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POSTER ABSTRACTS

803.EMERGING TOOLS, TECHNIQUES AND ARTIFICIAL INTELLIGENCE IN HEMATOLOGY

Artificial Intelligence Derived Changes between Baseline and Interim FDG-PET/CT Radiomics Features Are Associated with Survival Outcomes in Diffuse Large B-Cell Lymphoma (DLBCL)

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Background:
Relapsed DLBCL occurs in up to 40% of patients and has a poor prognosis. Current prognostic tools such as the international prognostic index (IPI) and newer forms (NCCN-IPI) only include baseline clinical features. PET/CT features have not yet been incorporated into prognostic risk models despite being essential for staging and response assessment. Deep learning computer algorithms have consistently demonstrated the ability to analyze imaging data and identify features that are not readily apparent to the human eye. Using a deep learning computer vision model that automatically extracted radiomic features from PET/CTs, we examined the association of changes between baseline PET and interim PET (PET2) radiomic features on survival outcomes and compared the prognostic performance with NCCN-IPI.

Methods:
Adult patients with newly diagnosed diffuse large B-cell lymphoma (DLBCL) between 2005 and 2015 and enrolled in the prospective MER cohort were included. Native DICOM images from FDG PET/CT scans at baseline and interim PET (PET2, after 2-3 cycles of chemotherapy) were preprocessed for regularity and then segmented using the nnU-Net architecture with an external lymphoma-specific model. Feature extraction and standard uptake value (SUV) characterization were accomplished with PyRadiomics and NiBabel. Our computational method included no manual segmentation correction. Individual radiomics features (n=115) and the % change above (Δ High) and below (Δ low) 50 th quartile from baseline to PET2 were evaluated for association with event free survival (EFS) and overall survival (OS) using a univariate Cox regression model and by Kaplan Meier analysis. EFS was defined as time from PET2 to first systemic relapse or death from any cause. OS was defined as time from PET2 to death from any cause. Additionally, Spearman and Pearson correlation matrices were used to guide feature selection while minimizing collinearity. We then assessed the association of the highest scoring radiomics features with EFS in a multivariate cox regression model.

Results:
A total of 506 patients had baseline and PET2 scans available for radiomic feature extraction. Median age at diagnosis was 61 years (range 18-90), 43% were females. NCCN-IPI composition and outcomes of our cohort was comparable to the previously published NCCN cohort, with patient distribution and 5-year OS as follows: Low (9%, 5-y OS 83%), Low-intermediate (38%, 5-y OS 49%), High-intermediate (41%, 5-y OS 31%), High (11%, 5-y OS 12%). At a median follow up of 81 months,there were 308 events, and272 patients had died.Several radiomics features were associated with EFS including change in tumor surface area (SA Δ) (HR: 1.75, 95% CI 1.36-2.24, p<0.005, median of 26,927 mm ^{2}, **Figure 1A**) and change in total metabolic tumor volume (TMTV Δ) (HR: 1.64, 95% CI 1.27-2.10, p<0.005, median of 120,473 mm ^{3}, **Figure 1B**). As a reference, NCCN-IPI univariate Cox regression analysis of EFS produced a Harrell's C-statistic (c) of 0.624. Single radiomics features of SA Δ and TMTV Δ individually produced unadjusted c-statistics of 0.616 and 0.614 respectively. Combinations of radiomics features (SA Δ, TMTV Δ and NCCN-IPI classification) demonstrated cumulative benefit (c=0.652).

Conclusion:
Automatic PET-CT radiomic feature extraction using deep learning models is feasible among patients with newly diagnosed DLBCL. The change in tumor SA and TMTV appear to be promising radiomic biomarkers. A low decline in either tumor SA or TMTV by PET2 is associated with higher risk of relapse and poor survival outcomes. As individual characteristics, these features are similar prognostic indicators of EFS as the NCCN-IPI. Further investigation into risk stratification when combining radiomics with clinical and genomic variables is warranted.

Figure 1. Event free survival for DLBCL patients with A) a change in tumor surface area by PET2 less than 50% percentile (SA_Δ Low) and greater than 50 th percentile (SA_Δ High) and B) a change in TMTV by PET2 less than 50% percentile (TMTV_Δ Low) and greater than 50 th percentile (TMTV_Δ High).

