Real-time cardiovascular magnetic resonance tissue characterisation in patients undergoing transcatheter aortic valve replacement

Backhaus SJ.[1]; Lange T.[1]; Beuthner BE.[1]; Topci R.[1]; Wang X.[2]; Kowallick JT.[2]; Lotz J.[2]; Seidler T.[1]; Toischer K.[1]; Zeisberg EM.[1]; Puls M.[1]; Jacobshagen C.[1]; Uecker M.[2]; Hasenfus G.[1]; Schuster A.[1]

[1]Heart Centre Goettingen, Goettingen, Germany
[2]University Medical Center Göttingen, Institute for Diagnostic and Interventional Radiology, Göttingen, Germany

Funding Acknowledgements: Type of funding sources: Public grant(s) – National budget only. Main funding source(s): German Research Foundation (DFG, CRC 1002, D1)

Background:

Myocardial fibrosis is a major determinant of outcome in aortic stenosis (AS). Novel fast real-time (RT) cardiac magnetic resonance (CMR) mapping techniques allow comprehensive quantification of fibrosis but have not yet been compared against standard techniques and histology.

Methods:

Patients with severe AS underwent CMR before (n = 110) and left ventricular (LV) endomyocardial biopsy (n = 46) at transcatheter aortic valve replacement (TAVR). Midventricular short axis (SAX) native, post-contrast T1 and extracellular volume fraction (ECV) maps were generated using commercially available MOLLI (native: 5(3)3, post-contrast: 4(1)3(1)2) and RT single-shot inversion recovery fast low-angle shot (FLASH) with radial undersampling. Focal late gadolinium enhancement was excluded from T1 and ECV regions of interest. ECV and LV mass were used to calculate LV matrix volumes. Variability and agreements were assessed between RT, MOLLI and histology using intraclass correlation coefficients, coefficients of variation and Bland Altman analyses.

Results:

RT and MOLLI derived ECV were similar for midventricular SAX slice coverage (26.2 vs. 26.5, $p = 0.073$) and septal region of interest (26.2 vs. 26.5, $p = 0.216$). MOLLI native T1 time was in median 20 ms longer compared to RT ($p < 0.001$). Agreement between RT and MOLLI was best for ECV (ICC >0.91), excellent for post-contrast T1 times (ICC >0.81) and good for native T1 times (ICC >0.62). Diffuse collagen volume fraction by biopsies was in median 7.8%. ECV (RT $r = 0.345$, $p = 0.039$; MOLLI $r = 0.40$, $p = 0.010$) and LV matrix volumes (RT $r = 0.45$, $p = 0.005$; MOLLI $r = 0.43$, $p = 0.007$) were the only parameters associated with histology.

Conclusions:

RT mapping offers fast and sufficient ECV and LV matrix volume calculation in AS. ECV and LV matrix volume represent robust and universally comparable parameters with associations to histologically assessed fibrosis and may emerge as potential targets for clinical decision making.