

Left ventricular strain and strain rate during submaximal semisupine bicycle exercise stress echocardiography in healthy adolescents and young adults – systematic protocol and reference values

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Objectives:

Combining stress echocardiography with strain analysis is a promising approach for early detection of subclinical cardiac dysfunction not apparent at rest. Study protocols differ considerably, data on normal myocardial strain and strain rate response to exercise in adolescents and young adults is contradictory and limited. The aim of this study was to propose a systematic standardized protocol for semisupine bicycle stress echocardiography and to provide corresponding reference values of left ventricular (LV) two dimensional speckle tracking echocardiography (2D STE) strain and strain rate (SR) in adolescents and young adults.

Methods:

50 healthy adolescents and young adults (mean age 17.8 ± 3.2 years, 44% female) were prospectively assessed. Images were acquired at rest, low stress, submaximal stress and post exercise. Optimal image quality for offline strain analysis was pursued and image quality was rated. Global longitudinal, apical 4-/2-/3- chamber longitudinal and short axis circumferential strain and SR were analyzed using vendor-independent software. Interobserver variability was assessed.

Results:

Strain and SR increased during progressive exercise stress. Mean LV global longitudinal strain was $-20.4 \pm 1.3\%$, SR $-1.1 \pm 0.15/s$ at rest (heart rate (HR) $79.4 \pm 12.0/min$), increasing to $-22.6 \pm 1.6\%$ and $-1.5 \pm 0.16/s$ at low stress level (HR $117.1 \pm 8.7/min$) and $-23.7 \pm 1.1\%$ and $-1.9 \pm 0.29/s$ at submaximal stress level (HR $154.2 \pm 7.0/min$) respectively, returning to $-20.6 \pm 1.4\%$ and $-1.2 \pm 0.16/s$ post exercise (HR 90.1 ± 9.4). Restriction on submaximal stress level ensured adequate image quality allowing 2D-STE strain analysis in $>95\%$ of loops recorded in apical 4-chamber and short axis view and in $>80\%$ for apical 2- and 3- chamber view. Interobserver variability was within acceptable limits and did not reveal significant interobserver bias.

Conclusions:

This study provides a systematic, standardized protocol and corresponding reference data for 2D-LV STE derived strain and strain rate during semisupine bicycle stress testing in adolescents and young adults. According to our results, global longitudinal strain and strain rate might be the most comprehensible parameters for cross-sectional studies. This might help to interpret future stress strain studies for the detection of subclinical LV dysfunction.