WHOLE-BODY PET-MRI - Co-Registration And Image Fusion In Pattients With Cancer

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The purpose of our paper is to illustrate and evaluate the feasibility of fusion functional positron emission tomography (PET) data with anatomical magnetic resonance (MR) images, using highly-quality whole body MRI imaging.

Cancer is one of the leading causes of morbidity and mortality in developed countries. Complex clinical decisions on the treatment of oncologic patients are largely guided by imaging findings, among other factors. Most radiologic procedures show the anatomy and morphology of tumors with little or no information about their metabolism. Positron emission tomography (PET) performed with 2-[fluorine-18]fluoro-2-deoxy-d-glucose (FDG) has proved valuable in providing important tumor-related qualitative and quantitative metabolic information that is essential to diagnosis and follow-up. PET– computed tomography (CT) is a unique combination of the cross-sectional anatomic information provided by CT and the metabolic information provided by PET, which is acquired during a single examination and is then fused.

MRI had shown to be superior to CT for examining specific regions of the body, such as the central nervous system, the abdomen, the pelvis, the skeletal and soft tissues. The exception to this rule has the been imaging of the lungs, which are better examined by CT than by MR, although MR is rapidly advancing. Regarding safety, MRI is a safer than CT, both the imaging system itself (x-rays) and the intravenous contrast agent (gadolinium X iodine-based agents).

Although theoretically highly attractive, MR imaging of tumor and metastases is hampered by severe limitations. Time-consuming repositioning of the patient and the surface coils, which is necessary for the entire body to be imaged, leads to lengthy examination time.

Two years ago, high-quality whole body MRI imaging would take 2 hours, and now, with the new designs of transmit-receiver coils, an easier movement of the imaging table, and new data acquisition techniques, we have been able to obtain rapid imaging of the entire body with highly quality in 20 up to 30 minutes, with an acceptable image quality of the lungs.

Dual-modality positron emission tomography (PET) and magnet resonance (RM) scanning provide both accurately fused morphologic (MR) and functional (PET) data sets. With combined PET and MR, the lack of anatomic information, which is considered the major limitation of PET scanning, can be overcome. If the MR component is used only for anatomic correlation, however, the diagnostic potential of the combined scanning approach is not fully exploited. Since some malignant tumors do not demonstrate increased glucose metabolism, the addittional information provide by MR images is substantial benefit.

Whole-body PET/MR examinations were performed in 20 patients with different cancerous diseases (lung carcinoma, endometrial sarcoma, carotid body paraganglioma, melanoma, lymphoma, ovary cancer, sarcoma, colon cancer, desmoplastic round cell tumor).

MR examinations were performed on a 1.5-T system (Magnetom Avanto; Siemens Medical Systems, Erlangen, Germany) equipped with Tim (Total imaging matrix) technology and high-performance gradient systems (45 mT/m) and a slew rate of 200 mT/m/msec. Isotropic volumetric interpolated breath-hold examination (VIBE) with and without fat saturation, pre- and post-gadolinium, and T2-weighted images were obtained. PET studies were performed with a PET scanner (ECAT/EXACT; Siemens Medical Solutions). Whole body PET-MRI co-registration and image fusion were analyzed and performed at the workstation (E-soft and Leonardo, Siemens).

The preliminary results indicate that the described technique has the potential to emerge as an all-encompassing alternative to conventional multimodality tumor staging strategies.