Evaluation of PET/MR and DWI in malignant lymphoma: initial results in 17 patients

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Target audience: Radiologists, Nuclear Medicine physicians

Purpose:

Lymphomas are among the malignancies with the highest incidence in Europe and the United States and imaging plays a critical role, in both the initial staging and restaging, of this group of diseases.[1-2] Whereas the diagnostic value of 18F-fluorodeoxyglucose PET/CT (18F-FDG PET/CT) in the assessment of patient affected by Hodgkin (HL) and non-Hodgkin lymphoma (NHL) is already well established, only recently whole-body positron emission tomography/magnetic resonance imaging (PET/MR) started to be no longer restricted to brain examinations, and its role in lymphoma investigation still has to be assessed.

This new and innovative hybrid modality combines metabolic information provided by PET and anatomic information provided by MR. FDG PET/MR has already shown promising results for imaging of malignant diseases[3-4] but, to the best of our knowledge, only a few data are available in the literature about PET/MR analyses of patients affected by lymphoma and most of them are focused on nodal involvement. [1-2]

Aim of this study was to assess sensitivity and specificity of Positron Emission Tomography/Magnetic Resonance imaging (PET/MR) in the detection of nodal and extranodal involvement in patients affected by NHL.

Methods:

This study was performed with Institutional Review Board (IRB) approval, and written informed consent was obtained from each patient.

From January until October 2014, 17 patients (10 males and 7 females; mean age ± SD, 62.24 ± 13.39 years) with histologically proven lymphoma underwent PET/CT and PET/MR on the same day. Histology revealed mucosa-associated lymphoid tissue lymphoma (MALT) in 10 patients; nodal marginal zone lymphoma in 2 patients; and Burkitt lymphoma, follicular lymphoma, mantle cell lymphoma, cutaneous B-cell lymphoma, and anaplastic B-cell lymphoma in one patient each.Patients were examined with a single 18F-FDG injection, dual-imaging protocol, as part of which PET/CT was performed on a 64-row multi-detector scanner (Biograph TruePoint64; Siemens), and subsequently, PET/MR was performed on a fully integrated PET/MR system (Biograph mMR Siemens, Erlangen, Germany). The PET/CT protocol included a venous-phase CE-CT after the intravenous injection of iodate contrast medium. Diagnostic MR sequences for PET/MR were: axial T1-weighted VIBE; coronal T2-weighted HASTE; and a single-shot, EPI-based SPAIR DWI (b=50 and b=800) with ADC maps. Three sets of images (PET/CT, PET/MR and DWI) were analyzed in consensus. Eight pre-therapeutic staging and 11 restaging examinations were available in the 17 patients; i.e., two patients underwent both initial staging and restaging. The 14 nodal regions defined at the Rye symposium[5], and the following 12 extranodal regions were evaluated: Waldeyer ring, lungs, liver, spleen, stomach, small intestine, large intestine, right kidney, left kidney, bones, soft tissues (skin/fat/muscle), and other organs/tissues (e.g. salivary glands). The maximum and average standardized uptake values (SUV), as well as maximum diameters of nodal and extranodal lesions were assessed on both PET/CT and PET/MR. The minimum and the average ADC values were computed through a manual Region of Interest (ROI); the maximum diameter of each positive finding was computed also on the ADC maps. To determine the diagnostic values of PET/MR (excl. DWI) and DWI, sensitivities (Se) and specificities (Sp) as well as their 95% confidence intervals were calculated.

Results:

Four patients demonstrated both nodal and extranodal involvement, 2 only nodal and 4 only extranodal involvement. Seven patients were negative and one out of the two patients scanned at initial staging and at restaging, demonstrated stable disease (MALT lymphoma of the bladder), whereas the other patient showed a full remission (MALT lymphoma of the tonsil). Sensitivity and specificity of PET/MR (excl. DWI) for nodal and extranodal lymphoma involvement were 97.8 and 99.8% (CI 95% Se 88.7-99.6% and Sp 98.7-100%), respectively. DWI showed a sensitivity of 95% (CI 95% 83.5-98.6%) and a specificity of 99.3% (CI 95% 98-99.8%).

Due to motion artifacts, DWI of the chest were not assessable on 2 patients and 1 bone lesion, localized in the hand, was not detectable with this technique. The diagnosis of a MALT lymphoma of the bladder had been achieved only through DWI and one lesion of the liver was precisely recognizable only on PET/MR (both on the DWI and the PET images).

Discussion:

PET/MR is an emerging hybrid technique that has already demonstrated very good results for the diagnosis of malignancies in different anatomical districts[3-4] but up to now, only few data are available in the literature about its application on patients affected by lymphoma[6-7]. Recently Platzek et al evaluated its sensitivity and specificity, but only for the diagnosis of nodal involvement and without any comparisons with PET/CT.

Our preliminary results demonstrated that PET/MR has a high diagnostic value for nodal and extranodal lymphoma. The high accuracy of PET/MR for the detection of liver lesions combined with molecular imaging features allowed the diagnosis of an extranodal involvement of the liver not recognizable on PET/CT.(Fig 1) As already well established in the literature[6-8], we also strongly believe that DWI is fundamental in a PET/MR protocol; in our cohort of patients DWI revealed – despite its limited spatial resolution and artifacts – substantial sensitivity and specificity and allowed the diagnosis of a MALT of the bladder not assessable through PET. The low number of patients and the lack of a more homogeneous distribution of histological types of lymphoma (e.g. absence of Hodgkin lymphoma) might be considered the main limits of this study but the hereby provided data represents only preliminary results.

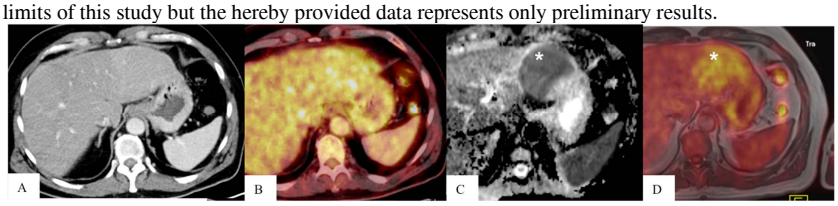

Fig 1. Extranodal involvement of the liver (MALT lymphoma), not recognizable on CT (A) and PET/CT (B) images but well assessable on the ADC map (C) and PET/MR images (D) (asterisks in C and D pointing the lesion).

Conclusion:

Lymphoma is a heterogeneous cancer group, which requires accuracy at the initial diagnosis as much as during restaging. On the basis of our preliminary results, we strongly believe that PET/MR is a highly promising technique for the evaluation of this category of patients. Indeed its high spatial resolution, the lack of radiation exposure, combined with molecular information and with the application of DWI may really improve the diagnostic work-up of this disease.

References

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