Dokumenttyp: journal article

Autor(en) des Beitrags: Shi, K; Souvatzoglou, M; Astner, ST; Vaupel, P; Nüsslin, F; Wilkens, JJ; Ziegler, SI


Abstract: Several kinetic models have been proposed to assess the underlying oxygenation status behind hypoxia tracer uptake and have shown advantages, compared with static analysis, in discriminating hypoxic regions. However, the quantitative assessment of mathematic models that take into consideration clinical applications and their biologic nature is still challenging. We performed a feasibility study to assess hypoxia kinetic models using voxelwise cross-analysis between the uptake of the perfusion tracer (15)O-H(2)O and the hypoxia tracer (18)F-fluoroazomycin arabinoside ((18)F-FAZA). Five patients with advanced head and neck cancer were included. For each patient, dynamic sequences of (15)O-H(2)O for 5 min and (18)F-FAZA for 60 min were acquired consecutively after injections of approximately 1 GBq and 300 MBq of each tracer, respectively. The compartment model, Thorwarth model, Patlak plot, Logan plot, and Cho model were applied to model the process of tracer transport and accumulation under hypoxic conditions. The standard 1-tissue-compartment model was used to compute a perfusion map for each patient. The hypoxia kinetic models were based on the assumption of a positive correlation between tracer delivery and perfusion and a negative (inverse) correlation between tracer accumulation (hypoxia) and...
Positive correlations between tracer delivery and perfusion were observed for the Thorwarth and Cho models in all patients and for the reversible and irreversible 2-compartment models in 4 patients. Negative correlations between tracer accumulation and perfusion were observed for the reversible 2-compartment model in all patients and for the irreversible 2-compartment model and Cho model in 4 patients. When applied to normal skeletal muscle, the smallest correlation variance over all 5 patients was observed for the reversible 2-compartment model. Hypoxia kinetic modeling delivers different information from static measurements. Different models generate different results for the same patient, and they even can lead to opposite physiologic interpretations. On the basis of our assessment of physiologic precision and robustness, the reversible 2-compartment model corresponds better to the expectations of our assumptions than the other investigated models.