5th Annual Research Symposium of Henry Ford Health System

Sponsored by

Henry Ford Medical Group Academic Programs

Friday, April 25, 2008

8am - 5pm

Poster Presentations
Thursday April 24 - Friday April 25
(Mixer 3.30 - 5.30 PM on Thursday)

Education & Research Building
2nd Floor
Henry Ford Hospital
2799 West Grand Blvd.
Detroit, MI 48202

Abstract #73
5th Annual Research Symposium
HFMG Academic Affairs

Comparison between transgenic endothelial progenitor cells and dendritic cells in gene delivery and their expressions

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Objectives: Gene therapy is expected to be a potential approach for breast cancer treatment. Beside the invasive nature of breast cancer, several factors, including lack of an efficient vector and delivery system itself, limit the effectiveness of systemically or locally administered genes. Previously we have shown possible application of endothelial stem/progenitor cells (EPCs) or dendritic cells (DCs) as gene delivery vehicles. In this study we compared the efficacy of gene delivery of these two cell types at 2 diffferent time points.

Method: Three million human breast cancer (MDA-MB-231) cells were subcutaneously implanted in the right flank of nude mice. Both, EPCs and DCs were genetically transformed to carry hNIS gene using adenoviral vectors. Genetically transformed cells were administered intravenously in tumor bearing. Single photon emission computed tomography (SPECT) images were acquired 3 and 7 days after cell injection, with a custom built micro-SPECT (converted from a clinical PRISM 3000XP using multi-pinhole animal collimators from Bioscan Inc.) using Tc-99m. Ratio of sums of signal intensities of whole tumor volume and sums of signal intensities of the same volume of contra-lateral muscle was used as indicator of the level of transgene expression.

Results: No difference was observed between EPCs and DCs in their abilities for gene delivery and expression. In addition no difference was observed between transgene expression for day 3 and day 7 within the cell type group.

Conclusion: Our study indicates that both EPCs and DCs can be used for gene delivery by systemic administration and their gene expression doesn't change significantly after 7 days of injection.

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Subject Category: Imaging

Abstract #76
5th Annual Research Symposium
HFMG Academic Affairs

Validation of Integrated EEG/MEG and fMRI Model Using Real Data

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Introduction: For the diagnosis and treatment evaluation of some neurological disorders such as epilepsy, multi-modality analysis of magnetoencephalography (MEG) or electroencephalography (EEG) with functional MRI (fMRI) is expected to be beneficial. An integrated model of the brain activation is crucial for this multi-modality analysis.

Methods: The main aim of this study is to determine the parameters of our proposed integrated EEG/MEG and fMRI model using real MEG and fMRI data. In this model, the external stimulus generates neural activities related to the post synaptic potentials (PSPs) which are the common link between MEG and fMRI. First order linear filter is used to calculate the number of active PSPs as a function of the external stimulus. We derive the relationship between the number of active PSPs and the overall synaptic activity to generate the fMRI signal. For estimating the parameters of the model, we use real MEG and fMRI data. While it is impossible to record MEG and fMRI signals simultaneously, these data are gathered from 7 normal subjects using the same auditory stimulus of tones. After calculating the average MEG block response, we use independent component analysis (ICA) to extract the MEG signal of the brain activity occurring in the primary auditory cortex. This signal is used to estimate parameters of the linear filter which generate the number of active PSPs. The corresponding spatio-temporal sequence of the fMRI activation, measured in the primary auditory cortex, is used to estimate the fMRI parameters of the proposed model.

Results: The estimated values of the parameters of the integrated Model are in agreement with other works which separately studied MEG and fMRI. The estimated values of the parameters for all 7 subjects have reasonable means and standard deviations. In addition, we have two series of fMRI datasets for some subjects whose estimated parameters have very small deviations. Finally, we illustrate goodness of fit of the real MEG and fMRI datasets to the proposed integrated MEG/fMRI model.

Conclusions: The proposed model with estimated values of its parameters can be used to simulate realistic datasets for evaluation of the integrated MEG/fMRI analysis methods. In addition, proposed integrated model and its parameterization can be used to diagnose or characterize related neurological diseases.

