

Loss and Regain of Compensatory Mechanics in Severe Aortic Stenosis Patients with Left Ventricular Systolic Dysfunction and Aortic Valve Replacement

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Background: We have recently shown that left ventricular (LV) longitudinal (LONG) function is reduced and circumferential (CIRC) function is elevated in patients with severe aortic stenosis (AS) and preserved LV ejection fraction (LVEF), compared to normal subjects, and that aortic valve replacement (AVR) normalized LV mechanics. The objective of our current study was to characterize cardiac mechanics (LV deformation, strain) before and early after AVR in patients with severe AS and variable degrees of LV systolic dysfunction.

Methods: Paired echocardiographic studies before and early [7±3 days] after AVR were analyzed in 64 patients with severe AS, 32 with normal LVEF (≥50%), 16 with mild-to-moderate LV dysfunction (LVEF 36-50%), and 16 with severe LV dysfunction (LVEF<36%). LONG myocardial function was assessed from 3 apical views (average of 18 segments) and CIRC function was assessed at mid and apical levels (averaging 6 segments per view). LV strain and apical rotation were measured using the 2-dimensional Velocity Vector Imaging software (Siemens, CA).

Results: Baseline LV mechanics differed according to LVEF. LONG strain and mid and apical CIRC strain correlated with EF ($R^2=0.61$, 0.77 , and 0.67 , respectively, $p<0.001$). Apical rotation was higher in patients with LV dysfunction, mainly in patients with moderate LV dysfunction. Following AVR LVEF increased and mechanical abnormalities partially reversed (Table). The percent change from baseline after AVR was progressively higher in patients with lower LVEF. **Conclusions:** The compensatory mechanisms to AS observed in patients with preserved LVEF (decreased LONG function with a compensatory increase in CIRC function) are lost in patients with reduced LVEF, in whom both LONG and CIRC functions are reduced. AVR partially reverses these changes in patients with baseline LV dysfunction

| | LVEF≥50% | | | 36≥LVEF<50 | | | LVEF<36 | | |
|-----------------------------------|----------|----------|------------|------------|----------|------------|---------|----------|------------|
| | Pre AVR | Post AVR | Change (%) | Pre AVR | Post AVR | Change (%) | Pre AVR | Post AVR | Change (%) |
| Peak aortic valve gradient (mmHg) | 96±28 | 39±14 | | 94±36 | 29±9 | | 75±28 | 31±11 | |
| AVA (cm ²) | 0.8±0.2 | 1.6±0.3 | | 0.7±0.2 | 1.7±0.3 | | 0.8±0.2 | 1.7±0.4 | |
| LV EF (%) | 67±6 | 65±4 | | 43±4 | 56±8 | | 28±8 | 41±9 | |
| Strain (%) | | | | | | | | | |
| LONG | -13±2 | -16±3 | +23±15 | -11±3 | -13±2 | +18±30 | -7±2 | -9±2 | +22±40 |
| CIRC - Mid | -27±5 | -22±5 | -21±17 | -14±4 | -18±5 | +30±33 | -10±3 | -14±4 | +50±75 |
| CIRC - apex | -33±7 | -31±7 | -3±3 | -22±9 | -27±7 | +45±64 | -10±4 | -19±5 | +160±180 |
| Apical Rotation (÷) | 3.2±2.0 | 4.5±1.9 | | 8.5±3.9 | 6.6±2.7 | | 6.4±2.9 | 4.8±2.9 | |

Change(%) = absolute change (post vs. pre- AVR) in percentages.

All pre -AVR differences between groups significant ($p<0.05$), except AV gradient and valve area.

All pre vs. post -AVR paired differences are significant ($p<0.05$), except EF and apical strain for the normal EF group.