



P1.143: SYNAPSE: A Preoperative Synthetic PET-CT Based Multimodal Analysis for Survival Evaluation in Stage IA Pure Solid NSCLC

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INTRODUCTION

Clinical stage IA pure solid NSCLC shows significant prognostic heterogeneity, with frequent occult pathological upstaging and early-stage recurrence. Noninvasive preoperative risk stratification remains challenging. We developed SYNAPSE, a multimodal deep learning system integrating clinical data, CT and real/synthetic PET to predict pTNM upstage and recurrence, enabling personalized treatment decisions.

METHODS

- **Study Design:**
Multicenter retrospective cohort of 889 patients with stage IA pure solid NSCLC from three medical centers.
- **Synthetic PET (Pix2Pix cGAN):**
Translates CT into synthetic PET to address missing PET data.
- **SYNAPSE Architecture:**
 - Encoders: MedicalNet34 for CT and 3D ResNet18 for PET; metabolic parameters and clinical data encoded via an MLP.
 - Multi-task Learning: CT, PET, and clinical features are fused through a gated fusion module, and the fused representation is fed into task-specific heads to jointly predict pTNM upstaging (binary classification) and RFS (Cox proportional hazards).

DISCUSSION AND CONCLUSION

Actionable Take Away Message

- Leverage Synthetic Data for Risk Stratification
- Enhanced Recurrence Prediction Before surgery
- Cost-Effective Workflow

Future Direction for Research

- External validation and multicenter prospective trials is needed to establish generalizability and clinical benefit.
- Using mechanistic studies integrating multiomics data to decode the biological basis of prognostic heterogeneity in early stage NSCLC.

REFERENCES & ACKNOWLEDGEMENTS

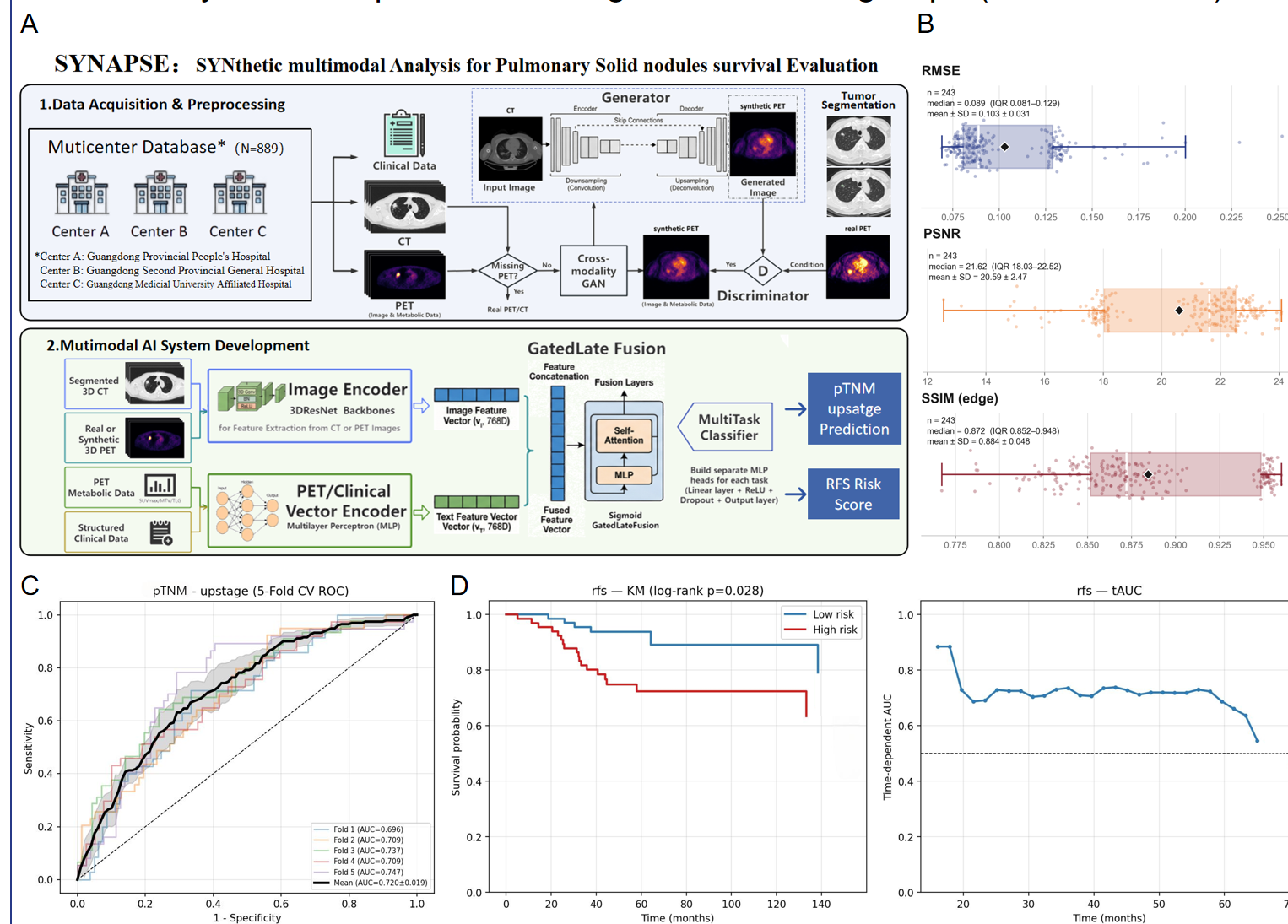
- 1.Salehjahromi, M. et al. Synthetic PET from CT improves diagnosis and prognosis for lung cancer: Proof of concept. Cell Rep Med 5, 101463 (2024).
- 2.Wang, T. et al. Radiomics for Survival Risk Stratification of Clinical and Pathologic Stage IA Pure-Solid Non-Small Cell Lung Cancer. Radiology 302, 425–434 (2022).
- 3.Yan, H. et al. Preoperatively predicting survival outcome for clinical stage IA pure-solid non-small cell lung cancer by radiomics-based machine learning. J Thorac Cardiovasc Surg 169, 254-266.e9 (2025).
- 4.Chen, Sihong, Kai Ma, and Yefeng Zheng. "Med3D: Transfer Learning for 3D Medical Image Analysis." arXiv, 2019. <https://arxiv.org/abs/1904.00625>.



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RESULTS

- **Synthetic PET Quality:** 243 synthetic–real PET pairs were validated with high fidelity (median RMSE=0.089, PSNR=21.62, SSIM=0.872). Synthetic PET-derived metabolic parameters correlated with real PET (SUVmax $r=0.775$ MTV $r=0.815$, TLG $r=0.811$).
- **SYNAPSE Performance:** Integrating clinical data, CT & PET/CT, SYNAPSE predicted pTNM upstaging with an AUC of 0.720 (training), 0.732 (internal test) and 0.620 (external test). For recurrence risk evaluation, the model effectively stratified patients into high and low risk groups (C-index 0.734).



Figures: (A) SYNAPSE workflow; (B) Box plots of synthetic PET quality metrics; (C) ROC curves for pTNM upstaging (5-fold cross-validation, training set); (D) time-dependent AUC curves and Kaplan–Meier curves stratified by model-predicted risk group for RFS.