Characterizing cerebellar growth in infants born pre-term or with congenital heart defects between 6 and 12 months of age

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Introduction

The cerebellum

- The cerebellum represents 10% of the total brain size and weight.
- The most active period of cerebellar development occurs during the 3rd trimester of pregnancy and the first year of postnatal life.
- The cerebellum is known to play a key role in higher-order cognitive functions and emotional control.
- Atypical cerebellar development is thought to be an underlying mechanism of many neurodevelopmental disorders.

Clinical population

Infants born with Congenital Heart Disease (CHD)
- Congenital heart disease is the most common neonatal malformation, and the most complex forms require open heart surgery during infancy to survive.
- Improved cardiovascular circulation during pregnancy observed in CHD infants could contribute to altered cerebellar development.

Infants born with Very Pre-Term (VPT)
- VPT infants are highly vulnerable to cerebellar injury.
- Timing of preterm birth coincides with most active period of cerebellar development.

Both clinical populations are at high risk for neurodevelopmental disorders, such as:
- ADHD
- Impaired executive functions

Methods

Segmentation using Infant FreeSurfer toolbox (ages 0-2)

Pre-processing
- Visual assessment of image quality
- Resampling (fsl-reorient) for images with voxel sizes other than 1 x 1 x 1 mm
- Bias Field Correction (FSL’s n4itk)

Manual correction done on all images for regions:
- Left and right cerebellar hemispheres (cerebellar cortex and cerebellar white matter)
- Left and right cortical cortices
- Vermis

Results

Table 1. Participant Characteristics

<table>
<thead>
<tr>
<th>Type of CHD</th>
<th>Group</th>
<th>6-month visit</th>
<th>12-month visit</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>VPT</td>
<td>Gestational age of &lt;32 weeks</td>
<td>36.83 (31.66)</td>
<td>28.19 (11.12)</td>
<td>0.04</td>
</tr>
<tr>
<td>CHD</td>
<td>Gestational age of &lt;32 weeks</td>
<td>46.88 (33.68)</td>
<td>51.88 (22.11)</td>
<td>0.40</td>
</tr>
</tbody>
</table>

Table 2. Cerebellar volumes at 6 months and 12 months of age, and percentage volume gain between visits for groups VPT & CHD; Significance was established at p < 0.05.

<table>
<thead>
<tr>
<th>Group</th>
<th>6-month visit</th>
<th>12-month visit</th>
<th>t-test Adjusted for MRI_AGE + TBV</th>
<th>Mean volume (mm³)</th>
<th>Adjusted for MRI_AGE + TBV</th>
<th>p-values</th>
</tr>
</thead>
<tbody>
<tr>
<td>VPT</td>
<td>71832.0</td>
<td>73495.9</td>
<td>-0.18</td>
<td>1.06</td>
<td>94585.4</td>
<td>0.02</td>
</tr>
<tr>
<td>CHD</td>
<td>32836.0</td>
<td>34733.5</td>
<td>-0.08</td>
<td>0.24</td>
<td>42733.0</td>
<td>0.60</td>
</tr>
<tr>
<td>VPT</td>
<td>33116.5</td>
<td>35279.4</td>
<td>-0.10</td>
<td>0.37</td>
<td>44055.9</td>
<td>0.78</td>
</tr>
<tr>
<td>CHD</td>
<td>6340.1</td>
<td>6359.0</td>
<td>0.05</td>
<td>0.90</td>
<td>8000.1</td>
<td>0.76</td>
</tr>
<tr>
<td>VPT</td>
<td>692028.9</td>
<td>710240.6</td>
<td>0.43</td>
<td>-</td>
<td>82393.6</td>
<td>0.67</td>
</tr>
<tr>
<td>CHD</td>
<td>32836.0</td>
<td>34733.5</td>
<td>-0.08</td>
<td>0.24</td>
<td>42733.0</td>
<td>0.60</td>
</tr>
</tbody>
</table>

Conclusion

Based on a preliminary analysis conducted on a partial sample:
- Our results suggest that there is no significant difference in cerebellar volumes over the second half of the first year of life (6 and 12 months of age) between infants born VPT, and those born with CHD.
- Further analysis should focus on potential group difference in the cerebellar volumetric gain between the 6 and 12 month visit in each group.
- To do so, the number of participants present at both visits must be increased (participant recruitment is currently ongoing).
- Further studies should focus on comparing the cerebellar growth trajectory between these two clinical populations and healthy term-born infants.
- To determine if the observed cerebellar developments in these two clinical populations are altered or follow a typical trajectory.
- The next step of this project would be to look at the possible association between these cerebellar growth trajectories and the neurodevelopmental assessments (cognitive, language and motor performance) at the 12-month visit.

Acknowledgements

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Gratuit autrem

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References