RPS 1803-3 10:42

Tissue characterisation by parametric mapping and strain cardiac magnetic resonance for the detection and monitoring of myocardial injury in fulminant myocarditis

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Purpose: To investigate whether multiparametric cardiac magnetic resonance (CMR) could detect and monitor inflammation myocardial alterations in fulminant myocarditis.
Methods and materials: 19 patients (35 ± 14 years, 37% male) with a clinical diagnosis of fulminant myocarditis underwent CMR examinations at 3.0T in the acute phase and at 3-months follow-up. The control group consisted of 19 healthy volunteers. The CMR protocol included cine, black blood T2-weighted imaging, T1 mapping, T2 mapping, and late gadolinium enhancement (LGE). Cardiac strain was evaluated by feature tracking.
Results: The left ventricular mass index (64 [57, 76] versus 52 [47, 63], P<0,05) and interventricular septum thickness (10.5 [9, 11.3] versus 8.3 [6.6, 9.8], P<0,001) in the acute stage was significantly higher compared with controls and normalised at the chronic stage. All quantitative inflammation metrics, including oedema ratio, LGE mass, native T1, T2, and extracellular volume were significantly (all P<0,001) decreased in the follow-up scan, but still higher than controls. Compared with the controls, strain indices were all significantly (all P<0,001) impaired in the acute stage. Native T1 and T2 values led to excellent diagnostic accuracy for discriminating fulminant myocarditis from healed myocarditis, with AUC of 0,947 and 0,931.
Conclusion: Multiparametric CMR could detect and monitor inflammation myocardial injuries in patients with fulminant myocarditis. Native T1 and T2 values achieved excellent diagnostic performance in distinguishing acute from healed myocarditis.
Limitations: Though the diagnosis of FM was made by strict clinical criteria and typical CMR findings, the lack of EMB makes the myocardial histopathological verification unavailable.
Ethics committee approval: The study was approved by our Institutional Review Board and written informed consent was obtained prior to CMR.
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Mapping cardiac magnetic resonance (CMR) for early prediction of unfavourable left ventricle remodelling in acute myocarditis: a MIAMI study

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Purpose: A pixel-wise mapping technique resulted in more sensitive than conventional CMR images in the diagnosis of acute myocarditis. The role in the detection of subtle inflammation is still under investigation and imaging predictors of outcomes are still largely unknown.
Methods and materials: 68 patients with clinical suspicions of myocarditis underwent cardiac MR (CMR) at a 1,5T scanner for the evaluation of morpho-functionality, hyperaemia with ce-SSFP images, oedema with STIR and T2 mapping, scarred myocardium with LGE, native-T1, and ECV. When clinically indicated endomyocardial biopsy (EMB) was performed, a second CMR was performed 2 months after baseline. 45 healthy volunteers underwent CMR as the control group.
Results: Acute myocarditis was confirmed in 45 patients by both CMR and EMB. An Infarct-like presentation was the most frequent (25 patients, 56%). At baseline CMR, LV-EDV was 135 ml with EF.53%, LL criteria were positive (T2-ratio: 2,8, Hyperemia: 13%, LGE: 6%), and T1, T2 mapping, and ECV were significantly higher than normal values without difference among clinical presentation (p>0,05). Mapping parameters showed excellent diagnostic accuracy in the acute (AUC: 95%, 98%, and 90% for T1 map, T2 map, and ECV) and convalescent phases (90%, 85%, and 89% for T1 map, T2 map, and ECV). At short-term follow-up, a slight recovery of EF was experimented on with a reduction of all LL and mapping parameters. The modification of native-T1 values correlated to the recovery of EDV (R=0.8242, p=0.0005) and ejection fraction (R= -0,4559, p=0.0378).
Conclusion: Lower recovery of T1 value in the convalescent phase is associated with higher EDV and lower EF.
Limitations: A imited sample size and relatively short follow-up.
Ethics committee approval: The study was approved by Institutional Review Board. Aall study participants signed informed consent.
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Agreement between old and new Lake Louise criteria for the diagnosis of acute myocarditis with a different clinical onset

