AbstractID: 11538 Title: Incorporation of angiogenesis in the stochastic imaging-based tumor vasculature model

Aim

Controlling interaction between tumor growth and vasculature development are the basis of anti-angiogenic therapies. A model simulating tumor growth and angiogenesis was developed and the tumor oxygenation status was evaluated with respect to two parameters: tumor proliferation rate (TPR) and endothelial cell proliferation rate (EPR).

Methods and Materials

Our previous image-based model of vasculature was expanded by incorporating angiogenic development. The tissue volume encapsulating the tumor and vasculature was simulated as a MATLAB matrix. Vessels were simulated to sprout from the existing vasculature towards the tumor driven by hypoxia-induced growth factors. The relative magnitude of TPR and EPR determined the simulation time steps. Xenografted and spontaneous tumors were simulated and the tumor oxygenation status was evaluated with respect to TPR & EPR. The model was verified against the experimental data obtained from CE-CT and Cu-ATSM PET imaging.

Results

The time-dependant growth of vessels towards hypoxic regions in the tumor was demonstrated. TPR was found to have the most profound impact on development of hypoxia and heterogeneity of the oxygen concentration inside the tumor. Higher TPR led to faster development of hypoxia. Due to the limited vasculature available, xenografted tumors become hypoxic faster than spontaneous tumors for similar TPRs. When comparing simulations to the experiments, the overall development of vasculature and consequent hypoxia matched well with the imaging data.

Conclusions

A model capable of simulating temporal development of tumor and vasculature has been developed and tested on the imaging-derived experimental data. The presented model has a potential to study the response of tumor and the vasculature to therapy, which can be a valuable input for optimizing anti-angiogenic therapies.