Optimization of Gadolinium-enhanced MR Angiography by Manipulation of Acquisition and Scan Delay Time

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Purpose: To develop and test a new calculation method for acquisition time and scan timing based on the analyses of arterial and venous time-intensity curves and the pulse sequences utilized to try to achieve a more consistent and tailored examination.

Materials and Method: By the parameters -arterial enhancing time (Tae), arteriovenous transit time (Tt), sensitive acquisition zone (SAZ), the most sensitive point (MSP)-, the new calculation method for an optimal acquisition time and scan delay time during CE-MRA was formulated. Using the newly optimized protocol, CE-MRA was performed in 56 patients (average = 56 yr.). The destination sites were iliac (n = 13), femoral (n = 9), tibial (n = 3), renal (n = 4) and carotid (n = 27) arteries. A 1.5T MR scanner and 2D turbo FLASH sequence were used to acquire the time-intensity curve by test-dose contrast media injection. As the test dose injection, 2-ml contrast media was injected into the superficial vein of upper extremity, by power injector at the rate of 3 ml/sec. Subsequently, 20-ml normal saline was injected at the same rate. The CE-MRA was performed with 3D turbo FLASH sequence. The scanning parameters were 4.0 msec, 1.6 msec, 45 degrees for TR, TE and FA, respectively. The Ta and the scan delay time (Td) were calculated by the new method. The number of phase encoding and slice thickness were tailored according to the calculated acquisition times. Surface coils were always used to increase the SNR. The contrast media was injected in the same way with test-dose contrast injection except the total dose, which was 0.1 mmol/kg. Post-processing of the data consisted of digital subtraction and maximum intensity projection. To evaluate the quality of the image, the degree of enhancement was estimated in the artery, soft tissue and vein. The grade of enhancement was defined as none (no evidence of enhancement), mild (minimal enhancement without definite contour of the structure), moderate (enhancement with definite contour of the structure but not obscuring the arteries) and high (marked enhancement with obscuration of arterial signal).

Results: Whole cases (n=56) showed high arterial enhancements, which were available to interpret the images. There was no venous overprojection in 46 cases (82%) and eight cases showed mild or moderate venous enhancement. The mild or moderate-degree soft tissue enhancement was visualized in 40 cases (71%), however, it was not hazardous in either depiction of arteries or interpretation of images. The average Ta's of renal, carotid and iliac angiography were 18.5, 19.5 and 46.5 seconds, respectively.

Conclusion: Using the new parameters of time-intensity curve and pulse sequences, we could develop new protocol for optimization of acquisition time and scan delay time of gadolinium-enhanced MR angiography. Although the evaluation of the new protocol was performed qualitatively and clinically, the new protocol was feasible to acquire higher quality MR arteriography.