Purpose:

To examine the accuracy of FGD-PET histogram distances as predictors of pathologic tumor response to chemo-radiotherapy (CRT) in esophageal cancer.

Methods:

Twenty patients were included. A rigid registration was used to align the post-CRT PET/CT with the pre-CRT PET/CT images. The primary tumor was delineated using a region-growing algorithm with a threshold of SUV $\geq 2.5$ on the pre-CRT PET. Two histograms of SUVs within the tumor were constructed on the pre-CRT PET and registered post-CRT PET, respectively. The differences between the two histograms reflected changes in the SUV distribution and were therefore potential predictors of tumor response. The differences were quantitatively measured by histogram distances using 12 bin-to-bin and 8 cross-bin algorithms. The accuracy of histogram distances in predicting pathologic tumor response to CRT was measured using the area under ROC curve (AUC), prediction accuracy, and the Mann-Whitney tests, in comparison with traditional PET response measures and texture features.

Results:

Cross-bin histogram distances were shown to be significant (p<0.05) predictors of pathologic tumor response. They were more accurate than bin-to-bin histogram distances (not significant). The most accurate cross-bin histogram distances were: Quadratic-Chi distance (AUC=0.89, accuracy=80%, p=0.003), Earth Mover distance (AUC=0.83, accuracy=80%, p=0.014), diffusion distance (AUC = 0.82, accuracy=85%, p=0.02) and Match distance (AUC = 0.79, accuracy=80%, p=0.03). This family of novel predictors were more accurate than traditional PET response measures using SUVmax (AUC=0.76, accuracy=75%, p=0.05), SUVpeak (AUC=0.74, accuracy=70%, p=0.08), Total Glycolytic Volume (AUC=0.76, accuracy=70%, p=0.05), as well as texture features based on the co-occurrence matrix (Inertia: AUC=0.85, accuracy=80%, p=0.01).

Conclusions:

The cross-bin histogram distances characterized changes in the SUV distribution within a tumor and showed high accuracy for the prediction of pathologic response to CRT in esophageal cancer.
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