Background: Diagnosis and prognostication of patients with possible myocarditis and myocardial inflammation can be challenging. Cardiac magnetic resonance imaging (CMR) has become a key investigative tool in such scenarios, but the prognostic implications of CMR findings remain uncertain.

Objectives: Event-free survival analyses of a large patient cohort who presented with suspected myocarditis who underwent CMR.

Methods: 670 Patients with clinically suspected myocarditis were included. CMR findings including the presence and extent of late gadolinium enhancement (LGE) were associated with major adverse cardiac events (MACE), including all-cause death, heart failure, heart transplantation, documented ventricular arrhythmia, or recurrent myocarditis.

Results: At a median follow-up of 4.7 [interquartile-range (IQR) 2.3–7.3] years, 98 patients experienced a MACE. 294 (44%) patients presented with LGE on CMR. LGE presence was associated with a more than 2-fold increase in risk of MACE (HR 2.55, 95% CI: 1.77–3.83; p < 0.001). Each percentage increase in LGE extent was associated with a 6% increase in risk of MACE (HR 1.06, 95% CI: 1.02–1.06, p = 0.001). Annualized event rates of MACE with regards to presence or absence of LGE were 4.8% versus 2.1% (p = 0.001). Midwall LGE involvement was associated with a HR of 2.39 (95% CI: 1.56–3.62; p < 0.001) with a MACE, but not epicardial LGE involvement (p = 0.291). Strongest association was observed in septal LGE involvement (HR 2.55, 95% CI: 1.77–3.83; p < 0.001), whereas lateral involvement was not associated with MACE (p = 0.145).

Conclusions: CMR with the use of tissue characterization is a useful tool in the risk stratification of patients with clinically suspected myocarditis.

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MR-guided endomyocardial biopsy in a preclinical in vivo model

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MR-guided endomyocardial biopsy in a preclinical in vivo model

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Background: Endomyocardial biopsy (EMB) is considered as the diagnostic “gold standard” in detection of myocardial inflammation and is clearly recommended in current guidelines. However, conventional fluoroscopy-guided EMB is associated with a considerable sampling error due to lack of lesion-visualization and precise anatomy. These drawbacks may be overcome by Cardiovascular Magnetic Resonance (CMR)-guided EMB.

Purpose: The aim of the present study was to investigate the basic feasibility of interventional CMR (ICMR) guided EMB in a preclinical in vivo pig model.

Methods: First, ex vivo experiments on explanted pig hearts (n = 4) were conducted for technical optimization, especially for improvement of a guide sheath-labeling concept and establishment of an overall approach of ICMR. Transferability of this concept into in vivo conditions was investigated (n = 3) and subsequently basic feasibility of focal lesion (acute myocardial infarction, AMI) guided EMB was assessed (n = 4). ICMR followed 7 days after AMI on a 1.5 Tesla MRI-System equipped with an Interventional MRI Suite research prototype. All instruments applied were passively visualized via iron-markers. Real-time imaging (RT) was realized with a single-shot-balanced-SSFP-sequence (vowel size: 1.7 x 1.8 x 8 mm³, temporal resolution: 0.4 s) and myocardial lesions were identified under RT with a single-shot-T2-weighted-TSE (sshT2) and a single-shot-inversion-balanced SSFP-LGE (sshLGE) sequence. ICMR was conducted as follows: generation of a roadmap (3D-balanced SSFP), then switching to RT, introduction of guidewires via arterial or venous introducer sheaths and forwarding into the respective cavity. After lesion identification by means of sshT2 and sshLGE, guide sheath was introduced via the wire followed by angulation maneuvers towards the target area (remote or lesion). Finally, the biotom was introduced for EMB and biopsies were assessed historiologically.

Results: Optimal imaging quality of the guide sheath was enabled by specific continuous labeling concept with 7.4 mm artifact diameter in vivo under RT. Imaging. With the aid of contiguous labeled guide sheath the operator kept the direction information under in vivo conditions, even if only a small part of guide sheath was visualized. Length guided EMB in both RV and LV were feasible in 4/4 cases (Fig. 1A). On average two EMB trials for one successful biopsy of ap-propriate size and quality were necessary (Fig 1B). Lesion imaging (sshT2- and sshLGE) showed excellent signal-to-noise ratios and contrast-to-noise ratios in this pig model and additionally in human protocols. For simulation the worst case scenario: 10 repetitive EMBs in the RV apex led to pericardial effusion, which could be immediately detected under RT.

Conclusion: This study promise basic feasibility of CMR-guided EMB. As future perspective, iCMR might significantly improve sensitivity and specificity of EMB.

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