Abstract

Quantitative flow measurements using phase-contrast (PC) MRI enable non-invasive assessment of blood flow. Such measurements, however, suffer from limited spatial resolution due to the truncated sampling of *k*-space data. Other factors, such as slice angulation and non-ideal magnetic field gradients also affect the accuracy of the PC flow quantification. Phantom measurements can be used to study the influence of these factors and determine the accuracy of the flow quantification. In this thesis, recommendations are given on how such phantoms should be designed. Computer simulations and phantom measurements are presented that show the influence of the limited spatial resolution on the estimated diameter, peak velocity, and flow rate for different spatial resolutions, different blood-to-background-signal-contrast ratios, and the presence of a second vessel closely positioned to the examined vessel. A method for effective correction of these effects is presented, clearly demonstrating significantly higher accuracy. Finally, a novel flow quantification method that utilizes the inflow effect on the balanced steady-state free precession (b-SSFP) signal is presented.

This thesis may have implications on the performance of assessments of the accuracy of PC flow quantifications and may be of importance for PC flow quantifications in small vessels such as those in the brain and the coronary arteries where the spatial resolution is low relative to the vessel diameter and the wall-to-wall distance between the vessels. The b-SSFP based flow quantification method may open new possibilities to improve the accuracy in the quantification of high flow velocities and to reduce the scan time and thereby increase the time resolution of dynamical studies.

Key words: phase-contrast, balanced steady-state free precession, test object, computer simulation, accuracy