Purpose. Apparent diffusion coefficient (ADC) plays a key-role in the context of quantitative diffusion-weighted MRI (DW-MRI) for response assessment in particle-therapy. With this purpose, threshold values defined on ADC could be clinically used to discriminate respondent and not-respondent patients. However, concordant ADC measurements are required for their acceptance as quantitative biomarkers [1]. This study aims at retrospectively investigating the role of ADC maps estimation by comparing different offline strategies with respect to an online map, directly derived from the clinical scanner.

Methods. DW-MRI at 7 b-values (0, 50, 100, 150, 200, 400, 1000 s/mm²) were acquired during 58 examinations of the brain using a clinical MR scanner (3T). ADC was computed online and offline. For the latter case, DW-MR images at two (ADC_2b: 0–1000 s/mm²; ADC_200b: 200–1000 s/mm²), three (ADC_3b: 50–400–1000 s/mm²) and all (ADC_7b) b-values were used to linearly fit a mono-exponential model exploiting least-square optimization. Voxel-wise absolute differences were computed between any offline and the online ADC for each exam (∆ADC_**b**, both on the whole image and on the manually delineated gross tumour volume (GTV). Median values of such differences were then compared using the Friedman test (α = 0.01).

Results. Evaluating the whole DW-MRI images, ∆ADC_2b did not show any statically significant difference with respect to ∆ADC_3b, whereas all other pairs did. Focusing on the GTV, differences between
any pair were found to be significantly different. The smallest differences were found for ΔADC_7b (median [iqr] = 0.011 [0.009] and median_{TP} [iqr] = 0.006 [0.001] 10^{-3} \text{mm}^2/\text{s}) and the highest for ΔADC_200b (median_{TP} [iqr] = 0.274 [0.034] and median_{TP} [iqr] = 0.231 [0.034] 10^{-3} \text{mm}^2/\text{s}), whereas ΔADC_3b and ΔADC_2b showed intermediate results.

Conclusions. From this preliminary evaluation, online ADC seems to make use of all available DW images, thus better relating to ADC_7b. Attention must be paid when comparing discriminative threshold values based on online ADC maps and studies aiming at defining the optimal b-values combination for different target tissues should be encouraged.

Reference


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