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Purpose: To compare the diagnostic performance of old and new Lake Louise criteria (oLLC and nLLC) in suspected acute myocarditis patients among various clinical presentations: infarct-like [IL], cardiomyopathic [CM], and arrhythmic [A].
Methods and materials: 110 patients with a clinical suspicion of acute myocarditis underwent 1.5T cardiac magnetic resonance. The protocol included cine–SSFP, T2wSTIR, early and late gadolinium-enhancement, T2-mapping, and native and post-Gd T1-mapping. 3 patients were excluded for unknown clinical hystory. Cohen's k test was used to assess the level of agreement and a McNemar test to compare the diagnostic proportion between oLLC and nLLC among different clinical presentations.
Results: The frequency of clinical presentations were 56/107 (52%) IL, 29/107 (27%) CM, and 22/107 (20.5%) A. A diagnosis was performed in 45/110 (40,9%) patients with oLLC and in 69/110 (62.7%) with nLLC [k=0,48[0,33-0,62], p<0.01. A statistically significant difference in the agreement of oLLC and nLLC was found for CM and A presentations [15/29(51,7%) vs 7/29(24,1%), k= 0,46[0,19-0,73] p<0,01 and 11/22(50%) vs 4/22(18,2%), k=0,36[0,063-0,66], p<0,05, respectively]. No statistical difference was found for IL onset [nLLC 41/56(73,2%) vs oLLC 33/56(58,9%), k=0,45[0,22-0,69], p>0,05]. Mapping sequences allowed for the diagnosis of acute myocarditis when oLCC were negative in 5/56 (9%) for IL, 3/29 (10%) for CM, and 4/22 (18%) for A. In particular, with T1-mapping and ECV, T1 criterion was met in 9/56 (16%) IL, 7/29 (24%) CM, and 8/22 (36%) A onset (p>0.05), and, with T2-mapping, T2 criterion in 13/56 (23%) IL, 9/29 (31%) CM, and 8/22 (36%) A onset (p>0,05).
Conclusion: The degree of agreement between oLLC and nLLC was moderate for overall, IL, and CM presentations, and fair for A. nLLC allowed for a diagnosis of more acute myocardites than oLLC in CM and A onsets.
Limitations: Bioptic diagnosis of acute myocarditis was made only in few patients.
Ethics committee approval: Informed consent was obtained.
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Early T1 shortening (eT1sh): a new CMR parameter to detect myocardial hyperemia in acute myocarditis

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Purpose: To evaluate T1-mapping based approaches for the quantification of hyperemia in patients with acute myocarditis.
Methods and materials: 55 subjects (40 patients with acute myocarditis [AM]; 15 age- and sex-matched healthy control subjects [HC]) underwent 1.5T CMR. T1 mapping was acquired before (native T1) and 2 minutes after gadoliunium administration (early-enhanced T1). 3 different T1 mapping-based parameters were calculated: early enhanced T1-rt (eT1), early T1-rt shortening (eT1sh), and early relative T1-rt shortening (erT1sh). Optimal cut-off values and their diagnostic performances in the identification of AM were calculated.
Results: In AM patients, median eT1 was 275,6 ms [252-297], eT1sh was 75% [73%-78%], and erT1sh was 2.15 [1.83-2.59], all being significantly higher with respect to HC (p=0,0014, p<0,0001, and p<0,0001, respectively). eT1sh showed the best diagnostic performance with excellent AUC (97%, 95% confidence interval, CI: [93%-100%]). A reduction of eT1sh ≥69.5% identified AM with very

high sensitivity (93%), specificity (100%), NPV (83%), PPV (100%), and accuracy (95%). eT1 had a good AUC (92.5%, 95% CI: [86%-99%]), slightly worse than eT1sh. eT1≤331 ms identified AM with 93% sensitivity, 87% specificity, 81% NPV, 95% PPV, and 91% accuracy. erT1sh showed the worst diagnostic performance with 78% AUC (95% CI: [66%-91%]). erT1sh>1.9 identified AM with 68% sensitivity, 87% specificity, 50% NPV, 93% PPV, and 73% accuracy.
Conclusion: eT1sh showed the best diagnostic performance in the identification of AM. It can be a promising alternative method for the detection of hyperemia in AM.
Limitations: A relatively small sample size.
Ethics committee approval: The study was approved by the Institutional Review Board. Written informed consent was obtained.
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Derived-CMR strain efficacy in myocardial inflammation: a retrospective comparison with standard practice

