Paediatric and Adolescent Lymphoma: Comparison of MR Imaging and PET-CT for detection of focal splenic lesions

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INTRODUCTION: Of the extranodal organs, the spleen is of particular importance in lymphoma as involvement upstages disease and alters treatment strategy [1]. Reported sensitivities of computed tomography (CT) for detection of splenic disease range between 22 and 65% [2] and standard ultrasound techniques miss 35 to 40% of lesions [3]. PET-CT is now considered the imaging standard of reference for disease staging, with recent data indicating it is likely superior to conventional imaging for detection of focal splenic disease (sensitivity and specificity of 100% and 95% respectively) [4]. Because magnetic resonance (MR) imaging, does not utilize ionising radiation, it is an intuitively attractive modality for staging paediatric and adolescent patients. [5]. The aim of our study was to compare the diagnostic performance of MR imaging (STIR-HASTE ± DCE) and PET-CT for identifying focal splenic involvement in paediatric and adolescent lymphoma.

METHODS: Permission was obtained from the local ethics committee for use of retrospective patient data and requirement for written consent waived. A single observer searched our local picture archiving communication system (PACS) database of MR imaging examinations performed at our institution between August 2007 and January 2010 and selected patients aged ≤18 years with histological confirmed lymphoma that had undergone both whole body MRI and PET-CT as part of their routine staging and early response assessment investigations. In total, 44 patients were eligible for inclusion.

***MRI**:* Immediately prior to imaging 0.3 mg per kilogram of body weight of hyocine butylbromide (Buscopan; Boehringer Ingelheim, Ingelheim, Germany), was intravenously administered to reduce bowel motility. In all 44 patients, respiratory and electrocardiogram (ECG) gated axial and coronal STIR-HASTE MR images of the neck, chest, abdomen and pelvis were acquired with the patient supine using the manufacturer's body and spine array coils and a 1.5T MR system (Avanto; Siemens, Erlangen, Germany) (table 1). Twenty-three of the 44 patients underwent additional DCE-MR imaging of the spleen using axial 3D Fast Low Angle SHot technique (FLASH) (table 1). A single dose (0.1 mmol/kg body weight) of gadoterate meglumine (Dotarem; Laboratoire Guerbet, Aulnay-sous-Bois, France) was administered IV at 3 mL/sec, followed by a saline chaser (10 mL). At injection, the patient was asked to breath hold for 30 seconds. Acquisition of axial 3D FLASH images through the spleen with a temporal resolution of 5 seconds was commenced at the start of the injection and continued throughout the breath hold and then every 15 seconds for 2 minutes to allow for controlled breathing. A total of 16 individual scans through the spleen were acquired.

Table 1: MR imaging parameters

Parameter	Coronal and Axial STIR-HASTE	3D FLASH for DCE
No. of sections	27 / 19	80
Stacks	2 / 6-8*	1
Repetition time (msec)	800	2.87
Echo time (msec)	60	0.93
Inversion time (msec)	130	N/A
Matrix	256x256	256x176
Section thickness (mm)	7	2.5
Section gap (mm)	0.7	0
Averages	2	1
Echo train	256	1
Parallel acquisition	2	2
Flip angle	150	9

Sequence parameters for STIR-HASTE and DCE-MR studies.

***PET-CT**:* Data were acquired by using a dedicated combined FDG PET/CT in-line system (Discovery LS; GE Healthcare, Milwaukee, Wis). A standard PET/CT protocol was employed as previously described [5]. Combined transaxial emission images of FDG PET and CT were reconstructed to a resolution of 128 x 128 and a thickness of 5 mm.

Image Review: For the 21 patients without DCE-MR imaging, axial and coronal STIR-HASTE images of the spleen with identifying information removed were first evaluated independently, then in consensus by two radiologists. For the 23 patients with DCE-MR, radiologists blinded to DCE-MR images independently recorded presence or absence of disease on STIR-HASTE images. DCE-MR images were then revealed to radiologists subsequent to evaluation of STIR-HASTE images for each patient; and radiologists independently re-recorded presence or absence of splenic disease for the combined STIR-HASTE + DCE-MR dataset. The final consensus review was performed using the combined MR datasets. PET-CT images of the spleen were independently and then in consensus assessed for presence or absence of splenic disease by two nuclear medicine physicians for all 44 patients. All readers (radiologists and nuclear medicine physicians) were aware of the diagnosis of lymphoma but unaware of the other imaging results or clinical follow-up.

Reference Standard: An independent panel consisting of two expert observers reviewed all cases together with a multi-disciplinary team comprising of a paediatric oncologist, radiotherapist and pathologist. The panel had access to all concurrent imaging investigations and reports, including high-resolution ultrasound of the spleen, PET-CT and MR imaging. The panel was made aware of all clinical details for each patient. In addition, follow-up PET-CT and MR imaging studies for each patient were revealed for evaluation by the panel. The panel re-evaluated the initial staging MRI and PET-CT study using pre-determined criteria for each of the 44 patients for the presence or absence of disease to determine the reference standard against which to compare individual techniques.

RESULTS: Sensitivity and specificity for detecting focal splenic disease was 100% for STIR-HASTE and STIR-HASTE+DCE-MR, and 83.3% and 87.5% for PET/CT at consensus review. Reader concordance was 88.6% for STIR-HASTE MRI (κ=0.73, 95% CI: 0.52-0.95), 95.7% for STIR-HASTE+DCE (κ=0.90, 95% CI: 0.71-1.0) and 84.1% for PET/CT (κ=0.63, 95% CI: 0.38-0.88).

CONCLUSION: STIR-HASTE MR imaging accurately detects focal splenic involvement by lymphoma and compares favorably with PET-CT. Addition of DCE-MR to STIR-HASTE improves overall reader concordance.

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