## Stress Myocardial Elastography for Improved Ischemia Detection

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### Background, Motivation and Objective

Myocardial ischemia is diagnosed via nuclear imaging or angiography. Both modalities are expensive and ionizing, impeding early diagnosis of abnormal heart activity. Myocardial Elastography (ME) is a strain estimation technique previously shown capable of identifying ischemic regions of the myocardium (Lee et al. IEEE-UFFC 2007). In order to enhance sensitivity, an ME stress test is proposed to emphasize left-ventricular regions presenting mild or moderate ischemia.

### Statement of Contribution/Methods

An initial feasibility study was performed in a canine model. The left anterior descending artery of a mongrel canine was partially ligated to cause ~60% decrease in blood flow. Transthoracic short-axis views were acquired at the mid and base levels, first while the canine was at rest and then during stress (8µg/kg/min dobutamine infusion).

Stress ME was performed on human subjects undergoing PET or SPECT persantine stress tests. Short axis views of the mid, base, and apex levels of 6 patients were obtained. This yielded 18 acquisitions, 3 of which were excluded from the analysis due to high noise preventing reliable strain estimation or myocardial masking. After estimating strain at rest and stress, the American Heart Association's recommended 17-segment model was applied to each acquisition, for a total sample size of 78 regions to be analyzed. The median strain within each segment was used to compute its stress-rest strain difference (Fig 1). One-way ANOVA analysis was performed to determine significant divergence in the distributions of strain differences for segments with normal nuclear imaging findings, and those classified as ischemic or infarcted.

### Results/Discussion

At rest, the occluded canine anterior wall exhibited strain that was slightly reduced but positive (i.e. exhibiting myocardial thickening). However, in stress ME, the ischemic region presented reduced strain at stress compared to rest, indicating low-level ischemia.

Across the human subjects imaged, the strain difference for normal segments of the myocardium (mean=7.2±22.0%) was significantly different ($p<0.01$) from that of ischemic or infarcted segments (mean=13.6±18.9%). Significance was not achieved when only considering rest ME, emphasizing the improved diagnostic potential of stress ME.

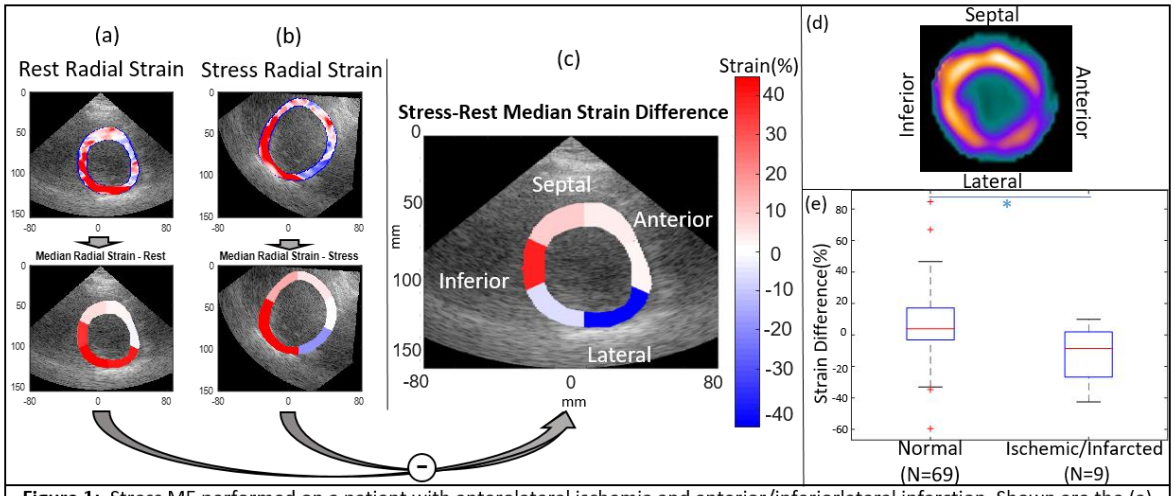


**Figure 1:** Stress ME performed on a patient with anterolateral ischemia and anterior/inferiorlateral infarction. Shown are the (a) estimated and median strain at rest, (b) estimated and median strain in stress, (c) difference between stress and rest for each segment, (d) PET perfusion map for this patient, (e) box plot of segments strains included in statistical analysis (* = $p<0.01$)