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Purpose: A major role in the diagnosis of myocarditis is played by new CMR-based biomarkers. The aim of the study was to investigate the diagnostic capabilities of tissue-tracking (TT) strain analysis in patients with a CMR-based diagnosis of myocarditis.
Methods and materials: 43 patients with a CMR-based diagnosis of myocarditis according to the standard Lake Louise criteria were retrospectively analysed. 27 healthy participants were selected as a control group. Cine-RM data was used for the analysis. Dedicated TT-software was used to perform radial, circumferential, and longitudinal strain for global, per-plane (basal, middle, and apical), and segmental (AHA 16-segments standard) evaluation in short and long-axis left ventricle images.
Results: Patients with myocarditis showed significantly reduced LV radial and circumferential strain values, both in global and per-plane evaluation (GRS: 23.39 ±7.16% vs. 31 ±7.15%)(GCS: -14.90 ±3.69% vs. -18.21 ±2.52%)(RSbas: 21.92 ±6.47% vs. 29.25 ±6.28%)(CSbas: -14.21 ±3.38 vs. -17.50 ±2.46%), compared with healthy participants. Good accuracy was found according to the ROC analysis (AUC up to 0.824). No significant correlations were found with oedema, while a significant correlation was found between segmental radial and LE (p-value:0.019), and an interesting trend between segmental circumferential and LE (p-value:0.087).
Conclusion: Tissue-tracking strain analysis has proved accurate in the evaluation of patients diagnosed with myocarditis based on standard Lake Louise criteria. Tissue-tracking strain analysis could improve diagnostic accuracy in clinical practice, adding useful information over the standard findings.
Limitations: A lack of mapping sequence, especially in elderly examination, does not permit an adequate comparison with revisited Lake Louis criteria.
Ethics committee approval: The study was conducted in accordance with the declaration of Helsinki.
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Coronary inflammation by CT pericoronary fat attenuation in MINOCA and Tako-Tsubo syndrome

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Purpose: The pericoronary fat attenuation index (pFAI) emerged as a marker of coronary artery inflammation (CAI), measurable by standard coronary CT angiography (CCTA). It compares well with the gold standard for the CAI assessment and can predict future cardiovascular events. pFAI could prove invaluable in differentiating CAI from a noninflammatory status, helping to unravel the mechanisms subtending an event classified as myocardial infarction with nonobstructive CA (MINOCA) or Tako-Tsubo syndrome (TTS).
Methods and materials: Patients admitted with MINOCA and TTS between 2011-2018, who had both CCTA and cardiac MR during/shortly after the acute phase, were selected and pFAI measured in their CCTA. pFAI was also measured in control subjects who had CCTA for atypical chest pain workup, no obstructive CAD found in their CCTA, and no cardiac events at a 2-year follow-up.
Results: In the n=106 MINOCA/TTS, mean pFAI was 68.378.29 vs. 78.036.20 in the n=106 controls (P<0.0001), and the difference confirmed also when comparing mean pFAI in each CA between MINOCA/TTS and controls (P<0.0001). Nonobstructive coronary plaques at CCTA, high-risk plaques in particular, were more frequently found (P<0.01) in the MINOCA/TTS group versus controls.
Conclusion: In MINOCA and TTS pts, CCTA is not only able to detect angiographically invisible atherosclerotic plaques, but its diagnostic yield can be expanded using the simple measurement of pFAI to characterise pericoronary fat tissue. In MINOCA/TTS, mean pFAI demonstrates higher values compared with controls, a finding that has been associated with CAI.
Limitations: The drug therapy was not recorded. We cannot exclude an effect of drugs used in acute coronary syndromes on pFAI in our MINOCA/TTS group.
Ethics committee approval: The study was approved by Institutional Review Board and Research Ethics Committee and all subjects gave written informed consent.
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Differentiating chronic myocarditis from non-ischemic dilated cardiomyopathy using segmental T1 mapping

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Purpose: To determine the T1-relaxation time differences between chronic myocarditis (CM) and non-ischemic dilated cardiomyopathy (DCM) using an overall and segmental approach on native T1 mapping.
Methods and materials: We performed a retrospective analysis of 62 cases, including 52 consecutive patients who had a presentation at >14 days from initial symptoms and underwent CMR as part of a complete diagnostic work-up for clinically suspected myocarditis in accordance to current guidelines. 26 patients were included in each of the CM and DCM groups and 10 individuals served as normal controls. The CMR protocol at 1.5T included non-contrast T1-mapping using a 5(3)3 MOLLI acquisition. We analysed a mid-myocardial slice for overall and segmental myocardial T1-relaxation. A Wilcoxon rank sum test was used to assess the differences between the groups.
Results: The overall median and interquartile range was 1060 [1002-1155] ms for CM and 1058 [1034-1093] ms for DCM, showing no significant difference between the two groups. The overall T1-relaxation time was significantly higher in both groups compared to controls, T1-relaxation 1007 [966-1036] ms, (p<0.05). In CM, we found no statistical difference in T1-relaxation between the lateral and septal segments, while the septal values were significantly higher compared to the values in the lateral wall segments in DCM (p<0.001). We found significantly higher T1-relaxation in the inferoseptal segment in DCM, 1120 [1088-1154] ms, compared to CM, 1075 [1042-1136] ms, (p=0.04).
Conclusion: A per-segment approach can help to differentiate chronic myocarditis and non-ischemic DCM, while an overall approach can only differentiate both groups from healthy subjects.
Limitations: The small sample size.
Ethics committee approval: This study approved by the institutional ethics committee. Written informed consent was obtained.
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