Diffusion-Weighted Imaging of the Parotid Gland: Influence of the Choice of b-Values on the Apparent Diffusion Coefficient (ADC) Value.

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Introduction:

Considerable discrepancies in the ADC values of the salivary glands in healthy volunteers are found amongst published reports [1,2,3]. We postulate that these differences in ADC values could be due to the choice of different b-values applied, based on the fact that the signal attenuation by increasing b-values is not a single exponential function and, therefore, analysis of one part of the curve by a single exponential or by a logarithmic analysis necessarily leads to a different result than an analysis of another part. Reasons for the non-single-exponential character of the diffusion curve signal = f(b) are manifold, including perfusion [4] and the division into intra-and extracellular compartments [5].

The purpose of this study was to determine how the ADC value of parotid glands in healthy volunteers is influenced by the choice of b-values.
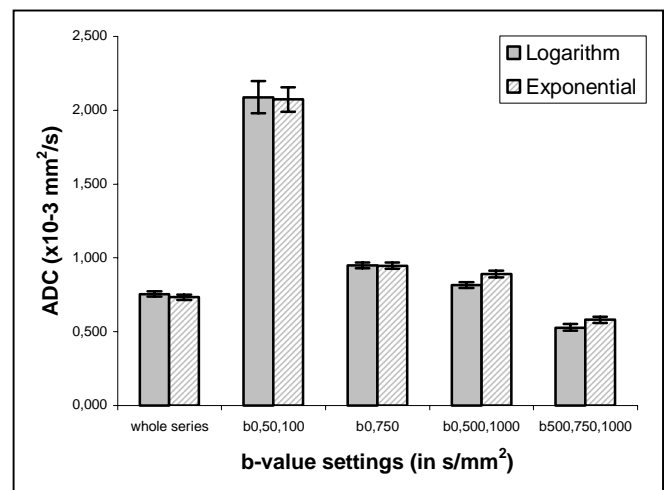
Material and Methods:

Eight healthy volunteers (five men, three women) with a median age of 24 years (range: 22-31) were examined on a 1.5T MR system using an 8-channel head coil. Axial T1-weighted spin-echo and T2-weighted turbo spin-echo sequences were acquired for morphological evaluation. Diffusion-weighted echoplanar imaging (DW – EPI) was performed with b-values (in s/mm²) of 0, 50, 100, 150, 200, 250, 300, 500, 750 and 1000. The other imaging parameters of the DW-EPI sequence consisted of: TR=3000 ms, TE=73 ms, a matrix size of 128 x128, and six averages acquired. The time of acquisition was 5:45 min. All series were performed with parallel imaging with a GRAPPA-factor of two. ADC values were calculated by two alternative methods (exponential vs. logarithmic fit) from 5 different sets of b-values: (A) all b-values; the following sets of b-values were used to calculate separate ADCs: (B) b=0, 50, 100, (C) b=0, 750, (D) b=0, 500, 1000, and (E) b=500, 750, 1000.

Results:

The mean ADC values for the different settings were (average ± standard error of the mean in 10^{-3} mm^2/s, exponential fit): (A) 0.732 ± 0.019 (B) 2.074 ± 0.084, (C) 0.947 ± 0.020 (D) 0.890 ± 0.023, (E) 0.581 ± 0.021 (Fig). ADC values were significantly ($p<0.001$) different for all pairwise comparisons of settings (A – E) of b-values, except A vs. D ($p=0.172$) and C vs. D ($p=0.380$). ADC values from exponential vs. logarithmic fit ($p=0.542$) as well as left vs. right parotid gland ($p=0.962$) were indistinguishable (Fig).

Bar charts of signal intensity versus different sets of b-values for exponential and logarithmic fits. These findings show that the higher the b-values the lower the ADC, and the lower the b-values the higher the ADC. It also shows the independence of the fit procedure.

Discussion:

ADC values calculated from low b-value settings were significantly higher then those from high b-value settings. These results suggest that not only true diffusion but also perfusion contributes to the ADC. Attention has to be paid when interpreting the ADC values in DW – EPI of the salivary glands: by a varying contribution of molecular diffusion and tissue perfusion, the ADC values are influenced by the chosen b-values. Appropriate selection of b-values may provide additional functional and morphological information, potentially helpful in the characterization of salivary gland lesions.

References:

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