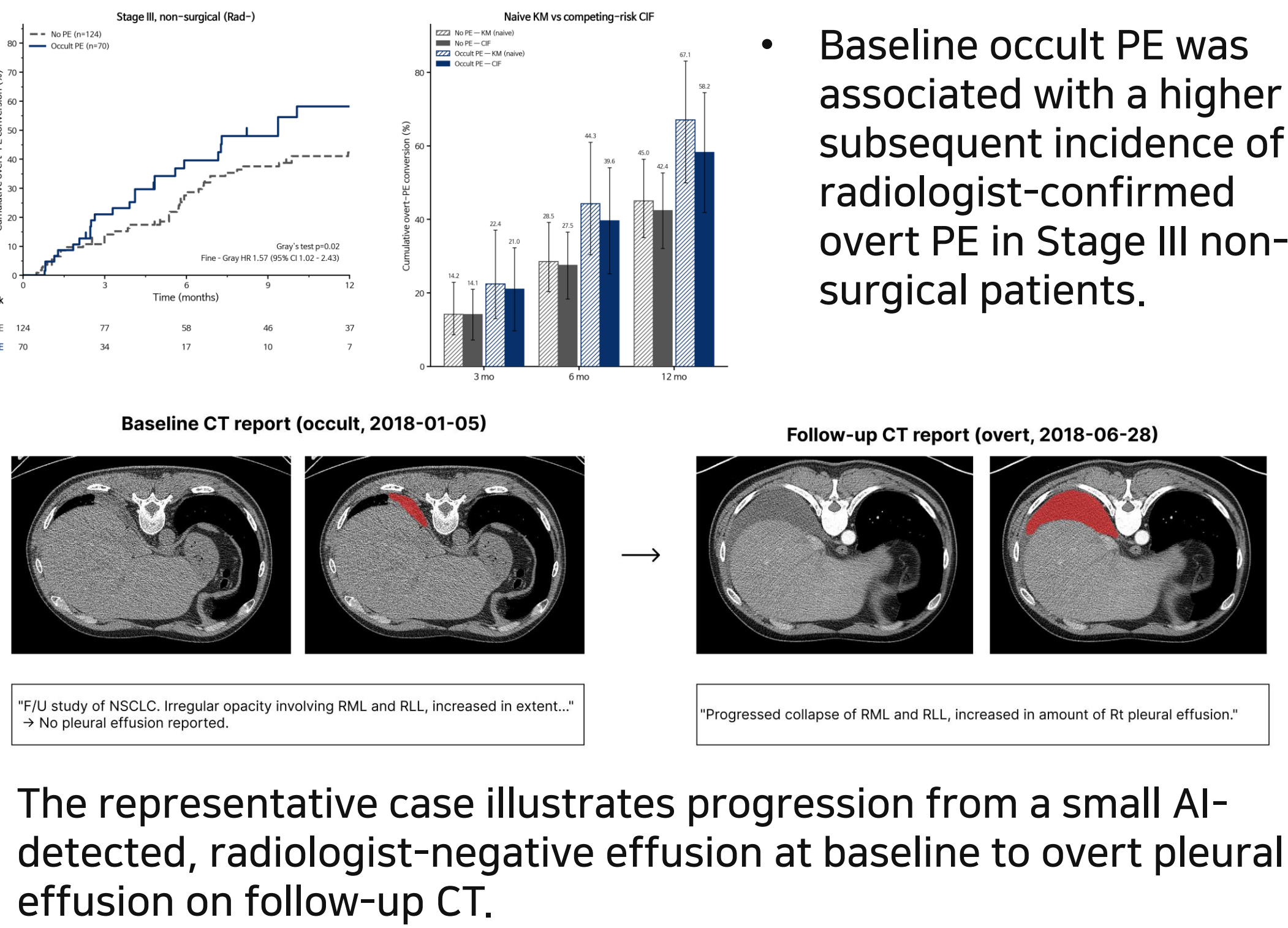
Survival According to Pleural Effusion Status



