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- Oral presentation preferred
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PRESENTATION TITLE
Treatment response prediction using texture features from longitudinal diffusion MRI in sarcoma patients

AUTHOR(S)
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ABSTRACT
Purpose:
Diffusion MRI has been shown to be a promising imaging biomarker for tumor response assessment. Various studies have revealed the possible correlation between baseline apparent diffusion coefficient (ADC) or changes of ADC and treatment outcome. However, in most of these studies, mean ADC was the only feature used in the analysis, and the data were collected only for once or twice throughout the course of treatment. In this study, we sought to explore more features from longitudinal diffusion MRI to build a predictive model for necrosis score prediction.

Materials & Methods:
Twenty soft-tissue sarcoma patients were recruited in this study with IRB approval. Each patient received five fractions of radiotherapy treatment. Diffusion images was acquired using the conventional diffusion-weighted single-shot echo-planar(DW-ssEPI) sequence on an MRI guided radiotherapy(MRgRT) system(ViewRay) three times during the treatment: one before the first treatment(T1), one after the third fraction(T2), and one immediately after the final fraction(T3). A necrosis score ranging from 0% to 100% was obtained from the post-radiotherapy resection as an immediate surrogate of the treatment outcome. Patients were divided into two groups Nlow and Nhigh based on the necrosis score(<50% v.s. >=50%).

ADC maps were generated using mono-exponential fitting, after which tumors were manually segmented. A total of 36 features were extracted from each time point(table 1). Ratio and difference between features from different time points were calculated, resulting to a total of 324 features.

Minimum redundancy maximum relevance(MRMR) was used to select the most relevant features while minimizing the redundancy between selected features. Five-fold cross-validation was applied,
Logistic regression (LR), support vector machine (SVM) and adaptive boosting (AB) were implemented to predict treatment outcome. Five-fold cross-validation with 50 repetitions was conducted to estimate the stability. Area under curve (AUC), sensitivity, specificity, and accuracy were recorded. Classifications using only individual time point were performed to identify the best imaging time point.

Results:

Four features were selected when using data from all three time points. They are: GLCM homogeneity at T1, 10% percentile at T2, entropy of R31, and volume of D21. Prediction performance is listed in Table 2. SVM had the best performance in terms of AUC, specificity and accuracy. Adaptive boosting provided the best sensitivity. Logistic regression had the worst performance. Moderate standard deviation indicated the stability of the prediction.

Classification performance comparison was shown in Figure 1. SVM outperform the other two methods. Overall, using T1-3 provided the highest performance, and then followed T1. This might be an indication that imaging should be acquired before the treatment if only one imaging can be scheduled.

Conclusions:

Longitudinal diffusion MRI was used for the prediction of necrosis score on sarcoma patients. The SVM model with features from all time points provided the best performance.

Reference: