Heart rate variability in single ventricle patients - before and after Glenn surgery

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Introduction: Atrial arrhythmias and sinus node dysfunction are well-known complications in patients with Fontan circulation. In the Glenn procedure, preceding TCPC, the SVC is divided at the entrance to the heart. In this area cardiac autonomic ganglia are located. Thus, there is a risk of damage to the autonomic ganglia at the procedure, potentially affecting cardiac autonomic innervation which theoretically would raise the risk for arrhythmia. Heart rate variability (HRV) can be used to evaluate the autonomic nervous control. Our aim was to investigate HRV in ambulatory 24-hour ECG recordings (Holter-ECG) in a cohort of children with TCPC, focusing on HRV changes after Glenn surgery.

Methods: Patients with single ventricle physiology underwent 24-hour ECG during daily activity; 35 before and 27 after Glenn surgery. HRV was analyzed with power spectrum analysis. Total variability and RR-intervals were measured from Holter-ECGs performed before and after Glenn surgery. Data were expressed as z-scores based on the age development in the control group (n=36 healthy children). We used Kruskal-Wallis test for comparison of ranks in the three groups.

Results: Group means and standard deviations are presented in Table 1. In patients before Glenn-surgery: RR-interval was normal compared to controls. Patients had lower HRV than controls (p<0.05). Twelve patients showed reduced HRV (<2 z-score).

In patients after Glenn-surgery: RR interval was longer than controls and patients before Glenn-surgery (p<0.05). Patients had lower HRV than controls (p<0.05). Nine patients showed reduced HRV (z-score <2).

Conclusions: We found a significant reduction in RR-intervals in patients with single ventricle physiology after Glenn surgery. This finding is interesting since low heart rate may indicate sinus node dysfunction. We also found a reduced HRV in single ventricle patients compared to health controls both before and after Glenn surgery.

Table 1.

<table>
<thead>
<tr>
<th></th>
<th>Controls (n=36)</th>
<th>Before Glenn (n=35)</th>
<th>After Glenn (n=27)</th>
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</thead>
<tbody>
<tr>
<td>RR (s)</td>
<td>0.52 SD=0.07</td>
<td>0.47 SD=0.05</td>
<td>0.54 SD=0.05</td>
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<tr>
<td>Ptot (ms², log)</td>
<td>3.15 SD=0.26</td>
<td>2.69 SD=0.26</td>
<td>2.83 SD=0.3</td>
</tr>
</tbody>
</table>

Figure 1. HRV as represented by total power. Lines indicate regression lines for controls and 95% confidence intervals.