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Subject Category: Imaging

Abstract #80
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BLOOD CIRCULATORY MODEL TO ESTIMATE ARTERIAL INPUT FUNCTION IN BRAIN MR PERFUSION STUDY

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Introduction:
The arterial input function (AIF) plays an important role in estimating relative Cerebral Blood Flow and Volume (rCBF and rCBV) in MRI perfusion studies. Thus, a mathematical model of Contrast Agent (CA) concentration in the circulatory system as a function of time is of interest since it may allow the description of the AIF based on the Intravenous (IV) injection function.
Material and Methods: In this study, as a building block, the concentration-time profile in the circulatory system for each organ (compartment) was modeled by simple physical and pharmacokinetic assumptions using the Fick and Kety's model. A complete model of the CA concentration as a function of time in the circulatory system was then constructed by combining those building blocks using typical flow and volume parameters for the various compartments. Using a model of the IV bolus injection, its results were compared to MR perfusion (T2*) signal. Three parameters defined each compartment (volume, flow, and time lag) in four ratios: $[(V_r^2/\tau F^2)_H, (V_r^2/\tau F^2)_L, (V_r^2/\tau F^2)_B$, and $(V_r^2/\tau F^2)_{W-O}]$ for the four compartments, using typical parameters of an adult human. Simulation was long enough (75 Sec) to generate all orders of bolus passages (first, second, etc.), and long compared to the duration of injection (5 sec).
Results and Discussion: Results imply that there is a good agreement between the model estimation and experimental AIF ($r=0.79$, $p<0.0001$). Note that, since the peak of the measured AIF is often underestimated, the model curve, if appropriately scaled, may provide a better representation of the true shape of the AIF than does the measured curve alone. There are about 1.5 seconds of delay between the model (carotid site) and the experiment (inside brain) which is due to the difference in sites of measurement. The proposed model needs only 4 parameters to generate a CA concentration profile, and may be more accurate and easier to implement compared to the methods that fit gamma-variate functions to the perfusion curves. Since all model parameters are defined regardless of the signal type and imaging parameters, this model can be easily translated to animal studies and can also be used in other imaging techniques (e.g., CT).

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Subject Category: Imaging

Abstract #84
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SPECT Analysis of Hippocampus and Amygdale for Lateralization in Temporal Lobe Epilepsy

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Background & Objective: Perfusion patterns may be used for lateralization of temporal lobe epilepsy (TLE). Between epileptic events, the abnormal area experiences a decrease in the blood flow which may be detected from the interictal SPECT scans. During the seizure event, the epileptic zone experiences an increase in the blood flow, which is detected from the ictal SPECT images. Conventionally, the subtraction of the SPECT images is seen by radiologists looking for any asymmetry of perfusion pattern within the brain, in particular the temporal lobe, which may help declaring focal epileptogenicity. We have improved the TLE lateralization by analyzing the SPECT data for hippocampus and amygdale instead of the whole temporal lobe.

Experimental Approaches: T1-weighted (T1W), ictal and interictal SPECT studies of 28 patients (12 males, 16 females; ages 17-62, mean 42, 13 right-sided, 15 left-sided, determined through pre-operative EEG examinations) were acquired. The T1W images were segmented into 93 structures by non-rigid co-registration of an atlas to the T1W image set. We also used rigid transformation to co-register the ictal and interictal SPECT images to the T1W images. Linear transformation of the SPECT intensities obtained by minimizing the L1 norm of the ictal and interictal difference was used for normalization of the ictal and interictal SPECT intensities. Using the segmentation and co-registration results, we calculated the mean and standard deviation (StD) of the intensities of SPECT images for the aforementioned structures. We calculated the difference of right and left mean values as well as the ratio of their StDs for each structure, and used these features for lateralization.

Results: SPECT features of hippocampus provided 93% correct classification of the subjects into left-sided and right-sided. This is in contrast to 89% and 82% correct classification using the SPECT features of the amygdale and whole temporal lobe, respectively.

Conclusions: SPECT analysis of the individual structures may improve the accuracy of lateralization in temporal lobe epilepsy compared with SPECT analysis of the whole temporal lobe.

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