EVALUATION OF DIFFUSION-WEIGHTED IMAGING APPARENT DIFFUSION COEFFICIENT HISTOGRAM FOR THE DIFFERENTIAL DIAGNOSIS BETWEEN LIPOMA AND LIPOSARCOMA

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Purpose: To explore the potential value of Apparent Diffusion Coefficient (ADC) in identifying lipoma and liposarcoma by histogram analysis.

Introduction: ADC values are influenced by many kinds of micro factors, such as the cellular structure, density, proliferation activity, the size of the intercellular space, the water molecules proportion of cells inside and outside, and the liquid viscosity, etc[1-4]. Some previous studies have shown low ADC values are present in cellular malignant tumors, whereas higher ADC values are found in cellular regions or tumors of low cellularity[5]. Most previous studies evaluated lesions by measuring the average ADC value(ADC_{mean}) of ROI. But even if the ADC_{mean} of the lesions are same, the ADC value distribution of all pixels within the ROI will be different. Previous studies also evaluated lesion by measuring the minimum ADCvalue(ADC_{min}) of ROI, but ADC_{min} is vulnerable to the effects of extreme values, such as noise, artifacts and adjacent structures. The histogram can reflect different diffusion characteristics in the ROI[6-7], meaning that all elements in the ROI that could contribute to group differences would be analyzed.

Methods: Diffusion-weighted MRI was performed in 12 histologically proven soft-tissue tumor cases using diffusion-weighted spin-echo sequences. Of the 12 soft-tissue tumor cases, there were 5 cases of lipoma and 7 cases of liposarcoma. The b values of diffusion were 0 and $600mm^2/s$. The histograms of ADC were achieved from the commercial software equipped on the GE AW workstation(Figure1-6). ADC_{mean}, color ADC values and Color proportions of lipoma and liposarcoma were compared by using Independent-samples t test. Receiver operating characteristic(ROC) analysis was performed to assess an optimal threshold value for distinguishing between lipoma and liposarcoma. P≤0.05 was considered indicative of a statistically significant difference.

Results: ADC_{blue}($505.2\pm147.3X10^{-6}mm^2/s$) for lipoma was significantly lower than ADC_{blue}($736.6\pm98.9X10^{-6}mm^2/s$) of liposarcoma(P=0.008). A cut-off value of $680.0X10^{-6}mm^2/s$ for ADC_{blue} in differentiating lipoma from liposarcoma with a specificity of 100%, a sensitivity of 86%. There was no statistical difference in other type of ADC values between lipoma and liposarcoma, p>0.05.

Discussion: The results of our study suggest that the ADC_{blue} of cumulative ADC histogram could be used to differentiate lipoma from liposarcoma, whereas the ADC_{mean} appears to have limited value in distinguishing between lipoma and liposarcoma, which further validated the histogram analysis may evaluate tumor heterogeneity more effectively than ADC_{mean}. In our study, ADC_{black} corresponds to the
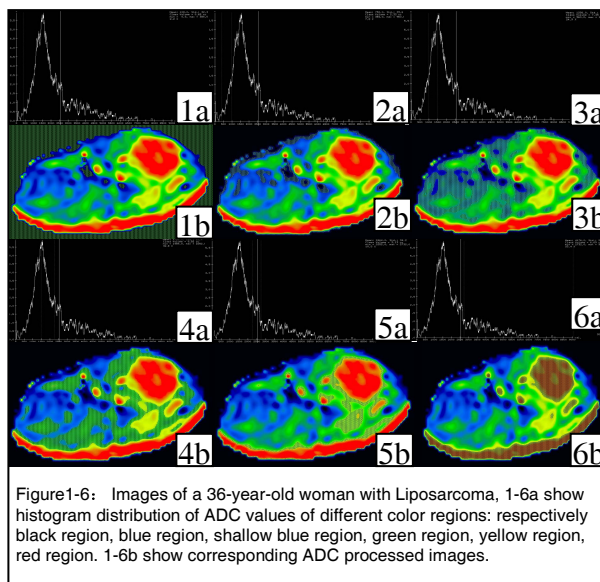

