Original Research Article

Evaluation of Vascular Malformations on SWI in Patients Presented with Acute Stroke in 3T MRI

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Abstract

Background: Susceptibility-weighted imaging (SWI) had high spatial resolution 3D gradient-echo MRI sequence with phase post-processing that accentuates the paramagnetic properties of blood products.**Aim:** Significance of SWI sequence in detecting occult vascular lesions in patients with acute stroke.**Method:** A prospective study of 75 patients done in the department of Radio-diagnosis at tertiary care centre. Patients who were having symptoms of stroke and suspected vascular malformations of the brain were advised MRI Brain. Stroke Profile with SWAN, FLAIR, DWI & ADC done on 3T MR machine. SWI images were retrospectively examined by 2 independent radiologists. Their findings were then compared to study the efficacy of SWI in better detection and characterization of lesions.**Results:** Of 75 cases, 61 had microbleeds, 9 patients had cavernomas, venous angiomas in 4 patients and Arterio-venous malformation in one patient. SWI was highly sensitive and specific towards the detection of vascular malformations of the brain. **Conclusion:** SWI images are fast sequences requiring not more than a total scan time of about 3 minutes. Inclusion of this sequence as a part of brain pathology can play an important role in diagnosing different brain lesions without missing hemorrhagic lesions thus avoiding inappropriate therapeutics.

Keywords: Susceptibility weighted imaging, Microbleeds, vascular malformations of the brain.

Introduction

Vascular lesions of brain may pose the diagnostic challenge due to their similar clinical manifestations and imaging characteristic features. Haacke et al. [1] described susceptibility-weighted imaging (SWI), in which at sufficiently long echo times (TEs), the signal from substances with various magnetic susceptibilities becomes out of phase when compared to their neighboring tissues. In SWI, the phase images provide excellent contrast between gray and white matter as well as materials with susceptibilities that are different from surrounding tissue such as hemorrhage, calcification and blood vessels carrying deoxygenated blood [2]. Using SWI, it is easy to evaluate the arterial and venous systems of the brain [3].This study aimed to determine the accuracy of susceptibility-weighted (SWI) MRI for the detection of vascular lesions in patients with acute stroke.

Materials and Methods

The study was conducted at department of radio-diagnosis, Narayana medical college and hospital referred from Emergency medicine and Neurology departments.

Inclusion criteria: Patients who were having symptoms of stroke were advised MRI Brain.

Exclusion criteria: Patients who are claustrophobic, unwilling, with metal/ cochlear implants/ pacemakers and pregnant women were excluded.

MRI Brain protocol: Stroke Profile with SWAN, FLAIR, DWI & ADC done on 3T GE machine.

Imaging: All patients were subjected to brain MRI examination using 3 Tesla MR system. SWI data were collected with a 3D, fully flow-compensated GRE sequence using the following parameters: echo time (TE) = 40 ms, repetition time (TR) = 49 ms, 72 slices, flip angle (FA) = 15°, bandwidth (BW) = 77 Hz/px, FoV = 187 x 230, acquisition matrix = 216 x 320, and voxel size = 0.72 x 0.72mm x 3 mm; no interpolation was applied. Total acquisition time of 2:57 min.(Fig 1)

Data Analysis: We compared their findings to analyze the role of SWI in better lesion detection and characterization.

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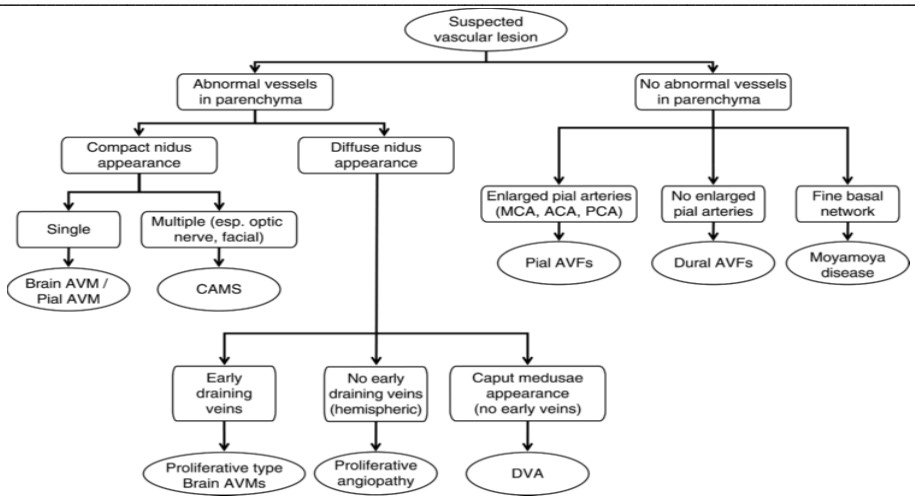