Independent Prognostic Value of Occult PE



Progression from Occult to Overt Pleural Effusion



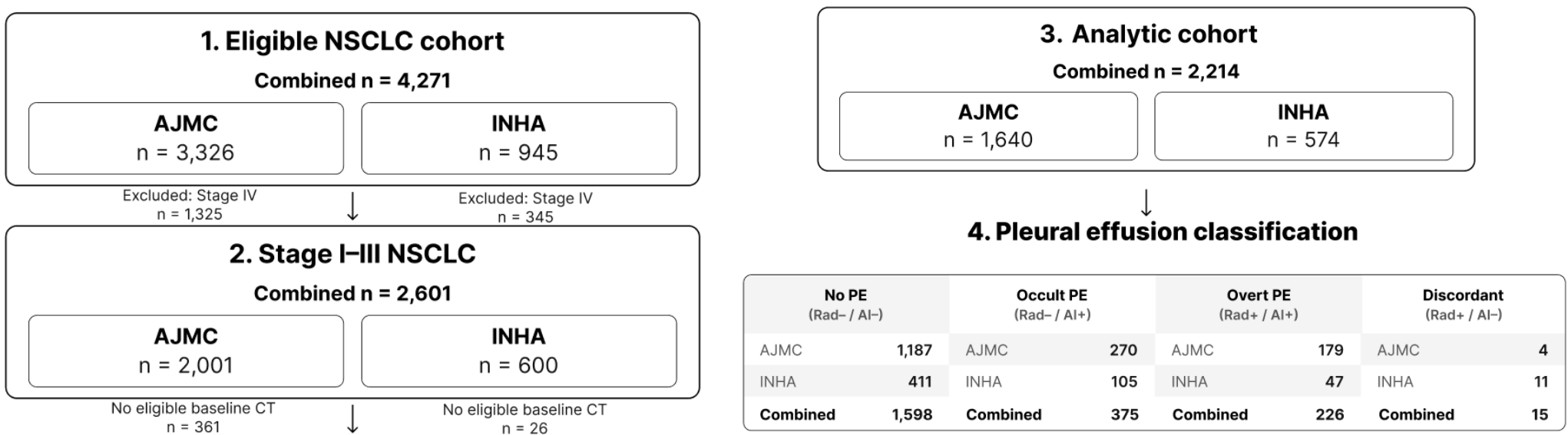
- OS and DFS progressively decreased from No PE to Occult PE and Overt PE.
- Occult PE was associated with significantly worse survival than No PE in the combined cohort.
- All pairwise log-rank comparisons were significant.
- Occult PE remained significantly associated with both OS and DFS after adjustment for clinical covariates.
- Overt PE showed a further increase in risk, supporting a stepwise prognostic gradient across PE groups.

