



Comparison of myocardial fibrosis quantification methods by cardiovascular magnetic resonance imaging for risk stratification of patients with suspected myocarditis

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BACKGROUND: Although the presence of late gadolinium enhancement (LGE) using cardiovascular magnetic resonance imaging (CMR) is a significant discriminator of events in patients with suspected myocarditis, no data are available on the optimal LGE quantification method.

METHODS: Six hundred seventy consecutive patients (48 ± 16 years, 59% male) with suspected myocarditis were enrolled between 2002 and 2015. We performed LGE quantitation using seven different signal intensity thresholding methods based either on 2, 3, 4, 5, 6, 7 standard deviations (SD) above remote myocardium or full width at half maximum (FWHM). In addition, a LGE visual presence score (LGE-VPS) (LGE present/absent in each segment) was assessed. For each of these methods, the strength of association of LGE results with major adverse cardiac events (MACE) was determined. Inter-and intra-rater variability using intraclass-correlation coefficient (ICC) was performed for all methods.

RESULTS: Ninety-eight (15%) patients experienced a MACE at a medium follow-up of 4.7 years. LGE quantification by FWHM, 2- and 3-SD demonstrated univariable association with MACE (hazard ratio [HR] 1.05, 95% confidence interval [CI]:1.02-1.08, $p = 0.001$; HR 1.02, 95%CI:1.00-1.04; $p = 0.001$; HR 1.02, 95%CI: 1.00-1.05, $p = 0.035$, respectively), whereas 4-SD through 7-SD methods did not reach significant association. LGE-VPS also demonstrated association with MACE (HR 1.09, 95%CI: 1.04-1.15, $p < 0.001$). In the multivariable model, FWHM, 2-SD methods, and LGE-VPS each demonstrated significant association with MACE adjusted to age, sex, BMI and LVEF (adjusted HR of 1.04, 1.02, and 1.07; $p = 0.009$, $p = 0.035$; and $p = 0.005$, respectively). In these, FWHM and LGE-VPS had the highest degrees of inter and intra-rater reproducibility based on their high ICC values.

CONCLUSIONS: FWHM is the optimal semi-automated quantification method in risk-stratifying patients with suspected myocarditis, demonstrating the strongest association with MACE and the highest technical consistency. Visual LGE scoring is a reliable alternative method and is associated with a comparable association with MACE and reproducibility in these patients.

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