

Initial investigation of the feasibility of Quantitative Susceptibility Mapping in clinical practice: an image quality analysis

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INTRODUCTION:

An MRI technique that has received increasing attention recently is Quantitative Susceptibility Mapping (QSM), which quantifies the magnetic susceptibility property of tissue [1-7]. It is therefore, particularly effective at elucidating anatomy with paramagnetic or diamagnetic components. In this study, we assess the feasibility of applying QSM in clinical practice by examining image quality.

METHODS:

An experienced radiologist reviewed the QSM reconstruction in 114 consecutive patients (50F/64M, 17-87yrs) imaged from 9/12/2011-10/10/2011 referred to our hospital for suspected stroke, seizure, or mass lesion or for memory loss and multiple sclerosis workup. Image quality overall and in four specific brain regions (substantia nigra/red nucleus, basal ganglia, vein of Galen, and cortical gray matter/white matter border) and lesions were assessed using the following scale: 1=severe artifacts/blurring; 2=moderate artifacts/blurring; 3=no artifacts/blurring. Indications of pathology were noted. A chi-squared test was performed to compare image scores among 8 age intervals, between the four brain regions, and between normal and diseased subjects.

RESULTS:

Fifty patients showed no indication on QSM of pathology (Fig 1a). In the remaining 64 patients, 279 lesions were identified, including 136 diffuse white matter lesions of slightly higher susceptibility than surrounding white matter (Fig.1b) (suspected as demyelinating lesions) in 24 MS patients, 45 isolated points of very high susceptibility value (suspected as microbleeds) in 15 patients (Fig.1c), 25 suspected hemorrhages in 15 patients, 3 suspected vascular malformations in 3 patients, and 70 other lesions in 7 patients.

There was no statistically significant difference in image quality (table 1) with respect to the presence of pathology (p=0.14), age of subject (p=0.17) or brain regions (p=0.90). Overall image quality was 2.86±0.43 for all subjects and 2.89±0.36 for diseased subjects. In two patients, motion corruption lower the image (score 1), while in six patients, images were degraded in the presence of hemorrhages (score 2).

CONCLUSION:

QSM is an imaging technique capable of high image quality in a wide range of subject ages and pathologies. QSM is potentially useful for evaluating hemorrhages, microbleeds, vascular malformations, and the demyelinating lesions of multiple sclerosis.

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		Score 1	Score 2	Score 3
Age	10-19	0(0.0%)	1(20.0%)	4(80.0%)
	20-29	1(8.3%)	1(8.3%)	10(83.3%)
	30-39	0(0.0%)	0(0.0%)	23(100.0%)
	40-49	0(0.0%)	0(0.0%)	21(100.0%)
	50-59	1(4.3%)	1(4.3%)	21(91.3%)
	60-69	0(0.0%)	2(22.2%)	7(77.8%)
	70-79	0(0.0%)	1(12.5%)	7(87.5%)
	80-89	2(15.4%)	2(15.4%)	9(69.2%)
Area	SN/RN	4(3.5%)	7(6.1%)	103(90.4%)
	GV	4(3.5%)	5(4.4%)	105(92.1%)
	BG	4(3.5%)	10(8.8%)	100(87.7%)
	GM-WM	4(3.5%)	6(5.3%)	104(91.2%)
Lesions	Absense	0(0.0%)	3(6.0%)	47(94.0%)
	MB*	0(0.0%)	1(6.7%)	14(93.3%)
	Demyelination*	0(0.0%)	0(0.0%)	24(100%)
	VM*	0(0.0%)	0(0.0%)	3(100%)
	Other	2(9.1%)	3(13.6%)	17(77.4%)

Table 1: Scores of group. SN- substantia nigra, RN-red nucleus, GV-Galen's vein, BG-basal ganglia, GM-WM - gray matter/white matter border, MB-microbleeds , VM-Venous Malformation, *lesion type classified based on radiologist's impression

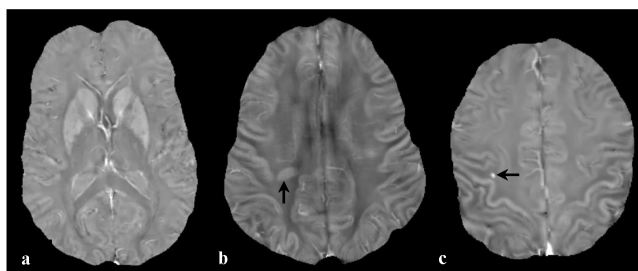


Fig 1. The images of QSMs. a. one image of patient without abnormality on QSM. b.patient with a hyperintense plaque in the centrum semiovale. c. patient with a punctate lesion.