Relationship Between Quantitative, Histogram and Textural Parameters of 18F-FDG PET in Non-Small Cell Lung Cancer

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Objectives
To retrospectively calculate different quantitative metabolic parameters of non-small cell lung cancer (NSCLC) primary tumors defined by means of 18-F-FDG PET/CT and to analyze correlation between these indices and an array of histogram and textural indices derived from segmented PET images of these tumors, in order to determine most useful parameters for further investigation among multiple textural indices and to describe relationship between tumor metabolic activity intensity, represented by most conventional SUV indices and intratumoral tracer distribution features, described by different textural parameters which is hypothesized to represent tumor biologic heterogeneity.

Methods and Materials
• 44 pretreatment 18F-FDG PET/CT studies of patients with NSCLC were retrospectively reviewed to calculate quantitative metrics and extract histogram and textural indices of metabolically active primary tumors
• All reviewed studies were performed with one scanner (Philips GEMINI 16), with technique compatible with EANM guidelines for FDG imaging in solid tumors
• Primary tumor region was segmented with fixed threshold method (41% SUVmax)
• Five metabolic quantitative parameters (SUVmax, SUVpeak, SUVmean, MTV and TLG) along with four histogram indices and total of thirty-three textural indices (GLCM, GLRLM, GLZLM and NGLDM parameters). Textural features extraction was performed with LIFEx software
• Correlation matrices were constructed to assess direction and strength of relationships between these quantitative parameters

Results
Correlation analysis showed strong connection (|r|>0.8, p<0.05) between SUV indices representing quantitative characterization of FDG uptake and both histogram and textural parameters:
• Positive with entropy and negative with energy from histograms and GLCM matrix;
• Among GLRLM textural indices LGRE and SRLGE demonstrated strong positive correlation to quantitative parameters of tumor metabolic activity, while HGRE and SRHGE showed similarly strong negative correlation;
• Coarseness calculated in NGLDM group was strongly negatively correlated to volume-based quantitative metabolic parameters (MTV and TLG), while compacity from shape indices correlated positively with both MTV and TLG.

Conclusions
Quantitative metabolic parameters of primary NSCLC tumors, representing their metabolic activity are strongly correlated with several histogram and textural indices calculated in 18F-FDG PET images, showing general increase of intratumoral uptake heterogeneity along with increase of metabolic activity in primary tumors. Bigger and more active tumors according to MTV and TLG tend to show less coarse but more compact intratumoral tracer distribution.

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