Methods

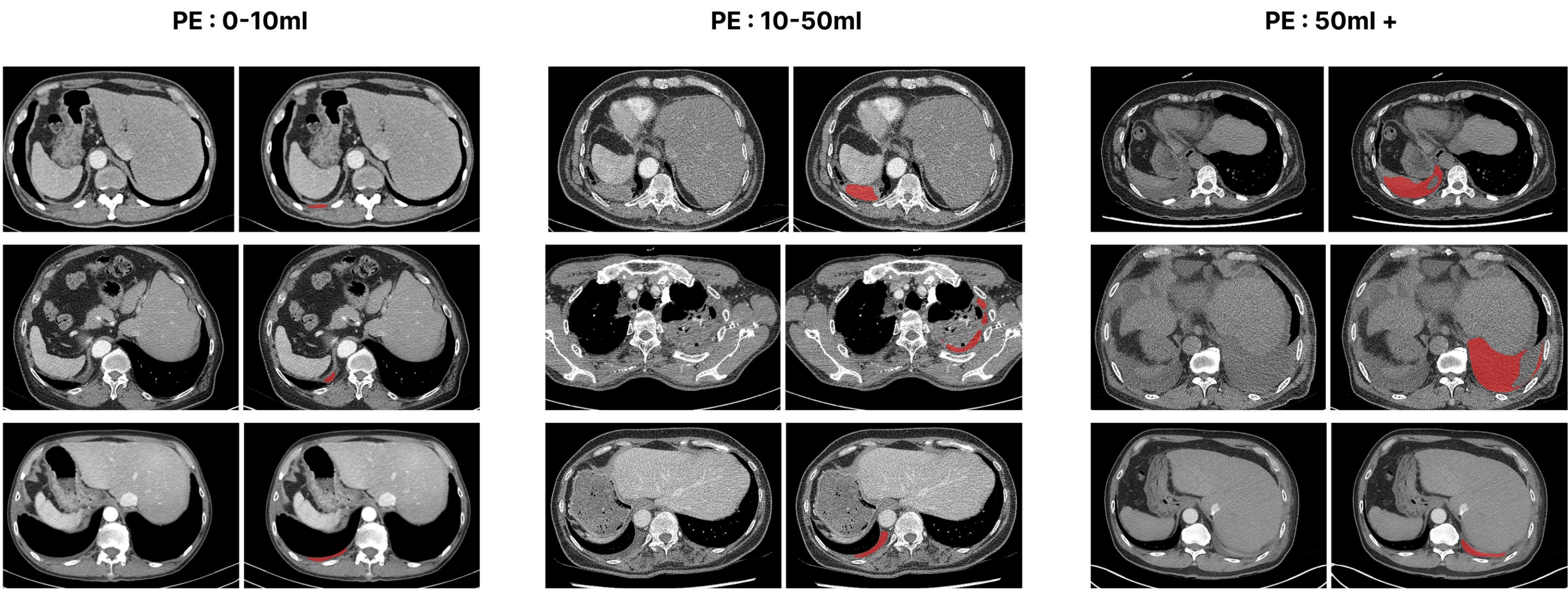
PE Quantification and Statistical Analysis

- AI-based PE segmentation**
Pleural effusion masks were automatically segmented from baseline chest CT using TotalSegmentator, and PE volume was quantified in milliliters.
- PE classification based on radiology report and AI detection**
Patients were classified into four groups according to radiologist-reported and AI-detected PE status:
 - No PE (Rad–/AI–)
 - Occult PE (Rad–/AI+)
 - Overt PE (Rad+/AI+)
 - Discordant (Rad+/AI–)
- Outcome analyses**
Associations with overall survival (OS), disease-free survival (DFS), and progression to overt PE were evaluated using Kaplan–Meier analysis, multivariable Cox regression, and competing-risk analysis.

