Title of the PhD project:

Multimodal metabolic and functional imaging of the ischemic heart using PET registered ultrafast sonography

Professional domain: Experimental imaging

Host laboratory / Company:

Paris Cardiovascular Research Center – Inserm U970 / Laboratory for in vivo Imaging Research

Lab / Office location:

Paris Cardiovascular Research Center, Inserm U970, 56 rue Leblanc, 75015 Paris, France
www.parcc.inserm.fr
Lab head: Professor Bertrand Tavitian / Head of PARCC-Inserm U970 : Alain Tedgui
Environment: PET-CT Mediso nanoPET; Bruker 4.7 T MRI; Supersonic Imagine Aixplorer; Animal facilities, software and computing power. Radiology
Staff: PARCC = 280, Radiology Dept = 80, involved in the project: 1 MD, 2 engineers, 2 post docs, 2 Lab assistants + Master students

Contact (send CV and motivation letter)

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Contract type / compensation:

Inserm internship salary for PhD students

Description of the Project

Objective (s) of the project:

Establish the correlation linking cardiac perfusion and function with metabolic flux of the normal and ischemic myocardium.

State of the art & rationale:

Determining whether a “stunned” or “hibernating” myocardium is viable, i.e., can benefit from a revascularization procedure, is a complex problem involving the mechanical, vascular, perfusion, and metabolism properties of the cardiac tissue.
Positron emission tomography (PET) and Ultrafast Ultrasound Imaging (UUI) are, respectively, the most sensitive and the most specific viability imaging modalities when predicting functional recovery.
Viability imaging is at a crossroads: while viability imaging can predict functional recovery, the STITCH study demonstrated that it fails when attempting to predict the long-term outcomes of revascularization procedures.

These shortcomings could be potentially due in part to limitations of existing imaging technologies: the limited resolution of nuclear imaging techniques and the lack of quantification in echocardiography.
Novel imaging modes applied to cardiology bring new quantitative biomarkers to the table, namely, the imaging of intramyocardial vessels and of local myocardial stiffness.

Methods and tools:

Our world-first prototype of UUI combined with PET allows for simultaneous molecular, anatomical, and quantitative functional imaging of tissues and paves the way to novel synergistic imaging modes.

Main tasks:

1. To improve the accuracy of full coregistration of PET and UUI image volumes in 4D using the tools developed in the lab.
2. To extend UUI to perfusion imaging of the myocardium using contrast agents.
3. To apply PET-UUI to perfusion+stiffness+metabolic imaging of the heart in permanent and temporary (ischemia-reperfusion) models in rodents.
4. To progress towards the definition of new biomarkers of myocardial viability

Anticipated outcomes and potentials:

To obtain and validate a new biomarker linking cardiac metabolism, output and perfusion.

Role of the doctoral student:

To realize and analyse imaging experiments in the animal model.

References:

Provost J, Garofalakis A, Sourdon J, Bouda D, Berthon B, Viel T, Perez-Liva M, Lussey-Lepoutre C, Favier J, Correia M, Pernot M, Chiche J, Pouysségur J, Tanter M, Tavitian B. Simultaneous Positron Emission Tomography and Ultrafast Ultrasound for Hybrid Molecular, Anatomical, and Functional Imaging. Nature Biomed Eng., 2018;2(2):85-94.

Mabrouk R, Dubeau F, Bentabet L. A Bayesian framework for the extraction of input function for 18F-FDG metabolism study for both healthy and infarcted rats' hearts J. Biomed. Graphics Comput., 2013, 3(4):9-19

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; 55:1380–1388

Su HL, Qian YQ, Wei ZR, He JG, Li GQ, Zhang J, Zhou XD, Jing W. Real-time myocardial contrast echocardiography in rat: Infusion versus bolus administration, Ultrasound Med. Biol. 2009, 35(5):748–755, 2009