Assessing non-invasive quantitative methods for [^{18}F]SynVesT-1 PET imaging of synaptic vesicle glycoprotein 2A in the rat brain

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Understanding how brain cells communicate is crucial for studying neurological diseases like Alzheimer's disease, epilepsy and spinal cord injury. Therefore, brain imaging techniques, such as PET scans, can be used to measure synaptic density—the number of connections between neurons. A specific PET tracer, called [^{18}F]SynVesT-1, binds to synaptic vesicle glycoprotein 2A in the synapses and can be used to visualize these connections. However, its application in rats has not been explored. Accurate quantification of PET images in small rodents also requires arterial blood sampling, which is an invasive procedure.

Therefore, our study aimed to validate quantification methods to measure synaptic density in rats using [^{18}F]SynVesT-1. First, different kinetic modelling methods were investigated to accurately quantify synaptic density. Then, the use of two image-derived input functions was assessed as non-invasive alternatives to the arterial blood sampling.

Our results showed that the 2-tissue compartmental model and Logan plot fitting (two kinetic modelling methods) were able to provide a good fit for this tracer in rats. Additionally, both non-invasive image-derived approaches were found to be good alternatives to invasive arterial blood sampling. This means that synaptic density in rats can be quantified with [^{18}F]SynVesT-1 PET imaging without the need for invasive blood sampling, making future studies more efficient and less stressful for the animals. Ultimately, our findings contribute to advancing brain imaging techniques and improving preclinical research on neurological disorders.