Dual ^{18}F-FDG and ^{68}Ga-DOTATOC PET/CT radiomic analysis in the evaluation of primary pulmonary neuroendocrine tumor

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Introduction

Both ^{18}F-FDG and ^{68}Ga-DOTApeptides-PET/CT are recommended in the characterization of lung NETs (i.e. typical (TC), atypical carcinoid (AC), large-cell neuroendocrine carcinomas (LCNEC) and small-cell neuroendocrine carcinomas (SCNEC))(1). Radiomic approach of dual tracer 68Ga-DOTATOC and 18F-FDG PET/CT had been already assessed to characterize the histological pattern of pancreatic NETs but there is no data regarding lung-NETs (2). The objective of this retrospective pilot study was to evaluate whether radiomic features (RFs) extracted by ^{68}Ga-DOTATOC and ^{18}F-FDG-PET/CT are predictors of histology patterns in patients affected by lung NETs

Materials and Methods

Population : We retrospectively analyzed data from 14 naïve-treatment patients who performed ^{68}Ga-DOTATOC and ^{18}F-FDG-PET/CT prior to surgery, for histologically confirmed lung NET (Typical (TC; n=8); atypical carcinoid (AC; n=5) and small-cell neuroendocrine carcinoma (SCNEC; n=1).

Study design : PET/CT images were obtained from 5 PET/CT scanners (referring to 4 Nuclear Medicine Units) with different reconstruction parameters. Manual Segmentation was performed by two experienced operators allowing extraction of 52 RFs (LIFEx 5.10): 10 conventional PET parameters; 6 histogram; 4 shape-based features; 32 second-order statistics texture signatures from all VOI>64 voxels. In the volume of interest (VOI), intensities of Tracer uptake were resampled using an absolute intensity rescaling factors of 0-20 of the SUV of the VOI (64 bins, 0.32 fixed bin width). We used native voxel size.

Statistical analysis : Lesions were gathered into 2 groups according to histological data (TC and AC/LCNEC/SCNEC). The Mann-Whitney test was used to compare RFs of the lesions among the 2 groups. The reproducibility of each RFs was assessed using intra-class correlation coefficient (ICC) between the two operators (RFs considered as robust if ICC>0.8). The correlation of each RF with all the others was studied using regression analysis, thus generating a matrix of Pearson correlation coefficients. ROC AUC were calculated for each independent RF and a multivariate logistic regression analysis was performed to identify a potential radiomic signature able to predict the histological type.

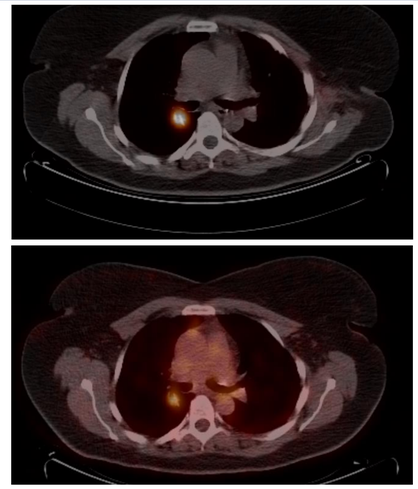

Figure 1 : Dual tracer ^{68}Ga-DOTATOC (top; SUVmax=19.7) and ^{18}F-FDG (bottom; SUVmax=4.6) PET/CT acquisitions in a 49-yo patient with a right typical carcinoid tumor

Results

Among the 14 patients, 19 lesions (primary tumor (n=14), lymph node (n=5)) were segmented.
None of conventional PET parameters from both ^{68}Ga-DOTATOC and ^{18}F-FDG-PET/CT was significantly different between the two groups for both operators.

