

# Basic Kinetic Modeling in PET and MR Imaging

## March 4-8, 2024

### Teachers

- (GMK) Gitte Moos Knudsen, professor, DMSc, Neurobiology Research Unit, Rigshospitalet (course director)
- (HL) Henrik B.W. Larsson, professor, DMSc, Functional and Diagnostic MR Unit, Rigshospitalet (course Director)
- (SC) Stig Præstekjær Cramer, MD, PhD, Functional Imaging Unit, Rigshospitalet Glostrup
- (AEH) Adam Espe Hansen, Professor, MSc, PhD, Dept Diagnostic Radiology, Rigshospitalet
- (AJ) Annette Johansen, MD, PhD, Neurobiology Research Unit, Rigshospitalet
- (IL) Ian Law, Professor, DMSc, Dept. Clinical Physiology, Rigshospitalet
- (UL) Ulrich Lindberg, MSc, PhD, Functional Imaging Unit, Rigshospitalet Glostrup
- (CM) Clara Madsen, PhD student, Neurobiology Research Unit, Rigshospitalet
- (LM) Lisbeth Marnér, DMSc, Dept. Clinical Physiology/Nuclear Medicine, Bispebjerg Hospital
- (IR) Ilan Rabiner, BSc Hons, MBBCh, FCPsych SA, Invicro, Hammersmith Hospital, UK
- (PS) Pontus Plavén-Sigraý, PhD, Neurobiology Research Unit, Rigshospitalet
- (MS) Martin Schain, MSc, PhD, Antaros Medical
- (CS) Claus Svarer, PhD, Neurobiology Research Unit, Rigshospitalet
- (MV) Mark Vestergaard, MSc, PhD, Functional Imaging Unit, Rigshospitalet Glostrup

### Location

Neurobiology Research Unit, Rigshospitalet, entrance 7-8, Inge Lehmanns Vej 6-8, DK-2100 Copenhagen Ø  
All days except Wednesday: Ground floor, room 12.00.8523 (located between entrance 7 and 8)  
Wednesday: NRU conference room, entrance 8, 5th floor

### *Monday, March 4, 2024*

- 09.00-9.30 Introduction (GMK, CS, HL)  
Presentation of the individual participants. Please prepare a short presentation of yourself and the relation of tracer kinetics to your project.
- 9.30-10.00 Basic mathematics, exponentials, compartment modelling and differential equations (CS)
- 10.00-10.30 Basic physiology, blood, tissue and Blood Brain Barrier (GMK)
- 10.30-11.00 **Coffee break**
- 11.00-12.30 Basic tracer kinetic concepts: Steady state, linearity, stationarity etc. (MV)
- 12.30-13.30 **Lunch**
- 13.30-14.30 Clearance and Fick's principle, including examples (SC)
- 14.30-15.30 PC exercise 1 (intro, basics) (CS, GMK, PS, AJ)
- 15.30-16.30 Extraction, Renkin-Crone model, examples of determination of permeability (SC)

### *Tuesday, March 5, 2024*

- 09.00-10.00 Bolus injection (HL)
- 10.00-11.00 Impulse response, convolution (HL)
- 11.00-12.00 Mean transit time, external residue detection (HL)
- 12.00-13.00 **Lunch**
- 13.00-14.00 System theory (HL)
- 14.00-15.00 PC exercise 2 (convolution, extraction) (CS, GMK, PS, AJ)
- 15.00-16.00 Kety-Schmidt – Examples (HL)

### ***Wednesday, March 6, 2024***

- 09.00-09.45 Introduction to positron emission tomography (PET) and single photon emission tomography (SPECT) (MS)
- 09.45-10.30 PET and SPECT kinetics (MS)
- 10.30-10.45 ***Coffee break***
- 10.45-12.00 Receptor kinetics (MS)
- 12.00-13.00 ***Lunch***
- 13.00-14.00 Applications of PET in drug development (IR)
- 14.00-15.00 Determination of glucose consumption, deoxyglucose method (PS)
- 15.00-16.00 PC exercise 3 (models and rate constants) (CS, MS, LM, PS, AJ)

Visit to the PET department in order to see the local setup for, e.g., blood sampling, PET, and new combined PET/MR scanner.

### ***Thursday, March 7, 2024***

- 09.00-10.00 Testing new radioligands and pharmacology development (GMK)
- 10.00-11.00 Reference tissue modeling (CS, LM)
- 11.00-12.00 PC exercise 4 (linearization and reference tissue modeling) (CS, PS, GMK, LM, AJ)
- 12.00-13.00 ***Lunch***
- 13.00-14.00 Introduction to magnetic resonance imaging (MRI) (AEH)
- 14.00-15.00 Measurements of heart perfusion using dynamic contrast enhancement and T1 weighted MRI (UL)
- 15.00-16.00 Measuring brain perfusion with Dynamic Susceptibility Contrast MRI (AEH)
- 16.00-17.00 PC exercises (MR) (AEH, UL, CS)

### ***Friday, March 8, 2024***

- 09.00-09.45 Perfusion measurements in brain using [<sup>15</sup>O]-H<sub>2</sub>O PET techniques and clinical applications (IL)
- 09.45-10.30 Measurements of tissue perfusion using [<sup>15</sup>O]-H<sub>2</sub>O PET - kinetic models of heart, kidney and liver. (LM)
- 10.30-10.45 ***Coffee break***
- 10:45-11:30 Blood flow measurements using MR Arterial Spin Labelling (UL)
- 11.30-12.15 Small animal imaging (CM)
- 12.15-12.45 PC exercise 5 (guess a model and wrap-up) (CS, GMK, LM, AJ)
- 12.45-13.15 ***Lunch***
- 13.15-14.00 Example of analysis and kinetic modeling of a dynamic brain PET dataset using standard software like PVElab and PMOD (CS)
- 14.00-14.30 Discussion of the course participants own projects - bring material from your own project that you want to share and discuss (GMK, CS, HL)
- 14.30-15.00 Plenum discussion of course material (HL, CS, GMK)