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Meeting abstract

1106 Normal values for strain calculated from velocity encoded MRI

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Background

Regional wall function is an important parameter in the diagnosis of heart disease. Qualitative assessment of wall function has limitations in terms of inter-observer variability and reproducibility. Strain is a relatively new way to obtain a quantitative measure of cardiac function and can be calculated from phase velocity encoded magnetic resonance images.

Methods

Images were acquired from 25 (8 female, 17 men) healthy volunteers without history of cardiac events and with normal blood pressure. Mean age was 40 ± 14 (mean ± SD)

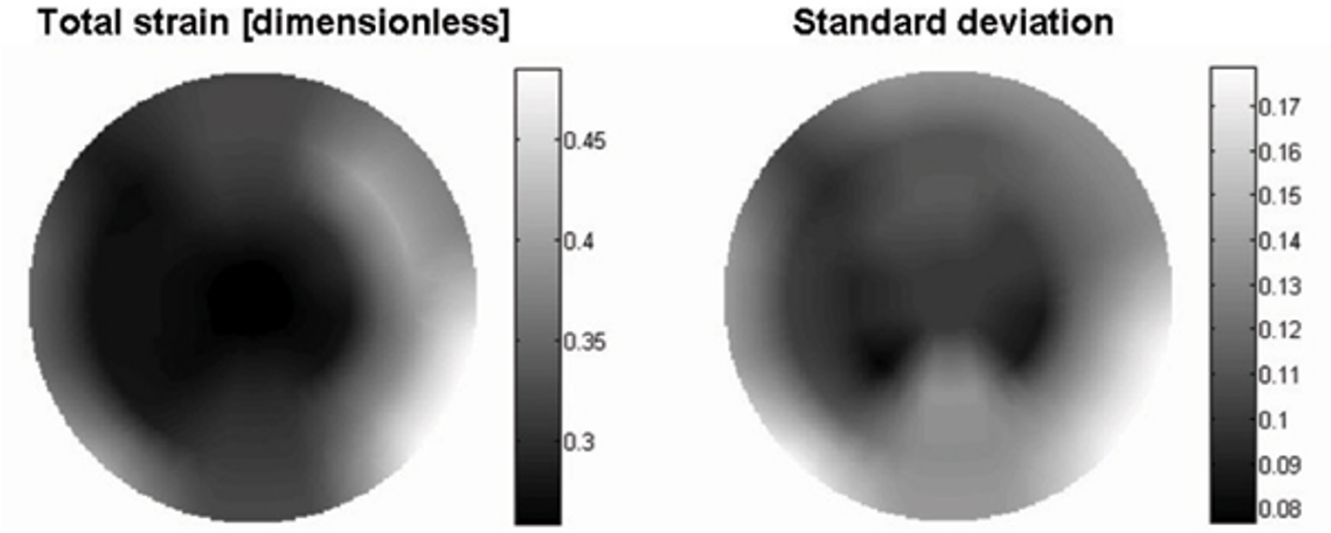

Figure 1
The left panel shows mean strain from 25 healthy volunteers visualized in a bulls eye plot. The right image panel shows the variability expressed as standard deviations for the 25 healthy volunteers.

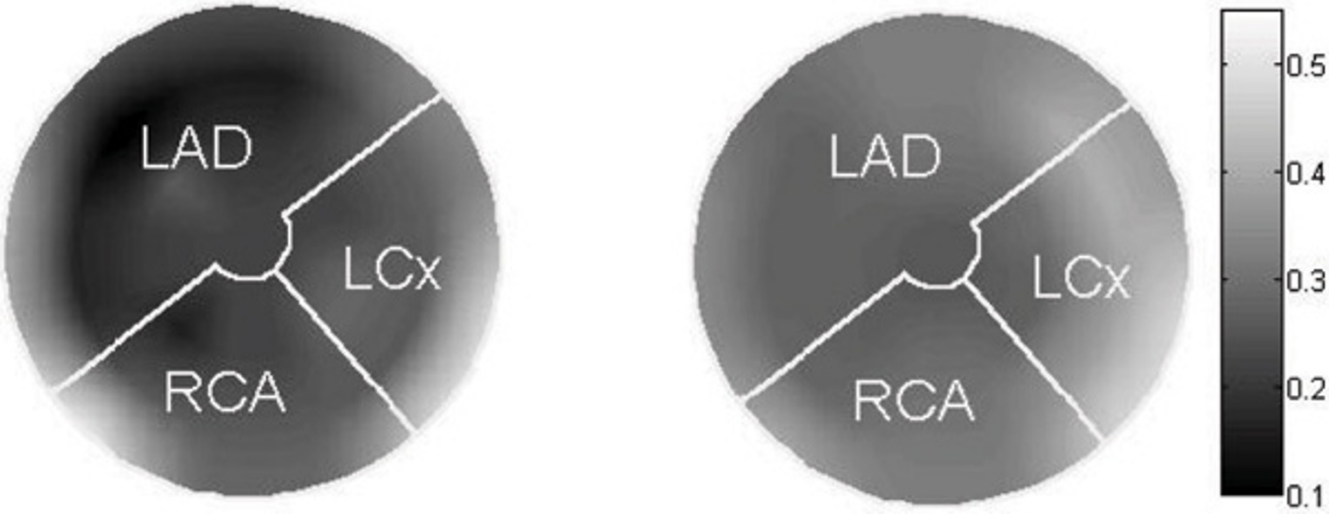

Figure 2
Left image panel shows an example of a patient with an acute LAD myocardial infarction and the right image panel shows the normal values with the vessel territories overlaid.

years. Phase contrast encoded MR images were acquired in 2CH, 3CH and 4CH projections using a 1.5 T Philips scanner (TE = 4.9 ms, TR = 7.1 ms, flip angle = 15 degrees, and echo train length 5). The myocardium was manually delineated in end diastole. A tracking algorithm based on solving a non linear partial differential equation followed all particles within the myocardium over time. To ensure smoothness, motion was spatially restricted to and described by a third order polynomial. From the displacement, a linear strain tensor was calculated. Total calculation time was a around 3 seconds on an ordinary PC. Data from the three long axis slices were visualized in a bullseye plot (Figure 1). Normal values were calculated for total strain (measured as the Frobenius norm), radial and longitudinal strain. The algorithm was implemented in the software Segment http://segment.heiberg.se.

Results

The normal values permits quantitative analysis on how a patient's strain differs from strain in the normal healthy heart. Figure 1 shows normal value of strain (total strain) in the heart. The right image panel shows the variability (SD) across all 25 subjects. Figure 2 shows an example where a patient with an acute LAD myocardial infarction is contrasted to the normal values.

Discussion and conclusion

Normal values are necessary to correctly identify hypofunctioning myocardium and may aid in detection of multi vessel disease as well as to analyse regions with compensatory hyper contraction. In conclusion, strain derived from phase contrast MR images is a highly promising, fast and simple method to quantify regional wall function.