

Assessment of Longitudinal Changes in Contractile Function using DENSE in Patients with Myocardial Infarction

Christie McComb^{1,2}, David Carrick³, Rosemary Woodward^{2,4}, John McClure², Aleksandra Radjenovic², Colin Berry^{2,3}, and John Foster^{1,2}
¹Clinical Physics, NHS Greater Glasgow & Clyde, Glasgow, United Kingdom, ²BHF Glasgow Cardiovascular Research Centre, Glasgow, United Kingdom, ³Cardiology, Golden Jubilee National Hospital, Glasgow, United Kingdom, ⁴MRI, Golden Jubilee National Hospital, Glasgow, United Kingdom

Introduction: Myocardial infarction (MI) causes contractile dysfunction in the affected tissue, which can be assessed by using DENSE (Displacement ENcoding with Stimulated Echoes) to quantify myocardial strain^{1,2}. The aim of this study was to investigate changes in strain revealed by DENSE between the occurrence of MI and a 6 month follow-up.

Methods: 50 male patients (age 56 ± 10 years) underwent CMR on a 1.5T Siemens Avanto within 7 days of MI, and 47 returned for a follow-up scan after 6 months. The protocol included DENSE (2D) and late gadolinium enhancement (LGE) imaging. DENSE and LGE were compared using a single mid-ventricular short-axis slice, which was analysed after division into 6 AHA segments. The percentage of each segment which contained LGE (%LGE) was calculated using a threshold of mean+5SD of remote myocardium intensity. DENSE images were analysed to obtain a value for peak circumferential strain (Ecc) and strain rate.

Segments in the baseline scans were categorised according to their proximity to LGE (remote, adjacent, infarcted). For both peak Ecc and strain rate, the values obtained at baseline and follow-up for each category individually were evaluated using Wilcoxon signed rank tests. A one-way ANOVA with Tukey's post-hoc test was then used to compare the differences in strain between baseline and follow-up for the three categories.

Segments with LGE present at baseline were allocated a score according to %LGE within the segment (0: 0%, 1: 1-25%, 2: 26 – 50%, 3: 51 – 75%, 4: 76 – 100%). This was repeated at follow-up, and segments were categorised according to the change in score (lower, unchanged, higher). A one-way ANOVA with Tukey's post-hoc test was used to compare the differences in strain for the three categories.

Results: Diagnostic images were obtained for 50 patients at baseline, and for 43 patients at follow-up. No differences in strain were observed in remote segments, but statistically significant increases were observed in both adjacent and infarcted segments. The results of the comparisons between changes in strain in remote, adjacent and infarcted segments are illustrated in Figure 1. The results of the comparisons between changes in strain in segments with lower, unchanged and higher %LGE score are illustrated in Figure 2.

Conclusions: Strain recovery was observed using DENSE in infarcted tissue at 6 months post-MI, and also in segments which are adjacent to infarction. The changes in the mechanical properties of myocardium following MI are complicated, but it appears that a reduction in infarct size at follow-up compared to baseline is associated with a greater recovery in contractile function.

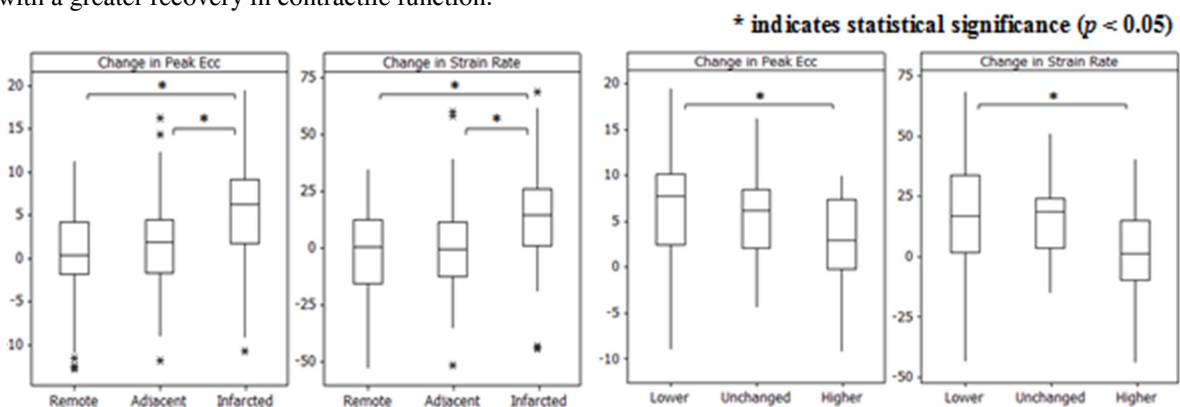


Figure 1: Comparison of changes in peak Ecc and strain rate in segments which are categorised as remote, adjacent and infarcted.

Figure 2: Comparison of changes in peak Ecc and strain rate in segments in which the %LGE score is lower, unchanged or higher at follow-up compared to baseline.

References:

1. J Magn Reson 1999; 137: 24 – 252
2. Magn Reson Med 2012; 67: 1590 – 1599