Detection of Stroke and Microbleeds Using Susceptibility Weighted Imaging

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Introduction: Microbleeds (MBs) are associated with vascular dementia (VaD) and cerebral amyloid angiopathy (CAA). These MBs are small hemorrhages that can result from vessel wall injury from CAA. Studies have shown that patients with VaD have a higher risk of developing MBs (1). Susceptibility Weighted Imaging (SWI) (2), a high resolution gradient echo imaging technique, is sensitive to hemosiderin even for arteriole bleeds and has revealed MBs much smaller than 5 mm (above which they are usually referred to as macrobleeds). There is also an association between MBs and stroke (3). The purpose of this paper is to examine the presence of developing major bleeds over time for Alzheimer patients.

Methods: A series of 106 patients, 28 controls and 78 mild cognitively impaired (MCI) patients, were evaluated in a longitudinal study of aging (informed consent was obtained in all cases). All subjects were scanned at least on an annual basis over a period of 4 years. Apart from conventional imaging methods (T1 and T2), SWI was also done. SWI acquisition parameters were: in-plane resolution 0.5mm x 1.0mm; TH = 2mm, FOV = 256mm x 256mm; Nx = 512; Ny = 256; Nz = 48; TE = 40 ms; TR = 57 ms; and FA = 20 degrees. The phase images were high-pass (HP) filtered and an SWI magnitude images were created. The images were reviewed for the presence of MB All of the original magnitude images, SWI filtered phase images and the contrast-enhanced SWI magnitude images were used in the data review process. Local minimum intensity projections (mIPs) over 5 slices were used to ensure that a MB was not part of a major vessel but rather was isolated from the macro-vasculature. Out of 78 MCI cases, 16 progressive cognitively impaired (PCI) subjects were evaluated for this study.

Results: Six out of 16 PCI subjects developed MBs. Out of these 6 cases, 3 subjects appear to have developed stroke. These 3 subjects have a higher initial incidence of MBs compared to the other 3 (Table 1). This suggests that MBs and stroke are associated. Figure 1 shows the three different subjects with possible stroke (the macrobleeds are highlighted with an arrow). These 3 cases have more macrobleeds than shown here (see Table 1). Figure 2 shows a case with no MBs in the first two scans eight months apart, while images from the third scan show development of several microbleeds (second and third scans were 11 months from each other). In the same subject, several MBs also increased in size. This phenomenon was also seen for other cases where MB development was observed over time. Figure 3 shows a comparison between the first and last scans (almost two years apart) for subject 5. A stroke was observed in the last scan of a patient for which no MBs were noted in the first scan. These images are mIPs over 3 slices. The fact that this is a stand-alone lesion and not connected to any vessel gives us confidence that this is a newly developed major bleed.

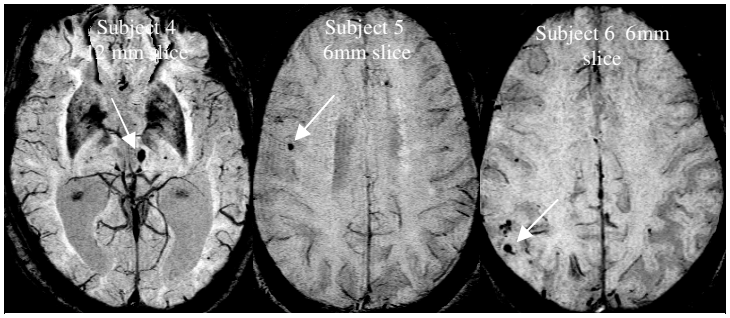

Figure 1: Possible stroke in different regions of the brain.

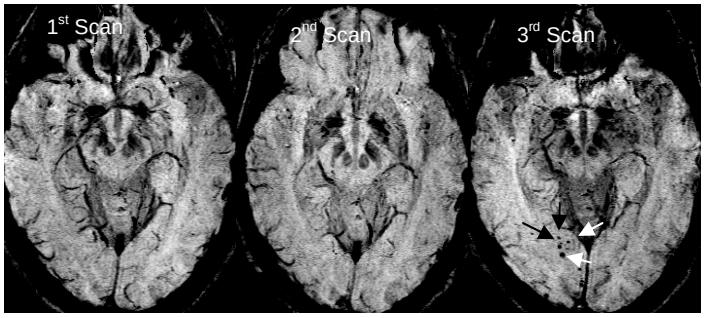

Figure 2: Demonstration of MB development.

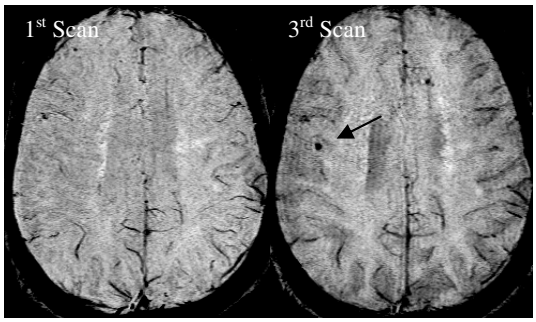

Figure 3: Development of possible stroke.

Microbleed Count				
Subject No.	Scan 1	Scan 2	Scan 3	Scan 4
1	8	16	29	45
2	6	7	9	12
3	4	4	6	9
4	36	49	46	
5	20	17	18	
6	17	16	40	

Table 1: MB count in each scans for all 6 cases

Discussion and Conclusion: Elderly subjects with numerous MBs and who are also MCI patients appear to have the potential to develop major strokes. For these 3 subjects with a high initial incidence of MBs, their proclivity to developing MBs can be postulated to come from a degenerative vascular condition that may stem from CAA.

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