

Introduction to Project 8: Dopamine Receptor Mapping with PET

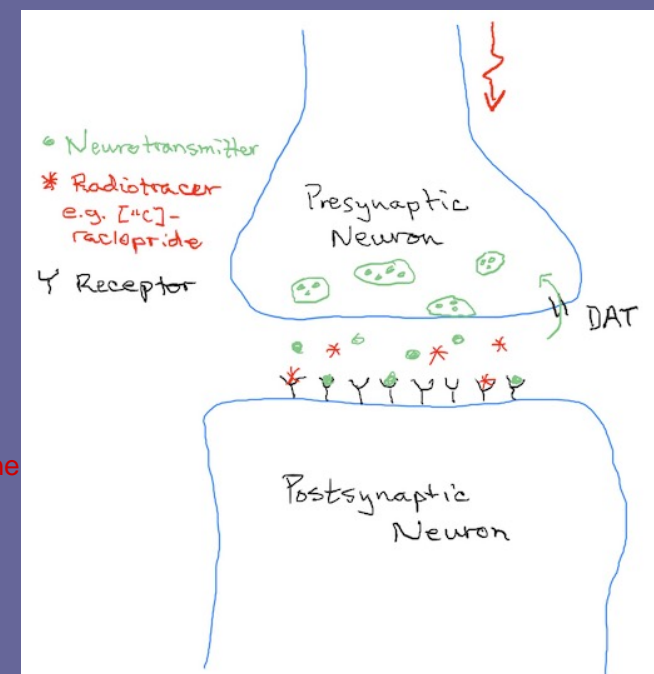
Quantitative and Functional Imaging

BME 4420/7450

Fall 2022

Mapping dopamine receptor density in the brain

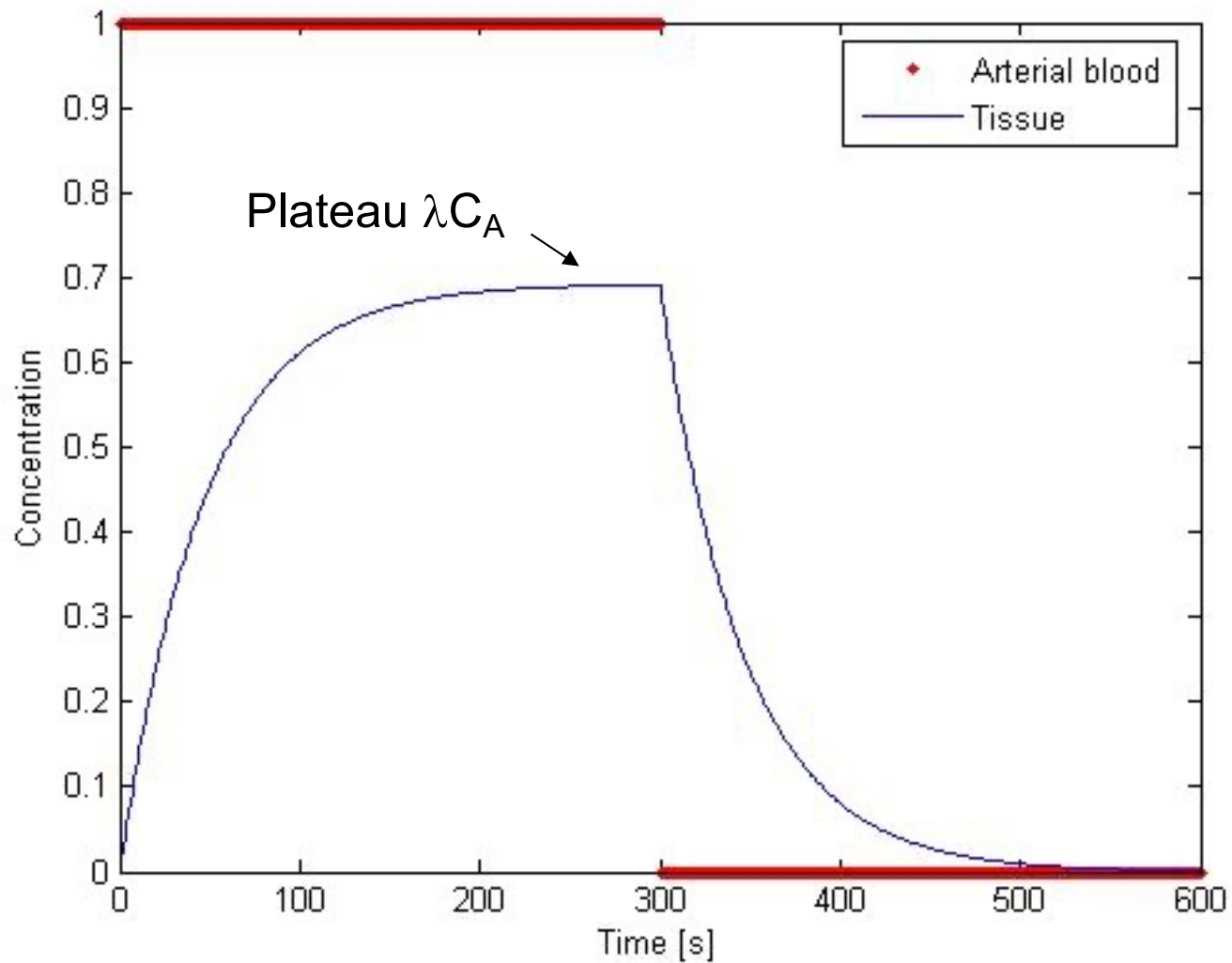
- Dopamine plays a critical role in
 - Motor control
 - Reward/pleasure
- Dopamine activity changes in
 - Parkinson's Disease produce less dopamine?
 - Addiction DAT gate is blocked - pleasure all the time with dopamine binding to post-synaptic receptors
- Dopamine function depends on
 - Production in presynaptic neuron
 - Binding with receptor on postsynaptic neuron
- How can we measure dopamine function?



