Abstract B022

Prediction of Radiotherapy-Induced Esophagitis in Non-small Cell Lung Cancer Using a 3D Vision Foundation Model

Chloe Choi[1], Maria Thor[1], Nikhil Mankuzhy[2], John Chang[3], Stephen Mihalcik[4], Jing Zeng[5], Carlos E. Vargas[6], James J. Urbanic[7], J. Isabelle Choi[8], Mark W. Mcdonald[9], James Gray[10], Joseph O. Deasy[1], Jue Jiang[1], Charles B. Simone II[2,8], Harini Veeraraghavan[1]

[1] Department of Medical Physics, Memorial Sloan Kettering Cancer Center, New York, NY, USA, [2] Department of Radiation Oncology, Memorial Sloan Kettering Cancer Center, New York, NY, USA, [3] Oklahoma Proton Center, Oklahoma City, Oklahoma, [4] Department of Radiation Oncology, Northwestern Medicine, Feinberg School of Medicine, Chicago, Illinois, [5] University of Washington and Seattle Cancer Care Alliance Proton Therapy Center, Seattle, Washington, [6] Department of Radiation Oncology, Mayo Clinic Proton Center, Phoenix, Arizona, [7] Department of Radiation Oncology, California Protons Therapy Center, San Diego, California, [8] Department of Radiation Oncology, New York Proton Center, New York, New York, [9] E Department of Radiation Oncology, Winship Cancer Institute of Emory University, Atlanta, GA, USA. [10] Tennessee Oncology Proton Center, Franklin, TN

Introduction

Radiotherapy (RT)-induced acute esophagitis (AE) is a common side effect in lung cancer patients receiving RT, which can significantly impact their quality of life and survival. This highlights the need for a predictive model that can estimate AE risk in advance using pretreatment imaging data. However, collecting sufficient data for model development is often resource-intensive and costly. Additionally, acquiring a homogeneous training dataset (e.g., from a single center or modality) is not always feasible.

This study aimed to develop an automated artificial intelligence-based 3D vision foundation model (VFM) combining standard-of-care planning computed tomography (pCT) and planned radiation dose maps to predict grade II or higher AE.

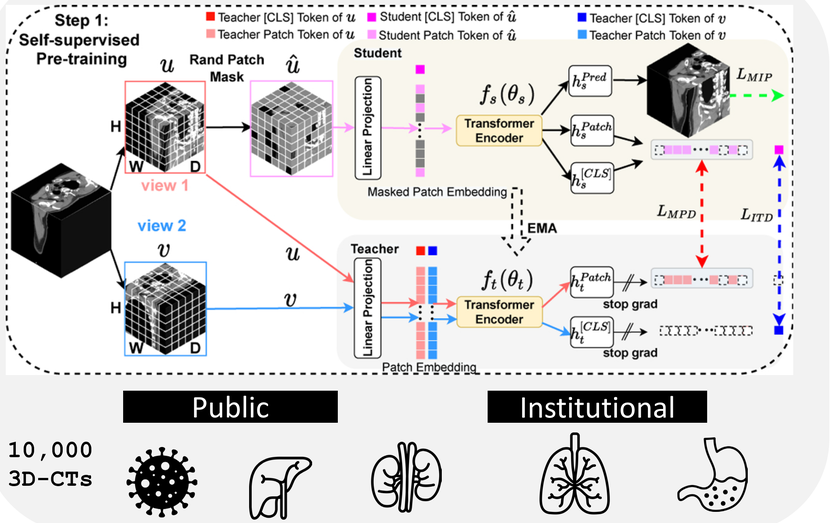
Methodology

We analyzed 246 NSCLC patients treated with IMRT (n=182, single center) or proton therapy (n=64, 11 institutions). The endpoint was grade ≥2 acute esophagitis (33% positive). For each case, pCT, dose maps, and RT segmentations were available.

A transformer-based volumetric feature model (VFM) was pretrained on unlabeled 3D CTs using self-supervised learning (Jiang et al., 2022; PMID: 36468915), then fine-tuned with fully connected layers using stratified 5-fold cross-validation. We developed CT-only and CT+dose models with and without pretraining.

Performance was evaluated via AUC, sensitivity, and specificity.

Step 1: Pre-training



Step 2: Task-specific Finetuning

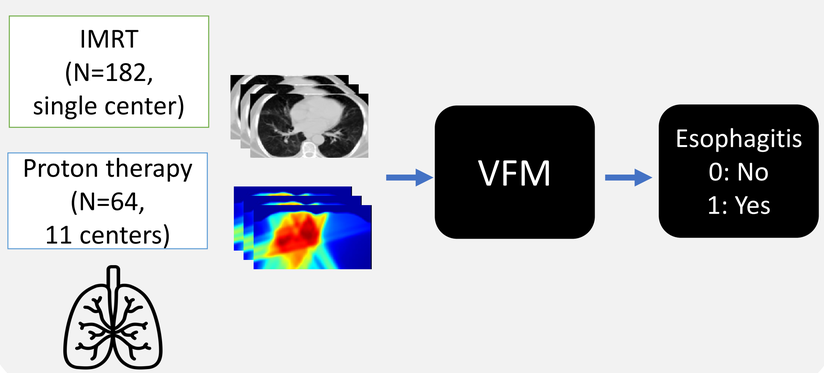


Figure 1: Overview of Prediction Framework

Results

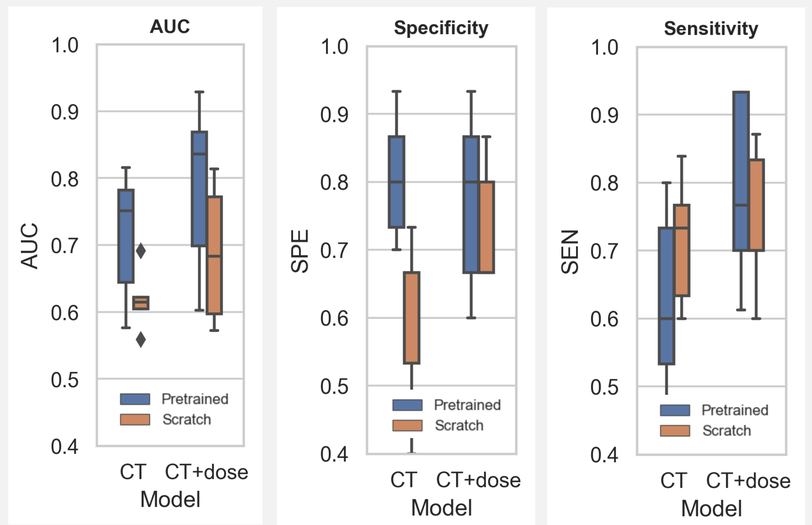


Figure 2: Comparison of model performance

- CT+dose models outperform CT-only across all metrics.
- Pretrained models achieve higher AUC and specificity than models trained from scratch.
- Best AUC (0.79) was observed with pretrained CT+dose model.

Conclusions / Funding information

A VFM model combining CT and radiation dose showed capability to more accurately predict AE with higher specificity. Further studies on larger cohorts of testing patients are planned to assess model generalization / This research was supported by the NCI R01CA258821.