INCREASED POWER LOSS IN THE TOTAL CAPOULMONARY CONNECTION IS RELATED TO DECREASED SINGLE VENTRICLE VOLUME

Poster Contributions
Poster Sessions, Expo North
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Session Title: Congenital Cardiology Solutions: Single Ventricles
Abstract Category: 13. Congenital Cardiology Solutions: Pediatric
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Background: Single ventricle (SV) lesions are associated with gradual attrition following surgical palliation with the total cavopulmonary connection (TCPC). Abnormalities in ventricular function are frequently noted, particularly diastolic function. We hypothesize that TCPC hemodynamic energy losses are adversely related to ventricular filling and volumes.

Methods: Cardiac magnetic resonance (CMR) data were retrospectively analyzed for 40 patients. Cine ventricular short axis scans were semi-automatically segmented for all cardiac phases. Ventricular volumes, peak filling rate (PFR), peak ejection rate, and time to PFR were calculated. TCPC geometry was acquired from an axial CMR image stack; relevant flow rates were taken from phase velocity CMR data. TCPC indexed power loss (iPL) was calculated from computational fluid dynamics simulations. Pearson correlations were used to detect relationships between variables, with p<0.05 considered significant.

Results: The Table provides mean results and variable correlates with iPL. End diastolic and end systolic volumes had significant negative correlations with the natural log of iPL; a similar trend for stroke volume was observed. iPL also had a significant relationship to time to PFR (normalized to cycle time).

Conclusions: Indexed TCPC power loss is inversely related with ventricular volumes, particularly end diastolic. High iPL may contribute to diastolic dysfunction and limited preload reserve in SV.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Mean ± SD</th>
<th>Correlation (R)</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>iPL</td>
<td>0.040 ± 0.028</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Age [years]</td>
<td>13.0 ± 5.0</td>
<td>0.15</td>
<td>NS</td>
</tr>
<tr>
<td>Body Surface Area [m2]</td>
<td>1.36 ± 0.42</td>
<td>0.25</td>
<td>0.11</td>
</tr>
<tr>
<td>Cardiac Index [L/min/m2]</td>
<td>3.1 ± 0.8</td>
<td>-0.09</td>
<td>NS</td>
</tr>
<tr>
<td>Systemic vein flow [L/min/m2]</td>
<td>2.9 ± 0.8</td>
<td>-0.21</td>
<td>0.20</td>
</tr>
<tr>
<td>End Diastolic Volume [mL/m2]</td>
<td>77 ± 16</td>
<td>-0.43†</td>
<td>0.005</td>
</tr>
<tr>
<td>End Systolic Volume [mL/m2]</td>
<td>35 ± 11</td>
<td>-0.36†</td>
<td>0.023</td>
</tr>
<tr>
<td>Stroke Volume [mL/m2]</td>
<td>42 ± 10</td>
<td>-0.31†</td>
<td>0.054</td>
</tr>
<tr>
<td>Ejection Fraction [%]</td>
<td>55 ± 9</td>
<td>0.125</td>
<td>NS</td>
</tr>
<tr>
<td>Peak Ejection Rate [EDV/s]</td>
<td>2.9 ± 0.6</td>
<td>0.20</td>
<td>NS</td>
</tr>
<tr>
<td>PFR [EDV/s]</td>
<td>2.7 ± 0.7</td>
<td>-0.10</td>
<td>NS</td>
</tr>
<tr>
<td>Time ratio to PFR</td>
<td>0.20 ± 0.06</td>
<td>0.32*</td>
<td>0.044</td>
</tr>
<tr>
<td>Heart Rate [bpm]</td>
<td>75 ± 16</td>
<td>0.11</td>
<td>NS</td>
</tr>
</tbody>
</table>

* p<0.05 †Correlation with ln(iPL)