COST ACTION B21
Physiological Modelling of MR Image Formation

MINUTES from the

Renal MRI and Renal Modelling Working Groups Meeting

LOCAL ORGANISER

Assoc. Professor A Lundervold
Department of Biomedicine
University of Bergen
Norway

E-mail : arvid.lundervold@biomed.uib.no

VENUE

Bygg for Biologiske Basalfag (BBG)
Department of Biomedicine
University of Bergen
Norway

8th December, 2006

Friday 8th December

Renal MRI Working Group:

09.00	Welcome, A Lundervold (NO)
09.10	Renal Disease and Clinical Assessment, O Tenstad/E Svarstad/J Rørvik (NO)
10.00	MRI Measurement Techniques, J Reichenbach (DE)
11.00	*Coffee*
11.15	Image Processing and Data Analysis, F Zöllner (NO)/A Santos (ES)
12.00	Pharmacokinetic Modelling and Estimation of Functional Parameters D Buckley (UK)/S Sourbron (DE)/ Conclusions: A Lundervold (NO)
13.00	*Lunch*

Renal Modelling Working Group:

14.00	Discussions on Methods and Clinical Issues, M Pedersen (DK), A Lundervold (N).
15.45	*Coffee*
16.00	Discussions on Collaborations and Follow-up, A Materka (PL)
18.00	Close
19.0	Dinner in Bergen City Centre (Potetkjelleren)

Participants outside Bergen

Working Group – Renal MRI

D Buckley (UK) – david.buckley@manchester.ac.uk
M Hajek (CZ) - Milan.Hajek@medicon.cz
S Kovacic (SI) - stanislav.kovacic@fe.uni-lj.si
J Reichenbach (DE) – Juergen.Reichenbach@med.uni-jena.de
S Sourbron (DE) – Steven.Sourbron@med.uni-muenchen.de

Working Group – Renal Modelling

P Rogelj (SI) – Peter.Rogelj@fe-uni-lj.si
A Materka (PL) - materka@p.lodz.pl
M Pedersen (DK) - michael@mr.au.dk
A Santos (ES) – andres@die.upm.es
R Sance (ES) – rosario.sance@gmail.com

Local participants

A Lundervold (NO) – moderator, J Rørvik (NO) – speaker, F Zöllner (NO) - speaker
A Anderlik (NO), I Brox (NO), O Tenstad (NO) – speaker, B Iversen (NO) , E Svarstad (NO) - speaker, E Andersen (NO), K Fosse (NO), T Taxt (NO)

Total number of participants: 21

The presentations of this meeting should be made available through the COST B21 website (http://www.die.upm.es/costb21/frame_main.html) for all participants. Thus, we ask kindly all speakers to submit their contribution and send them to Andrés Santos (andres@die.upm.es) to be placed at the website.

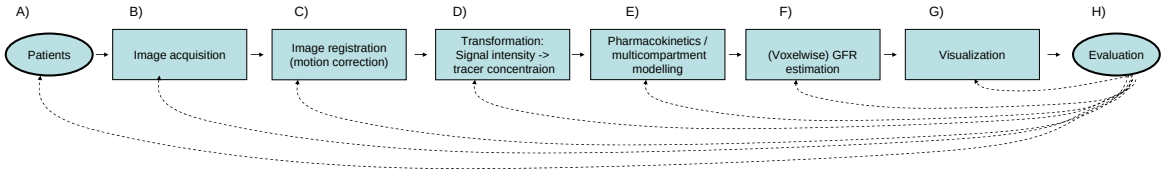
A follow-up meeting is expected to be scheduled September 2007. Exact date and venue is to be announced

Main goal:

All presenters have voxel-wise glomerular filtration rate GFR-estimation from 3D DCE-MRI data as the possible end-point. It was recongized that GFR is considered as the best standard measure for measurement of kidney function and that an accurate determination of kidney function is of fundamental importance in diseases of the kidney and urinary tract as well as extra-renal diseases associated with disturbed water and electrolyte homeostasis. Today, there are currently no available MRI methods that can accurately measure GFR on a pixel-by-pixel basis.

