

Optimized Visualization in Contrast Enhanced Abdominal and Peripheral MRA : The Phantom Study

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Purpose: The new contrast enhanced 3D spoiled gradient MR angiography shows enormous success in visualizing abdominal and peripheral vessels. In this study, we demonstrate experimentally the optimized visualization schemes in abdominal and peripheral 3D CE-MRA by optimizing imaging parameters such as flip angle, repetition time(TR) along with Gd concentration.

Materials and Method: The phantom consists of 40 centrifugal tubes, in which the different Gd concentrations, which ranged approximately from half dose (0.05 mmol/kg) to over 50 dose (5 mmol/kg), were prepared. Here, single dose is defined as 0.1 mmol/kg. The Gd-DTPA-BMA(Omniscan, Nycomed) was used for MR agent. The experiments were performed using 3D Turbo FLASH sequence on a 1.5 T scanner (Magnetom Vision Plus, Siemens, Erlangen, Germany). The images were obtained at coronal plane with 1.5 mm effective slice thickness over 50 mm slab thickness. Among imaging parameters, flip angle was changed from 10 degree to 60 degree and the TR was changed from 4 to 20 msec at each flip angle. The echo time(TE) was set to minimum value, 1.4 msec, in all study. The ROI was set inside each tube, which contains different concentration of Gd and signal-to-noise ratio(SNR) was evaluated. The SNR's over flip angle, TR, and Gd concentration were plotted to estimate optimized imaging parameters.

Results: For shortest TR (4 msec), the higher concentration achieves higher SNR at each flip angles as expected. Another finding was that the optimal flip angle increases as Gd concentration increases. That is, the optimal flip angle shifts from 10° at half dose to 30° at triple dose. However, it is also found that the optimal flip angle is dependant on TR. At Gd concentration of triple dose, the optimal flip angle was 30° from TR = 4 msec to TR = 12 msec but the optimal angle was larger than 50° if TR is longer than 20 msec. For typical single or double dose, moderate flip angle (20° - 40°) and longer TR resulted in better SNR.

Conclusion: For optimized visualization in Contrast Enhanced Abdominal and Peripheral MRA, the imaging parameters must be adjusted along with selected dose. For low dose application, small flip angle (approximately 10°) is preferred whereas large flip angle gives better SNR for high dose application. Another advantage of large flip angle is the improvement in background suppression. For both application, it is desirable to use longer TR to get higher SNR.