Preliminary comparative results between FES and FDG in ER plus metastatic breast cancer: a radiomic approach

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Gray-Level-Emphasis (p=0.0198) and SUVmax (p=0.028) resulted as significant prognostic factors (p=0.0091) and were significantly associated with higher OS rates. Of note, lower p-values were registered using parameters extracted from PET than CT images. A prognostic nomogram was developed using the most significative values to assign the OS probability at 60 months after baseline PET/CT (Concordance indexes=0.68). ***Conclusion:*** Despite our small cohort of patients, this preliminary study revealed that various RV, in particular CT-Contrast and PET-Large-Dependence-High-Gray-Level-Emphasis, are significantly associated with OS rates in patients with LACC treated with CRT. Further analyses are ongoing to validate this data in a larger population, which may help for stratifying the patient's pre-therapy risk. The prognostic nomogram, if validate with prospective study, could be introduced in LACC management and easily used in the clinical practice. ***References:*** None

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Relationship between histopathological parameters and ^{18}F-FDG PET radiomic features in breast cancer patients

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Aim/Introduction: The aim of this study is to evaluate the relationship between histopathological parameters and textural radiomic features of ^{18}F-FDG PET images in patients with breast cancer. ***Materials and Methods:*** Forty-three patients with histopathologically proven breast cancer who were referred to our department for pretreatment ^{18}F-FDG PET-CT scan were retrospectively enrolled in this study. Histopathological parameters including tumor type, histologic grade, estrogen and progesterone receptor status, Ki67 index and HER2 (Human Epidermal Growth Factor) status were derived from pathology specimens. ^{18}F-FDG PET/CT images were acquired from vertex to midthigh 60 minutes after i.v. injection of 6 MBq/kg ^{18}F-FDG at 2 minutes per bed position. SUV based parameters, as well as histogram, shape and textural radiomic features were extracted from PET images using a medical image analysis software. ***Results:*** Analysis between hormone receptor status and imaging features revealed statistically higher SUVmax (p=0,016; p=0,005), SUVmean (p=0,020; p=0,005), Histogram Entropy (p=0,005; p=0,019), GLCM Entropy (p=0,001; p=0,014), GLRLM HGRE (p=0,023; p=0,040), GLRLM SRHGE (p=0,015; p=0,002) and GLZLM HGZE (p=0,017; p=0,002) values in estrogen receptor negative and progesterone receptor negative patients respectively. Patients with higher Ki67 index demonstrated statistically higher SUVmax (p=0,033), SUVmean (p=0,042), Histogram Entropy (p=0,008), GLCM Entropy (p=0,002), GLRLM SRE (p=0,015), GLRLM RP (p=0,026), but lower GLCM Homogeneity (p=0,014), GLRLM LRE (p=0,014), GLRLM LGRE (p=0,000), GLRLM SRLGE (p=0,000), GLRLM LRLGE (s=0,003), NGLDM Coarseness (p=0,006), GLZLM LZE (p=0,044), GLZLM LGZE (p=0,000), GLZLM SZLGE (p=0,001), GLZLM LZLGE (p=0,011) values. Triple negative patients had statistically higher SUVmax (p=0,004), SUVmean (p=0,004), Histogram Entropy (p=0,004), GLCM Entropy (p=0,001), GLRLM Dissimilarity (p =0,022), GLRLM HGRE (p =0,003), GLRLM SRHGE (p =0,001), GLZLM HGZE (p =0,002), GLZLM SZHGE (p =0,008), GLZLM ZP (p =0,042) but lower GLCM Homogeneity (p =0,037) values. ***Conclusion:*** Our study results indicate that radiomic features of ^{18}F-FDG PET images of pretreatment breast cancer patients, consistent with estrogen, progesterone and HER2 receptor negativity as well as high Ki67 index values, contain inherent intratumoral heterogeneity. These may correlate with poor therapy response or high frequency of relapses during the course of the disease. Although higher SUVmax values generally correlates well with aggressiveness of the disease, revealing heterogeneous nature of the tumor at the beginning of treatment process will make clinicians to choose more aggressive treatment procedures for these patients. ***References:*** None

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Aim/Introduction: 16α-18Fluoro-17β-Oestradiol (FES) PET-imaging provides a non-invasive, in vivo measurement of the ligand binding function of estrogen-receptor (ER) in situ of metastatic breast cancer. We conducted a multicentric study (NCT03442504) to predict the value of FES PET at patient level, before a second hormonotherapy based on FDG response obtained at follow up. The aim of this work is to explore the correlation between FDG and FES PET examinations performed few days apart using radiomics features. ***Materials and Methods:*** Two FDG and FES PET examinations were performed for 20 patients from march 2017 to november 2019. The 5 most intense lesions visible in both PET images were delineated with DOSISOFT software (v.3.1.1.20L). We used all the software's algorithms to delineate each lesion for both examination. Thanks to a label majoritary voting approach [1], we created a unique mask from each lesion from which selected radiomics features were extracted [Table 1] using pyradiomics library (v.3.0). This selection was arbitrarily based on our previously work [2] related to radiomics reproducibility in multicentric trials. FES and FDG images were normalized in

