QUIET SWI VERSUS CONVENTIONAL SWI: RADIOLOGICAL EVALUATION IN PEDIATRIC PATIENTS

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Target audience Neuroradiologists and pediatric radiologists

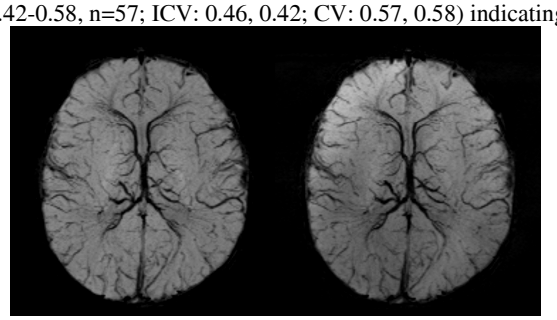
Purpose Recently SWI has been widely used in brain MRI, even for pediatric patients [1, 2]. However, the continuously high acoustic noise from SWI over several minutes may disturb sedated pediatric patients and is one of the main reasons for patient restlessness. A prototype Quiet SWI (qSWI) sequence with optimized gradients was used in order to reduce acoustic noise. The parameters of qSWI and conventional SWI (cSWI) were nearly identical. The purpose of this study was to evaluate the clinical efficacy of qSWI in pediatric patients compared to cSWI.

Methods *Patients* In pediatric patients who underwent routine brain MRI under sedation, we tried to run qSWI without applying additional sedation after routine examinations that included cSWI. Our IRB approved this prospective study, and written consent was obtained from parents. *MR Imaging* All studies were performed on a 3T clinical scanner (MAGNETOM Verio, Siemens, Erlangen) using a 32-channel head coil. Within the qSWI sequence, an automated algorithm optimized the gradient objects to allow for the lowest possible slew rates. Our routine cSWI and qSWI protocols are shown in the table. Acoustic noise levels were measured ten times for each sequence at a distance of 2.5m from the front panel of the magnet. *Image analysis* For all images from patients who underwent complete cSWI and qSWI scans, two independent radiologists (a pediatric radiologist and a neuroradiologist) rated the visualization of the following right deep cerebral veins: the anterior septal vein (ASV), thalamostraiate vein (TSV) and internal cerebral vein (ICV). A four-point scale was used: 0, obscured or interrupted; 1, visualized but partly interrupted; 2, visualized with fair continuity; 3, prominently visualized with smooth continuity. The one most conspicuous cortical vein (CV) around the right sylvian fissure was also rated using a four-point scale: 0, clearly thin; 1, slightly thin; 2, similar; and 3, prominent compared to the right ICV. *Statistical analysis* For each reader, agreement of scoring between cSWI and qSWI for each of the venous branches, was assessed by calculating intra-class correlation (ICC).

FOV(mm)	150		200		240	
	cSWI	qSWI	cSWI	qSWI	cSWI	qSWI
TR(ms)	38	*39*	38	*39*	38	*39*
TE(ms)	30	30	30	30	30	30
slice thickness(mm)	1.5	1.5	1.5	1.5	1.5	1.5
FOV Phase	87.5%	87.5%	87.5%	87.5%	87.5%	87.5%
slice oversampling	14.3%	14.3%	22.2%	22.2%	22.2%	22.2%
slice per slab	56	56	72	72	72	72
flip angle(deg)	15	15	15	15	15	15
matrix	168*256	168*256	235*320	235*320	258*320	258*320
PAT	3	3	4	4	4	4
scan time	3:09	*3:14*	4:53	*5:01*	4:50	*5:20*

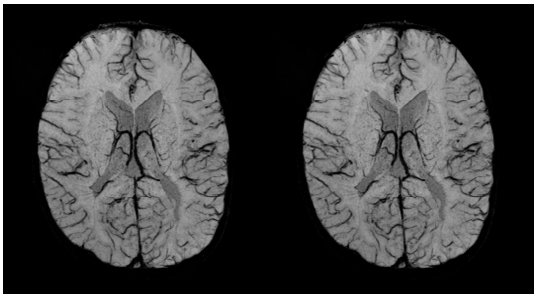
Results *Patients* Evaluable conventional and quiet SWI scans were completed in 57 children (age: 5 days-18 years, mean 43.9months, median 25 months). *Acoustic noise* Average mean acoustic noise levels of cSWI and qSWI were, respectively, 30.7 dB(A) and 21.9dB(A) higher than the baseline noise level of 53.4dB(A); i.e., the noise levels without subtracting the baseline were 84.1dB(A) and 75.3dB(A), respectively. *Image and Statistical analysis* All cSWI and qSWI images were of sufficient quality for radiological interpretation even though small motion artifacts existed in some images. ICC values for the ASV and TSV ranged from 0.63 to 0.66 for each reader (Single measures 0.63-0.66, n=57; ASV: 0.65 and 0.66 in each reader; TSV: 0.65, 0.63) indicating good agreement. Those of the ICV and cortical vein (CV) ranged from 0.42 to 0.58 (Single measures 0.42-0.58, n=57; ICV: 0.46, 0.42; CV: 0.57, 0.58) indicating moderate agreement.

Age 9 days



cSWI qSWI

Age 17 months



cSWI qSWI

Discussion The acoustic noise of qSWI was 8.8 dB(A) less than that of cSWI, indicating about 2.8 times less sound pressure, and was much gentler to the pediatric patients. Regarding image quality, ICC scores in all evaluated veins for both readers indicated good or moderate agreement, although those of the ICV were relatively low compared to other veins. Scoring of the appearance of cerebral veins was not easy, and the irregular continuity of the vessel might have been conspicuous due to the ICV's large caliber and extent over multiple slices. Overall, qSWI provided image quality that was almost identical to that of cSWI as shown in the figures, although with a scan time that was 5-30 seconds longer.

Conclusion The prototype qSWI sequence produced less acoustic noise by using slightly more scan time, and could be substituted for cSWI in order to provide gentler scans to pediatric patients.

References [1] Tong KA et al. Susceptibility-weighted imaging: a review of clinical application in children. AJNR 2008;29:9-17 [2] Niwa T et al. Anatomic dependency of phase shifts in the cerebral venous system of neonates at susceptibility-weighted MRI. JMRI 2011;34:1031-6