Real-Time Interactive Duplex MR in Neurovascular Imaging

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Purpose
Duplex MR enables quantification and display of flow velocities in real-time and allows interactive alteration of scan plane position and orientation (1). The feasibility and the reliability of the technique in assessing hemodynamic information in a phantom and in the carotid arteries and in venous sinuses was evaluated.

Materials & Methods
The MR sequence consisted of a 2D selective radio frequency pulse, followed by flow sensitizing and echo planar imaging readout gradients (TR/TE 53/27; flip angle, 90°; encoding velocity, 100 or 150 cm/s). Real-time interactive duplex MR measurements were performed by use of a steady flow phantom for a velocity range from 26 to 108 cm/s. Flow velocities in the common carotid arteries and the internal carotid arteries were measured in 10 healthy volunteers; in eight volunteers velocity measurements in the superior sagittal sinus were performed during normal breathing and hyperventilation. Flow distribution plots were analyzed qualitatively and quantitatively in comparison to phase contrast MR imaging and Doppler ultrasound.

Results
Qualitatively, real-time duplex MR imaging enabled the determination of the flow direction and evaluation of characteristic waveforms on the flow distribution plots for the different vessels. Quantitatively, velocity determinations for real-time duplex MR imaging and phase contrast MR imaging showed a correlation of 0.99 for phantom measurements, and a correlation of 0.85 for the carotid arteries and of 0.76 for the superior sagittal sinus. Small velocity changes occurring in the venous sinus during hyperventilation were reliably identified by real-time duplex MR (p < 0.01). Velocity measurements in the carotid arteries with real-time MR imaging were significantly lower compared to those obtained with phase contrast MR imaging or ultrasound (p < 0.01).

Conclusion
Real-time duplex MR can be applied in neurovascular imaging to obtain qualitative and quantitative hemodynamic information in the carotid arteries and in venous sinuses without the need for cardiac gating.

References