PET Pro: An Automated pipeline to estimate the image-derived input function for UCB-H PET

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Abstract

Quantitative positron emission tomography (PET) brain studies often require an input function, typically a measure of the arterial plasma time-activity curve (AIF). Image-derived input function (IDIF) offers a non-invasive alternative to the AIF.

Here, we propose an automated pipeline for estimating IDIF in the context of in vivo assessment of synaptic density using PET imaging and UCB-H radiotracer with nanomolar affinity for the synaptic vesicle protein SV2A. This tool includes an automatic detection of carotid arteries on the dynamic images, an estimation of IDIF, and a correction of the partial volume effect.

We assessed our method's reliability by comparing it with the gold standard AIF in 10 healthy subjects (8 males, age: mean±SD 51.11±12) who underwent dynamic PET and MRI scans. Arterial blood sampling was performed from the right arm artery during PET scans for all subjects.

In our data set, the pipeline successfully segmented carotid arteries in all participants. IDIF exhibited a 10% overestimation compared to blood-derived AIF (0.93±0.23). Additionally, both IDIF and blood AIF showed similar behavior in estimating total distribution volume maps (difference mean±SD ratio 1.06±0.30).

Our automatic approach provides a reliable alternative to manual or semi-automated methods for processing ECAT HR+ scanner images using the UCB-H tracer. It accelerates PET processing and ensures reproducibility. The pipeline code is freely available on GitHub.

Keywords: IDIF, carotid detection, PET, automated approach, open science