Master or Semester project

Location: EPFL, Lausanne

Dates/Duration: Spring semester 2024

Optimization of quantitative FDG-PET acquisition protocols

FDG-PET is a powerful approach to measure in vivo total glucose uptake and became therefore a method of choice to study local energy metabolism in the body, with a variety of applications ranging to daily clinical practice. In studies of neurometabolism, FDG-PET is particularly well adapted, since brain relies essentially on glucose for its energy needs. Our research at CIBM has pushed the FDG-PET approach to a further level by enabling the derivation of quantitative metabolic fluxes for total glucose uptake (CMR_{Glc} in micromole/g/min) [1], which is a key feature to enable in particular cross-validation and combination of this quantitative metabolic imaging approach with other in vivo methods, such as in vivo ^{13}C dynamic MRS. Moreover, we could show that the fewer assumptions needed in this quantitative metabolic imaging approach enabled the detection of metabolic alterations in particular brain diseases which were not distinguishable with standard approaches. In the field of multimodal metabolic imaging and more generally in biophysics, the development of such quantitative measurements is a key element.

In this project, we propose to develop further the in vivo 3D quantitative metabolic imaging with FDG-PET to enable a more practical application in human studies with the perspective of its use for quantitative diagnostic. The method as currently used requires the measurement of the tracer input function, measured from the PET image directly, during the first 45 minutes of the scan, following the FDG bolus injection [2]. In a second step, the total FDG uptake in the brain is measured during 10 minutes at labelling steady-state.

The aim of the project is to optimize this protocol, based on the acquired dynamic data sets, to shorten these acquisition periods. The effect of each modification of the protocol will be evaluated to derive an optimal study design. Specifically, the measured input function will be characterized over a series of scans and modelled to enable predictions of its shape with reduced acquisition duration. The time after bolus at which the steady-state brain acquisition is acquired will also be adjusted, based on metabolic modelling simulations of FDG metabolism.

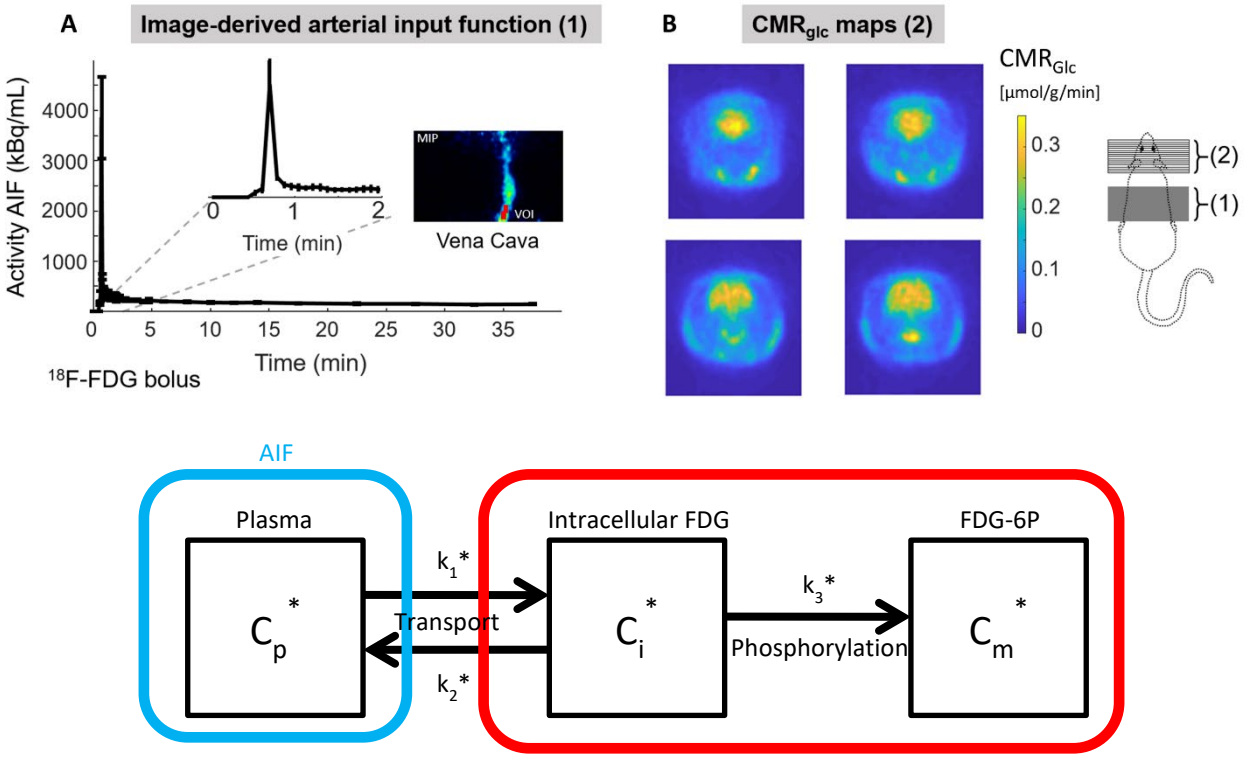

Figure 1: Quantitative metabolic modelling approach for the derivation of metabolic maps of the cerebral metabolic rate of glucose (CMR_{Glc}) from dynamic FDG-PET experiments

References

Please follow the structure of the examples of conference and journal papers below:

[1] Mosso J, Yin T, Poitry-Yamate C, Simicic D, Lepore M, McLin VA, Braissant O, Cudalbu C, Lanz B. PET CMRglc mapping and 1H-MRS show altered glucose uptake and neurometabolic profiles in BDL rats. Anal Biochem. 2022 Jun 15;647:114606. doi: 10.1016/j.ab.2022.114606.

[2] Lanz B, Poitry-Yamate C, Gruetter R. Image-derived input function from the vena cava for 18F-FDG PET studies in rats and mice. J Nucl Med. 2014 Aug;55(8):1380-8. doi: 10.2967/jnumed.113.127381.

Supervisor

- Dr Bernard Lanz, CIBM MRI EPFL AIT, https://cibm.ch/people/, bernard.lanz@epfl.ch
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Skills

- **Qualifications, previous experience and background:** This project is suitable for students with a background in physics or biomedical physics interested in biomedical imaging and development of quantitative in vivo approaches
- **Desirable:** Course PHYS-438 (Fundamentals of biomedical imaging), Programming experience (Matlab, …)

How to apply: Please contact the main supervisor: bernard.lanz@epfl.ch

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About CIBM

The CIBM Center for Biomedical Imaging was founded in 2004 and is the result of a major research and teaching initiative of the partners in the Science-Vie-Société (SVS) project between the Ecole Polytechnique Fédérale de Lausanne (EPFL), the Université de Lausanne (UNIL), Université de Genève (UNIGE), the Hôpitaux Universitaires de Genève (HUG) and the Centre Hospitalier Universitaire Vaudois (CHUV), with the generous support from the Fondation Leenaards and Fondation Louis-Jeantet.
CIBM brings together highly qualified, diverse, complementary and multidisciplinary groups of people with common interest in biomedical imaging.

We welcome you in joining the CIBM Community.

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