Brain structural connectome alterations in children and youth with prenatal alcohol exposure

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Learning objectives

- Get basic concepts about brain structural connectome analysis

- Identify brain areas where structure is altered in individuals with PAE
Outline

- Background
- Material & Methods
- Results
- Conclusions
- Future plans
What are human brain structures?

- Grey matter
- White matter
- PAE and white matter
  - Abnormal corpus callosum

Sowell et al., 2001

Unexposed

Sowell et al., 2001
Diffusion tensor imaging

O'Donnell & Westin., 2011
- Abnormal white matter fibers through the corpus callosum:

Wozniak et al., 2011
- Abnormal white matter anisotropy across the whole brain

Lebel et al., 2008
Graph theory based analysis:

Brain regions + White matter tractography = Structural connectome

Tzourio-Mazoyer, 2002
Global efficiency

Degree centrality = 5

Shortest path length = 2

Graph

Degree centrality = 5
Small world: High local connectivity and low shortest path length.

Watts & Strogatz., 1998
Global Functional Connectivity Abnormalities in Children with Fetal Alcohol Spectrum Disorders

Jeffrey R. Wozniak, Bryon A. Mueller, Christopher J. Bell, Ryan L. Muetzel, Heather L. Hoecker, Christopher J. Boys, and Kelvin O. Lim

Functional connectivity abnormalities and associated cognitive deficits in fetal alcohol Spectrum disorders (FASD)

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- Aim: Structural connectome in children and youth with PAE
103 Unexposed controls, 97 PAE;
5 ~ 18 years old, 83 females
Diffusion tensor imaging
Materials & Methods

- DTI datasets
- Deterministic tractography
- Whole brain tractography
- Brain regions
- Yeo et al., 2011
- Structural connectome
- Graph theoretical analysis
- Pre-defined networks

Color codes:
- Purple (Visual)
- Blue (Somatomotor)
- Green (Dorsal Attention)
- Violet (Ventral Attention)
- Cream (Limbic)
- Orange (Frontoparietal)
- Red (Default)
Results: Whole brain level

- Children and youth with PAE:
  - Higher shortest path length;
  - Lower global efficiency;
  - Lower degree centrality;
  - Nearly Small-world;
Results: Regional level

Red: PAE > Controls; Blue: PAE < Controls
Results: Network level

Yeo et al., 2011
Conclusions

- Structural network in children and youth with PAE requires longer path to transfer information, lead to decreased efficiency;

- Brain regions related to sensorimotor functions at the right hemisphere dominate the changes;

- Disrupted cooperations between cognitive, sensorimotor and attention system associated with PAE.
Future plans

- Relationship with cognitive and behavioural outcomes;
- Interactions between brain functions and structures;
Learning objectives

- Get basic concepts about brain structural connectome analysis:

  - Identify brain areas where structure is altered in individuals with PAE

http://thebrain.mcgill.ca/flash/a/a_06/a_06_cr/a_06_cr_mou/a_06_cr_mou.html
Thank you for listening!

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