Purpose: To generate a composite population-averaged (PA)-AIF for quantitative analysis of DCE-MRI data in head and neck (H&N) patients that is based on the right (RT) and left (LT) carotids, two pre-treatment scans, and one post-treatment scan.

Methods: Twenty patients were imaged while undergoing concurrent chemoradiation (CRT) for H&N malignancies. The imaging protocol (1) included two baseline scans one week apart (Base1, Base2), and one scan 1 week post-CRT (Post). For each patient and time point, regions of interest (ROIs) in both the RT and LT carotids were drawn on coronal images. The plasma concentration curves of all ROIs were averaged and fit to a bi-exponential decay function to obtain the final PA-AIF (AvgAll). The ROIs were also divided by time point to obtain AvgBase1, AvgBase2, and AvgPost AIFs. The vascular transfer constant for both primary and nodes, $K^{\text{trans}}$, was calculated (iCAD, Inc.) using the 4 AIFs, as well as the generic Weinmannâ€™s AIF. The median $K^{\text{trans}}$ values resulting from the AvgAll AIF were compared using Bland-Altman plots with the ones obtained from each individual time point. The Wilcoxon signed-rank test was used to compare the proposed AvgAll AIF and the generic AIF.

Results: The plasma parameters for the AvgAll AIF were $a_{1,2} = 27.1135/17.6486$ kg/liter, $m_{1,2} = 11.7525/0.2054$ min$^{-1}$. The differences in $K^{\text{trans}}$ values using these coefficients vs. Weinmannâ€™s were statistically significant ($p<0.0001$). The median $K^{\text{trans}}$ values from the AvgBase1, AvgBase2, and AvgPost AIFs were, in most cases, not significantly different from the AvgAll values, indicating that the latter is appropriate for use at all time points.

Conclusions: A population-averaged AIF for H&N was generated that accounts for differences in RT vs. LT carotids, day-to-day AIF fluctuations, and treatment-induced AIF changes. It is not necessary to measure a post-treatment AIF to evaluate treatment-induced $K^{\text{trans}}$ changes.

1. Craciunescu et al., MedPhys, 37, 6, 2683, 2010