

Population-Generalized vs. Individual-Specific AIF in Human Prostate DCE-MRI Pharmacokinetic Analysis

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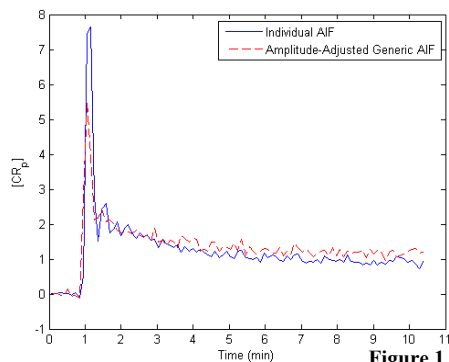


Figure 1

Matrix and flexible Body Matrix RF coils. The DCE-MRI sequence employed a 3D TurboFLASH sequence with a 256*144*16 matrix size and a 360*203 mm² field of view, resulting in an in-plane resolution of 1.4 * 1.4 mm². Other parameters are: slice thickness: 3 or 3.2 mm; TR/TE/FA: 5.0 ms/1.57ms/15°. Femoral arterial time-course data were obtained from all subjects, a subset of which (subjects 1-6) were temporally aligned and averaged to generate the generic AIF. Regions-of-interest (ROIs) were selected to include the entire prostate. **Figure 1** shows an example of an individual AIF (solid blue curve) and the averaged generic AIF (dashed red curve). Pharmacokinetic modeling (SM and SSM) was performed for all nine subjects on a pixel-by-pixel basis in each ROI using the subject-specific AIF. The analyses were repeated for all subjects using the generic AIF. In each case, the respective AIF was amplitude adjusted using obturator muscle as reference tissue [4].

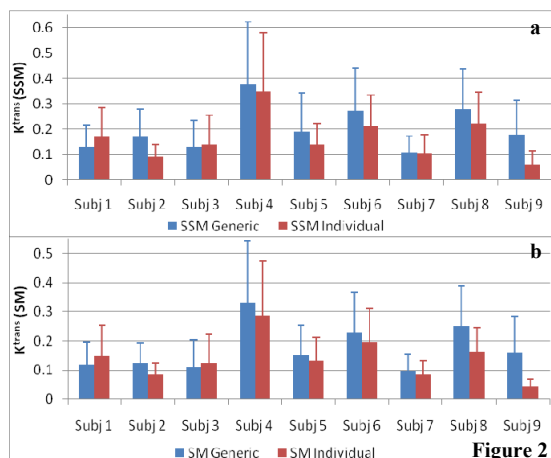


Figure 2

of the latter. The washout rate is often seen to be shallower than that of the individual AIF. Overall, the generic AIF takes on a somewhat different shape from the individual AIF and thus results in the elevated K^{trans} values in general. However, these differences may appear visually small. Since AIFs from subjects 1-6 were averaged to generate the generic AIF, it is expected that at least some of these data sets would display decreased K^{trans} values from use of the generic AIF (subjects 1, 3) and some would increase (subjects 2, 4 - 6). Even so, the trend of elevated K^{trans} values holds for the remaining population (subjects 7-9) whose individual AIFs did not contribute to the generic AIF. As seen in Figure 3, both approaches find hot spots in the same prostate areas, which correlates with that of a biopsy proven lesion. The hot spots seem better defined when the individual AIF is used, and are hotter when the SSM is used. This suggests that an individual AIF is preferable whenever one is possible, especially for large K^{trans} applications as in the prostate.

Results. When the generic AIF was used, both SM and SSM experienced parameter overestimation as compared with use of the individual AIF for most cases. **Figure 2a** shows the ROI-mean SSM-fitted K^{trans} values with error bars representing 1 standard deviation (SD). **Figure 2b** shows the same for SM. Most of the time, use of the individual AIF also yields higher precision as seen by the smaller SD. **Figure 3a** shows an axial pelvic DCE image for subject 7, with the prostate ROI circumscribed in yellow. False-color axial prostate K^{trans} parametric maps are shown for the SM (panels b, c) and SSM (panels d, e) fittings for the individual (panels b, d) and generic (panels c, e) AIFs.

Discussion. It can be easily seen in Figure 1 that, while the generic AIF is amplitude adjusted such that the total area under the curve (AUC) is approximately equal to that of the individual AIF, the peak of the former is generally lower than that of the latter.

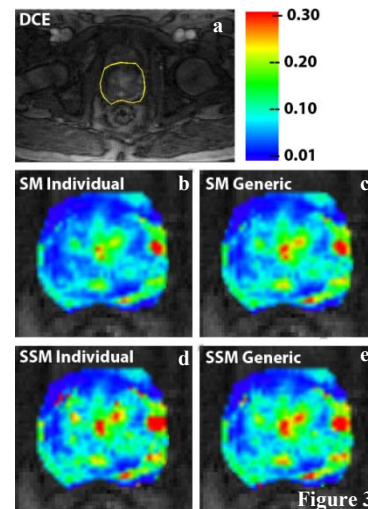


Figure 3

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