

MEASUREMENT OF BRAIN FUNCTION IN THE LIVING HUMAN USING POSITRON EMISSION TOMOGRAPHY IMAGING

Professor Julie C Price, Ph D
Department of Radiology and Department of Biostatistics
University of Pittsburgh

Abstract

Functional brain imaging studies performed using positron emission tomography (PET) primarily utilize radioactive indicator molecules (i.e., radiotracers) that follow, or trace, steps of a physiologic process. The radiotracer is generally introduced into the subject in very small (trace) amounts that do not perturb the process under study. Emission imaging provides an image of the spatial and temporal radioactivity distribution within a patient through the external detection of emitted gamma rays emanating from within the body. Mathematical and statistical methods are used to determine parameters-of-interest from tracer kinetic PET imaging data. These methods can be generally categorized as compartmental and non-compartmental approaches.

Compartmental methods involve the formulation of a compartmental model that is configured based on *a priori* knowledge of the chemical and physiological characteristics associated with the process-of-interest. The concentration of radiotracer in blood (input function) drives the kinetics of the radiotracer in brain. A compartment represents a space, or volume, that the tracer is distributed in that can be of physical (precursor pool) or chemical (metabolized tracer) relevance. Rate constants (internal parameters) link compartments and represent the various rates of inter-compartmental tracer exchange. It is generally assumed that the amount of tracer leaving a compartment is proportional to the total amount in the compartment, all injected tracer exists in one or multiple compartments, and the tracer is uniformly distributed within any given compartment. The validity of a compartmental approach rests on the validity of such assumptions, and others that may involve tracer administration, pharmacological and metabolic properties of the radiotracer, and tracer extraction from vasculature into tissue. Non-compartmental methods do not involve specific assumptions as to the internal behavior of the systemic substance. These techniques include those that mathematically unfold (deconvolve) the input function from the total brain kinetics to obtain the tissue response curve. Non-compartmental techniques generally do not require as many assumptions as compartmental methods, but are limited if specific information about the internal parameters is of interest. The methods used for the *in vivo* measure of biochemical activity in brain through PET tracer kinetic principles will be described

Speaker's Biographical Sketch

Julie C. Price, PhD, received a BS in physics (1982) and MS in medical physics (1985) from the University of Wisconsin. Her doctoral (Johns Hopkins University, 1987-1992) and post-doctoral (National Institutes of Health, 1992-1994) training focused on quantitative positron emission tomography (PET) imaging and the development and evaluation of novel PET methods for brain. She joined the University of Pittsburgh in 1994 and is currently Associate Professor of Radiology and Biostatistics. Her research involves the assessment of alterations in brain function associated with neurodegeneration, aging, medical and psychiatric comorbidity through mathematical and statistical modeling of PET data acquired in studies of ligand-binding interactions, blood flow, and glucose metabolism.

Date: Wednesday, February 25, 2009

Time: 12:00 pm

Location: 424 Benedum Hall