Recovery of Left Ventricular Mechanics Following Transcatheter Aortic Valve Implantation: Long-term Follow-up in Patients with Four Subtypes of Aortic Stenosis

INTRODUCTION

- Left ventricular mechanics are impaired in patients with severe aortic stenosis (AS).
- Global longitudinal strain (GLS) may recover differentially after relief of AS and help identify select patients who have a higher likelihood of survival post transcatheter aortic valve implantation (TAVI).

HYPOTHESIS

- We hypothesized there would be differences in myocardial mechanics (measured by GLS) following TAVI in patients with four subtypes of severe AS, and these differences could predict survival.

METHODS

- All patients undergoing TAVI from January 2011 – March 2016 who had pre and post TAVI GLS data available.
- Speckle-tracking transthoracic echocardiography using GE Vivid E9 and E95 platforms.
- Classified by peak velocity, mean aortic gradient, LVEF and stroke volume index as:
  1) Normal flow and high gradient
  2) Normal flow and gradient with low EF
  3) "Classic" low flow and low gradient (LFLGAS)
  4) Paradoxical low flow and low gradient.

Table 1

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Overall (n=208)</th>
<th>1 (n=108)</th>
<th>2 (n=29)</th>
<th>3 (n=31)</th>
<th>4 (n=40)</th>
<th>P. value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Demographics</td>
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</tr>
<tr>
<td>Age</td>
<td>81.8±10.1</td>
<td>81.4±11.2</td>
<td>81.9±10.2</td>
<td>83.1±5.3</td>
<td>80.7±9.7</td>
<td>0.800</td>
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<tr>
<td>Female</td>
<td>113 (54.3%)</td>
<td>65 (60.2%)</td>
<td>17 (58.6%)</td>
<td>8 (25.8%)</td>
<td>23 (57.5%)</td>
<td>0.007</td>
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<tr>
<td>STS Score</td>
<td>7.7±5.0</td>
<td>8.5±6.1</td>
<td>8.0±3.7</td>
<td>7.6±3.9</td>
<td>6.3±3.2</td>
<td>0.129</td>
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<td>Comorbidities</td>
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<tr>
<td>Coronary Artery Disease</td>
<td>159 (76.4%)</td>
<td>81 (75.0%)</td>
<td>23 (79.3%)</td>
<td>24 (77.4%)</td>
<td>31 (77.5%)</td>
<td>0.962</td>
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<tr>
<td>Diabetes Mellitus</td>
<td>79 (38.0%)</td>
<td>38 (35.2%)</td>
<td>12 (41.4%)</td>
<td>9 (29.0%)</td>
<td>20 (50.0%)</td>
<td>0.266</td>
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<tr>
<td>Hypertension</td>
<td>175 (84.1%)</td>
<td>89 (82.4%)</td>
<td>22 (75.9%)</td>
<td>27 (87.1%)</td>
<td>37 (92.5%)</td>
<td>0.258</td>
</tr>
<tr>
<td>Peripheral Artery Disease</td>
<td>104 (50.0%)</td>
<td>58 (53.7%)</td>
<td>12 (41.4%)</td>
<td>14 (45.2%)</td>
<td>20 (50.0%)</td>
<td>0.642</td>
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<tr>
<td>Cerebrovascular Accident</td>
<td>19 (9.1%)</td>
<td>14 (13.0%)</td>
<td>4 (13.8%)</td>
<td>1 (3.2%)</td>
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<tr>
<td>TAVI</td>
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<td>Valve Type</td>
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<tr>
<td>EVOLUT</td>
<td>47 (22.6%)</td>
<td>22 (20.4%)</td>
<td>3 (10.3%)</td>
<td>6 (19.4%)</td>
<td>16 (40.0%)</td>
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<tr>
<td>SAPIEN</td>
<td>19 (9.1%)</td>
<td>14 (13.0%)</td>
<td>3 (10.3%)</td>
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<td>2 (5.0%)</td>
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<tr>
<td>COREVALVE</td>
<td>142 (68.3%)</td>
<td>72 (67.6%)</td>
<td>23 (79.3%)</td>
<td>25 (80.6%)</td>
<td>22 (55.0%)</td>
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<tr>
<td>Access for TAVI</td>
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<tr>
<td>Transfemoral</td>
<td>176 (84.6%)</td>
<td>90 (83.3%)</td>
<td>24 (82.8%)</td>
<td>27 (87.1%)</td>
<td>35 (87.5%)</td>
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<tr>
<td>Transapical</td>
<td>15 (7.3%)</td>
<td>8 (7.4%)</td>
<td>1 (3.4%)</td>
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<td>2 (5.0%)</td>
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</tr>
<tr>
<td>Direct aortic</td>
<td>20 (9.6%)</td>
<td>9 (8.3%)</td>
<td>4 (13.8%)</td>
<td>4 (12.9%)</td>
<td>3 (7.5%)</td>
<td></td>
</tr>
</tbody>
</table>

Results

- Two hundred-eight patients with severe AS who underwent TAVI were analyzed (Table 1); 45 died during the 5 year study period
- No significant differences were noted in age or comorbidities. “Classic” low flow low gradient stenosis patients were more likely men
- GLS measured pre-TAVI and 0-30 days post TAVI (99% of patients, 2 patients with 30-90 day GLS assessment). (Table 2)
- Both GLS (-14.0 ± 4 to -15.0 ± 4.3, p<0.001) and LVEF (56 ± 14% to 56 ± 15%, p=0.0003) improved significantly post TAVI.
- Across all types of AS, improvement in GLS associated with a survival benefit, with GLS recovery in alive patients (mean GLS pre-TAVI -14.2 ± 4.1 and post-TAVI - 15.2 ± 4.1, p<.001) and no significant recovery in deceased patients (mean GLS pre-TAVI -14.1 ± 4.2 and post-TAVI -14.2 ± 4.4, p=0.885) (Figure 2)
- Patients with “classic” LFLGAS showed no significant improvement post TAVI in GLS or LVEF, and had highest overall mortality rate.

Figure 1 - Change in GLS Normal Flow, High Gradient Severe AS

Pre-TAVI GLS -16.8%

Post-TAVI GLS - 18.0%

Figure 2 - GLS Recovery from pre-to-post TAVI and Survival

Table 2

<table>
<thead>
<tr>
<th>Type of AS</th>
<th>Pre-TAVI</th>
<th>Post-TAVI</th>
<th>Alive (%)</th>
<th>Deceased (%)</th>
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<tbody>
<tr>
<td>1 (n=108)</td>
<td>62.5±9.6</td>
<td>-15.3±3.3</td>
<td>88 (81)</td>
<td>20 (19)</td>
</tr>
<tr>
<td>2 (n=29)</td>
<td>37.9±9.7</td>
<td>-10.6±3.2</td>
<td>24 (83)</td>
<td>5 (17)</td>
</tr>
<tr>
<td>3 (n=31)</td>
<td>37.3±10.1</td>
<td>-10.1±3.0</td>
<td>20 (65)</td>
<td>11 (35)</td>
</tr>
<tr>
<td>4 (n=40)</td>
<td>61.1±8.7</td>
<td>-16.6±3.6</td>
<td>31 (78)</td>
<td>9 (22)</td>
</tr>
</tbody>
</table>

CONCLUSIONS

- LVEF and GLS improved significantly post-TAVI
- “Classic” low flow, low gradient AS patients had lowest post-procedure GLS recovery and highest overall mortality in study period
- Across all types of AS, GLS recovery was noted in patients who survived, but not in patients who subsequently died.