Fig 1:Practical imaging-based diagnostic approach to suspected vascular lesions. CAMS = cerebrofacialarteriovenous metameric syndrome, ACA = anterior cerebral artery, PCA = posterior cerebral artery, MCA = middle cerebral artery.

Results

All patients underwent conventional MRI study as well as SWI sequence. SWI is part of our routine 'brain imaging' protocol and has been included in all brain imaging carried out at our department. Two radiologists were blinded and reviewed all brain imaging studies done at our centre. One of them reviewed the MR images with exclusion of SWI, while the other radiologist reviewed the entire set of images including SWI. Their findings were then compared to study the efficacy of SWI in better detection and characterization of lesions. In our study, 61 patients had microbleeds, 9 patients had cavernomas, venous angiomas in 4 patients and Arterio-venous malformation in 1 patient (Figure 2). We encountered 61 patients with vascular malformations and venous disease, in patients undergoing MRI for neurological symptoms. In 9 patients cavernous angiomas were seen, all these detected on SWI images, which were missed on conventional MR. Additionally SWI was helpful in delineating the draining vessel in 4 venous angioma malformations. In the setting of vasculitis and coagulopathies as well, SWI proves helpful in delineating the microbleeds that would otherwise have gone unnoticed if only conventional sequences were studied.

Cerebral Microbleeds: We encountered 81.33% patients where SWI revealed multiple foci of 'blooming' suggestive of cerebral microbleeds. The radiological diagnosis in these patients was chronic hypertensive encephalopathy/Amyloid angiopathy with multiple microbleeds. In some patients, initially, all the lesions were noted only in SWI while conventional MRI imaging and showed involutional brain changes and/or few lacunar infarcts.

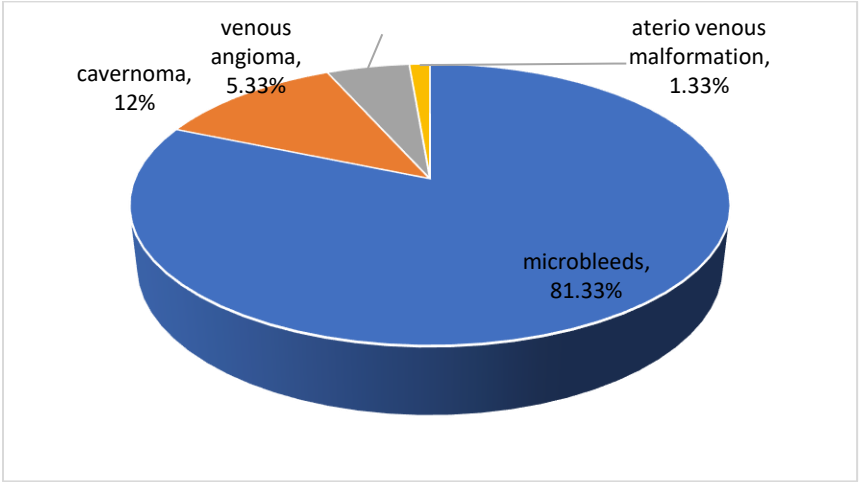
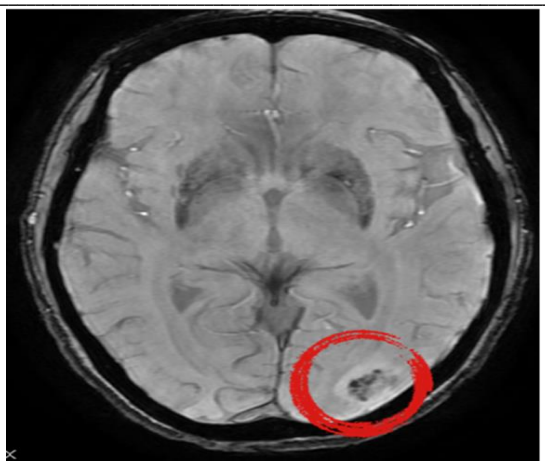
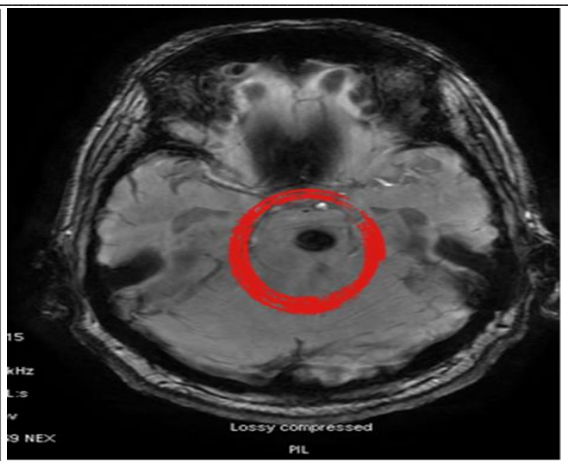


