The effects of age, gender and BMI on parotid fat and parotid ADC measurements in EPI based and FSE-PROPELLER based diffusion weighted imaging

H-C. Chiu[1,2], C-J. Juan[3], H-C. Chang[4,5], H-W. Chung[3,5], C-C. Cheng[3,5], S-C. Chiu[3,5], C-Y. Cheng[1], C-Y. Chen[3], and G-S. Huang[3]

[1]Department of Nuclear Medicine, Tri-Service General Hospital, Taipei, Taiwan, [2]EMBA in Global Chinese Management, Department of Business Administration, College of Management, Tamkang University, Taipei, Taiwan, [3]Department of Radiology, Tri-Service General Hospital, Taipei, Taiwan, [4]Applied Science Laboratory, GE Healthcare Taiwan, Taipei, Taiwan, [5]Institute of Biomedical Electronics and Bioinformatics, National Taiwan University, Taipei, Taiwan

Introduction: The measurement of apparent diffusion coefficient (ADC) value is influenced by technical factors, physiological factors and histological factors [1]. Whether the parotid fat content and parotid ADC values are influenced by age, gender and body mass index (BMI), however, has never been documented yet. The purpose of our study was to verify the effect of age, gender and BMI on the parotid fat content and parotid ADC values in healthy volunteers.

Material and method: This prospective study was approved by the institutional review board of our hospital. Written informed consent was obtained. A total of 114 healthy volunteers including 57 men (48.2 ± 12.8 years) and age-matched 57 women (44.2 ±13.9 years) (P =0.1) who were not smokers or addicted to alcohol use; had no history of head or neck disease, head or neck surgery or radiation therapy, or chemotherapy for systemic malignancy; and were not taking medication were enrolled in this study. The age distribution of volunteers was 18.4%, 16.8%, 19.3%, 27.7% and 17.8% in the range of 20 to 30 years, 31 to 40 years, 41 to 50 years and 51 to 60 years, respectively. 3D-FSPGR IDEAL fat-water separation technique was used for calculation of parotid fat fraction [2,3] (TR/TEs/NEX/flip angle: 8.9 ms/1.97, 3.53, 4.99 ms/ 1/ 10º). Four DWI pulse sequences including single-shot echoplanar DWI with ASSET acceleration factors of 1 (NA-EP-DWI) and 2 (A-EP-DWI) (TR/TE/NEX: 7000ms/60.5ms/4), fast spin echo PROPELLER-DWI with (FS-PROP-DWI) and without (NFS-PROP-DWI) fat saturation (TR/TE/NEX: 7600 ms/122 ms/ 1.8) with b values of 0 s/mm^2 and 1000 s/mm^2 were used for the parotid ADC measurement. The geometric parameters, field of view (240 × 240 mm), matrix size (128 × 128 mm), section thickness (5 mm), and intersection spacing (0 mm) were kept identical in all DWI pulse sequences.

Results:

Fig. 1 showed that parotid fat content was positively associated with age (P < 0.05 in men; P < 0.005 in women) and BMI (P < 0.005). The BMI (24.7± 2.66) and parotid fat content (50.6 ± 11.1 %) in men were significantly higher than BMI (21.8 ± 3.29) and parotid fat content (42.8 ± 12.9 %) in women (P < 0.005). The ADC values were significantly lower in men than in women using NFS-PROP-DWI (0.52 × 10^{-3} mm^2/s ± 0.13 × 10^{-3} mm^2/s versus 0.63 × 10^{-3} mm^2/s ± 0.17 × 10^{-3} mm^2/s; P < 0.005), NA-EP-DWI (0.82 × 10^{-3} mm^2/s ± 0.10 × 10^{-3} mm^2/s versus 0.91 × 10^{-3} mm^2/s ± 0.14 × 10^{-3} mm^2/s; P < 0.005), and A-EP-DWI (1.00 × 10^{-3} mm^2/s ± 0.10 × 10^{-3} mm^2/s versus 1.08 × 10^{-3} mm^2/s ± 0.12 × 10^{-3} mm^2/s; P < 0.005) but with no difference between men and women using FS-PROP-DWI (1.25 × 10^{-3} mm^2/s ± 0.21 × 10^{-3} mm^2/s versus 1.26 × 10^{-3} mm^2/s ± 0.24× 10^{-3} mm^2/s; P = 0.77). Parotid fat content was significantly positively correlated with age and BMI (P < 0.005) with a correlation coefficient (R) of 0.49 and 0.63, respectively. Fig. 1 demonstrated the scatter plots of parotid fat content versus age and BMI in male and female volunteers. Parotid ADC values were significantly negatively correlated with age, BMI and fat content in all pulse sequences (ADC versus age in A-EP-DWI and ADC versus BMI in FS-PROP-DWI: P < 0.05; P < 0.005 for the else) but not related with age in FS-PROP-DWI (P = 0.48). Fig. 2 demonstrated the scatter plots of parotid ADC values versus age, BMI and parotid fat contents. The correlation coefficients between the parotid fat content and parotid ADC values were 0.47, 0.83, 0.69 and 0.38 in FS-PROP-DWI, NFS-PROP-DWI, NA-EP-DWI and A-EP-DWI, respectively.

