

SWI Enhances Vein Detection Using UPSIO in Multiple Sclerosis

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INTRODUCTION

With susceptibility increased by ultrasmall superparamagnetic iron oxide (USPIO), subvoxel vessels (size < 100 μ m) became visible¹. Among all the USPIO particles, Ferumoxytol is the one most often used in human studies as an off-label magnetic resonance imaging (MRI) contrast agent. Multiple sclerosis (MS) is an inflammatory demyelinating disease of central nervous system (CNS) usually resulting in severe and irreversible disability. Using 7T-MR, previous studies showed that the presence of central vein sign (CVS) within white matter lesions (WML) could be an imaging diagnosis marker for MS². However, in clinical practice, 7T-MR are not routinely available. **To improve detecting capability for CVS at 3T-MR, we introduce an imaging protocol with the use of Ferumoxytol.**

METHOD

We enrolled 10 MS patients in total. The enrolled patients met Barkhof's Criteria³ published in 1997 for MS brain imaging abnormality.

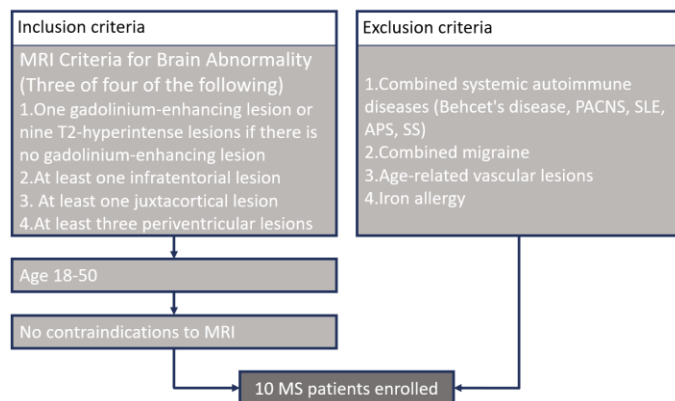
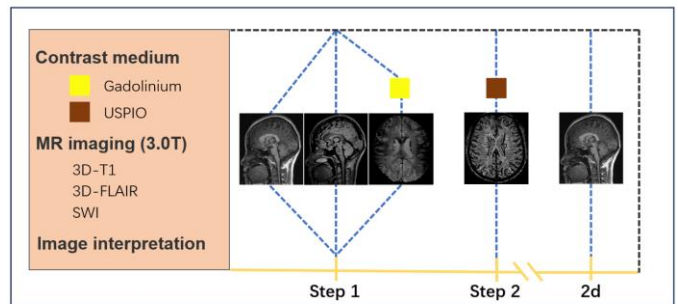


Fig.1 Inclusion and exclusion criteria for MS patients.



3T MR imaging system (Magnetom Skyra; Siemens)
MRI_Step1: 3D-T1+3D-FLAIR+SWI (post-Gd)
MRI_Step2: SWI (post-USPIO)
MRI-2d: 3D-T1

Fig.2 MRI data acquisition process

RESULT

A dose of 2mg/Kg USPIO has the highest value of contrast-to-noise ratio (CNR) and the optimal ability to detect cerebral veins. In contrast to gadolinium contrast agent, USPIO allows detection of CVS not only in the typical lesion of MS, but also in the subtentorial lesion and small lesions (diameter <3 mm).

There was a total of 531 WMLs in 10 MS patients. CVS could be observed in 435 WMLs after injection of USPIO while 305 WMLs after injection of gadolinium.

Tab.1 Clinical characteristics.

	Onset age, y./sex	Disease Duration, y	No. of attacks	EDSS at last flow-up	MMSE	MOCA	Other serum auto-antibodies	CSF OCB	Clinically phase	Treatment	TIV (cm ³)	cortical thickness (mm)
1	20/F	15	>10	4	30	22	ACA-IgM	/	remission	Teriflunomide	1506	2.71±0.81
2	33/M	5	2	2	30	29	-	-	remission	CS	1377	2.73±0.77
3	25/F	2	2	1	29	28	-	+	remission	Teriflunomide	1299	2.80±0.79
4	22/F	13	6	3	28	25	PR3	-	remission	CS	1393	2.49±0.68
5	27/M	9	5	3	28	24	-	-	remission	AZA, Teriflunomide	1556	2.42±0.66
6	25/M	3	3	2.5	29	26	-	+	remission	/	1389	2.69±0.75
7	31/F	2	2	1	28	29	-	+	remission	Teriflunomide	1417	2.69±0.75
8	15/F	4	4	1	30	29	-	-	remission	Teriflunomide	1405	2.76±0.80
9	22/F	8	2	1.5	29	27	-	-	remission	Teriflunomide	1321	2.62±0.75
10	28/M	9	4	3	-	14	-	-	remission	INF- γ , AZA, Teriflunomide	1523	2.49±0.64

AZA = azathioprine; CS = oral corticosteroids; EDSS = Expanded Disability Status Scale score; OCB = oligoclonal bands; MMSE = Mini-mental State Examination; MOCA = Montreal Cognitive Assessment;

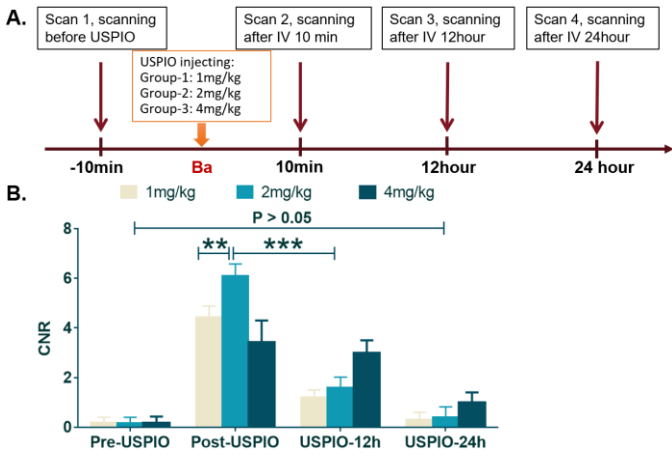


Fig.3 CNR values at different time-points after injecting different doses of USPIO.

