Differences in cortical neurogenesis and maturation between precocial and altricial species

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Introduction

<table>
<thead>
<tr>
<th>Alttricial</th>
<th>Precocial</th>
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<tr>
<td>Young are immature for a longer time after birth; &lt;br&gt; hairless, blind and are incapable of moving around.</td>
<td>Young are autonomous within a few hours after birth; &lt;br&gt; open ears and eyes and sophisticated locomotor and cognitive capabilities.</td>
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These higher capabilities at birth are indicative of higher prenatal neurogenesis and brain maturation.

Hypothesis: We hypothesise (1) that the length and the rate of prenatal neurogenesis is increased in precocial compared to altricial species and (2) that major aspects of neocortex maturation start in precocial – in contrast to altricial – species before birth.

Test: We will compare patterns of prenatal neurogenesis and neuron maturation in phylogenetically closely related precocial and altricial species: (1) laboratory mouse and spiny mouse and (2) rabbit and guinea pig.

Material and Methods

Tissue Samples
Embryonic and neonatal brain tissue of the following species have been obtained:
- Dwarf rabbit: embryonic day (E): E15, 20, 25, 30; postnatal day (P): P5, 10, 20, 30
- Guinea pig: embryonic day (E): E15, 20, 25, 31, 40, 50, 60
- Spiny mice: 3 months

All husbandry and experimental procedures are performed in accordance with German animal welfare legislation and approved by the Landesdirektion Leipzig.

Cryosectioning:
Brain samples are fixed in 4% PFA and processed for cryosectioning. Complete telencephalon is cut coronally at 30 μm and stored at –20°C.

Immunohistochemistry
Sections from dorsal lateral telencephalon at a medium position with regard to the rostro-caudal axis will be used for immunohistochemistry according to established protocols and distinct marker proteins.

Image Acquisition and Cell Counting
Fluorescence images are acquired using a Leica SP8 confocal laser-scanning microscope and analysed using Fiji and Prism software.

Work program
1. Collection of remaining brain tissue
2. Cryosectioning and immunohistochemistry
3. Image acquisition and data analysis

Initial Results

Table 1: Molecular markers established for immunohistochemistry

<table>
<thead>
<tr>
<th>Target</th>
<th>Antibody</th>
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<tr>
<td>Neural progenitor (Apical progenitor)</td>
<td>Pax6</td>
</tr>
<tr>
<td>Neural progenitor (Basal progenitor)</td>
<td>Tbr2</td>
</tr>
<tr>
<td>Neurons (neocortex)</td>
<td>Tbr1</td>
</tr>
<tr>
<td>Neurons (lamina)</td>
<td>HuC/HuD</td>
</tr>
<tr>
<td>Dendrite</td>
<td>Map2</td>
</tr>
<tr>
<td>Axon</td>
<td>Neurofilament</td>
</tr>
<tr>
<td>Myelin</td>
<td>MBP</td>
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<tr>
<td>Astrocytes</td>
<td>GFAP</td>
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Figure 1: Immunohistochemistry. All images show representative examples

Outlook and Conclusion
The investigated cells and structures will be analysed and compared between altricial and precocial species in order to define differences in cortical neurogenesis and maturation. This project will provide insight into the mechanisms that regulate patterns of mammalian development and growth, and thus greater understanding into the evolutionary mechanisms involved in the process of speciation.

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