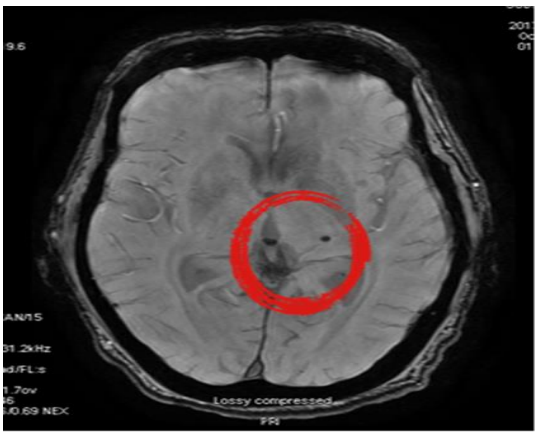
Fig. 2:Distribution of patients with microbleeds, cavernomas, venous angiomas and Arterio-venous malformation



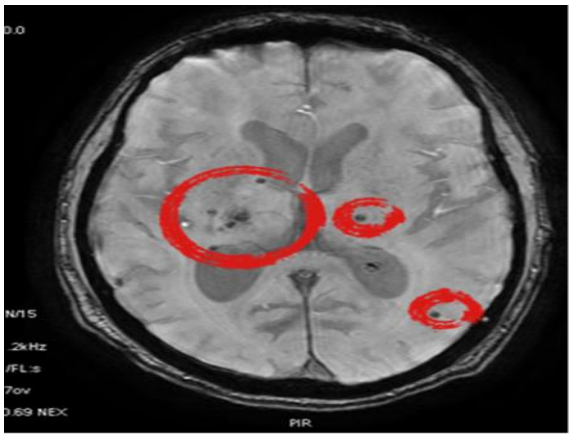
Case 1:Arteriovenous malformation



Case 2: Brain stem cavernoma



Case 3: Microbleeds



Case 4: Microbleeds

Discussion

SWI is a MRI novel sequence with high sensitivity for blood and blood products. This technique can demonstrate occult cerebrovascular malformations by increasing the visibility of small vascular structures which may be undetectable by conventional MR sequences. Therefore, we propose SWI in the imaging protocols which plays a major role in detection of occult vascular lesions which helps in further management of patients. SWI is also superior to conventional sequences in visualizing low flow vascular malformations like telangiectasias and venous anomalies [4].Cerebral microbleeds are an indirect evidence of microangiopathy in patients with increased vascular vulnerability [5]. SWI proved sensitive in detecting cerebral microbleeds that were not seen in conventional MRI sequences or CT.Cavernous angiomas that have bled previously are usually detectable on conventional imaging. However, intact lesions may be almost invisible except for ill defined blush of enhancement after contrast administration. SWI exploits the different relaxation rates between the venous and arterial blood by enhancing the signal-intensity loss resulting in these malformations.

Conclusion

Susceptibility weighted imaging(SWI) is accurate for the detection of vascular malformations of the brain, SWI offers the noninvasive and alternative to angiography in screening or follow-up of treated vascular malformations. SWI included as a routine sequence when examining any brain pathology. These sequences can play an important role in diagnosing and characterizing different brain lesions as well as increasing the sensitivity to hemorrhagic lesions. This will lead to better patient outcomes by avoiding inappropriate therapeutics.

References

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Conflict of Interest: Nil Source of support:Nil