A workflow were made that showed the step-by-step procedure from patient handling to estimated GFR values:

Workflow for voxelwise GFR-estimation from DCE MRI data using image registration techniques and pharmacokinetic modelling



Subprojects that will present their results at the proposed follow-up meeting in 2007:

Subproject 1: Clinical aspects and evaluation:

Groups: Bergen, Manchester, Munich, Aarhus.
Action: Clinical MRI data can be obtained from the clinical MRI systems. A standard protocol (consensus?) is needed in order to standardize quantitative dynamic contrast-enhanced MRI of the kidneys. This action will demonstrate differences and needs for a standardized method. The already strategies in Bergen, Manchester, Munich and Aarhus are compared, and based on their individual methods in (each Hospital) results are to some extent compared against internal references.

Subproject 2: Investigatoin of acquisition / protocol parameters:

Groups: Munchen, Manchester, Jena
Action: This action goes in parallel with subproject 1. Specific sequence and acquisition parameters are investigated: 3D DCE MRI, free breathing, navigators, time of scan: 2-8 min, sampling rate: 1 frame per 2-3 sec, conversion of signal intensity into Gd-concentration, etc. This Subproject could feed Subproject 3 with relevant data.

Subproject 3: Image registration / motion correction / image segmentation:

Groups: Madrid, Ljubljana, Bergen, Manchester
Action: This action highlights the importancy of post-processing of the acquired MRI images before pharmacokinetic modeling, including the need of image registration, automatic segmenation, alignment, and how to select kidney segments.

In the follow-up of this meeting first contacts between Madrid, Bergen, Manchester and Munich have been established to exchange data. Furthermore, collaborative work on evaluation of the algorithm and their impacts on the paharmacokinetic models is planned.

Subproject 4: Pharmakokinetics / modelling:

Groups: Munchen, Manchester, Aarhus
Action: Different pharmacokinetic models of the kidney has successfully been applied to the human kidney. However, there seems not to exist a comparative overview of the different methods applicable for the renal cortex. This action aims towards comparing the different renal parameters (GFR, RBF, extracellular volume, etc) with the different models. Renal data can be taken from either human or animals.

Subproject 5: Software development:

Groups: Lodz, Bergen, Madrid, Ljubljana, Munich
Action: This action presents a data work-flow needed in the steps presented in workflow figure (page 3). This includes a designed data strategy how to import/handle data, process data and view data. Should that be made as one single software package with an internal database, or as many software pieces each linked to a common Dicom server, or something else? The software may alternatively be configured as a web-based service that can be launched anywhere in order to process locale files.

Subproject 6: Database (annotated, DICOM):

Groups: Lodz, Bergen
Action: The data itself can be considered as unprocessed, partly unprocessed or fully processed. A database is designed that can handle data in the various steps (see workflow figure). This may preferably be configured as a Dicom interface, perhaps with a weblink / java interface allowing external users to communicate with this database. The practical needs are considered within this group.

