A software tool for aligning and linking morphological CT, quantitative DCE- and DWI-MRI with morphological CT and 3D pathology in lung cancer staging and tumor biology

All Day Location: QIRR, Learning Center

Participants
Hendrik O. Laue, PhD, Bremen, Germany (*Presenter*) Nothing to Disclose
Johannes Lotz, Luebeck, Germany (*Abstract Co-Author*) Nothing to Disclose
Peter Kohlmann, PhD, Bremen, Germany (*Abstract Co-Author*) Nothing to Disclose
Oliver Sedlaczek, MD, Heidelberg, Germany (*Abstract Co-Author*) Nothing to Disclose
Horst K. Hahn, PhD, Bremen, Germany (*Abstract Co-Author*) Nothing to Disclose

BACKGROUND

Imaging tumors using functional DCE- and DWI-MRI provides valuable information for staging and treatment decisions in various cancers. The morphology and volumetry derived from high spatial resolution CT data is of high clinical relevance, too, especially in lung cancer. The link to pathology can further help understanding the underlying pathology of cancer growth and treatment response, especially when molecular stainings are available revealing the microbiological context.The presented software tool provides quantitative DCE- and DWI-MRI using state of the art methods for calculating parameter maps of Ktrans,vi,vp and ADC in the tumor. It offers an automatic registration of functional and morphological MRI with CT data of the different tumor areas. This enables the user to gain a multimodal overview of the tumor investigated.A localization of pathological specimen is facilitated by an interactive 3D and multiplanar projection reformating (MPR) visualisation. This allows a direct comparison of functional and pathological findings. Available pathological 3D reconstructions (e.g., from whole slide scanning) can be navigated and aligned using the radiological data.Most of the described functionality is available. An updated version will be available at the end of 2015.The application is distributed to interested investigators at no costs as a binary installer for windows 7/8 64 Birt and for Mac OS X.A research license can be obtained with a one page research-proposal and the signing of a license agreement excluding clinical use.The software has been used at the German Cancer Research Center, the University Hospital Heidelberg, both in Heidelberg, Germany and in the University Hospital Cologne.

METHODOLOGY/APPLICATION

Our application is a software for quantitative MRI and CT of the lung providing: Advanced DCE-MRI and DWI using automatic motion correction in the lung. Automated AIF detection, the general kinetic model (GKM) and the extended GKM (eGKM), The use of B1 and T1 maps accounting for field and tissue properties. DWI-MRI, including advanced biexponential modeling. Accurate alignment of functional and morphological data. Two click segmentation of the tumor and some physiological structures.The software also allows to align excised segments from pathology to the radiological data. Creation an interactive color 3D view of the data allowing to manually place the cutting plane in the tumor. Creation of MPR images to use MRI contrast to identify soft tissue features such as necrosis or adjacent physiological structures also visible in the pathology.The localization information allows identifying an adjacent whole slide image or a 3D reconstruction from pathology for comparison with histological information (staining, cell count, vessel properties, …) to functional MRI data. The software can read and handle various pathological image formats and multi resolution pathological image display ensuring a convenient orientation and magnification of the histological data.

DEMONSTRATION STRATEGY

The visitor will be introduced to functional MRI in oncologic radiology: the requirements of motion correction, the application of the eGKM and the benefits of the DWI different models. Moreover, we will discuss the requirement for B1 and T1 maps with the visitor.We will show how to generate parameter maps from DCE and DWI-MRI sequences and how to automatically segment the tumor volume from a high resolution CT. The automatic alignment of the different modalities will be explained in detail.The visitor will then be introduced in the navigation through the 3D representation of lung and tumor to place a segment corresponding to the pathological specimen. He or She will then be shown how the soft tissue contrast of MRI and the contrast agent uptake can improve the alignment of histological and pathological data.Finally, we will show how to use the software to import, view and annotate histological data. We will also show how simple quantification results of the pathology can be displayed and exported.

REFERENCES AND PUBLICATIONS

[1] Kohlmann et al, 2011. Towards a research software platform for diagnosis and monitoring of COPD and asthma with pulmonary MRI. 5th International Workshop on Pulmonary Functional Imaging [2] Laue et al., 2007. Softwaretools for Pharmacokinetic Modeling in the Analysis of DCE-MRI data. RSNA 2007. [3] Ritter et al, 2011. Medical image analysis. IEEE Pulse [4] Ng et al, 2010. Reproducibility of Perfusion Parameters in Dynamic Contrast- Enhanced MRI of Lung and Liver Tumors: Effect on Estimates of Patient Sample Size in Clinical Trials and on Individual Patient Responses. AJR [5] Padhani et al, 2009. Diffusion-Weighted Magnetic Resonance Imaging as a Cancer Biomarker: Consensus and Recommendations. Neoplasia.

Meet-the-Experts Sessions:

Sunday 12:30pm - 1:30pm Monday 12:15pm - 1:15pm Tuesday 12:15pm - 1:15pm Wednesday 12:15pm - 1:15pm Thursday 12:15pm - 1:15pm