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Image-Derived Blood Input Function from FDG-PET Images in Mice

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Editorial

In a dynamic Positron Emission Tomography (PET) scan, the blood pool (BP) time activity curve forms the input function in a compartmental model technique for evaluation of rate constants to measure myocardial glucose uptake and utilization *in vivo*. Several methods have been described in the literature for arterial blood sampling, which is the accepted gold standard for measurement of the blood input function [1-3]. A major problem with image-derived blood input function (IDIF) method is that it is susceptible to Spill-over (SP) and Partial Volume (PV) effects more so at the early time points due to rapid metabolism and also at the late time points due to cellular trapping of 2-[18F] fluoro-2deoxy-D-glucose (FDG) .

In a recent publication from our lab [4], we obtained an image-derived blood input function (IDIF) from cardiac gated Ordered Set Expectation Maximization-Maximum a Posteriori (OSEM-MAP) reconstructed images with attenuation correction in a control mouse heart with no further SP correction. The PV coefficient was incorporated as an input parameter from phantom experiments. Although this method may work in a control mouse heart due to reduced SP contamination into the LVBP from the myocardium and vice-versa, SP contamination will be more severe in diseased hearts especially at the early time points, in a changing metabolic environment [5] in a dynamic PET scan. Also, it is non-trivial to account for PV coefficients with changing cardiac dimensions in a changing metabolic milieu.

In a recent work [6], we optimized a compartment model corrected blood input function (MCBIF) [7] *in vivo* in mouse hearts, wherein the blood input function with SP and PV corrections and the metabolic rate constants in a compartment model were simultaneously estimated from OSEM-MAP cardiac and respiratory gated PET images with attenuation correction. This technique not only improves quantitation but is also repetitive. From an imaging perspective accurate quantitation of the blood input function *in vivo* will reduce animal handling during imaging and provide reliable estimates of the kinetic parameters needed for accurate computation of metabolic influx constants. The unique advantage of this multi-parameter approach is that no apriori knowledge of the cardiac dimensions is needed. The proposed imaging technique [6] correctly takes into account PV and SP corrections, for both the LV and the myocardium, in a changing metabolic milieu by optimizing to the blood and tissue time activity curves obtained from high resolution gated and attenuation corrected dynamic PET images, without the need for any additional blood sampling.

Absolute quantification of the blood input function and thereby absolute myocardial metabolic activity *in vivo* is important especially in a changing metabolic environment with changing cardiac dimensions during the progression and the regression of a disease, for example, in a surgical mouse model of Transverse Aortic Constriction induced Left Ventricular Hypertrophy (LVH), to differentiate diseased hearts from controls [5]. From a clinical standpoint, this technique is important since quantification of absolute metabolic activity can differentiate which patients are going to develop LVH or heart failure with a single measurement.

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