DÉVELOPPEMENT D'UNE MÉTHODE DE QUANTIFICATION NON-INVASIVE DE LA CONSOMMATION CÉRÉBRALE EN OXYGÈNE.

Établissement **Université Toulouse III - Paul Sabatier**

École doctorale **GEET - Génie Electrique Electronique et Télécommunications : du système au nanosystème**

Spécialité **Radiophysique et Imagerie Médicales**

Unité de recherche **ToNIC-Toulouse NeuroImaging Center (UMR 1214)**

Directeur de la thèse Franck DESMOULIN

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Description de la problématique de recherche

SUJET(S) DE THESE
SUSCEPTIBLE(S) D'ETRE PROPOSE(S) POUR UN CONTRAT DOCTORAL

Sujet
Développement d'une méthode de quantification non-invasive de la consommation cérébrale en oxygène.

Development of a non-invasive quantification method of brain tissue oxygen consumption.

Monitoring tissue oxygenation is of particular interest in brain, for instance, to assess level of hypoxia and to test therapeutical interventions that could salvage brain tissue after a stroke, to feature neuropathological diseases such as degenerative diseases. Full characterization of oxygenation includes the tissue oxygen saturation (StO2) and the cerebral metabolic rate of oxygen (CMRO2). Recent advances in MRI methodology offer new non-invasive exploratory approaches to investigate and characterize metabolic and hemodynamic modifications which occur in the brain. Several methods have been proposed which allow for determination of a global or a voxelwise CMRO2. One of the most accurate, using numerical simulation to map StO2 and CMRO2, is based on a multiparametric quantitative blood oxygenation level-dependent (mqBOLD) method with cerebral blood volume (CBV), cerebral blood flow (CBF) and T2 measurements (1).
First step of the research project is to implement the methods to investigate temporal and spatial dynamics of these parameters with animal models using a 7T preclinical MRI system (CREFRE Toulouse Oncopole). The accuracy of the extravascular T'2-based method relies on a precise determination of the signal decay rate in tissue as the exclusive consequence of the oxygenated/deoxygenated hemoglobin ratio. Novel estimation methods that use complex-valued data will be tested to estimate T2 and T2* which allow the calculation of the T'2 parameter. These methods provide minimum variance unbiased estimate of parametric maps and markedly outperform commonly used magnitude-based estimators under most conditions (2).
The second step is the transposition of the method to a clinical MRI system operating at 3T (ToNIC, Purpan Hospital) with a reassessing of the acquisition parameters and of their processing patterns because of relaxometry caracteristics and dimension scale changes.
Evaluation will essentially rely on comparison between parametric response mappings obtained on the preclinical and clinical MRI units (equipped with preclinical antenna) on similar animal models. In a next step, this work will contribute to the determination of tissue oxygenation in human brain.

(1) Bouvier J. et al., Reduced CMRO2 and Cerebrovascular Reserve in Patients With Severe Intracranial Arterial Stenosis: A Combined Multiparametric qBOLD Oxygenation and BOLD fMRI Study. Human Brain Mapping 2015; 36:695–706
(2) Umesh Rudrapatna S et al., Improved estimation of MR relaxation parameters using complex-valued data. Magn Reson Med 2017; 77:385-397.

Direction de thèse : Franck DESMOULIN
ToNIC Toulouse NeuroImaging Center Responsable scientifique IRM petit animal
UMR 1214 Inserm/UPS Service Exploration Non Invasive
Pavillon Baudot CHU Purpan UMS 006 ENI-CREFRE
Place Docteur Baylac
31024 Toulouse cedex 3 Tél : 05 62 74 61 97
Franck.demoulin@inserm.fr

COLLABORATION(s) ACADEMIQUE(s) ou INDUSTRIELLE(s) sur ce sujet:

Dr. Emmanuel Barbier director of the 'Functional Neuroimaging and Brain Perfusion' team in The Grenoble Institut Neurosciences 1
Chemin Fortuné Ferrini, 38700 La Tronche
T 04 56 52 05 88
Email : emmanuel.barbier@ujf-grenoble.fr
Dr. Annette van der Toor Biomedical MR Imaging & Spectroscopy Group at University Medical Center Utrecht
Address: Biomedical MR Imaging & Spectroscopy Group (CIS), University Medical Center Utrecht
Building Nieuw Gildestein | Yalelaan 2 | 3584 CM Utrecht | The Netherlands
T +31 (0)30 253 5569 | F +31 (0)30 253 5561
Email : r.m.dijkhuizen@umcutrecht.nl

Thématique

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