

Comparison between ^{31}P MRS and ^{18}F -FDG PET for response prediction in non-Hodgkin's lymphoma

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Introduction. In addition to defining disease extent, ^{18}F FDG PET (^{18}F fluorodeoxyglucose positron emission tomography) has shown potential as a predictive biomarker in non-Hodgkin's lymphomas (NHL) [1]. ^{31}P MRS (^{31}P magnetic resonance spectroscopy) has also demonstrated promise as a predictive biomarker [2]: early results suggest the phosphomonoester (PME) peak normalized by the total amount of β -NTP (nucleoside triphosphates) predict treatment response in tumors [3]. The purpose of this study therefore was to determine whether

^{18}F FDG uptake and PME/bNTP ratio are correlated in NHL in order to explore the relationship between glucose utilization and cellular energy metabolism in predicting treatment response.

Methods. ^{31}P MRS was performed on a 1.5 T Siemens Avanto on a cohort of 10 NHL patients, within 7 days of the PET scan. The NHL subtypes were: 2 follicular lymphoma, 7 diffuse large B-cell lymphoma and one unknown. All 10 patients were treated by R-CHOP (rituximab, cyclophosphamide, doxorubicin, vincristine, prednisolone) for 3 to 8 cycles. MR data were acquired from 15.6-125 ml voxel using $^1\text{H}/^{31}\text{P}$ surface coils. Three orthogonal anatomical image sets (T2 steady state gradient echo, max FOV=400 mm, TR/TE=3.79/1.9, 12 slice of 7 mm thickness) were used for planning the ^{31}P spectra acquisition. The 3D ^1H -decoupled ^{31}P CSI protocol consisted of: TR/TE = 1000/2.3, 45° RF pulse, vector size 1024, 8x8x8 phase encoding steps, 2 averages, 1000 Hz spectral width, giving a total acquisition time ~ 17 min. MR data were processed using the jMRUI software [4], and the ratio between PME and total β -NTP was reported for the voxel over the tumour. The reported PET parameter was the maximum of the standardized uptake value (SUV) measured within the tumour, normalized by the mean of the SUV observed for the blood pool (left ventricle of heart).

Results and discussions. Figure 1 shows an example of ^{18}F FDG uptake (top left) and the corresponding ^{31}P MR spectrum (right) obtained from the voxel highlighted in the bottom left panel. The metabolites of interest were clearly detected in all tumour spectra: PME/ β -NTP was successfully quantified for all 10 patients. The high quality of spectra was reflected in low residual of the fitting (standard deviation range 0.6-2.1). Normalized SUV_{max} and PME/bNTP ratios are summarised in figure 2. Non parametric tests found no correlation between the measured ^{18}F FDG/ MRS parameters: Kendall tau (0.022), Spearman (0.0061).

Conclusion. Lack of correlation between normalized SUV_{max} and PME/bNTP ratios suggests that these parameters may contain complementary information regarding treatment outcome.

References. 1. Hutchings M, *J Nucl Med* 2009, 50:21S-30S; 2. Arias-Mendoza F, *NMR Biomed* 2004, 17:382-391; 3. Arias-Mendoza F, *NMR Biomed* 2006, 19: 504-512; 4. jMRUI v5.

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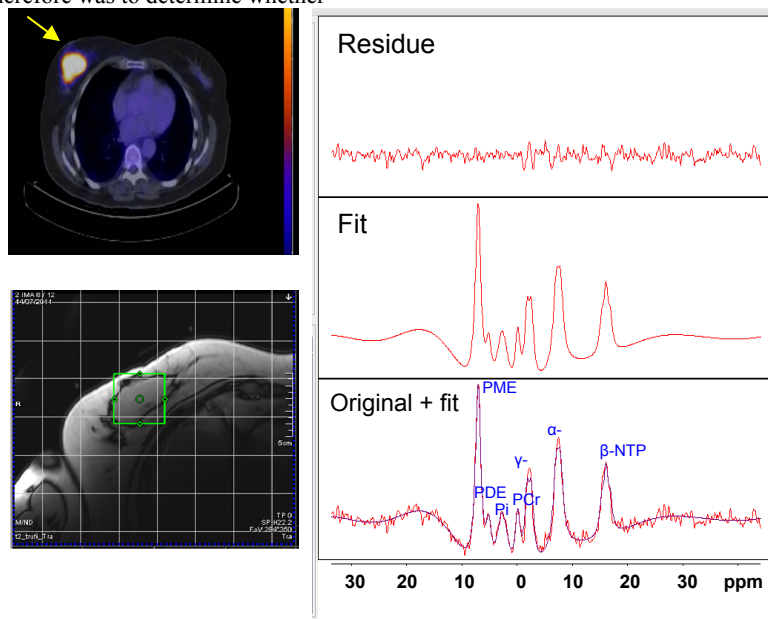


Figure 1. ^{18}F FDG uptake in a NHL mass within the right breast (top left panel). ^{31}P MR spectrum acquired from the same area is shown (right panels). The acronyms stand for: α, β, γ - nucleoside triphosphates, PCr - phosphocreatine, Pi - inorganic phosphate, PDE - phosphodiester, PME - phosphomonoesters.

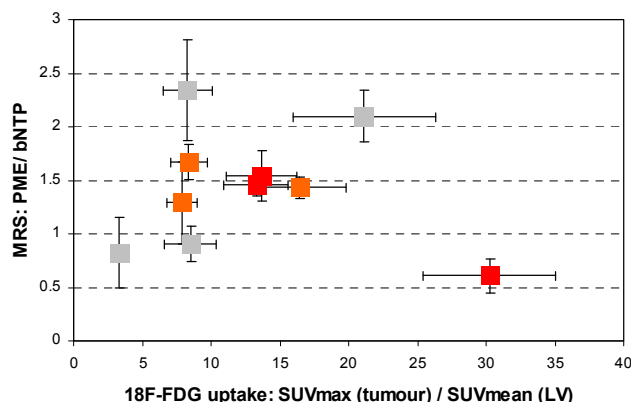


Figure 2. Relationship between SUV_{max} and PME/bNTP in NHL masses in 10 patients. Responders as assessed by RECIST criteria at 6 months are colour coded: red - complete response; orange - partial response; gray - 6-month time point not yet reached