Heart rate variability in single ventricle patients—before and after bidirectional Glenn procedure

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Introduction

Atrial arrhythmias and sinus node dysfunction are well-known complications in patients with Fontan circulation. In the bidirectional Glenn procedure, preceding total cavopulmonary connection, the superior caval vein is divided at the entrance to the right atrium. In this area populations of cardiac autonomic ganglia are located. Thus, there is a risk of damage to the autonomic ganglia at the procedure, potentially affecting cardiac autonomic innervation. Heart rate variability (HRV) can be used to evaluate the autonomic nervous control.

Aim

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 bidirectional Glenn surgery.

Methods

Patients with single ventricle physiology underwent 24-hour ECG during daily activity; 39 before and 31 after bidirectional Glenn surgery. HRV was analyzed with power spectrum analysis. Total variability and RR-intervals were measured from Holter-ECGs performed before and after bidirectional Glenn procedure. Data were also 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 of z-scores 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). Fourteen patients showed reduced HRV (<2 z-score).

Patients after bidirectional Glenn surgery had longer RR interval than controls and patients before bidirectional Glenn (p<0.05). After Glenn procedure patients had lower HRV than controls (p<0.05). Eleven patients showed reduced HRV (z-score <2).

<table>
<thead>
<tr>
<th></th>
<th>Controls (n=36)</th>
<th>Before Glenn (n=39)</th>
<th>After Glenn (n=31)</th>
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</thead>
<tbody>
<tr>
<td>RR (s)</td>
<td>0.52 SD=0.07</td>
<td>0.48 SD=0.08</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>2.66 SD=0.44</td>
<td>2.81 SD=0.38</td>
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Table 1: Group means of RR-interval and total power.

Conclusions

We found a significant increase in RR-intervals in patients with single ventricle physiology after bidirectional Glenn procedure. 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 healthy controls both before and after Glenn surgery.