# Concomitant atherosclerotic changes in whole-body MR-Angiography and coronary calcium deposit in patients with catheter-staged coronary artery disease (CAD)

K. Brauck[1], F. Breuckmann[2], J. Barkhausen[1], S. Ladd[1]

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

**Introduction:** Atherosclerosis is an important cause for premature death in the developed countries. Risk factors are cigarette smoking, diabetes mellitus, arterial hypertension, hypercholesterolemia and others. The aim of this study was to determine if atherosclerotic changes in the peripheral vessels as determined by whole-body magnetic resonance (MR) angiography are associated with coronary artery disease (CAD) and coronary calcium deposit.

**Materials and Methods:** *Subjects:* 129 Patients (age: 34-84 years) with suspected coronary artery disease were included. *Examinations:* All MR examinations were performed on a 1.5T whole-body System (Magnetom Sonata or Magnetom Avanto, Siemens, AG, Erlangen, Germany) after application of 0.2 mmol/kg Dotarem® (Guerbet, Roissy, France). On the Sonata, whole-body angiography was performed from the carotids to the ankles on a rolling table platform (AngioSurf®) with a 5-station contrast-enhanced 3D spoiled gradient echo sequence (TR/TE: 2.2/0.74 ms, FA: 20°, voxel size: 1.8 x 1.5 x 1.5 mm). On the Avanto the surface array coils supplied by Siemens were used. Presence of plaques or stenoses of the vessel lumen was evaluated for carotid, vertebral, mesenterial, renal, iliac, femoral, popliteal and lower limb arteries as well as for the complete aorta. An atherosclerosis index was calculated for each patient: $Index = \sum_{n=1}^{40} w_i$, with $w_i$ being the grading of the $i^{th}$ of 40 artery sections (0-no plaque; 1-plaque - ≤50% stenosis; 2-51-≤90% stenosis; 3-91-≤95 stenosis; 4-occlusion). Catheter evaluation of the coronary arteries was performed following clinical criteria; pathologies were categorized into: 0-no coronary artery (CA) diseased; 1-3: number of CA diseased; 4-diffuse CAD. Coronary calcium deposit was determined by a C 150 XP EBT-Scanner (GE-Imatron, South San Francisco, USA) using the Agatston-method. Statistical significant difference between subgroups was assumed if $p<0.05$. Correlations were tested with the Spearman correlation.

**Results:** Of all patients, 61 (47%) showed calcifications of the coronary arteries as detected by EBT. The coronary calcium deposit and the calculated atherosclerosis index correlated significantly with each other (p=0.001). There was a statistically significant difference regarding the coronary calcium deposit between patients without coronary artery disease and patients with coronary artery disease (p<0.001). MR angiography showed a significant higher atherosclerosis index in patients with coronary artery disease than in patients without coronary artery disease (p=0.008). If an atherosclerosis index >8 is used as positive predictive value for a coronary calcium deposit >800, the positive predictive value is 31% and the negative predictive value of 82% (Table 1).

**Discussion:** There is a clear association between the catheter CAD grading, the coronary calcium deposit and the here defined atherosclerosis index. Further prospective studies have to show if the easy-to-perform MR angiography can be used for the prediction of coronary artery disease in the clinical routine.

| | **Atherosclerosis Index < 8** | **Atherosclerosis Index ≥ 8** |
|---|---|---|
| **Calcium score < 800** | **93** | **11** |
| **Calcium score ≥ 800** | **20** | **5** |

Table 1: Correlation of atherosclerosis index and calcium score (Agatston) Absolute numbers and (percent).

Figure 1: The five whole body MRA stations in the maximum intensity projection mode of a 73 yo man with symptoms for occlusion of the right popliteal artery (arrow). Simultaneous stenosis of the left internal carotid artery (arrow) was not known previous to MR. Atherosclerosis index= 4 (popliteal occlusion) + 3 (high grade stenosis of the left internal carotid artery) = 7.