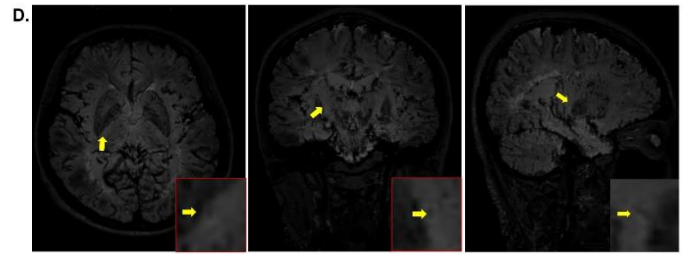
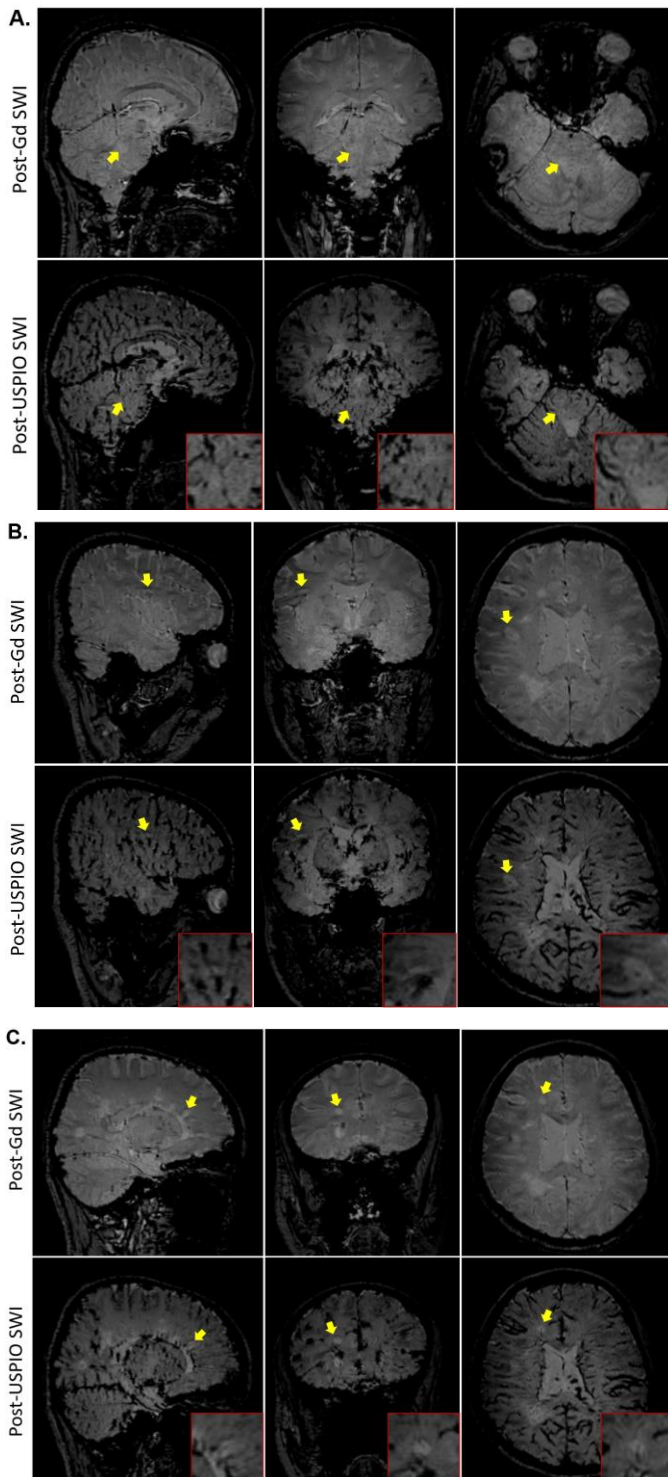


Fig.4 Comparison of central venous signs in post-Gd SWI and post-USPIO SWI. (A. subtentorial WML; B. Subcortical lesion; C. Lesion perpendicular to the lateral ventricles; D. Small lesions (diameter <3 mm))

Tab.2 Number of lesions with CVS in 2 scanning methods.

	Lesions with CVS/total number of lesions	n (%)
Post-Gd SWI	305/531	57.4%
Post-USPIO SWI	435/531	81.9%

CONCLUSION

After completing evaluation of 10 MS patients with USPIO enhanced SWI, we found that USPIO improve detecting capability for CVS at 3T-MR. Specifically, it was also able to enhance the detection of CVS in subtentorial WMLs as well as small lesions (diameter <3 mm). So, this method may be valuable for MS which involve the microvasculature.

REFERENCES

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