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Meeting abstract

1123 Cardiac MR elastography: observation of stiffness-related shear-wave amplitude variations in 6 healthy volunteers

Thomas Elgeti*, Jens Rump, Bernd Hamm, Juergen Braun and Ingolf Sack

Address: Charite Universitaetsmedizin Berlin, Berlin, Germany
* Corresponding author

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Purpose

It is proposed that in vivo time-resolved cardiac magnetic resonance elastography (MRE) enables noninvasive assessment of myocardial pressure changes. Therefore, an experiment is developed that identifies variations in myocardial stiffness during the heart cycle by measuring changes in externally induced shear-wave amplitudes.

Methods

Six healthy male volunteers underwent in vivo cardiac MRE on a clinical 1.5 T scanner. An ECG-gated, motion-sensitized and segmented spoiled GRE-MRE sequence was used for acquiring 360 phase-contrast wave images with a temporal resolution of 5.6 ms in the short-axis view. A custom-made remote oscillator was used to vibrate the thorax with 24.3 Hz synchronized to the MRE sequence. Phase signal oscillations due to the external vibrator were measured in the myocardium and in the chest wall anterior to the heart.

Results

Characteristic shear-wave amplitude variations were found between diastole and systole in the heart indicating that myocardial stiffness increases by a factor of about 37.7 ± 9.6 during heart contraction (inter-individual mean ± SD). It was observed that the dynamics of the stiffness variation precedes changes in the left ventricular diameter on the order of 75 ± 9 ms at the beginning of the systole.

Conclusion

The experiments demonstrate that external wave excitation of the living human heart is well achievable. The observed change in myocardial elasticity is the first noninvasively measured elasticity variation over the cardiac cycle. The detected delay between elasticity change and heart contraction corresponds to the cardiac phase of isovolumetric contraction.

In vivo cardiac MRE is a noninvasive method for measuring myocardial pressure changes and provides new insight into the elastodynamic process of cardiac function. The new technique is potentially useful for assessing diastolic dysfunction.