

EMMA study student project 2024

Background

EMMA study: Advances in obstetric and neonatal intensive care have led to a significant improvement of survival in infants born extremely preterm (<28 weeks of gestation). However, injury to the developing brain is still a very common finding in preterm infants and is an important risk factor for long-term neurodevelopmental deficits. Intriguingly, many preterm infants without apparent lesions on 3 Tesla MRI, tend to also experience neurodevelopmental delay in later childhood. Conceivably, because lesions might be too subtle to capture with 3 Tesla MRI, or conventional imaging is unable to show factors of brain maturation that dictate neurodevelopmental outcome. In depth in-vivo investigation of maturation of the preterm brain, is the crux in understanding the link between prematurity and outcome, but we need advanced imaging to accomplish this. Ultra-high field MRI (i.e. 7 Tesla MRI) especially improves the use of advanced imaging. With 7 Tesla MRI, we expect to be able to visualize the developing (micro-)vascular anatomy, perfusion, metabolic condition and myelination of the brain. We hypothesize that these combined modalities will provide unique information on the vascular and metabolic maturation and myelination of the preterm brain, improving neurodevelopmental prognosis, even in preterm infants without apparent brain damage.

MRSI: MRSI will be used to non-invasively analyze the chemical composition of tissue. For example, high levels of glutamate (glutamate excitotoxicity) are thought to be involved in the pathogenesis of white matter injuries. Furthermore, MRS gives insight into various aspects of brain development; NAA is involved in myelination; creatine levels reflect neuronal cell mass; myo-inositol is a glial marker; and lactate is a marker of hypoxia. The increased chemical shift dispersion at 7T results in less overlap between the different metabolite peaks, making the unambiguous identification of, for example, glutamate and myo-inositol feasible.

MSc project

In this project we are focusing on MR spectroscopic imaging in the EMMA study. The goal is to create a pipeline to generate metabolic maps from the MRSI sequence on 7T (and 3T if feasible within project time) in neonates.

Required experience

Matlab

Possible research questions:

1. *Are metabolic biomarkers related to severity of brain injury in preterm neonates?*
2. *Are metabolic biomarkers related to outcome in preterm neonates?*
3. *Is the myelin content as derived from ihMT-imaging related to metabolic markers?*
4. ...

Summary of possible tasks

Perform MRSI experiments in neonates at 3T and 7T

Metabolic mapping (e.g., In Matlab)

Data analysis

Image processing