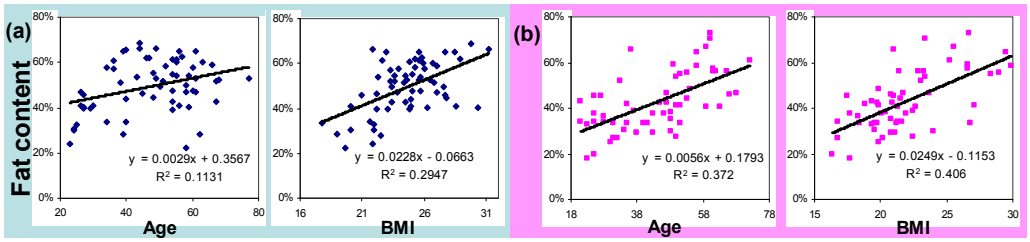
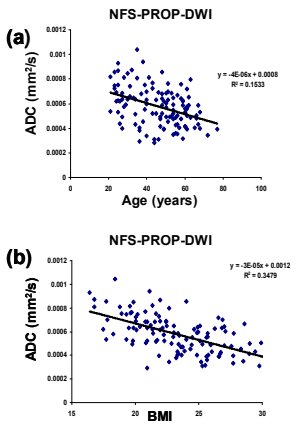


Fig. 1. Scatter plots show positive correlations between parotid fat content and age (years) and between parotid fat content and BMI in (a) men and (b) women with statistical significance.



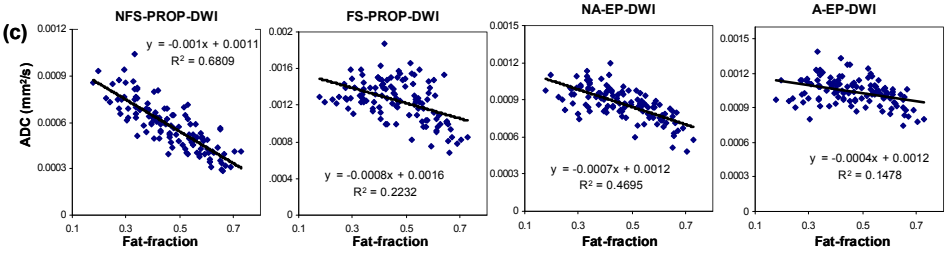


Fig. 2. Scatter plots of parotid ADC values versus age (a), BMI (b), and parotid fat fractions (c).

Discussion & Conclusion:

Our study shows significantly gender difference in BMI, parotid fat content and parotid ADC values. The parotid fat content is significantly positively correlated with factors of age and BMI, respectively. Furthermore, the parotid ADC values are significantly negatively correlated with age, BMI and parotid fat content, respectively, with highest correlation coefficient between parotid ADC values and parotid fat content. It indicates that parotid fat content might be the key factor that influences the measurement of parotid ADC measurement. Our study also shows that NFS-PROP-DWI is most sensitive to the effect of parotid fat content than other pulse sequences, in which the fat signal has been saturated. Nevertheless, the parotid ADC measurements are still influenced by parotid content in all fat-saturated pulse sequences. In conclusion, our study highlights the effect of age, gender, BMI and parotid fat on the parotid ADC measurements and further discloses that NFS-PROP-DWI is the pulse sequence most sensitive to the effect of parotid fat content. For inter-subject and inter-experimental comparisons, it is crucial to measure the parotid fat content in addition to parotid ADC values.

Reference: [1] Juan CJ, et al, Radiology, 253(1):144 (2009). [2] Scott BR, et al, MRM, 51:35 (2004). [3] Liu CY, et al, MRM, 58:354(2007).