Radiology Case Reports

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Detection of multiple intracranial hemorrhages in a child with acute lymphocytic leukemia (ALL) by susceptibility weighted imaging (SWI)

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Susceptibility weighted imaging (SWI) combines magnitude and phase information from a high-resolution, fully velocity compensated, three-dimensional (3D) gradient echo sequence. We report on the use of this MRI technique in a young patient with acute lymphocytic leukemia (ALL) and demonstrate a higher detection rate of hemorrhagic lesion in comparison with other T2*-weighted sequences.

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Abbreviations: SWI, susceptibility-weighted imaging; 3D, three-dimensional; MRI, magnetic resonance imaging; ALL, acute lymphocytic leukemia; T1W, T1-weighted; T2W, T2-weighted; GRE-EPI, gradient-echo single-shot echo-planar imaging; FoV, field of view; GRE, gradient-echo

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Introduction

Susceptibility weighted imaging (SWI) combines magnitude and phase information from a high-resolution, fully velocity compensated, three-dimensional (3D) gradient echo sequence [1,2]. Originally designed as MR-Venography, this sequence uses susceptibility differences between deoxygenated venous blood and the adjacent tissue for depiction of intracranial veins. However, SWI is able to display susceptibility differences between any tissues e.g. between normal brain parenchyma and blood products. The magnetic susceptibility (χ) is a physical property that describes the degree of magnetization of a material in response to an applied magnetic field. If χ is positive, the material is called paramagnetic and the local magnetic field is strengthened compared to the external magnetic field e.g. hemorrhage; alternatively, if χ is negative, the material is diamagnetic and the local magnetic field is weakened e.g. calcification.

We report on the use of this MRI technique in a young patient with acute lymphocytic leukemia (ALL) demonstrating multiple cerebral hemorrhages.

Case Report

A 14-year-old boy presented with increasing fatigue, diminished appetite and generalized loss of power in the pediatric outpatient department. The physical examination showed multiple hematomas on the lower limbs, petechiae on the body as well as conjunctival and intraocular signs of bleeding. He did not present any focal neurological signs; the lab test indicated normal blood coagulation. A bone marrow biopsy revealed the diagnosis of dendritic cell leukemia, a subtype of T-cell leukemia.

A magnetic resonance imaging (MRI) scan (Siemens Magnetom Vision plus) of the brain showed multiple abnormal signal intensity foci, consistent with hemorrhages of varying ages on T1-weighted (T1W) and T2-weighted (T2W) images. Because of suspected hemorrhages a gradient-echo single-shot echo-planar imaging (GRE-EPI) and an SWI data set were also acquired.

The high-resolution SWI sequence is a fully flow compensated 3D gradient echo sequence (TR/TE/α = 60/40/25°, FoV = 240 x 150 x 72 mm3, matrix = 512 x 240 x 60, zero filling to 512x384x96). Acquisition time for the coverage of the whole brain was 9.5 minutes. Phase images do not need additional acquisition time. Images were reconstructed with an in-house developed interactive tool chain [3]. Phase images were unwrapped using a new algorithm (S Witoszynskyj et al., presented at the 2005 annual meeting of the International Society of Magnetic Resonance in Medicine, freely available from the author), high pass filtered and converted into a phase mask [4,5] to highlight phase changes associated with differences in magnetic susceptibility. The phase masks were then multiplied with the corresponding magnitude images to create susceptibility weighted images (SWI). Minimum intensity projections over 7 slices were computed from the SWI in sliding window mode.

T1-weighted images showed 13 lesions and T2-weighted images 15 lesions, all consistent with subacute to chron-

Figure 1A. A minimum intensity projection over 7 adjacent slices depicts two hypointense lesions in the right pedunculus cerebelli and the pons.

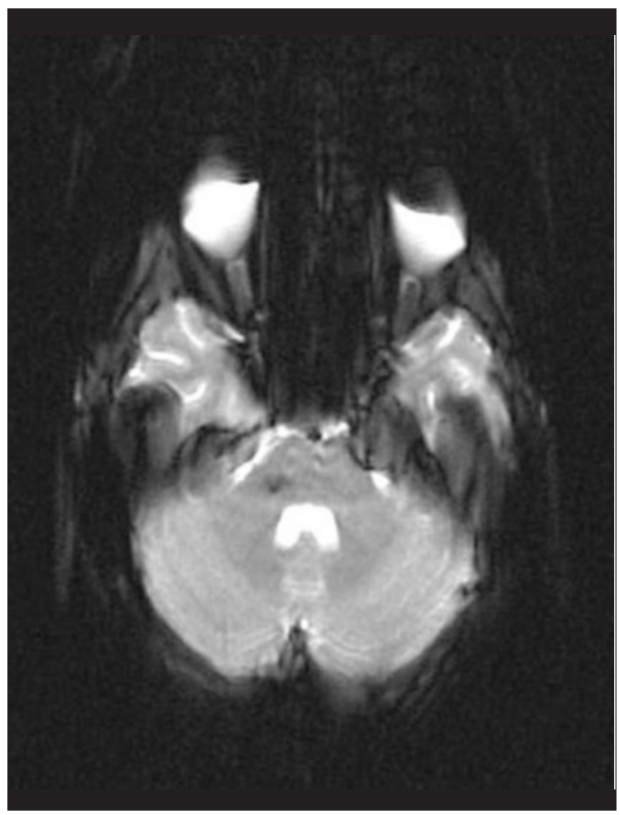

Figure 1B. Corresponding GRE-EPI image. Note the suboptimal demarcation of the cerebellar lesion and the geometric distortion due to magnetic field inhomogeneities at the interfaces between tissue and air.

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