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Treatment effect prediction for sarcoma patients treated with preoperative radiotherapy using radiomics features from longitudinal diffusion-weighted MRI

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Abstract

Purpose: To explore radiomics features from longitudinal diffusion-weighted MRI (DWI) for pathologic treatment effect prediction in patients with localized soft tissue sarcoma (STS) undergoing hypofractionated preoperative radiotherapy (RT).

Methods: Thirty patients with localized STS treated with preoperative hypofractionated RT were recruited to this longitudinal imaging study. DWI were acquired at three time points using a 0.35T MRI-guided radiotherapy system. Treatment effect score (TES) was obtained from the post-surgery pathology as a surrogate of treatment outcome. Patients were divided into two groups based on TES. Response prediction was first performed using support vector machine (SVM) with only mean apparent diffusion coefficient (ADC) or delta ADC to serve as the benchmark. Radiomics features were then extracted from tumor ADC maps at each of the three time points. Logistic regression and SVM were constructed to predict the TES group using features selected by univariate analysis and sequential forward selection. Classification performance using SVM with features from different time points and with or without delta radiomics were evaluated.

Results: Prediction performance using only mean ADC or delta ADC was poor (AUC<0.7). For the radiomics study using features from all time points and corresponding delta radiomics, SVM significantly outperformed logistic regression (AUC of 0.91±0.05 v.s. 0.85±0.06). Prediction AUC using single or multiple time points without delta radiomics were all below 0.74. Including delta radiomics of mid- or post- treatment relative to the baseline drastically boosted the prediction.

Conclusion: An SVM model was built to predict treatment effect score using radiomics features from longitudinal DWI. Based on this study, we found that mean ADC, or delta ADC, or radiomics features alone was not sufficient for response prediction, and including delta radiomics features of mid- or

post- treatment relative to the baseline can optimize the prediction of treatment effect score, a pathologic and clinical endpoint.

Keywords: Response prediction; longitudinal diffusion imaging; radiomics; soft tissue sarcoma.