# Breath hold Magnetic resonance coronary angiography with MS 325: initial experiences

K. Nassenstein[1], K. U. Waltering[1], F. Breuckmann[2], T. Schlosser[1], P. Hunold[1], J. Barkhausen[1]

[1]Dep. of Diagnostic and Interventional Radiology and Neuroradiology, University Hospital Essen, Essen, Germany, Germany, [2]Dep. of Cardiology, University Hospital Essen, Essen, Germany, Germany

**Introduction:** Within the last 5 years, hard- and software developments have made magnetic resonance angiography of the coronary arteries (MRCA) feasible, but low SNR values und limited contrast between vessels and myocardium are still an issue. Recent developments have launched different intravascular contrast agents into preclinical studies, which may help to overcome these limitations. Either iron particles or gadolinium chelates with and without albumin binding have been evaluated and all compounds have been reported to improve signal-to-noise ratio (SNR) as well as contrast-to-noise ratio (CNR) of blood vessels and surrounding tissues. However, due to fast renal excretion of some macromolecular compounds, SNR and CNR values significantly decrease as soon as 10 minutes after injection. Gadofosveset trisodium (MS-325; EPIX, Cambridge, Boston) is a new contrast agent with reversible albumin binding and therefore predominant intravascular distribution. The aim of our study was to assess MS-325, an intravascular contrast agent with long plasma half-life time, for breath hold MRCA.

**Materials and Method:** 24 healthy volunteers (10 female, 14 male, mean age 29.8±6.1 years) were included in this study. All examinations were performed on a 1.5 T MR scanner (Sonata, Siemens Medical Solutions). For all exams 0.05 mmol/kg body weight of MS-325 (EPIX, Boston) was injected. T1-values of the myocardium and of the left ventricular cavity (LVC) were repetitively measured using a steady state free precision sequence with increasing inversion times (TR 2.4ms, TE 1.1. ms, FA 50°) within the first 30 minutes after injection. Additionally, MRCA was performed using a breath hold inversion recovery fast low angle shot sequence (TurboFLASH: TR 3.8ms, TE 1.6ms, FA 25°, band width 490 Hz/pixel, voxel size 1.8–2.3mm$^3$). 3D data sets covering the mayor coronary arteries were acquired immediately after contrast injection and repeated at 5, 10, 15, 20, 25 and 30 minutes after injection. The inversion-recovery preparation pulse was employed to suppress myocardial signal and to maximize blood-myocardium contrast. Inversion-times for maximal blood-myocardium contrast were individually determined for each scan. Signal-to-noise ratio (SNR) and contrast-to-noise ratio (CNR) values were calculated. Image quality of the proximal and middle coronary segments was assessed by two radiologists in consensus based on a 5-point Likert scale ranging from 1 (excellent), 2 (good), 3 (moderate), 4(poor), 5 (non-diagnostic).

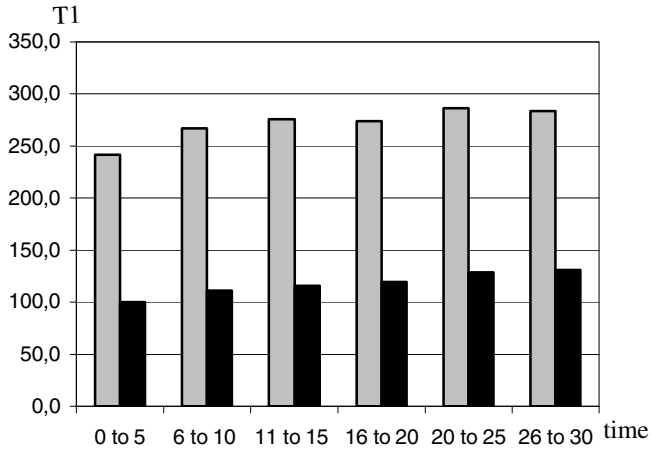


**Figure 1:** Time course of T1 values of the left ventricular cavity (grey bars) and the myocardium (black bars).

**Results:** MRCA with MS-325 was successfully completed in all volunteers. No clinically relevant adverse events were observed in our study cohort. Figures 1 shows that the T1 time of the LVC remains unchanged, whereas the T1 time of the myocardium slightly increases over time. Correspondingly, SNR of blood showed no significant differences with in the first 30 min after injection (SNR blood: 23.6 at 1 min p.i. versus 21.2 at 30min p.i.) (Figure 2). However, the CNR of blood and myocardium decreased over time (CNR: 18.1 at 1 min p.i. versus 13.8 at 30 min p.i.). The mean images quality scores slightly degraded over time ( 2,9 at 1 min p.i. versus 3,8 at 30 min p.i.)

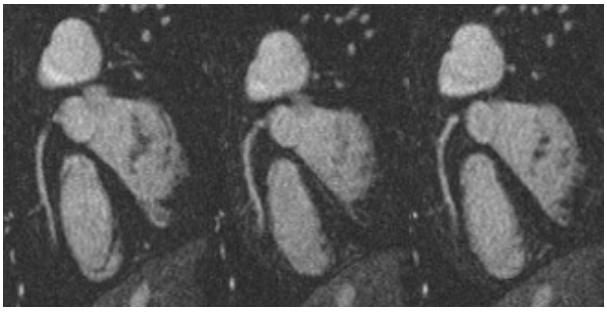

**Figure 2:** High quality MRCA of the RCA. 10 (left image), 20 (middle image) and 30 (right image) minutes after MS-325 injection.

**Discussion:** Our study demonstrated that following a single injection of MS-325 inversion recovery gradient echo sequences allow visualization of the coronary arteries with high signal and contrast to noise ratios for at least 30 minutes. Therefore, MRCA of the entire coronary system can be performed using either multiple breath-hold (VCATS, volume coronary angiography with targeted scans) or even navigator scans of all three mayor coronary arteries. However, the T1 measurements proved a slow elimination of the compound resulting in a slightly reduced contrast and overall image quality for scans with long delay after injection.