Introduction into Kinetic Modelling

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In modern medical imaging there are different ways to study in vivo pharmaceutical drugs injected at lower concentration to living being, as well human patients as small animals. Most popular ones are magnetic resonance imaging (MRI) and positron emission tomography (PET) but PET seems the best as sensitive to pico-molar concentrations at a level lower than pharmaceutical effects. Despite the small number of available (and easy to use) positron emitting isotopes (18F, 11C, 13N, 15O…) radiochemists are able to label many compounds and this radiolabelled tracers make PET a powerful tool to study therapeutic agents and help in the development of new drugs. This talk will give example of use of small animal PET in biophysics and medical research.

Devices adapted to small animal imaging are now commercially available and allows us to study the function rather than the structure of living tissues in in vivo analysis. PET methodology, from the physics of electron-positron annihilation to the biophysics involved with the tracers is treated by other authors in this workshop and for basics of coincidence detection, image reconstruction, spatial resolution and sensitivity we refer to previous Ivo Rausch talk.

The use of compartment analysis combined with pharmacokinetics will be described to illustrate on an application to neuroimaging and to show how parametric imaging can bring insight on the in vivo bio-distribution of a radioactive tracer with small animal PET scanners.

The talk would like to show some examples of modeling performed in the neuroimaging unit of the hospital of Geneva with whom we were in collaboration.

We will begin by a quick background of the mathematical models we use to analyze PET data.

The first example is a neurotransmission study done in Human with PET and SPECT. The goal was to build parametric images of benzodiazepine receptors.

The second example is also a neurotransmission study, but done in rat with serotoninergic receptors. In that case, we used our microPET imaging camera. We describe a small animal PET experiment which allows to measure the density of 5HT 1A receptors in rat brain.