SUV and resampled with a 0.4x0.4x0.2 cm^3 pixel size using BSpline algorithm. Gray value histograms were discretized with a fixed 0.5 SUV bin size. We only considered for this analysis volumes greater than 64 voxels (2 cm^3). Statistical analysis were conducted with scipy stats module (v.1.3.1). ***Results:*** Among 96 delineated lesions, only 43 paired lesions remained after applying the 64 voxels cut-off. Hence, 4 patients did not exhibit FES-FDG any paired lesions. Spearman correlation and regression slopes are presented in table1. Among all compared features, no correlation was observed except than a weak one for coarseness (rho=0.5, p=0.002) in neibourghood grey tone difference matrices. This suggests that higher values are observed in FES than in FDG respective volume, implying that textures tends to be more locally uniform in former than in latter volume. ***Conclusion:*** In ER+ metastatic breast cancer, intra-tumoral textural properties extracted from correlated FES and FDG volumes seem to be different. These preliminary findings should be confirmed and this work should be extended to assert whether both FES and FDG intra-tumoral properties assessed using handcrafted radiomics are related to patient outcomes. ***References:*** 1. T. Rohlfing et al, "Multi-classifier framework for atlas-based image segmentation," Pattern Recognition Letters, 2005 2. C. Bailly et al., "Revisiting the Robustness of PET-Based Textural Features in the Context of Multi-Centric Trials". PLOS ONE 11: e0159984, 2016

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Identifying a reliable radiomic signature from scarce data: illustration for 18F-FDOPA PET images in glioblastoma patients

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Aim/Introduction: The design and validation of a reliable radiomic signature is challenging when few patients are available because the disease is rare, the imaging protocol is specific and/or the classes are unbalanced. In this context, we propose an approach to identify a signature and estimate its reliability. ***Materials and Methods:*** 84 patients with a clinical and MRI suspicion of recurrent glioblastoma were retrospectively included. Each patient underwent a 18F-FDOPA PET-CT scan. For each patient, the suspicious lesion was segmented and 49 radiomic features were calculated using LIFEx [1]. Our goal was to distinguish between tumor recurrence and radiation-induced necrosis as confirmed on pathological data, or on a 3-month clinical/imaging follow-up. A screening procedure was developed to identify a signature using leave-one-out (LOO) cross-validation. The procedure involved: 1) selection of all features with a p-value of univariate Wilcoxon test lower than alpha varying from 0.005 to 0.10 for (N-1) learning patients, 2) based on these features, selection of only one feature among correlated features using a Pearson correlation cut-off R varying from 0.95 to 0.50, 3) building of a radiomic signature involving the resulting features using a linear discriminant analysis, 4) test of the model on the N^{th} patient, 5) characterization of the model performance using the Youden Index (Y=sensitivity+specificity-1). The final model selection was based on the consistency of Y values as a function of alpha and R, on the consistency of selected features between the different models, and favored models involving a low number of features. To test the reliability of the selected signature, we repeated the process by excluding one patient using a jackknife procedure (ie, 84 LOO of 83 patients each). We compared the results with those obtained with the same alpha and R when randomly assigning a label to each patient (sham task). ***Results:*** 61 patients had tumor recurrence and 23 had radiation necrosis. Visual interpretation yielded Y equal to 0.35 (Lizarraga scale, Se=100%, Sp=35%). Using LOO, 10/28 radiomic models had Y>0.35. The largest Y (Y=0.49, Se=62%, Sp=87%) were obtained with 4 features on average, reflecting the volume, sphericity and heterogeneity (GLCM_Correlation, GLCM_Contrast) of the lesion uptake. Using the jackknife procedure, Y was 0.47±0.06 (range: [0.32;0.56]), significantly higher (Wilcoxon $p < 0.05$) than for the sham task (Y=0.06±0.18, range: [-0.52;0.47]). ***Conclusion:*** The proposed systematic screening procedure enabled the identification of a parsimonious radiomic signature from scarce data. ***References:*** [1] Nioche et al. Cancer Res 2018.

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Textural features combined with static and dynamic parameters of ^{18}F-FDopa PET imaging for the non-invasive prediction of the IDH mutation status in glioma

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Aim/Introduction: The IDH mutation is a key-factor of favorable prognosis in patients with glioma. ^{18}F-FDopa PET imaging, currently recommended in glioma assessment,