Magnetic Resonance Angiography Can Serially Evaluate Thrombolysis of In-stent Thrombus

M. Hyon[1], H. Kaneda[1], F. Ikeno[1], K. Nayak[2], A. C. Yeung[1], M. V. McConnell[1]

[1]Cardiovascular Medicine, Stanford University, Stanford, CA, United States, [2]Electrical Engineering, Stanford University, Stanford, CA, United States

Background: Thrombosis is a major cause of acute coronary syndromes and can be treated with thrombolytic therapy. A noninvasive approach to detect arterial thrombosis and the response to thrombolysis would be beneficial. Using an in-stent thrombosis model, we evaluated MR angiography (MRA) for serial monitoring of thrombolytic therapy.

Methods: Minimal-artifact coronary-size copper stents (3.5mm x 6mm) were placed in the infra-renal aorta in 6 New Zealand White rabbits under fluoroscopic guidance. Imaging of the stented aorta was performed on a 1.5T MRI system (Signa, GE Medical System, Milwaukee, WI) using: 1) a real-time MRA sequence (20 cm FOV, 1.1 x 1.1 x 5 mm, 12-30 f/s), 2) a multi-slice 2D spiral coronary MRA "bright-blood" sequence (16cm FOV, TR=1000 ms, TE=7ms, flip angle=60º, 20 interleaves, 0.58 x 0.58 x 3 mm) and 3) a T1-weighted 3D SPGR "black-blood" MRA seqeunce with saturation slabs (10cm FOV, TR 41ms, TE 4ms, flip angle=40°, 0.4 x 0.8 x 1.5 mm). MRA was performed on Day 0 (after stent placement), Day 1-2 (to detect in-stent thrombus), and then 1hr, 3hr, and 24hr after t-PA (2mg/kg given intravenously over 30 min). Single doses of heparin (250U IV) and aspirin (30mg PO) were also given at the same time. Follow-up necropsy was performed for confirmation of thrombus.

Results: MRA findings indicative of in-stent thrombosis were seen within the stent in all 6 rabbits at Day 1-2 post stenting, but not at Day 0. The thrombus appeared as luminal irregularities with the spiral bright-blood MRA sequence (Fig. $1A_1$). With SPGR black-blood MRA, thrombus appeared as a more extensive ring along the stent as well as extending into the lumen (Fig. $1A_2$). At 1-3 hours post thrombolytic therapy, a marked decrease in in-stent thrombosis was demonstrated with both sequences (Fig. 1B), with partial recurrence of thrombus by 24 hours (Fig. 1C). The contrast-to-noise ratio (CNR) of the thrombus on the black-blood SPGR sequence decreased significantly at 1-3 hrs post-tPA, but not at 24 hrs (Fig. 2).

Conclusions: MRA can detect in-stent thrombosis and thrombolysis in coronary-size vessels. This is a promising noninvasive approach for studying arterial thrombosis and its response to treatment.

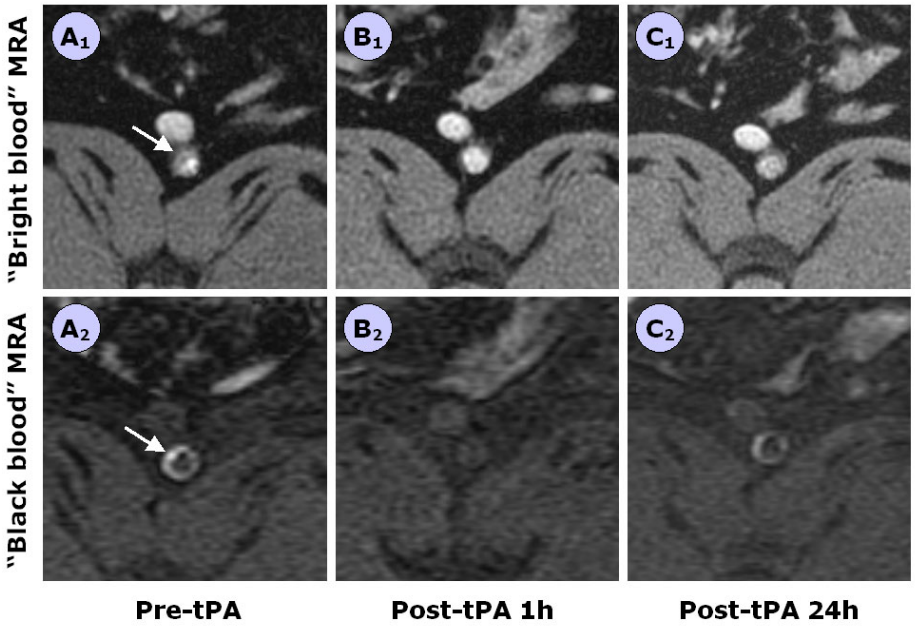

Fig. 1. MRA findings before and after thrombolysis

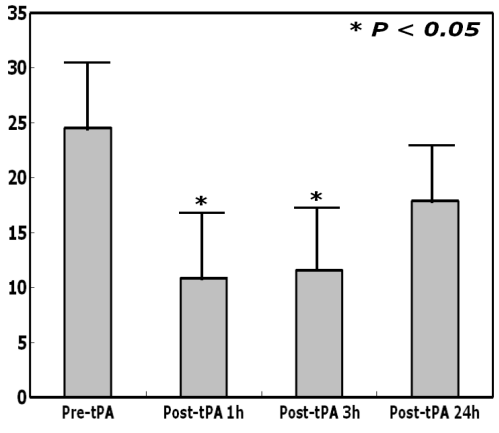

Fig. 2. CNR before and after thrombolysis