Also RFs extracted from ^{68}Ga-DOTATOC PET were not significantly different between the two histologic class, whereas for ^{18}F-FDG-PET/CT, 16 RFs show Mann Whitney p values< 0.05 and at the same time ICC between operators > 0.8.
After the Pearson correlation analysis (fig.2), 4 uncorrelated RFs were selected allowing discriminating the 2 groups(fig.3): GLCM_Entropy_log10 (AUC=0.80), GLRLM_LGRE (AUC=0.82), GLZLM_SZHGE (AUC=0.83), GLZLM_GLNU (AUC=0.82). The multivariate logistic regression model including these RFs achieved an AUC value of 0.95 (95% CI 0.86–1) (fig.4)

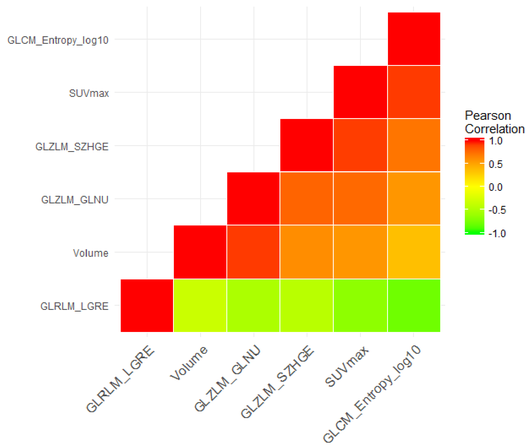

Figure 2 : Pearson correlation analysis between selected uncorrelated RFs and SUVmax

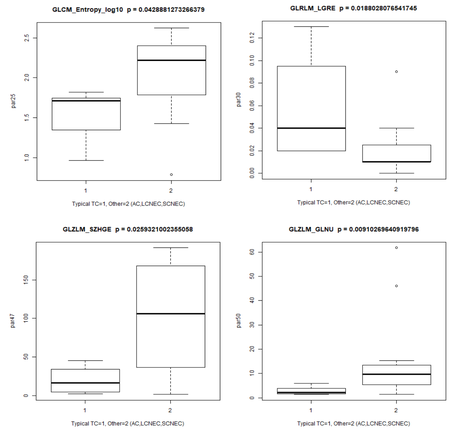

Figure 3 : Blots plots between the 2 groups of patients (TC versus AC/LCNEC/SCNEC)

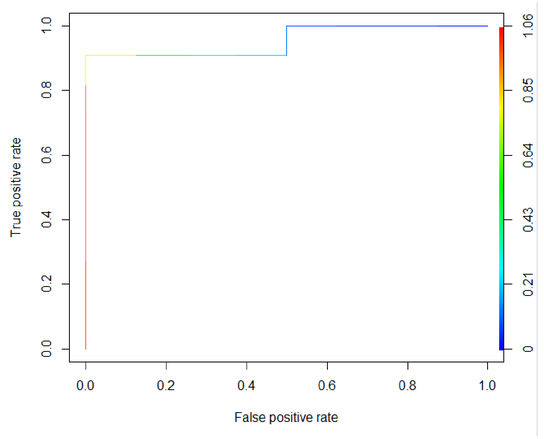

Figure 4 : ROC curve analysis of the multivariate logistic regression model including the 4 RFs

Discussion and Conclusion

To our knowledge, this is the first study assessing diagnostic performance of RFs extracted from dual tracer ^{68}Ga-DOTATOC and ^{18}F-FDG-PET/CT acquisitions to classify Lung NETs according to their histopathological subtypes. Our results suggest that RFs extracted from ^{18}F-FDG PET/CT might be used to distinguish TC from AC/LCNEC/SCNEC, while RFs from ^{68}Ga-DOTATOC appear to be not informative. However, due to the small sample size and the retrospective nature of the study, these results call for further relevant, larger prospective studies.

References

1. *Bozkurt MF, Virgolini I, Balogova S, et al. Eur J Nucl Med Mol Imaging. 2017;44:1588-1601.*
2. *Mapelli P, Salgarello M, Partelli S, et al. J Nucl Med. 2019;60:476-476.*