Impact of the arterial input function on the classification of contrast-agent uptake curves in dynamic contrast-enhanced (DCE) MR images based on heuristic shape modeling

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ABSTRACT

Purpose: To demonstrate that inter-patient differences in the spreading of the contrast agent throughout the blood, described by the arterial input function (AIF), should be considered in the classification of contrast-agent uptake curves in the tissue of interest, e.g., a suspicious lesion in the breast. In the application of heuristic shape modeling (Kuhl et al. 1999, three-time-point (3TP) by Weinstein et al. 1999), the AIF is not extracted from the DCE-MR image series and, therefore, not taken into account.

Methods and Materials: A two-compartment model (extended Kety) with fixed pharmacokinetic parameters is used to simulate the tissue-response curves for different AIFs. The shape of these curves is classified into benign, suspicious or malignant by means of the 3TP method.

Results: While AIFs are known to differ in a wide range, our simulations indicate that already small changes of the AIF considerably alter the shape of the response curve. These changes may even lead to different curve classifications, although the simulated response curves relate to 'tissue' with fixed pharmacokinetic properties.

Conclusion: The shape of contrast-agent uptake curves expressed by simulated tissue with fixed pharmacokinetic properties can get classified differently in different patients owing to inter-patient variations of the AIF. Evaluation of the influence of variation in AIFs in real patient data is work in progress. Validation of our observation with real patient data might suggest that deconvolution with patient-specific AIFs, as it is done in pharmacokinetic modeling, improves reliability of tissue classification derived from the shape of contrast-agent uptake curves.