Master de Sciences et Technologies
Mention Biologie Intégrative et Physiologie
Parcours : Neurosciences
Responsable : Professeur Régis Lambert

Internship Proposal
Academic Year 2018-2019

1. Host team:

Research Unit (e.g. Department or Institute): Inserm UMR1141 (from January 2019: NeuroDiderot Unit)
Research Unit Director: P. Gressens
Research Team Director: L. Hertz-Pannier / J. Dubois
Team name: Imaging neurodevelopmental phenotypes *inDev*

Team address :
CEA/SAC/DRF/NeuroSpin, 91191 Gif-sur-Yvette
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2. Internship project title:

Morphometric, structural and functional connectivity correlates of cognitive development after Neonatal Arterial Ischemic Stroke (NAIS)

3. Internship Description:

Could we predict soon after birth the motor and cognitive outcome of a neonate who sustained a NAIS? Considering that 'only' 30% of those children develop unilateral cerebral palsy (uCP), and half show subtle language impairment in childhood with other cognitive difficulties revealed throughout adolescence, **what are the neural correlates of such an outcome variability**?
The world-unique AVCnn cohort[1] collected data in 100 neonates followed from birth on with both clinical neonatal imaging and multimodal monocentric-research MR imaging (n =55) along with comprehensive motor and neuropsychological evaluations at age 7.
As **NAIS constitutes a unique model to study infant brain plasticity**, we started to unravel anatomo-functional correlates of the plasticity of specific functions, in reference to healthy age-matched children, and we already showed that: i. uCP can be predicted from birth on[2,3] and later hand motor performance mainly depends upon both lesion localization (with regard to the central cortex and corticospinal tract)[4] and atrophy of distant but connected regions[5] and of the corpus callosum[6] ii. Contra-lesional hemispheric language organization is most common, but clinical language profile does not clearly depend on lesion nor language organization sides.

The current Master project aims to deepen our understanding of early language plasticity after NAIS, by studying ***in combination*** **the structural (diffusion MRI) and functional (resting**

state-fMRI) connectivity patterns, and brain growth (T1-based morphometry), in correlation with detailed language tests at age 7 AND lesion quantification in the newborn.

1) **Functional and structural connectivity** studies are exquisitely useful in children as they do not require active participation, but their **complementarity** is not well studied. We expect that language outcome is adversely influenced by decreased inter-hemispheric functional connectivity, while ipsi and contra-lesional intra-hemispheric patterns may partly relate to structural connectivity alterations (i.e. interruption of the arcuate fasciculus, and/or the corticospinal tract).

2) **Brain growth** might also exhibit distinct patterns in the ipsi vs contralesional hemisphere, as **crowding effect** with cognitive impairments beyond language is supposedly associated with a lack of 'neural space'. Detailed volumetric studies of both lesion and brain structures *at birth AND at age 7* will be correlated to language outcome, also searching for a **sex effect**.

The student will essentially conduct MRI data analyzes, in relation with cognitive and clinical variables, using dedicated research tools, developed mostly at Neurospin. The internship will take place in NeuroSpin neuroimaging research center on the CEA campus in Saclay (15kms south of Paris).

1, Chabrier, 2016, 2, 3 Husson, J Ped 2010, EJR 2016, 4, 5 Dinomais, Hum Br Map 2015, Stroke 2016, 6 Groeschel, DMCN 2017