Neovascularization in the Carotid Atherosclerotic Plaque can be Identified by Dynamic Contrast-Enhanced High Resolution 3TMRI

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Background—Neovascularization in the atherosclerotic plaque may contribute to further complications of inflammation and plaque destabilization [1].Recent publications have demonstrated that contrast-enhanced high resolution MRI can identify the main components of the atherosclerotic plaque such as the lipid-rich /necrotic core (LR/NC), calcification, and hemorrhage in vivo[1,2,3]. This study investigates whether gadolinium-based **dynamic** contrast-enhanced MRI would yield more information to detect the major carotid atherosclerotic plaque components in vivo due to their characteristic enhancement patterns, especially to identify neovascularization-rich area (NRA).

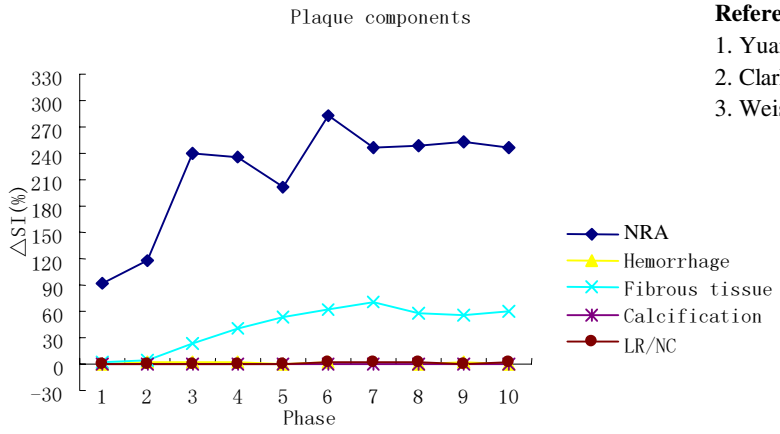
Methods --Eighteen patients (male 17, female 1, aged 68±8 years) with unilateral or bilateral carotid stenosis (≥30%) were included in this study. MR examination was conducted by a superconductive 3.0T MR scanner (Signa EXCITE, GE Healthcare, Milwaukee) and the phase-array carotid coil. Pre-contrast axial DIR T1WI, FSE T2WI/PDWI, 3D TOF and post-contrast DIR T1WI (5-minutes delay) of the carotid artery were obtained in all patients. Dynamic contrast-enhanced (DCE) high resolution MRI was performed with two-dimensional FSPGR sequence. The parameters included: TR/TE=100 /6.2 ms, Flip angle=30 degree, NEX=3, matrix=256×256 (reconstructed to 512×512 by zero-filled Fourier reconstruction), thickness=2mm. Six locations were obtained each phase. The temporal resolution is 16 seconds and total 10 phases were obtained right after the administration of contrast material (Magnevist, Schering) (0.1ml/kg, 2ml/s) by a power injector.

Plaque components(LR/NC, recent hemorrhage, calcification, fibrous tissue and NRA) were diagnosed by 2 radiologists based on the pre- and post contrast MR appearances [1-3]. The NRA was defined as the area with more than 100% increase of the signal intensity on post-contrast T1WI comparing to pre-contrast T1WI [1]. The area of each Region-of-Interest (ROI) of the plaque components was ≥5mm^2. The time–signal intensity curves were acquired on the workstation by using FuncTool software (ADW4.2). The curves for each component were firstly analyzed with subjective evaluation of the time–signal intensity curve, then the change between pre-post contrast signal intensity(ΔSI) were calculated as a increasing percentage: $\Delta SI=SI_{post}- SI_{pre} /SI_{pre}\times 100\%$. The values for time to peak (TTP) and peak enhancement were also calculated. All the data were statistically analyzed by Student t-test.

Results–The number of ROIs (≥5mm^2) of LR/NC, NRA, fibrous tissue, recent hemorrhage and calcification were 13, 6, 11, 9 and 12, respectively. The time-signal intensity curves were shown in Figue1. The Peak ΔSI of LR/NC, NRA, fibrous tissue, recent hemorrhage and calcification were 8±0.3%, 317±58.5%, 57±8.5%, 4±0.4% and 3.5±0.5%, respectively. Both NRA and fibrous tissue showed strongly SI enhancement than others (P<0.05). The TTP of NRA and fibrous tissue were 96±22.5s and 112±18s, respectively, and there was significant difference (P<0.01).

Conclusions–The TTP can provide useful information to detect NRA. Accurately identifying the presence of neovasculature based on DCE MRI may provide valuable information on predicting plaque stability.

Figue.1.



Reference

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