Influence of delineation modality on overall accuracy of machine learning predictive model on colorectal carcinoma

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Aim

The aim of this study is to investigate the differences in the performance of predictive models depending on PET- and CT-driven delineation with the help of machine learning.

Method

Patient Data
73 patients undergoing 18FDG PET/CT scans for colorectal cancer were included in this study. A total of 319 lesions were delineated twice: first only based on PET images and secondly based on contrast-enhanced CT. For each case, semi-automated tumour delineation, as well as a normal background definition in a region of the ascending aorta, was conducted on a standardized medical imaging software (Hybrid 3D, Hermes Nuclear Diagnostics, Sweden). PET SUV values were normalized to the mean of the respective background to provide target to background (TBR) values. Extraction of 150 radiomic features from each TBR-normalized VOI was performed by optimized radiomics (Figure 1).

Additional patient information
Demographic parameters (gender, weight, height, and age group), clinical features (TNM staging, location of the primary tumor, treatment response, K-ras mutation status, grading, number and location of metastases) and laboratory findings, which may be associated with worse outcome (elevated creatinine, LDH- and CRP values, leukocytopenia, thrombocytopenia, and anemia) were merged with the extracted imaging features.

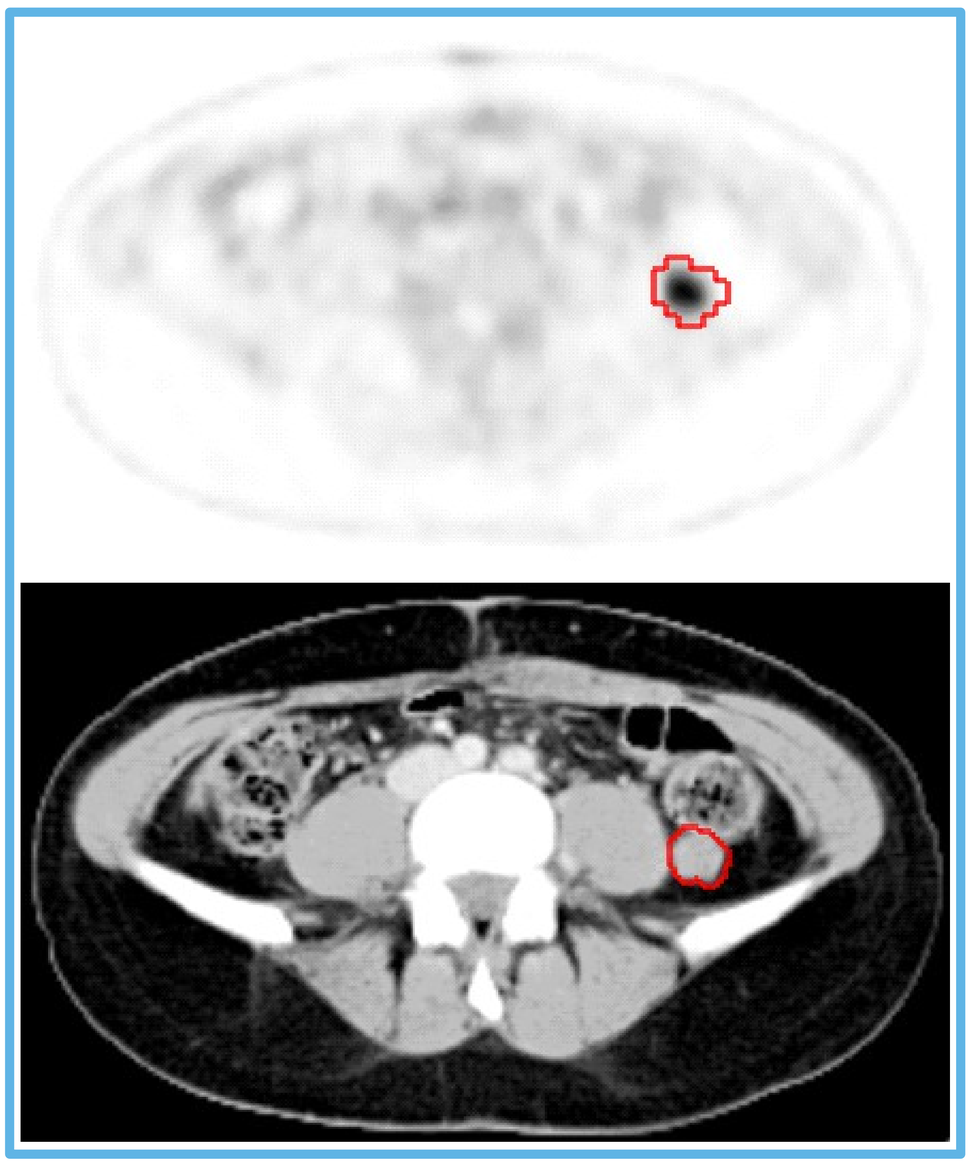

Figure 1: An axial [18]FDG PET (upper image) and CT (lower image) slice of a patient with delineated tumor (red line).

Results

Our results indicate that for the 12-months overall survival with Monte Carlo cross-validation (90% training and 10% validation sets) in a 100-fold cross-validation scheme, the accuracy of the PET-driven delineation was higher than the CT-driven delineation. Furthermore, the sensitivity, specificity as well as positive predictive value, and negative predictive value of the PET-driven delineation was higher as compared to the CT-driven delineation. The class imbalance was handled with random under-sampling. (Table 1).

Table 1: Performans of 12-months overall surival predictive models.

	PET driven delineation	CT driven delineation
Accuracy	74%	66%
Sensitivity	69%	68%
Specificity	78%	64%
Positive Predictive Value	76%	65%
Negative Predictive Value	72%	67%

Conclusions

The PET-driven delineation approach outperformed the CT-driven approach. Considering the PET heterogeneity, in combination with a bigger segmentation mask (as of the partial volume effect and/or positron range) and the surrounding tissue of the lesion in CT, seems to provide additional supporting information for survival prediction in colorectal cancer patients.

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