Left Ventricular Function Early and Late After Acute Myocardial Infarction Assessed by Echocardiographic Two-Dimensional Strain– Comparison with Conventional Echocardiography and Myocardial Perfusion Imaging

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Background:

Visual left ventricular (LV) wall motion scoring (WMS) is a well-established method for assessment of LV function, yet it is subjective, circumstantial relative and requires training to become reproducible. Quantification of myocardial shortening (strain) using 2D speckle tracking potentially less subjective for segmental and global assessment. We cross-related strain measurements with visually-assessed LV function and myocardial perfusion imaging (MPI), in 20 patients (age 54 ± 9 years) with acute myocardial infarction (AMI), early and late post revascularization.

Methods:

Contrast echocardiography and rest MPI were performed early (3-5 days) after AMI and contrast echo repeated at 4 months. Peak segmental and global endocardial longitudinal, circumferential and principal strains were correlated to visual WMS and MPI scores. Normal strain parameters were derived from echocardiograms of 62 healthy subjects.

Results:

All three methods, visually assessed LV function, quantifiable 2D strain and MPI were found to closely correlate.

Wall motion score		1 n=172	2 n=51	2.5 n=14	3 n=75	Normal controls n=1116
LS	Early	-15.7±5.8	-11.1±5.0*	-8.2±4.1*	-7.7±3.4*†	19.5±4.3‡
CS		-23.5±9.3	-18.3±9.9*	-13.8±8.0*†	-11.1±6.3*†	27.8±3.7‡
PS		29.0±8.9	22.2±9.3*	17.0±7.3*	14.1±6.0*†	33.9±5.7‡
MPI		0.3±.84	0.8±1.1*	2.08±2.02*†	1.91±1.86*†	
LS	Late	-17.0±6.2 Δ	-13.7±6.0*Δ	-13.2±5.6 *Δ	-10.6±6.4†Δ	19.5±4.3‡
CS		-23.0±8.4	-19.6±7.8*	-13.8±6.4*†	-13.4±7.6*†Δ	27.8±3.7‡
PS		29.2±9.1	24.2±8.1*	20.3±7.0*†Δ	17.8±8.2*†Δ	33.9±5.7‡
MPI		0.22±0.81	0.39±1.03*	2.27±1.94*†	1.79±1.86*†	

ANOVA: $p<0.0001$ between WMS, for all strain components and both early and late phases;
Bonferroni: $p<0.05$ for individual comparisons vs. 1 *, vs. 2 †
Unpaired t-test: $p<0.05$, Normal controls vs. normal (WMS =1) in patients ‡
Paired t-test: $p<0.05$, late vs. early study, Δ

Using ROC curves optimal strain thresholds for abnormal WMS were identified (-14%(AUC=0.74),-19%(AUC=0.77) and -24%(AUC=0.80) for longitudinal, circumferential and principal strains, respectively). Circumferential strains varied minimally over time, whereas longitudinal strain which improved in most segments and especially in the infarct zone, a sign of uncoupling of the two strain components. Segmental

functional recovery could be predicted by a higher early circumferential strain (>15), probably implying less transmurality of ischemic damage.

Conclusion:

2D Segmental strain values are highly related to visual WMS and MPI but appear to contain additional information not apparent from visual assessment in patients with acute myocardial infarction early and late after percutaneous revascularization. Ranges of strain components corresponding to different WMS were characterized. Improvements in strain over time corresponded to visual WMS recovery and moreover, higher circumferential strain was found to be predictive of late wall motion improvement and bi-plane strain improvement.