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PERCIST-like automatic guided treatment response assessment on FDG PET images driven by full extension metastatic breast cancer

Background Evaluation of metastatic breast cancer (MBC) treatment response using PET imaging is particularly based on the PERCIST score. Intermediate or final evaluations are based on the highest SUL_{peak} lesion, which could even be different from one exam to another and not highlighting the metastatic heterogeneity patient status. This work aims at taking into account this limitation by the evaluation of semi-automatic segmentation and registration tools compared with manually extracted PERCIST information.

Methods 10 MBC patients (61 ± 14 y/o) undergoing either chemo- or hormono-therapy were randomly selected from the prospective Epicure study. A baseline and two follow up FDG PET images were acquired at pre-, early- and mid-treatment cycle for each patient. All metastatic lesions were manually segmented by experts on all images.

Using the Advanced Normalization Tools (ANTs) registration method, we wrapped baseline lesions segmentations to automatically obtain the follow-up ones. These registered segmentations were evaluated against manual ones using standard biomarkers, namely SUL_{peak} , lesion size and Total Lesion Glycolysis (TLG).

We visually represented baseline to follow-up evolutions by coloring responsive (decreasing SUL_{peak}) and progressive (increasing SUL_{peak}) follow-up lesion segmentations in 2 different colors. Using these colored segmentations overlaid onto PET images, two expert physicians evaluated the treatment's response for every patient. Hence, they observed baseline and blindly early- or mid-follow up pairs of FDG PET images. We finally compared these evaluations i) between the follow-up pairs, and ii) with the clinical patient outcomes after treatment.

Results Biomarkers extracted from the registered segmentations are similar to the manual ones, with a Lin correlation coefficient of 0.92, 0.87 and 0.95 for the SUL_{peak} , lesion size and TLG respectively. Moreover, these findings are obtained within ~ 10 min, as compared to ~ 1 h for 3 PET image segmentations of every patient.

Regarding the treatment response evaluation using the colored segmentations, the early evaluation is predictive of mid-treatment evaluation in 65% of the cases. Moreover, the blinded physicians' evaluations agreed with the clinical outcomes 85% and 95% of the time for the early- and mid-treatment images respectively.

Conclusion With the ANTs registration method, we can automatically produce segmentations allowing the extraction of biomarkers very close to the ones from manual segmentations, hence carrying similar information.

Moreover, the early-treatment follow-up images were predictive of the mid-treatment evaluation. Finally, the colored lesion representation was helpful to evaluate treatment response.

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