AbstractID: 10499 Title: Effects of inter-frame motion in pharmacokinetic modeling using simulated heterogeneous phantoms

Purpose: Motion induced errors in parametric measures using DCE-MRI are reduced after image co-registration, but no prior studies considered heterogeneity of lesions for assessment of uncertainties from inter-frame motion. It is necessary to investigate heterogeneity dependence of motion effects, since tumors are known to be heterogeneous for many characteristics. In this study, we investigated motion effects in kinetic modeling using the simulated phantoms generated at various levels of heterogeneity in vascular permeability.

Method and Materials: We created 3D ellipsoidal phantoms. Time series images were generated for three different tumor types using the Tofts model. To simulate heterogeneity, a sinusoidal pattern was generated in a K^{trans} map. The kinetic parameters were generated from multivariate normal distributions, and pixel values at 16 time points were filled using the Tofts model. All the images were randomly transformed based on the *in vivo* measurements with fiducial markers. Image co-registration was performed. Pharmacokinetic analysis was done on a voxel-by-voxel basis with and without motion correction (MC).

Results: Motion correction improved accuracy for all lesions, but the degree of improvement depended on malignancy. Coefficient of variation of K^{trans} was much larger in benign lesions than in malignant lesions. Mean K^{trans} was overestimated for all lesions even after MC. Largest overestimation of 55% in mean K^{trans} was observed for heterogeneous benign tumors. Large variation in mean K^{trans} due to heterogeneity was seen for benign tumors leading to poor separation between benign and malignant lesions.

Conclusion: Results showed that small scale motion leads to large errors in quantitative measures of kinetic modeling especially for benign lesions. After MC, the accuracy was improved but mean K^{trans} was overestimated for all lesions. Large overestimation of mean K^{trans} for benign lesions makes it difficult to distinguish benign from malignant lesions. The results will be validated with an increased number of realizations.