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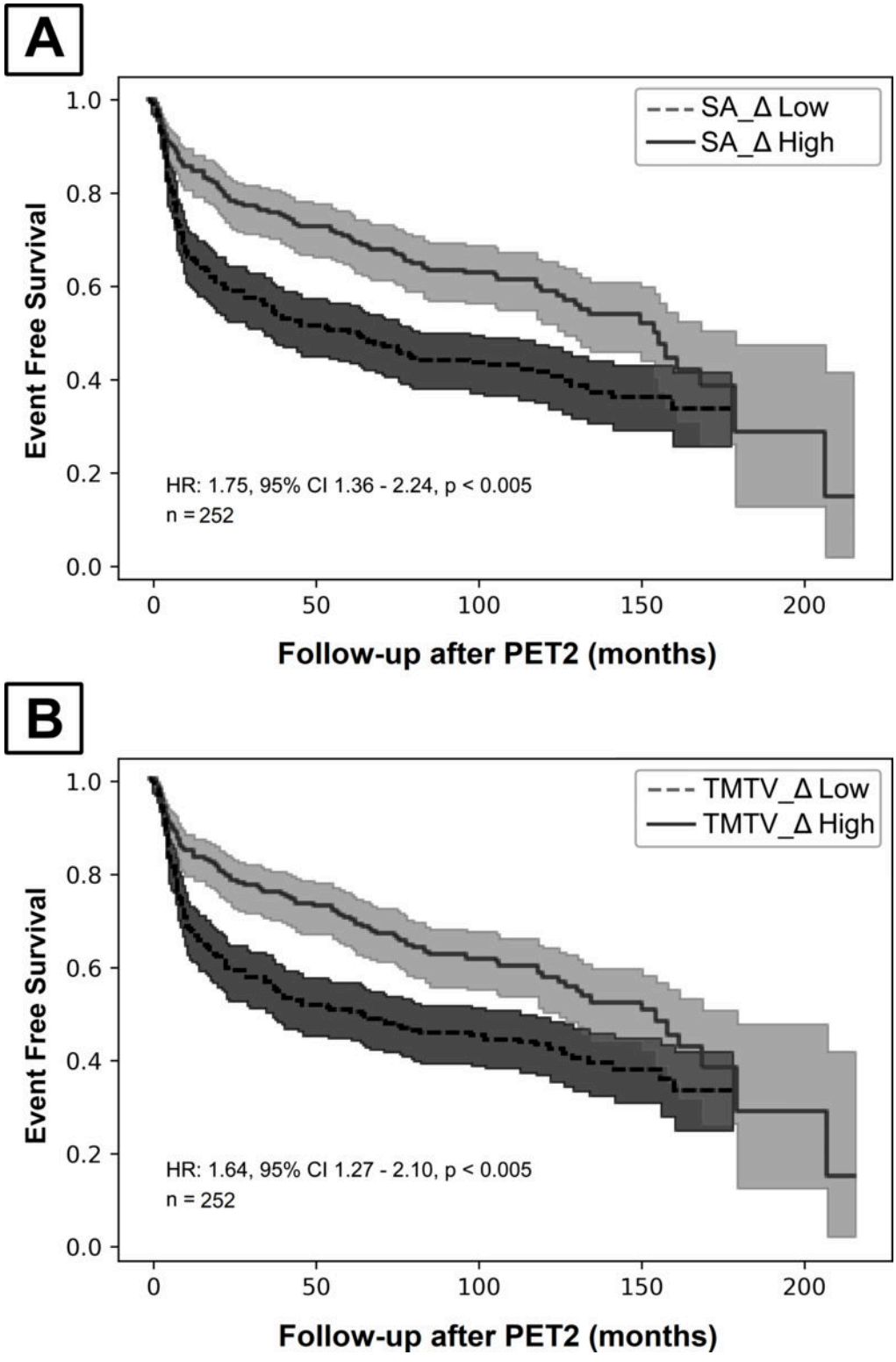

Figure 1

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