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A novel center point trajectory model for cardiac wall motion abnormality assessment compared with echocardiography strain

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Introduction

Proper identification and quantification of left ventricular wall motion is essential for clinical management of many patients with cardiac disease [1].

Purpose

A novel method using left ventricular center point trajectory (CPT) analysis to measure myocardial wall motion is proposed. Echocardiography strain analysis is used to validate the concept.

Methods

The method entails the tracking of the left ventricular center point of the left ventricle on 2D SSFP images over time. A polar coordinate map indicating amplitude and angle parameters provides a quantitative way to describe systolic (red) and diastolic (blue) wall motion. Transthoracic echocardiography using 2D strain maps were used to validate the findings from CMR and CPT analysis. Three patients with myocardial infarction (3 Male, 67 ± 4 y/o, EF 54% ± 14%) and one healthy volunteer (1 Female, 51 y/o, EF 63%) were enrolled in this IRB approved study. On the echocardiography peak systolic strain map, the smaller the magnitude absolute value, the less the echocardiographic strain measurement.

Results

CPT analysis demonstrates significant movement of the center in the first column Figures 1, 2, 3 (a). The second column (b) represents the corresponding short axis T2 weighted or delayed enhancement positive images. The third column (c) represents the long axis echocardiographic strain maps. Figures 1 and 2 are patients with myocardial infarction of the anteroseptal wall of the left ventricle. The CPT plot provides amplitude and angle of center point progression, which reflects the degree of abnormal wall motion during both systolic contraction, and diastolic filling of the left ventricle. In these two cases, the center point trajectory points toward the hypokinetic anteroseptal wall [arrow on the T2 weighted and myocardial delayed enhancement images (1b and 2b) and echocardiographic strain maps (1c and 2c)]. Figure 3 shows a patient with myocardial infarction of the anterior and anterior lateral wall (3b, arrow) with corresponding hypokinesis and an abnormal strain map clearly visualized on echocardiography. Figure 4 shows a normal volunteer without significant center point movement on CPT and corresponding normal echocardiographic strain maps. Strain analysis from echocardiography confirms the hypothesis of the center point trajectory model from cardiac MR.

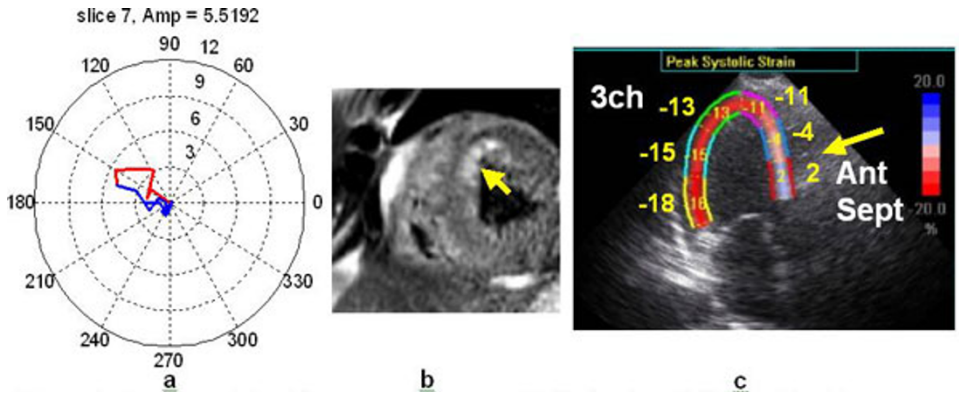

Figure 1

A patient with mid anteroseptal myocardial infarction CPT map (a) with corresponding T2 weighted image (b). CPT mapping demonstrates the same area (arrow) as indicated by increased signal consistent with edema on T2 weighted image. (c) Echocardiography strain map in 3-chamber view shows decreased strain in the same region (2 and 4 vs. 15 and 18 in the inferolateral wall).

