Myocardial first pass persusion imaging with integrated parallel acquisition (iPAT): A Comparison of TrueFISP and TurboFlash Sequences

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Purpose: To assess the value of integrated partially parallel acquisition (iPAT) in 2D SR-GRE and SSFP sequences for myocardial first-pass perfusion imaging by means of artifacts, signal-to-noise ratio (SNR), contrast-to-noise (CNR) ratio and semiquantitative perfusion parameters.

Materials and Methods: In twenty healthy individuals, contrast-enhanced (Gd-DO3A-butriol) perfusion imaging was performed with SR-TurboFlash and TrueFISP sequences with integrated partially parallel acquisition (R=2) using GRAPPA (Generalized Auto-calibrating Partially Parallel Acquisition) algorithm for image reconstruction. As standard of reference served a non-accelerated SR-TurboFLASH sequence. Artifacts were assessed quantitavely and qualitatively. Furthermore, SNR and CNR were calculated and semiquantitative perfusion parameters were determined from signal intensity (SI) time curves.

Results: Phantom measurements yielded increased SNR (157 ± 11%) and CNR (154 ± 12%) values for True-FISP in comparison with both TurboFLASH sequences.

In volunteer studies, SNR/CNR were consistently higher (p<0.0001) in TrueFISP (12.2 ± 4.1/4.7 ± 3.0) than in accelerated (9.5 ± 3.5/3.5 ± 2.8) or standard (11.9 ± 4.3/4.4 ± 3.6) TurboFLASH images. The evaluation of semiquantitative perfusion parameters Maximum Upslope and Peak Signal Intensity yielded significantly highest values for TrueFISP images (p<0.0001, figures 1 and 2). A qualitative examination of all images for artifacts by two board-certified radiologists yielded significantly more susceptibility artifacts in non-accelerated TurboFLASH images (p<0.001) than in the iPAT sequences, in which differences in number of artifacts were statistically non-significant. Interobserver variability was low (r=0.91, slope=1.1, p<0.0001).

Conclusion: Saturation-recovery TrueFISP sequences in combination with integrated parallel acquisition provide better image quality and higher SNR and CNR than TurboFLASH sequences in myocardial first-pass perfusion imaging. The application of parallel acquisition techniques leads to a significant decrease in susceptibility artifacts in comparison with the established non-accelerated TurboFLASH technique.
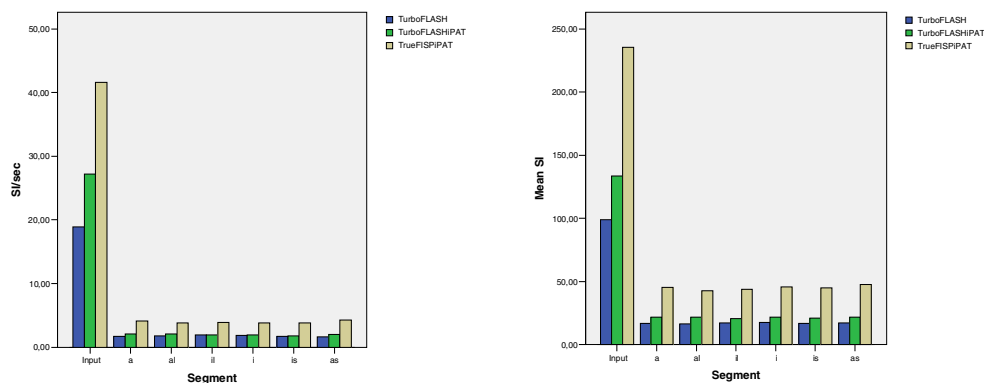
Figure 1 and 2 Comparison of Maximum Upslope and Peak Signal Intensity, calculated separately for each myocardial segment. Input: left ventricular cavity; a: anterior; al: anterolateral; il: inferolateral; i: inferior, is: inferoseptal; as anteroseptal.