Optimization of brain MRA with contrast injection in 1.5 Tesla by high power RF - Seyed Ali Rahimi - Faculty of Health, Mazandaran University of Medical

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Abstract

Background and purpose: In brain MRA, selecting suitable parameters for imaging requires accurate measures, because the image quality depends on the location of arteries, veins and also the velocity differences of blood, due to the low flow of the blood in veins and small arteries.It is suggested to use paramagnetic contrast media. Hence in present study, we investigated the imaging optimization of brain vessels using contrast media in 1.5 Tasla high field power RF. Material and method: for image optimization after determining approximately T1at blood with contrast injection 0.1mmol/kg of Gd-DTPA , calculated relative signal of blood in T1=300,600,900,1200 ms by using parameter TR=20ms and TE=7ms, decrease T1,resulting increasing of Ernest angle and relative signal was shown .then, MRA was obtained in three groups, each including five volunteer patients by using parameters TR=20ms,TE=7ms and flip angle 10,20&30 degrees in two series without and during contrast injection. Then calculation C/N after measured signal of carotid, M.C.A, thorcolar herofili and SD in standard deviation of noise in air. by measurement it was shown that in 20 degrees flip angle, C/N maximize. At the last stage, three series MRA, without, during c.i and 15minutes after c.i where obtained in 20 patient volunteers by using parameters TR=20ms & TE=7ms and flip angle 20 degrees and calculated C/N. Results: we saw the highest C/N in during c.i MRA after statistical analysis. to be onfirm that if the difference between mean of C/N ratio is meaningfully we mutually compared them by paired t-student test. For clinical study, in obtained images, 1 vein and 2 arteries were graded in 5 definite levels.Conclusion: Results indicated an important effect of paramagnetic contrast media on better observing of small arteries and vein. The best quality was taken during c.i , but in some arteries contrast media had not any benefit in improving the quality. By taking advantage of the increased S/N provided by 3T magnets over conventional 1.5T magnets and converting this additional S/N into higher temporal resolution through acceleration strategies, intracranial time-resolved MRA becomes feasible. Several approaches to MR angiography (MRA), using different contrast mechanisms, have been developed, including time-of-flight (TOF), phase contrast (PC), T2-preparation, and contrast-enhanced (CE) MRA. Of these techniques, all can produce high-quality static images, but only first-pass multiphase CE-MRA is capable of capturing the dynamic filling of vessels, similar to conventional radiographic digital subtraction angiography (DSA). Although CE-MRA cannot yet match the spatial and temporal resolutions of conventional radiographic DSA (∼0.1 × 0.1 mm and as many as ∼10 frames/s), CE-MRA is noninvasive, does not involve ionizing radiation, has no risk of iatrogenic stroke, and provides a true 3D dataset. Time-resolved MRA techniques have been applied to various anatomic regions with success. Previously, however, the primary goal of time-resolved MRA was to eliminate error associated with timing the arrival of contrast. As hardware and software continue to improve, noninvasive evaluation of certain pathologies where the order, direction, and rapidity of vessel filling are of clinical significance—such as with intracranial arteriovenous malformations (AVMs) and fistulas (AVFs)—is potentially within reach. MR imaging is flexible in that signal intensity-to-noise ratio (S/N), spatial resolution, and temporal resolution may be traded to accommodate the application. Time-resolved MRA, for example, requires high temporal resolution while maintaining sufficient S/N and spatial resolution. In recent years, much effort in the field has been devoted to developing novel acceleration, or undersampling, techniques to increase spatial and temporal resolution at the expense of S/N. These techniques can be classified as temporal or spatial undersampling, where temporal undersampling involves the interpolation of k-space samples from past and future samples at the same spatial frequency and includes techniques such as sliding window, keyhole, and time-resolved imaging of contrast kinetics (TRICKS). Spatial undersampling involves the interpolation of k-space samples from other acquired samples in the same timeframe and includes techniques such as partial Fourier and parallel imaging. The standard superconducting MR scanner found in today's clinic operates at 1.5T. A new generation of 3T scanners has been introduced in recent years to take advantage of the theoretical doubling of S/N at double the field strength. Several groups have found success with high-field timed CE-MRA in various anatomic regions, including the intracranial vasculature. High-field imaging does not come without technical challenges, however; the radio-frequency (RF) wavelength is sufficiently short that dielectric resonance and RF penetration effects become significant, resulting in signal intensity nonuniformity. Off-resonance effects also become more pronounced for sequences like bSSFP (balanced steady-state free precession) that are particularly sensitive to this. Finally, the specific absorption rate (SAR) increases as the square of the increase in field strength. Even so, if the S/N boost of high-field imaging could be converted into improved temporal resolution via an undersampling technique, higher frame rate scans would be possible. The goals of this study were to determine suitable imaging parameters for time-resolved CE-MRA at 3T, verify the increase in signal intensity at high field for CE-MRA, develop a method for intracranial high spatial resolution timed MRA at 3T, and finally based on previous goals, develop a method for undersampled time-resolved MRA at 3T. This report builds on previous reports by providing a pulse sequence with a higher data acquisition rate as well as further acceleration via temporal undersampling. Greater reconstructed data rates enable higher frame rates and higher spatial resolution, particularly in the

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through-plane dimension where intravoxel dephasing in thick partitions limits sensitivity to small vessels. Simulations: At 1.5T and 3T, the T1 values of nonenhanced blood and cortical gray matter. The plots of S/N and S/N difference were similar in shape, so just the plots of S/N are shown. Although the increase in T1 at higher field was taken into account, this was found to have a negligible effect on the S/N curves over the range of independent parameters studied

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