The clinical value of veno-BOLD on vascular malformations at 3.0T

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Purpose: To investigate the characteristic features and clinical value of veno-BOLD on vascular malformations in CNS

Introduction

The susceptibility differences between venous blood, calcifications, iron laden tissues and surrounding tissues can be utilized to created new contrast in MR imaging(1-2). Several studies have addressed the capability of veno-BOLD to be sensitive to venous vasculature based on BOLD effects (3-4), which indicates that veno-BOLD may be helpful in detection and assessment of vascular malformations in central nerve system.

Methods

Twenty-eight patients (40± 3.75 years old) with 35 lesions of vascular malformations underwent MR examinations. All examinations were performed on a Philips 3.0T MR Achieva scanner using 8-head coil. Conventional T1W_TSE，T1W_SE+GDPA, T2W_DRIVE, T2W_FLAIR and DWI were acquired in each of the studies, followed by veno-BOLD imaging with the sequence of PRESTO (Principles of Echo Shifting with a Train of Observation), the parameters are 3D T2* , transverse, slices 100, FOV 200, RFOV 100%, TR 26ms, TE 37ms, Flip 10, combined with SENSE technique, NSA 1, total scan time 5:57ms, 320x336r. Postprocessing was performed in the independent workstation, MinIP and reconstruction was done with the slice thickness of 3-5mm. The comparison between veno-BOLD image and the conventional images was on a slice to slice basis (Fig1, A-F). The sensitivity of detection for vascular malformations was estimated for all the sequences. X^2 test was applied in this study for statistic analysis. The diagnosis was referred to combined results of DSA and CT.

Results and discussion

The detection of vascular malformations in different sequences was shown in the table. In our study, we had 5 telangectasis, 15 cavernomas, 3 venous malformations, and 12 AVMs. We count as 1 lesion of cavernoma which was from a patient with multiple cavernomas (>50) for statistic purpose. Compared to the other conventional sequences, veno-BOLD revealed more lesions in each type of vascular malformations, with the sensitivity of 80%, 100%, 100%, and 66.7% respectively. Furthermore, the accuracy of diagnosis for vascular malformations was as high as 97.1% by veno-BOLD. Particularly, there was significant difference between veno-BOLD and T2WI in detecting cavernomas (X^2 =8.35, p<0.05).

	T1WI	T1WI+C	T2WI	T2 FLAIR	DWI	VenoBOLD	Total
Telangectasis	1	4	2	3	1	4	5
Cavernomas	4	10	7	8	4	15	15*
Venous malformation	2	3	2	1	0	3	3
AVMs	8	12	10	11	8	12	12

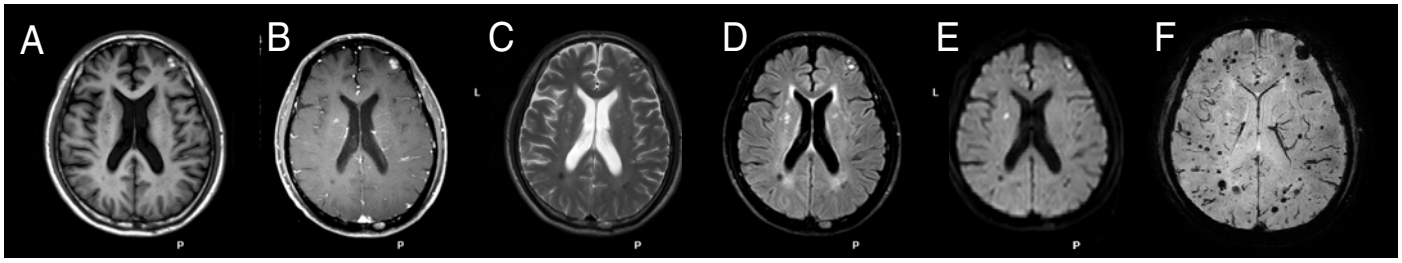

Fig 1, Cavernomas and microhemorrhage in the brian. A T1W_TSE， B T1W_SE+GDPA, C T2W_DRIVE, D T2W_FLAIR, E DWI, F Veno-BOLD

The vascular malformations in central nerve system consists of four distinct types telangectasias, cavernous malformations, venous malformations and arteriovenous malformations (AVMs), which may occur throughout the central nervous system. To ascertain the exact type of vascular malformation, high resolution MR imaging is mandatory to provide internal detail content and vasculature of the lesions. But long scan time hinders its routine practice and vulnerable to motion artifacts. Veno-BOLD with PRESTO (Principles of Echo Shifting with a Train of Observation) makes use of echo shifting leading to gradient echoes with a TE larger than TR, the actual TE is the sum of routine TE and TR. It offers time efficient 3D T2* weighted imaging. Using this technique, venous pool can be visualized in a relative static state without contrast agents in shorter scan time, based on the blood oxygen independent (BOLD) effects. In our study, veno-BOLD showed continuously tubular-like low signal intensity which demonstrated abnormal dilated venous with slow flow and deoxyhemoglobin. The evidence of microhemorrhage which indicated hemosiderin deposits consistent with recurrent and remote bleeding in the lesions was also optimized to view on the veno-BOLD, compared with the other conventional sequences.

Conclusion

Veno_BOLD has shown the power in demonstrating characteristic features of vasculature and blood components due to the susceptibility and BOLD effect, it may play an important role in detection and assessment of vascular malformation in central nerve system.

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