

# USPIO-SWI showed vascular factors involved in the evolution of "black holes" in multiple sclerosis

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## BACKGROUND

Black hole (BH) lesions show hypointensity on T1 images and hyperintensity on T2 images in patients with multiple sclerosis (MS). The etiology of BH progress is unknown.

## OBJECTIVE

Investigate whether vascular factors are involved in BH progress using USPIO-enhanced SWI images (USPIO-SWI) in a prospective cross-observational study.

## METHOD

3D-SWI, 3D-T1 and 3D fluid-attenuation inversion recovery (FLAIR) were performed on 10 patients with MS (Table 1). BH lesions were classified into 3 subtypes based on T1 intensity, which demonstrated BH gradual progress. Counts were conducted for USPIO-enhanced central vessel signs (USPIO-CVSs) or vessels in the paraventricular regions (USPIO-vessels) on USPIO-SWI images.

## RESULT

The total number of isolated BH lesions was 117, comprising 17, 38, and 62 instances of the type 1-3 BHs. The USPIO-CVS detection rates for the three types of BH from 1 to 3 were 17.65%, 73.68% and 91.94%, respectively (Figure 1). The median number of USPIO-vessels in the middle slices of paraventricular regions was 29 (range = 26-29) and the median BH volume was 0.03 mm<sup>3</sup> (range = 0.03-0.13). There was a

negative correlation ( $r = -0.61$ ,  $p = 0.11$ ) (Figure 2).

Table 1 Clinical characteristics of ten MS patients

	Onset age, y /sex	Disease Duration, y	No. of attacks	EDSS at last follow-up	MMSE	MOCA	Other serunauto-antibodies	CSF OCB	Clinically phase	Treatment
1	20F	15	>10	4	30	22	ACA-IgM	no	remission	Teriflunomide
2	33M	5	2	2	30	29	-	no	remission	CS
3	25F	2	2	1	29	28	-	yes	remission	Teriflunomide
4	22F	13	6	3	28	25	PR3-IgG	no	remission	CS
5	26F	3	1	3.5	30	27	AHA	yes	progressive	/
6	25M	3	3	2.5	29	26	-	yes	remission	/
7	31F	2	2	1	28	29	-	yes	remission	Teriflunomide
8	15F	4	4	1	30	29	-	no	remission	Teriflunomide
9	22F	8	2	1.5	29	27	-	no	remission	Teriflunomide
10	28M	9	4	3	-	14	-	no	remission	INF- $\gamma$ , AZA, Teriflunomide

EDSS = Expanded Disability Status Scale score; MMSE = Mini-mental state examination; MOCA = Montreal Cognitive Assessment; ACA = antinuclear antibody; PR3 = protein 3; AHA = antihistone antibodies; OCB = oligoclonal bands; CS = oral corticosteroids; INF- $\gamma$  = interferon-gamma; AZA = azathioprine.

Figure 1. USPIO-CVS detection rates in three types of black holes.

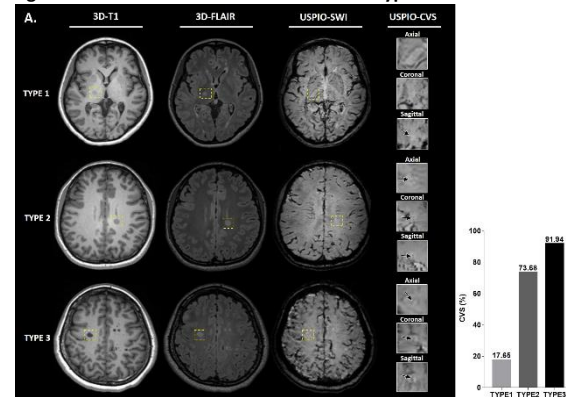
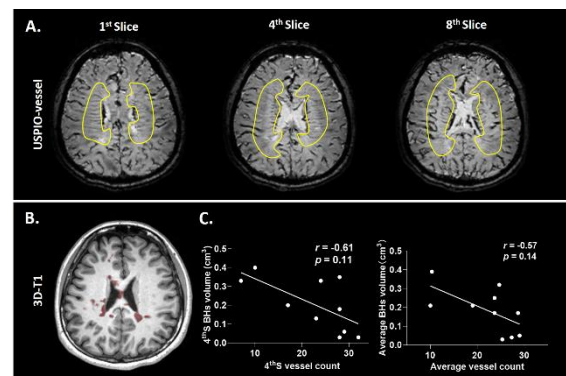


Figure 2. USPIO-vessel counts on paraventricular regions and its correlation with BHs.



## CONCLUSION

USPIO-CVS was increased with BH progress, suggesting that perivascular inflammation may contribute to the evolution of BH.