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Kardiale Magnet Resonanz (CMR)
in der täglichen Praxis

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CMR in Daily Practice

CMR Today: A Unique Way to Investigate the Heart

- Anatomy, morphology, dimensions
- Tissue characterization
- Function, volumes
- Necrotic myocytes, fibrosis, amyloid...
- Adenosin stress
- Myocardial edema
- 4D flow quantification
- Myocardial perfusion
- Rest and stress
Myocardial Fibrosis

- **effects:**
  - increases myocardial stiffness
  - decreases myocardial compliance

- **characterization:**
  - fibroblast accumulation
  - excess deposition of matrix proteins

- **patterns:**
  - reactive: perivascular and interstitial collagen accumulation, no myocyte loss
  - replacement: myocyte loss followed by fibrosis
<table>
<thead>
<tr>
<th>Method</th>
<th>Description</th>
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<tbody>
<tr>
<td>Late Gd enhancement</td>
<td>Accumulation of Gd in areas of extracellular expansion due focal myocardial replacement fibrosis diagnosis of areas fibrosis (scar) prolonged washout of Gd shortens T1-relaxation high signal intensity in areas of fibrosis limited quantification low sensitivity for microscopic/diffuse fibrosis</td>
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<tr>
<td>T1-mapping</td>
<td>Measurement of absolute T1-relaxation time for all areas of the myocardium on a pixel by pixel bases subtle changes in T1 due to interstitial expansion</td>
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Mechanisms of Hyperenhancement in Diffuse Interstitial Fibrosis and Replacement Myocardial Fibrosis

- Normal myocardium: intact cell membrane, normal interstitial space
- Microscopic fibrosis: interstitial expansion
- Chronic MI, scar: collagen matrix
CHF: Differentiation of Ischemic vs. Non-Ischemic Etiology

- Subendocardial late Gd enhancement
- Myocardial infarction (scar)
CHF: Differentiation of Ischemic vs. Non-Ischemic Etiology

midwall late Gd enhancement  nonischemic etiology
Congestive Heart Failure
Congestive Heart Failure
CMR and Prognosis in Cardiac Amyloidosis

Maceira AM et al. JCMR 2008; 10: 54.
Cardiomyopathy??

Cardiomyopathy?? (2)

final diagnosis: cardiac sarcoidosis
LV Midwall Fibrosis as Predictor of Mortality and Morbidity after CRT

FU > 8.7 y of patients with (n=20) or without (n=77) MWEH and patients with ICH (n=161) undergoing CRT

patterns of myocardial fibrosis in ischemic and nonischemic cardiomyopathy

CV Mortality and Hospitalization after CRT

Cardiac Tumors: Tissue Characterization by CMR
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T1-TSE

T2-TSE

CE-GRE LE
Cardiac Tumors: Tissue Characterization by CMR
Assessment of AR by CMR
Quantification of AR by CMR

- VE CMR = only technique with true in vivo quantification of AR
- High interstudy and inter/intraobserver reproducibility

AR Quantification with CMR Predicts Clinical Outcome

- 94 asymptomatic patients with moderate or severe AR
- Quantification of RF and LV volumes by CMR
- FU > 2.7±2 years
- Survival without surgery

Assessment of Aortic Valve and Ascending Aorta in AS with CMR
Summary and Take Home Message

- myocardial tissue characterization by CMR for differential diagnosis in cardiomyopathies, heart failure and masses
- myocardial fibrosis can be reliably shown by decrease of T1 relaxation following Gd
- late Gd enhancement is an excellent and robust tool for depiction of focal myocardial fibrosis and interstitial expansion
- for quantification of microscopic myocardial fibrosis T1 mapping is mandatory
- myocardial fibrosis is a powerful prognostic marker for major CV events