ORIGINAL ARTICLE

ADDED VALUE OF SUSEPTABILITY WEIGHTED IMAGING (SWI) IN NEURORADIOLOGY

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ABSTRACT

OBJECTIVE: To determine the sensitivity of SWI in further characterization of brain lesions identified on conventional MR imaging. **METHODS AND MATERIALS:** A descriptive cross sectional retrospective study was performed in 3 months period (November 2009 till January 2010). 120 patients with signal abnormality on conventional MRI sequences were included, while grossly normal brains on conventional MRI were excluded from the study. MRI was performed on achieva nova dual Philips 1.5 Tesla. Initially routine conventional T1, T2 and FLAIR images were obtained with 5 mm slice thickness and gap of 1 mm beside DWI. SWI was then performed with protocol TR-15 ms, TE-6 ms, flip angle-30 degree, 120 slices through brain. Findings were analyzed on workstation by two radiologists for presence of blood products, vascularity and calcifications appearing as low signal. **RESULTS:** 120 patients with brain lesions on conventional MRI were analyzed on SWI sequence. Out of 120 patients 90 patients (75%) were confidently characterized on conventional MRI while 30 patients (25%) remained unclassified. Among 90 confidently diagnosed patients 76 patients (84.4%) got no additional information, while in 14 patients (15.6%) there was change in the diagnosis. Out of 30 unclassified patients 8 patients (26.6%) had no additional information, while in 22 patients (73.4%) there was role of SWI in characterization. **CONCLUSION:** SWI technique adds only a few minutes to the current protocol of brain MRI but its use significantly improves the patient care and management and therefore should be routinely performed in patients with signal abnormality detected on conventional MRI.

Keywords: SWI, neuroradiology, MRI

Background

Susceptibility-weighted imaging (SWI) is an MRI sequence aiming to enhance contrast in MR imaging. The susceptibility information adds valuable data to what is already available with conventional spin density, T1 and T2 weighted imaging. SWI offers information about any tissue that has a different susceptibility from its surrounding structures such as deoxygenated blood, hemosiderin, ferritin, and calcium.[1]

Studies have shown that SWI is more sensitive in detecting hemorrhage inside acute infarct lesions than CT and 2D gradient recalled-echo (2D-GRE = T2*) weighted imaging. SWI is so sensitive that it can detect minute amount of hemorrhage, putting in consideration that early detection of hemorrhage inside acute infarction restricts the use of thrombolytic drugs and minimizes the development of large hematoma that needs to be evacuated surgically.[3]

The aim of this study was the further characterization of brain lesion identified on conventional MRI with the help of SWI.

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Materials & Methods

A descriptive cross sectional retrospective study was performed in 3 months period (November 2009 till January 2010). 120 patients with signal abnormality on conventional MRI sequences were included, while grossly normal brains on conventional MRI were excluded from the study. MRI was performed on achieva nova dual Philips 1.5 Tesla. Initially routine conventional T1, T2 and FLAIR images were obtained with 5 mm slice thickness and gap of 1 mm beside DWI. SWI was then performed with protocol of TR-15 ms, TE-6 ms; flip angle-30 degree, 120 slices through brain. Findings were analyzed on workstation by two radiologists with five-year experience, for the presence of blood products, vascularity and calcifications appearing as low signal.

Results

120 patients with brain lesions on conventional MRI were analyzed on SWI sequence. Out of 120 patients 90 patients (75%) were confidently characterized on conventional MRI while 30 patients (25%) remained unclassified. Among 90 confidently diagnosed patients 76 patients (84.4%) had no additional information, while in 14 patients (15.6%) there was a change in the diagnosis. Out of 30 unclassified patients, 8 patients (26.6%) had no additional information, while in 22 patients (73.4%) there was a role of SWI in their characterization. (Tab. 1)

