PRENATAL METHAMPHETAMINE EXPOSURE IS ASSOCIATED WITH SMALLER CAUDATE VOLUMES IN NEONATES

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INTRODUCTION

- Methamphetamine (Meth) use has been linked to dopaminergic neuron damage2,3.
- Prenatal exposure to Meth (PEM) is associated with neuropsychological, behavioural and cognitive alterations2,4,5.
- Few neuroimaging studies have examined structural effects in children with PEM:
  - MRS and DTI have shown alteration in neurometabolism and microstructure6,7.
  - MRI has shown volumetric changes in a number of brain regions
- No studies of PEM-associated volumetric changes in the neonatal brain.
- Studies in neonates allow the separation of prenatal drug exposure effects from potential confounding effects of a poor postnatal environment

METHODS

- Cape Coloured mothers were recruited prenatally and interviewed 3x during pregnancy regarding Meth use:
  - Exposed mothers reported using Meth at least twice per month during pregnancy.
  - Control mothers had no exposure to Meth/other drugs, minimal/no exposure to alcohol (no more than 2 drinks; no more than 2x during pregnancy).
- 16 infants were scanned without use of sedation on a 3T Siemens Allegra using a circularly polarised birdcage coil, custom built for use with neonates.
- Two multi-echo gradient echo acquisitions were performed with flip angles 5 and 20 degrees respectively:
  - Imaging parameters were: FOV 144mm, 128 slices, TR 20ms, TE 1.46/ 3.14/ 4.82/ 6.5/ 8.18/ 9.86/ 11.54/ 13.22ms, 1mm isotropic resolution.
  - Individual echoes from the two acquisitions were split, tissue parameters estimated and image volumes synthesised at an optimal contrast flip angle of 24°.
- The caudate nuclei were manually traced and the volumes calculated using Freeview software (FreeSurfer image analysis suite http://surfer.nmr.mgh.harvard.edu).

RESULTS

Table 1. Neonatal characteristics for methamphetamine-exposed and healthy control infants. *Highest data point (28.6, an extreme outlier) was recoded to 7, which is 1 point higher than the next highest observed value.

<table>
<thead>
<tr>
<th></th>
<th>Controls (n=10)</th>
<th>Meth - exposed (n=6)</th>
<th>p</th>
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<tbody>
<tr>
<td>Sex (M/F)</td>
<td>8/2</td>
<td>4/2</td>
<td>0.73</td>
</tr>
<tr>
<td>Gestational age (wk)</td>
<td>41.3 ± 2.4</td>
<td>41.3 ± 2.4</td>
<td>0.73</td>
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<tr>
<td>Birth Weight (g)</td>
<td>3113 ± 258</td>
<td>2950 ± 469</td>
<td>0.46</td>
</tr>
<tr>
<td>Cigarettes (/day)</td>
<td>3.0 ± 3.2</td>
<td>8.1 ± 7.0</td>
<td>0.06</td>
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<tr>
<td>Meth (days/month)</td>
<td>0</td>
<td>7.2 ± 10.7</td>
<td>0.046</td>
</tr>
<tr>
<td>Range</td>
<td>0</td>
<td>1.4 - 28.6*</td>
<td></td>
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<tr>
<td>Left caudate (mm³)</td>
<td>1314 ± 139</td>
<td>1192 ± 176</td>
<td>0.15</td>
</tr>
<tr>
<td>Right caudate (mm³)</td>
<td>1295 ± 108</td>
<td>1182 ± 159</td>
<td>0.11</td>
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Figure 1. A. Crystal methamphetamine. B. Left and right caudates traced in coronal view.

CONCLUSION

Increasing meth exposure was strongly associated with bilateral reduction in caudate volume in the brains of newborn infants, providing evidence for a dose-dependent effect. This novel finding corroborates evidence of reduced volume of the striatum in older children with PEM,6 and supports the hypothesis that PEM induces long-lasting changes in dopamine-rich regions of the brain and that these can already be detected in neonates.

REFERENCES