EC COST B21
Physiological Modelling of MR Image Formation

WORKING GROUP 1 MEETING

VENUE
COST OFFICE
149 Avenue Louise, XXI FLOOR
Brussels - Belgium

Saturday 26th June 2004

1) R Lerski opened the meeting by welcoming everyone to Brussels.

2) J.R. Reichenbach gave a brief overview to the focus of the meeting which aimed to introduce and present some of the available MR imaging as well as data evaluation techniques and tools to the COST members, in particular to the members of Working Group 1. As discussed before at the Dundee meeting the main goal of Working group 1 is to develop and implement MR sequences and/or techniques related to the following areas: Perfusion, DWI and DTI, BOLD-imaging, and ^{23}Na imaging.

3) **Scientific Presentations of the Participants**

The list of participants and the agenda of this one-day meeting are attached in Appendix I and Appendix II, respectively.

Christian Brekken (NO) gave an overview of existing MR-perfusion techniques, including arterial spin labeling and first-pass bolus techniques before presenting a new approach implemented at his home institution to apply T_1-weighted, contrast-enhanced dynamic 3D sequences on a 3 T scanner. He also referred to the data analysis which involves deconvolution of the tissue response function by the arterial input function.

Michal Bittsansky (SK) reported on the ^{23}Na imaging experiments performed in Vienna on cartilage and showed images obtained with a microimaging gradient insert system. He also gave an overview on the physical and magnetic properties of sodium and the different existing MR approaches to the imaging and characterization of cartilage.

Jürgen Reichenbach (D) gave an overview of the technique and applications of susceptibility weighted imaging, which makes it possible to image sub-voxel sized venous vessels and to create new tissue contrast by exploiting the full complex nature of the MR signal.

Markus Barth (A) presented results in patients with brain tumors by applying contrast-enhanced MR venography, which is based on susceptibility weighted imaging. Combining high field strength and administration of a contrast agent makes it possible to

obtain high-resolution images with superb contrast and resolution details within clinically acceptable acquisition times.

József Molnár (HU) introduced the possible role of negative entropy in tumor growth, which is based on the hypothesis that cancer and normal living state are metabolically different, and can be considered as thermodynamically different ensembles that exist in close proximity. He presented experimental data on the influence of low temperature on the survival time and tumor growth as well as changes of the body and tumor weights of tumor bearing mice.

Arvid Lundervold (NO) gave a comprehensive overview of diffusion weighted imaging and diffusion tensor imaging. He referred to the relevant physiologic aspects underlying the imaging features seen with DWI/DTI and also described the corresponding acquisition techniques and the tensor data analysis. Application fields of DWI/DTI for clinical studies were introduced and new approaches, such as diffusion spectrum imaging and tractography, were described.

Sune Jespersen (DK) presented results on numerical simulations to investigate the influence of cell size variations on pulsed field gradient diffusion measurements. He compared the two-compartment Kärger model with a mamillary model in which each cell has its own compartment and can only exchange with the extracellular space. He concluded that the two-compartment model is relatively robust against cellular size variations, but that there are situations (e.g. broad distribution of radii) which impact the compartmental volume fractions.

The final talk was given by **Hans Stødkilde-Jørgensen** (DK) who reported on the application of texture analysis (TA) for assessing the efficacy of anti-vascular tumor therapy in a mouse model. TA was able to detect changes in the carcinoma after administration of vascular targeting drugs. However, it was pointed out that the interpretation of the TA appears difficult.

Milan Hajek (CZ) gave an update of the current status of the textbook entitled "Texture Analysis for MR Imaging", which was proposed in detail at the last meeting in Dundee. As soon as he receives the two missing chapter abstracts he will go on to contact the publishing company.

4) Discussion

The discussion aimed to summarize the status of the available techniques and to point to future project directions. It was commonly agreed that the meeting has been helpful in setting the stage for ongoing projects between different groups. The webpage should serve as a platform for information exchange by updating, for instance, the compilation of the equipment and techniques available in the different groups to facilitate scientific exchange and contacts (see below).
J.R. Reichenbach presented a rough outline on the continuation of the SWI project including the development and testing of phantoms mimicking single vessels and capillary bed for modeling and measuring signal decays at 1.5 T and 3 T. It would be very interesting to extend this work at higher fields and to apply the technique to more clinical cases. One interesting aspect would be the extraction of the venous vessel tree from the MR data. This possibility is currently explored with the Lodz group and may lead to a STSM between in Jena and Lodz in the near future.

It was generally felt that there is an urgent need for appropriate phantoms, in particular with respect to diffusion, which would allow to mimick the physiological situation and to compare the experimental results with simulations.
M. Hajek raised the question about the application of texture analysis (TA) with respect to the presented MR techniques and sequence development. He expressed concerns that TA has not been explicitly incorporated into the presented talks and ongoing projects. This was confronted by several responses that the present meeting aimed to disseminate the different techniques available within WG 1 and COST B21 and that TA could and should be one of the possible evaluation tools for analyzing the acquired data. M. Hajek also referred to the existence of several phantoms whch have been designed and tested for TA applications in COST B11. Whether and how these phantoms may be used for experiments concerning diffusion, perfusion, and/or susceptibility-weighted imaging to answer specific physiology-related questions remains to be seen.

Short Term Scientific Missions

R. Lerski encouraged the participants to utilize the possibilities of the STSM and to apply for them. There has been a STSM between Jena and Vienna in June and an upcoming STSM between Vienna and Jena is already planned.

5) Website

It was discussed and agreed on that the website of COST B21 should be regularly updated (http://www.die.upm.es/costb21/) and that the compilation of the available equipment and the different imaging techniques of the COST members will be part of the web page.

J.R. Reichenbach, R.A. Lerski
28 June 2004