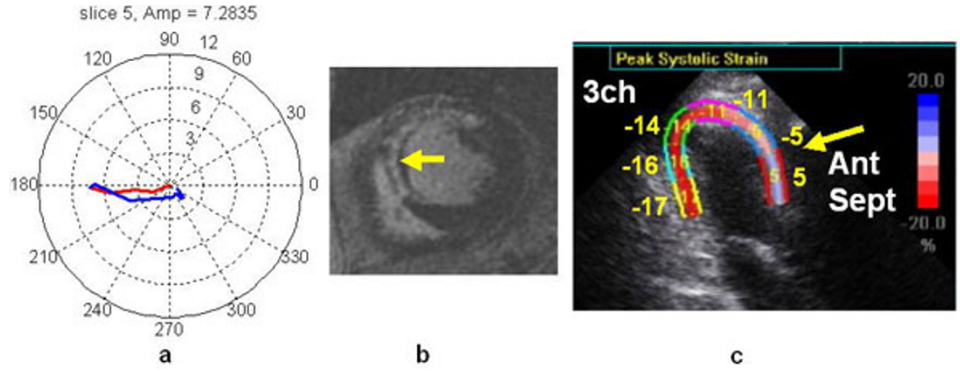

Figure 2

A patient with anteroseptal myocardial infarction CPT map (a) with corresponding MDE image (b) anteroseptal hypokinesis with positive MI (arrow): (c) Echocardiography strain map in 3-chamber view shows decreased strain in the same region (5 vs 16 and 17 in the inferolateral wall).

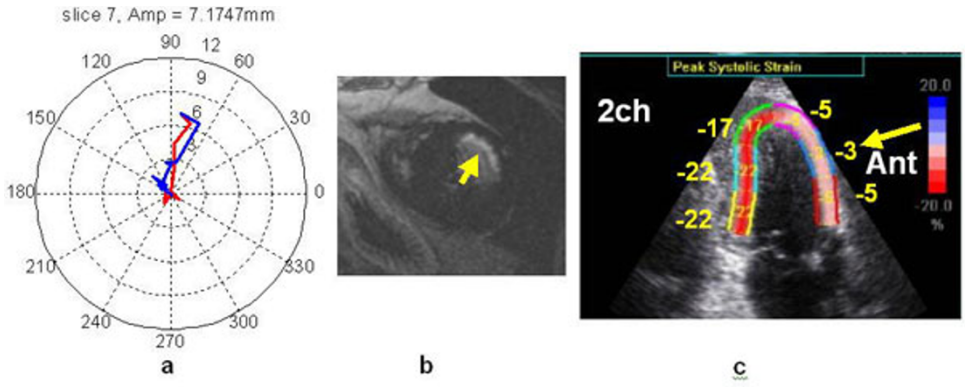

Figure 3

A patient with anterior and anterolateral myocardial infarction (arrow) CPT map (a) with corresponding MDE image (b) showing anterior hypokinesis with positive MI. (c) Echocardiography strain map in 2-Chamber view shows decreased strain in the same region (3 and 5 vs 22 in the inferior wall).

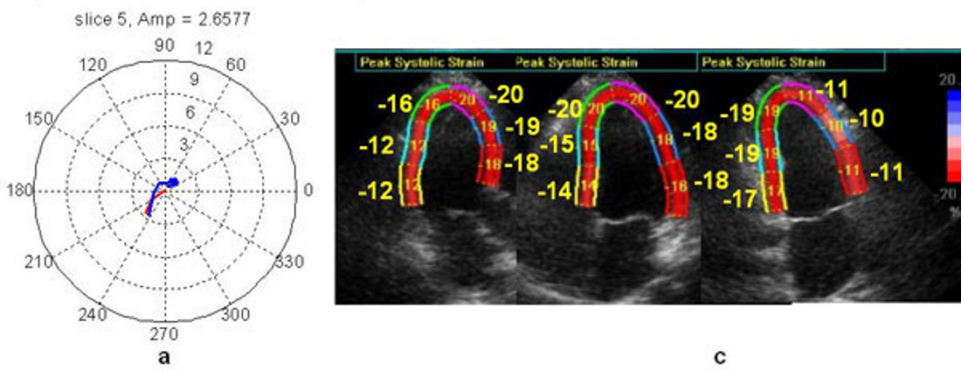

Figure 4
(a) A normal volunteer CPT map. (c) Echocardiography strain map in 3, 4, 2-chamber views.

Conclusion

A center point tracking method can provide a quantitative tool for wall motion assessment of conventional 2D cine MR images. This novel wall motion assessment tool correlates well with 2D echocardiographic strain maps as the reference standard.

References

1. Huang H, *et al.*: *Acad Radiol* 2006, **13:**.