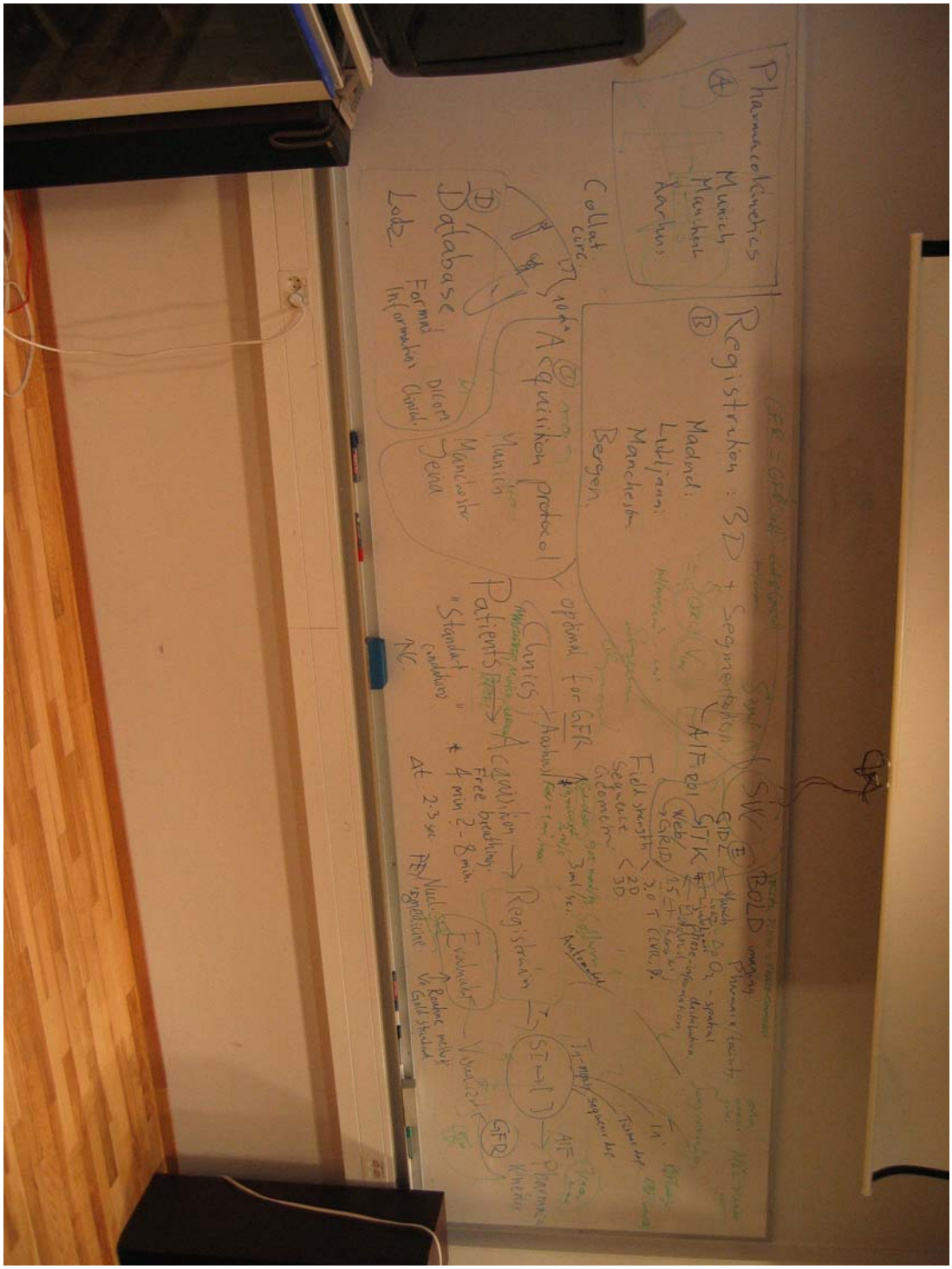
It was discussed that the following variables are needed to measure GFR based on dynamic contrast-enhanced MRI in the clinics:

System:
Machine manufacturer
Magnet field strength

Acquisition parameters:
Pulse sequence
2D / 3D acquisition
triggering?
Voxel size(matrix and slice position)
Signal-to-noise
What RF-coil used
Contrast-agent
Dose / flow-rate

Processing:
Compensation for inflow effects, artifacts, etc.
Movement correction
Reorientation / alignment
Region of interests / pixel-wise analysis
Automatic / manual segmentation
Conversion of signal to Gd-concentration
Kinetic model: (deconvolution, upslope model, Patlak model etc.)

Results:
Reproducibility and preceision
Reference method (nuclear medicine?)
Clinical consequences



From the kidney “brain-storming” session (Photo: Peter Rogelj)