Continuous infusion PET with constant input function

Vincent Keereman, Pieter van Mierlo, Benedicte Descamps,

Stefaan Vandenberghe, Robrecht Raedt, Christian Vanhove

January 2, 2013

INTRODUCTION Dynamic PET imaging can be used to study the pharmacokinetic behaviour of administered radiotracers. This requires knowledge of the arterial blood concentration of the radiotracer, usually determined using blood sampling. However, this is a cumbersome procedure, especially in small animal experiments. We have developed a method which yields a constant arterial blood concentration of radiotracer, thereby rendering the use of arterial blood sampling unnecessary.

MATERIALS AND METHODS The method was developed for 18F-FDG PET imaging of rats. First a bolus injection of 300 uCi of radiotracer is performed over 1 min. Continuous infusion of radiotracer is then started. The infusion rate is adjusted continuously so that during each unit of time the amount of infused radiotracer is equal to the amount of radiotracer that has decayed inside the animal. In stable physiological conditions, a steady state with constant blood concentration will be reached after a time interval. We tested our method on 3 control rats. A PET acquisition of 3 hours was performed and reconstructed in 10 min frames. The average reconstructed PET value inside a VOI on the cerebral cortex was calculated. Arterial blood samples were taken every second and the average arterial blood radioactivity concentration was calculated in each frame. The coefficient of variation (CoV) of the reconstructed PET value and arterial blood concentration was calculated over all frames after steady state was reached. To demonstrate a possible application of our method it was used to visualize the effect of intrahippocampal kainic acid (KA) injection (a model for epileptogenesis) on cerebral glucose metabolism in 1 rat'.

RESULTS In all animals steady state was reached after less than 60 min. CoV of the arterial blood concentration between 60 and 180 minutes was approximately 10% in all controls. CoV of the average reconstructed PET value was approximately 5%. In all controls no clear upward or downward trend was observed. In KA animals a strong increase of glucose uptake was observed in the ipsilateral hippocampus after injection of KA.

CONCLUSION We have demonstrated the feasibility of using continuous infusion of radiotracer to obtain a constant arterial input function. This method allows dynamic

PET imaging with knowledge of the arterial input function without the need for arterial blood sampling. Dynamic imaging of the effect of intrahippocampal KA injection was demonstrated as an application.

Figure

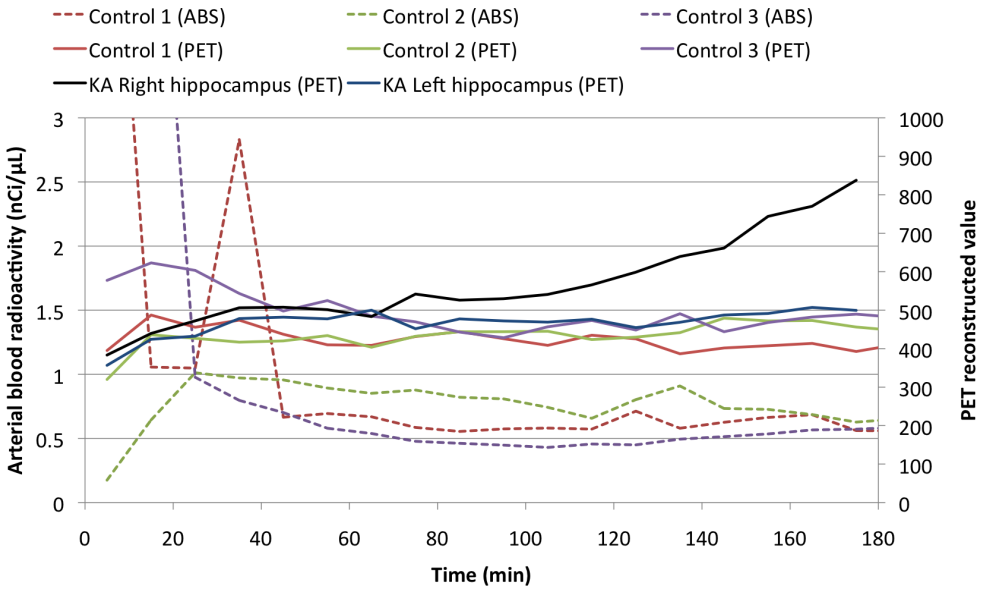

Figure 1: Arterial blood radioactivity concentration and reconstructed PET value in 3 control rats as well as reconstructed PET value in the right and left hippocampus of a rat in which injection of kainic acid into the right hippocampus was performed at 80 min.