Branch pulmonary artery flow reversal: Does it correlate with valve leak?

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Background

- The Contegra valved (bovine jugular vein - BJV) conduit is used for right ventricular outflow tract (RVOT) reconstruction.
- Early performance of the conduit varies, with most series reporting minimal regurgitation and low-pressure gradients.
- Branch pulmonary artery diastolic flow reversal (BPAFR) is an echocardiographic marker of severe pulmonary valve regurgitation.
- Cusp height in the human pulmonary valve is approximately half the valve diameter.
- Cusp height in the BJV is approximately equal to valve diameter.
  - Thus, at a given valve diameter, capacitance of the BJV during diastole is significantly greater than the human pulmonary valve.
  - This mismatch in conduit capacitance is greater in the smallest patients.

Hypothesis

- BPAFR is not predictive of severe regurgitation in patients with a BJV.
- The purposes of this study were to:
  1) Determine if smaller conduit size is associated with early severe regurgitation.
  2) Determine if BPAFR can occur in the absence of severe regurgitation.
  3) Determine if smaller BJV conduit size predicts increased incidence of BPAFR.

Methods

- Retrospective chart review for all patients who underwent RVOT reconstruction with BJV conduit from March 2004 to August 2010 (n=152).
- Valve performance was evaluated using initial and 6-month follow-up echocardiograms.
  - A single observer reviewed all echocardiograms, grading regurgitation on a 1-7 scale from none to severe. Consideration included color and spectral Doppler patterns from multiple views.
  - Patients with missing initial post-operative echocardiograms were excluded (n=17).
- Patient characteristics, surgical procedures were determined.
- Patients were divided into 2 groups: patients with 12mm or 14mm BJV comprised group 1 (n=51) and 16-22mm (n=84) BJV comprised group 2.
- Statistical analysis was performed using chi-square analysis and multivariable logistic regression.

Results

- There was an association between smaller conduit and early severe regurgitation.
- Flow reversal occurs more commonly in small conduits.
- Six-month follow-up echocardiograms were available for 22 and 38 observations in group 1 and group 2 respectively.
  - 13 (59%) had initial BPAFR in group 1. The degree of regurgitation increased over time in 9 patients to greater than moderate.
  - At 6 months there were 17 patients (77%) with BPAFR, but only 6 of these had moderate or less regurgitation.
  - In group 2, there were no patients with BPAFR at 6-month follow-up compared to 9 (24%) at the initial echo. The degree of regurgitation improved or remained unchanged in these patients.

Table 1. Patient characteristics.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Group 1 (n=51)*</th>
<th>Group 2 (n=84)*</th>
<th>p Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (months)</td>
<td>3.31 ± 3.88</td>
<td>91.3 ± 62.02</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Gender (% male)</td>
<td>64%</td>
<td>50%</td>
<td>0.2411</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>4.15 ± 1.72</td>
<td>26.31 ± 17.28</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Moderate or less regurgitation*</td>
<td>38 (74%)</td>
<td>84 (100%)</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Surgery</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Primary repair with BJV</td>
<td>44</td>
<td>3</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Ross procedure</td>
<td>13</td>
<td>20</td>
<td>0.88</td>
</tr>
<tr>
<td>Replacement of PV*</td>
<td>5</td>
<td>63</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>30-day mortality</td>
<td>11/54 (17%)</td>
<td>2/88 (2%)</td>
<td>0.0032</td>
</tr>
</tbody>
</table>

*Includes all 152 patients in the cohort. Subjects with missing post-operative echocardiograms were no excluded in subject characteristics
*Based on n=51 (Group 1) and n=84 (group 2) *PV is pulmonary valve

Conclusions

- Conduits ≤ 14-mm diameter are associated with early severe regurgitation.
- The presence of flow reversal alone does not predict severe insufficiency.
- Smaller patients have a greater probability of flow reversal.
- The reason for these findings may be higher capacitance in the conduit compared to the normal human anatomy.
- BPAFR alone should not influence the diagnosis of conduit regurgitation or indications for replacement.

Figure 1. Profile of the BJV conduit. From Burke et al. (2011).

Figure 2. Categorization of regurgitation in the subset of patients with BPAFR.

Figure 3. Odds of flow reversal for group 1 compared to group 2 before and after excluding observations with greater than moderate regurgitation.

Acknowledgements

University of Colorado, Clinical Science Program for funding support
University of Colorado School of Public Health for statistical support