

Susceptibility Weighted Imaging at 3 Tesla is superior to Time-of-Flight-Angiography for the Detection of Peripheral Thrombi in Patients with Acute Stroke

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Target Audience: Physicians and scientists interested in the field of clinical applications of SWI.

Introduction

Time-of-flight angiography (TOF) detects occlusion or stenosis of arteries in patients with acute ischemic stroke due to the absence of blood flow in the occluded vessel, depicted as loss of signal. In contrast susceptibility weighted imaging (SWI) enables intravascular clot imaging in terms of the susceptibility vessel sign (SVS). SVS is defined as a hypointensity within the occluded vessel with a greater diameter than the one of the contralateral vessel, which occurs due to the high sensitivity of SWI sequences for blood products.^{1,2} The aim of this study was to compare the diagnostic accuracy of both methods regarding the determination of vessel occlusion in patients with acute stroke.

Methods

94 patients who presented clinical symptoms for acute stroke (NIHSS>2) and displayed a region of impaired perfusion on the time to peak perfusion map determined by dynamic susceptibility contrast perfusion images (TE 35, TR 1920, FoV 240, slice thickness 5 mm, 75 dynamic scans, injection of 0,1 mmol/kg DOTAREM with bolus technique after the third frame followed by 20ml of NaCl solution) in the area of the anterior (ACA), middle (M1, M1/M2, M2/M3) or posterior (PCA) cerebral artery were included. For all patients TOF-angiography and SWI at 3 Tesla were assessed with respect to delineation of SVS on SWI and vessel occlusion or stenosis on TOF-Angiography.

Results

87 of 94 patients displayed a clearly definable SVS on SWI within the affected artery. In 72 patients the SVS could be correlated with occlusion or stenosis observed on the TOF-angiography (1 ACA, 36 M1, 13 M1/M2, 12 M2/M3, 10 PCA) (figure 1). No patient displayed occlusion or stenosis on TOF-angiography without a correlate on SWI. 15 patients displayed SVS on SWI (14 M2, 1 M1) without any sign for occlusion on the TOF-angiography (Figure 2). Sensitivity for detection of embolic occlusion within major vessel segments (e.g. M1, ACA and PCA) was 97% for SWI and 96% for TOF-angiography. In contrast sensitivity for detection of embolic occlusion within M2/M3 was 84% for SWI and 39% for TOF-angiography. All results are summarized in figure 3.

Discussion

SWI and TOF-Angiography provide equal results for the detection of central thrombemboli while SWI is superior for the detection of peripheral clots. Since TOF-angiography can provide additional information for stroke identification and classification due to peripheral vessel rarefaction we suggest a combined analysis of TOF angiography and SWI for vascular assessment of ischemic stroke.

Conclusion

SWI provides a fast and reliable technique for thrombus assessment and should be incorporated in the routine imaging protocol for acute stroke.

References

1. Rovira A., et al. Hyperacute ischemic stroke: Middle cerebral artery susceptibility sign at echo planar gradient-echo mr imaging. *Radiology*. 2004;232:466-473
2. Huang P., et al. Clinical applications of susceptibility weighted imaging in patients with major stroke. *J Neurol*. 2012;259:1426-1432

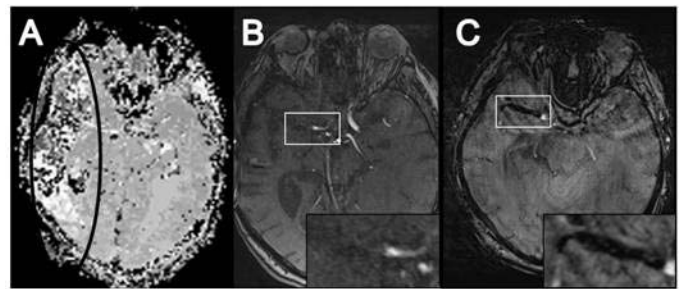


Figure 1. Patient with symptoms of acute right-hemispheric-stroke. Impaired perfusion on the TTP map in the area of the right MCA (A) while TOF-angiography shows occlusion of the right MCA in the M1 segment (B). Typical appearance of a SVS on the SWI is shown in (C).

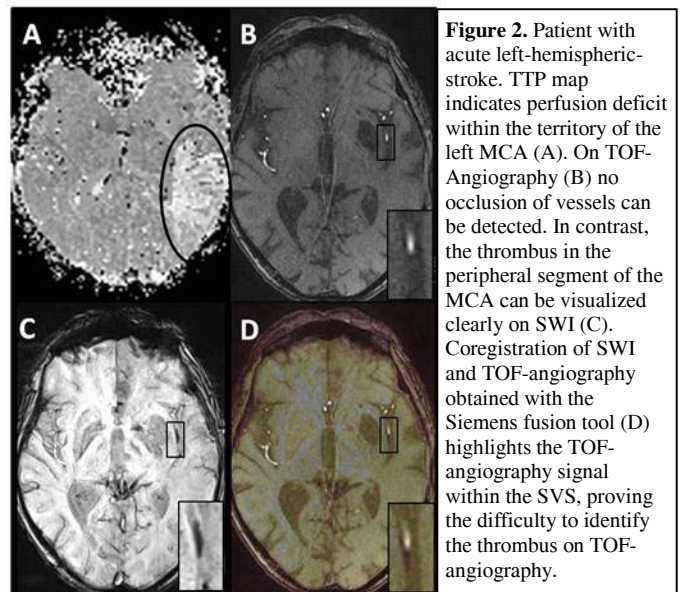


Figure 2. Patient with acute left-hemispheric-stroke. TTP map indicates perfusion deficit within the territory of the left MCA (A). On TOF-Angiography (B) no occlusion of vessels can be detected. In contrast, the thrombus in the peripheral segment of the MCA can be visualized clearly on SWI (C). Coregistration of SWI and TOF-angiography obtained with the Siemens fusion tool (D) highlights the TOF-angiography signal within the SVS, proving the difficulty to identify the thrombus on TOF-angiography.

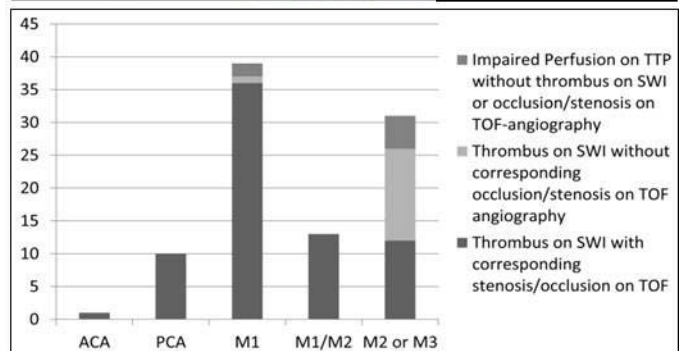


Figure 3. Number of patients (y-axis) with delayed perfusion on TTP and the presence of SVS on SWI and occlusion/stenosis on TOF images. 15 of 94 patients presented SVS on SWI without a corresponding occlusion or stenosis on TOF-angiography. In contrast no patient presented occlusion or stenosis on TOF-Angiography without a corresponding SVS on SWI. Only 7 patients did not present any SVS at all.