Map the distribution volume ratio (DVR)

- Analyze time-activity curves
 - In a region of interest (basal ganglia)
 - Each voxel in the slice of interest
 - Reference tissue (cerebellum)
- Use time-activity curves to
 - Create a Logan Plot
 - Calculate DVR

Tracer time-activity curve



Logan Plot Analysis

- Form variables:

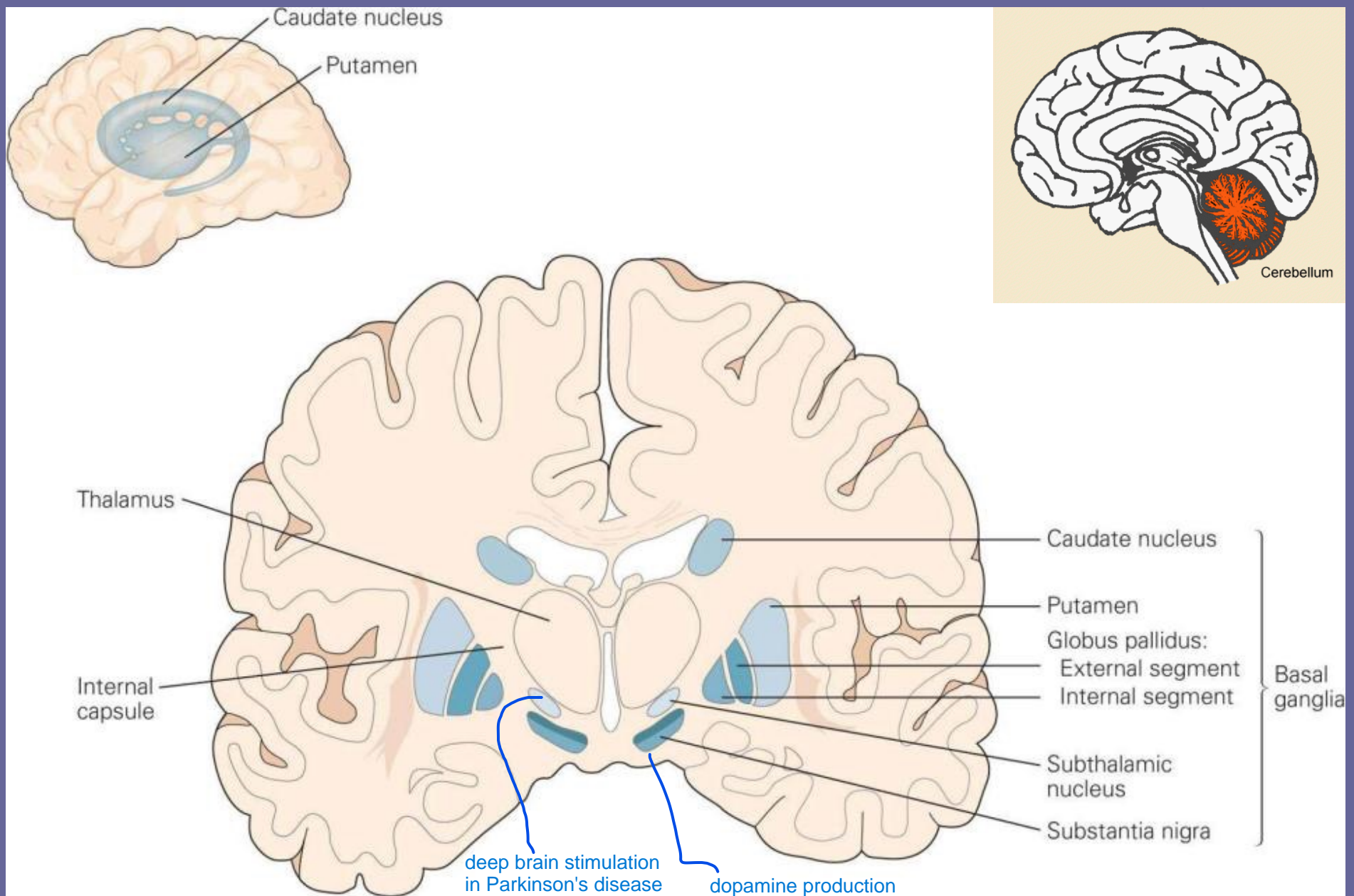
$$x(t) \equiv \frac{\int_0^t C_{CB}(t') dt'}{C_{BG}(t)}, \quad y(t) \equiv \frac{\int_0^t C_{BG}(t') dt'}{C_{BG}(t)}$$

- Plot y as a function of x :

$$y(t) = DVR \cdot x(t) + b$$

“BG” = basal ganglia; “CB” = cerebellum (reference region)

Location of the basal ganglia and cerebellum



<https://neupsykey.com/the-basal-ganglia-2/>

Project Goals

Molecular specificity (cant measure without PET)
is the advantage for measuring receptors

- Main goal: calculate a Distribution Volume Ratio (DVR) map in a slice that includes the basal ganglia
- How to accomplish this goal:
 - A. Analyze signal in cerebellum
 - a) Define a 'reference' region of interest (ROI) in the cerebellum
 - b) Get the time-activity curve for the cerebellum ROI
 - B. Analyze signal in the basal ganglia
 - a) Define an ROI for the basal ganglia
 - b) Get the time-activity curve for the basal ganglia
 - C. Calculate a Logan plot for the basal ganglia ROI
 - D. Calculate DVR from the Logan plot
 - a) Determine the time points to use in the DVR calculation
 - b) Loop over all pixels in the slice, calculating the DVR for each
 - c) Create a DVR map