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More on Exploiting the T1 Shinethrough and T2* Effects Using Multiecho Susceptibility-Weighted Imaging

C.C.-T. Hsu, L. Du, D. Luong, S. Suthiphosuwan, A. Bharatha, T. Krings, E.M Haacke and A.G Osborn

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We appreciated the response by Fonseca et al[1] to our article "Tumefactive Primary Central Nervous System Vasculitis: Imaging Findings of a Rare and Underrecognized Neuroinflammatory Disease"[2] on the importance of the "T1 shinethrough effect" on gadolinium-enhanced SWI (Gd-SWI).[3] Gd-SWI has been adopted in neuroimaging protocols for imaging of various CNS pathologies, such as primary brain tumor, brain metastasis, and demyelination.[3] Although SWI is extremely sensitive to paramagnetic substances such as venous blood, microbleeds, and brain iron, its signal intensity is not only dependent on the T2* susceptibility effect but also the T1-relaxivity effect. When this predominates through the T2* and phase effects, the "T1 shinethrough" phenomenon occurs.[3] Fonseca et al[1] emphasized acquiring Gd-SWI to exploit the T1-shinethrough effect, producing comparable imaging quality to post-gadolinium-enhanced T1WI (Gd-T1WI), which can show small enhancing intraparenchymal vessels in tumefactive primary CNS vasculitis.

We have been adopting the use of multiecho SWI sequences at our institution (Gold Coast University Hospital, Queensland, Australia) to further enhance the "T1 shinethrough" phenomenon by altering the scanning parameters. SWI data can be acquired as multiecho sequences.[4,5] Fine-tuning the TE can modify the image contrast weighting. Recently, multiecho SWI has been studied to provide multiple contrasts for imaging of both arteries and veins from the first and second echoes, respectively.[4,5] The first echo provides a time-of-flight inflow effect and some mild T1 weighting, even for intermediate flip angles near the Ernst angle of gray and white matter.[4,5] Therefore, a shorter TE of 10 ms can favor T1 shinethrough while a longer TE of 20 ms produces a stronger T2* effect, as used in a conventional single-echo SWI (Figure). Dual-echo SWI does not require an increase in scan time as both echoes are acquired simultaneously, which eliminates motion artifacts or misregistration between different TE images.[4,5] Multiple articles have promoted the use of fully flow-compensated dual-echo SWI in a rapid, multicontrast approach that can also be used to quantify spin density and T1, which also has the potential to evaluate local changes in T1 as the source of contrast.[4,5]

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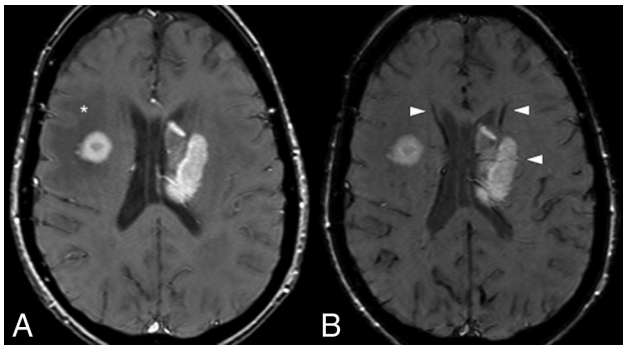

FIGURE. Dual-echo Gd-SWI of a 71-year-old man with primary CNS lymphoma showing periventricular enhancing masses. The shorter echo Gd-SWI (*A*) produced an image with greater T1-weighting demonstrating homogenous enhancement of the periventricular masses. The enhancing area has a signal-to-noise ratio of 108:1. Perilesional brain edema in the right centrum semiovale is also clearly depicted (*asterisks*). Conversely, the longer echo Gd-SWI (*B*) also highlights the periventricular enhancing masses, but with a lower signal-to-noise ratio of 53:1, compared with the shorter echo SWI. However, the longer echo Gd-SWI (*B*) has greater T2* weighting and reveals the draining medullary veins (*arrowheads*). Note that the area of brain vasogenic edema (*asterisks*) seen on shorter echo Gd-SWI (*A*) is not visible in the longer echo Gd-SWI (*B*) because the background brain tissue loses the signal faster than the tissue with edema, so it appears isointense. Dual-echo Gd-SWI parameters were: TE 1 = 10 ms and TE 2 = 22 ms, TR = 29 ms, flip angle = 15°, in-plane resolution = 0.9 × 0.9 mm, and a section thickness of 2.5 mm. The data were collected from a 3T MR imaging scanner (Siemens 3.0T Skyra, Erlangen, Germany).

In summary, multiecho Gd-SWI can produce images with different contrast weighting through a single image sequence acquisition, which can be advantageous in the characterization of various CNS pathologies.

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C.C.-T. Hsu
L. Du
D. Luong
Division of Neuroradiology, Department of Medical Imaging
Gold Coast University Hospital
Southport, Queensland, Australia

S. Suthiphosuwan
Division of Neuroradiology, Department of Medical Imaging
St Michael's Hospital
Toronto, Ontario, Canada

A. Bharatha
Division of Neuroradiology, Department of Medical Imaging and Division Neurosurgery, Department of Surgery
St. Michael's Hospital
Toronto, Ontario, Canada

T. Krings
Division of Neuroradiology, Department of Medical Imaging
Toronto Western Hospital
Toronto, Ontario, Canada

E.M Haacke
Department of Radiology
Wayne State University
Detroit, Michigan

A.G Osborn
Departments of Pathology and Radiology and Imaging Sciences
University of Utah
Salt Lake City, Utah