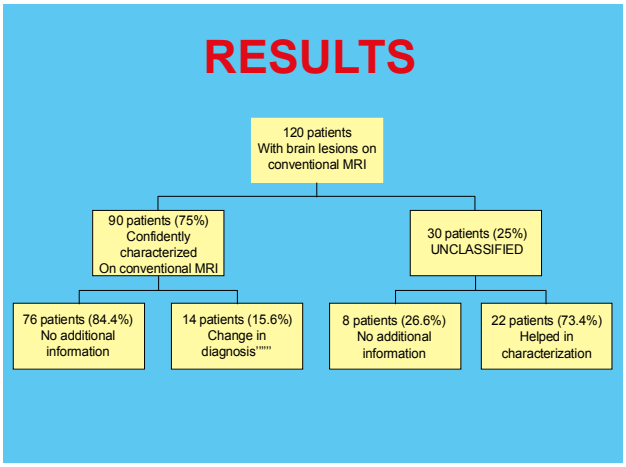

Table 1

Discussion

High-resolution susceptibility weighted imaging (HR-SWI) uses the blood oxygenation level dependent (BOLD) induced phase difference between venous blood and the surrounding brain tissue.[1-3] Moreover, HR-SWI was recently reported as being able to demonstrate the magnetic susceptibility differences of various tissues and to increase the sensitivity to the susceptibility effect of micro venous structures and blood products.[1-3] Therefore, this novel imaging technique can be used for noninvasive visualization of normal or pathologic vascular structures that are not visible on conventional MR imaging.[4] SWI has been applied mainly in the assessment of various vascular and hemorrhagic brain disorders, such as arteriovenous malformations, (Fig. 1) occult low-flow vascular lesions, and cavernous malformations.[4-6] Also very helpful in evaluation of traumatic brain injuries (Fig. 2)

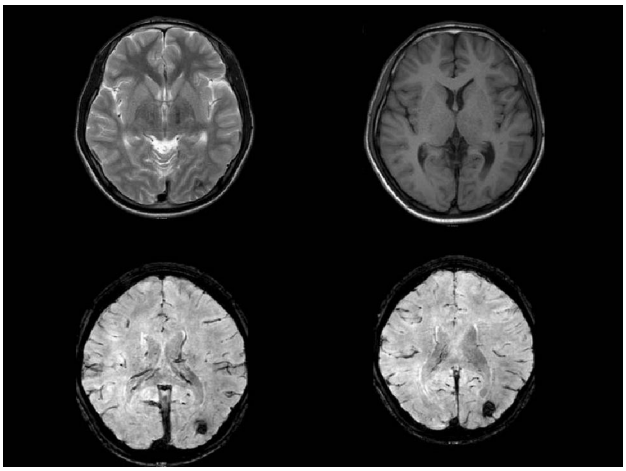

Figure 1: axial brain images T1W, T2W and SWI images. An arteriovenous malformation is well seen on SWI sequences as compare to routine sequences.

Previous reports showed the added value of SWI in brain tumor imaging compared with conventional MR imaging.[4-6] Sehgal et al[4] showed the added value of HR-SWI in brain tumor characterization compared with conventional MR imaging because of its ability to highlight blood products and venous vasculature better. On the other hand, high-grade gliomas contain a relatively large amount of deoxyhemoglobin, which is probably related to angiogenesis and an increased

tumor blood supply, and this can generate susceptibility effects and cause signal intensity loss.[7]

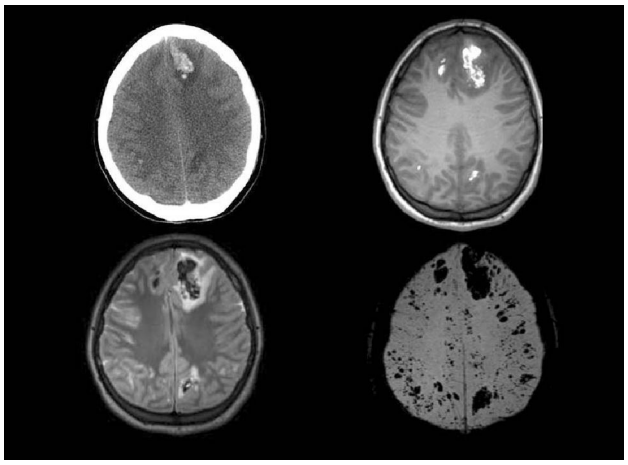

Figure 2: Axial plain CT, T1W, T2W and SWI images from a patient with traumatic brain injury due to TB motor vehicle accident. A SWI image demonstrates it well.

Neuroimaging-based detection of cerebral microhemorrhage has attracted growing attention in patients with cerebrovascular disease and dementia.[8-9] Recently introduced susceptibility-weighted imaging is an advance of the usual T2*-weighted MR imaging that enhances contrast from local susceptibility tissue variations and can depict up to 67% more cerebral microhemorrhages than can conventional T2 imaging.[11]

Earlier observations from noninvasive MR imaging documented increased iron content in the globus pallidum and the substantia nigra in Alzheimer disease and other dementing conditions.[12-13] Two recent studies[14-15] used phase-corrected MR imaging in patients with Alzheimer disease. In the first one, a statistically significant increase in iron concentration was mainly observed in the hippocampus, parietal cortex, putamen, caudate nucleus, and dentate nucleus of patients with Alzheimer disease. A subgroup analysis of severe versus mild Alzheimer disease revealed that the parietal cortex was the only region showing a statistically significant difference between patients with mild Alzheimer disease and healthy control subjects.

SWI technique adds only a few minutes to the current protocol of brain MRI but its use significantly improves the patient care and management and therefore should be routinely performed in patients with signal abnormality detected on conventional MRI.

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