Figure1-6：Images of a 36-year-old woman with Liposarcoma, 1-6a show histogram distribution of ADC values of different color regions: respectively black region, blue region, shallow blue region, green region, yellow region, red region. 1-6b show corresponding ADC processed images.

minimum ADC values within ROI, and ADC_{blue} corresponds smaller ADC values within the ROI, The results of our study suggest that the ADC_{blue} of cumulative ADC histogram could be used to differentiate lipoma from liposarcoma, whereas the ADC_{black} appear to have limited value in distinguishing between lipoma and liposarcoma. We assume that the ADC_{black} tend to reflect the extreme values inside the ROI, While ADC_{blue} correlates with areas where dispersion is more limited, so ADC_{blue} will have more predictive value when evaluating tumor lesions. Our study shows ADC_{blue} for lipoma were significantly lower than ADC_{blue} of liposarcoma, that is to say, ADC_{blue} of benign tumor is less than that of malignant tumor, this may be related to that selected cases are fatty tumors. We assume that fat cell structure may be a factor to reduce the ADC values, which is more significant than malignant tumor cell structure's it remains to be further verified through larger samples and other researches.

Conclusion: ADC_{blue} is helpful in identifying lipoma from liposarcoma.

Table 1: ADC Values Comparison between the Lipoma and Liposarcoma($\bar{X}\pm S$)

Parameter($x10^{-6}mm^2/s$)	lipoma	liposarcoma	t	P
ADC black	60.5±101.3	124.7±128.8	-0.834	0.429
ADC blue	505.2±147.3	736.6±98.9	-3.277	0.008
ADC shallow blue	1110.3±47.4	1140.5±144.5	-0.488	0.635
ADC green	1819.0±146.6	1775.1±187.9	0.481	0.639
ADC yellow	2293.3±372.1	2389.0±105.0	-0.700	0.498
ADC red	3083.2±306.9	3286.5±593.1	-0.670	0.524
ADC mean	1084.0±734.5	1299.8±631.0	-0.649	0.526

Table 2: Color Proportion Comparison between the Lipoma and Liposarcoma($\bar{X}\pm S$)

Parameter (%)	Lipoma	liposarcoma	t	P
P black	26.6±5.9	14.7±13.0	1.956	0.089
P blue	33.7±14.1	42.8±26.9	-0.684	0.509
P shallow blue	27.5±6.5	34.9±20.7	-0.950	0.367
P green	15.2±11.9	22.5±17.5	-0.889	0.390
P yellow	14.1±25.2	13.8±19.3	0.025	0.980
P red	6.5±11.8	8.5±9.6	-0.264	0.799

Figure 7: ROC curve shows the diagnostic performance of ADC $_{blue}$ for distinguishing between lipoma and liposarcoma.Areas under ROC curve is 0.943,the diagnostic performance is good.

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[7] Kyriazi S,Collins DJ, Messiou C, et aL Metastatic ovarian and primary peritoneal cancer: assessing chemotherapy response with diffusion-weighted MR imaging—value of histogram analysis of apparent diffusion coefficients[J]. Ra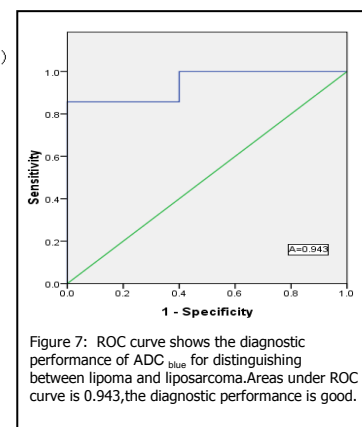diology, 2011, 261 (1) :182-192.