Study Population and Flow Diagram

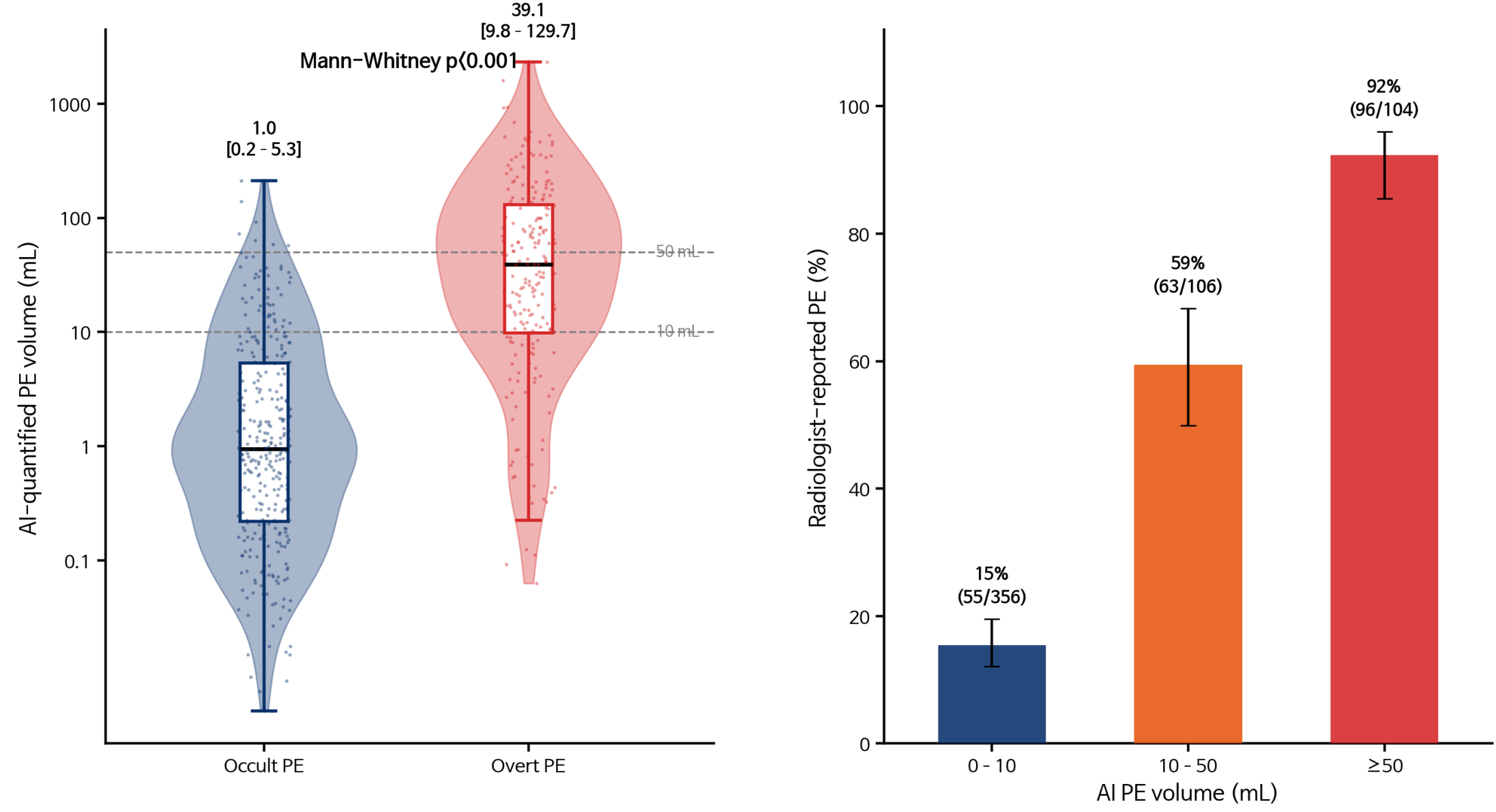


Representative Occult PE Across Volume Ranges



- AI-detected occult PE was observed across a wide range of volumes, with fluid consistently localized to the dependent pleural space.
- Representative CT examples illustrate the transition from subtle sub-radiologic fluid to larger pleural effusions.

Quantitative PE Volume and Radiologic Recognition



- Occult PE had substantially smaller volumes than overt PE.
- The probability of radiologist-reported PE increased progressively with increasing AI-quantified PE volume.

Conclusion

- AI-detected occult pleural effusion was independently associated with worse OS and DFS in radiologically negative Stage I–III NSCLC.
- Increasing AI-quantified PE volume showed a stepwise relationship with adverse outcomes and subsequent progression to overt PE.
- These findings suggest that sub-radiologic pleural fluid may provide clinically meaningful prognostic information beyond routine radiologic interpretation.

AI Use Disclosure:
Generative AI (ChatGPT, OpenAI) was used solely for language editing and improving the readability of the text presented on this poster.
Deep learning-based image segmentation (TotalSegmentator) was used as a study method, as described in Methods. No data were generated, analyzed, or interpreted by generative AI.
The authors reviewed and edited all content and take full responsibility for the accuracy and integrity of the work.