Comparing of mono-exponential, bi-exponential and stretched exponential models with multi-b value Diffusion Weighed imaging in uterus malignancies¡ªpilot study

Yan Zhou[1], Jianyu Liu[2], He Wang[3], and Nan Sun[4]

[1]Peking University Third Hospital, Beijing, Beijing, China, [2]Radiology Department, Peking University Third Hospital, Beijing, Beijing, China, [3]MR Research China, GE Healthcare, Shanghai, Shanghai, China, [4]MR Research China, GE Healthcare, Beijing, Beijing, China

TARGET AUDIENCE

Anyone who interested in different models within diffusion weighted imaging (DWI) using multi b values.

PURPOSE

To investigate the diagnostic utility of different models of multi b values DWI.

METHODS

22 female patients prior treatment (including 11 cervical carcinomas and 11 endometrial carcinomas) together with seven healthy volunteers underwent pelvic MR examination. Imaging system included conventional imaging and DWI, which were acquired with 10 b values (0, 30, 50, 100, 150, 200, 400, 800, 1000, 1500s/mm2). Calculation and synthesis of parametric mappings included standard ADC, slow ADC, fast ADC and perfusion fraction (F), distributed diffusion coefficient (DDC) and alpha. Regions of interesting (ROIs) were put onto the maximum axial section of cervical carcinoma and endometrial carcinoma respectively, with bleeding and necrosis excluded. For the control group, ROIs were placed on the normal cervixes and normal uterine cavities respectively. All of the data were grouped as endometrium (G_endo) and cervix (G_cervi), each group was divided into 2 subgroups, cancer (CA) and normal (NOR). Statistic analysis used nonparametric test of Mann-Whitney U test with SPSS 19.0 package. And areas under ROC curve between normal group and cancer group were assessed.

RESULTS

Table 1 Quantification Indices of Multi B Values DWI (Mean± Std. Deviation) and their Differences within G_endo

	No. of Cases	Age (year)	Standard ADC($10^{-3}mm^2/s$)	Slow ADC($10^{-3}mm^2/s$)	Fast ADC($10^{-3}mm^2/s$)	F	DDC($10^{-3}mm^2/s$)	alpha
CA	11	53.9±7.0	0.82±0.19	0.64±0.15	10.80±6.35	0.21±0.07	0.80±0.26	0.76±0.09
NOR	7	38.0±11.0	1.19±0.21	1.03±0.17	4.13±3.52	0.38±0.17	1.00±0.64	0.84±0.10
	Z	-2.631	-2.943	-3.215	-2.129	-2.491	-1.133	-1.540
	P	0.006	0.002	0.001	0.035	0.011	0.269	0.132

Table 2 Quantification Indices of Multi B Values DWI (Mean± Std. Deviation) and their Differences G_cervi

	No. of Cases	Age (year)	Standard ADC ($10^{-3}mm^2/s$)	Slow ADC($10^{-3}mm^2/s$)	Fast ADC($10^{-3}mm^2/s$)	F	DDC($10^{-3}mm^2/s$)	alpha
CA	11	45.3±8.4	0.87±0.16	0.70±0.11	10.65±4.93	0.20±0.08	0.88±0.21	0.78±0.06
NOR	7	38.0±11.0	1.40±0.12	1.10±0.17	10.51±3.77	0.41±0.09	1.66±0.36	0.82±0.10
	Z	-1.496	-3.487	-3.487	-0.770	-3.034	-3.487	-.317
	P	0.148	0.000	0.000	0.481	0.002	0.000	0.793

Table 3. Areas under ROC curve

Variables	Standard ADC	Slow ADC	Fast ADC	F	DDC	Alpha
Areas (±Std. error)	0.958±0.031	0.966±0.026	0.354±0.101	0.906±0.048	0.815±0.094	0.628±0.098
Sig.	0.000	0.000	0.144	0.000	0.002	0.200

1. Ages between groups were of no significant difference. And mean values of Standard ADC, Slow ADC, Fast ADC, F were significantly different within G_endo (P<0.05) while mean values of Standard ADC, Slow ADC, F, DDC were significantly different within G_cervi (P<0.01). The other coefficients were of no significant different (Table 1 and 2). 2. The area under ROC curve of Slow ADC was the largest, followed by Standard ADC, F and DDC in order (P<0.01). The others were of smaller areas under curve and with no significance (Table 3).

DISSCUSSION

The results showed both Standard ADC and Slow ADC were able to differentiate uteri malignancies. And Slow ADC may had better performance. DDC was to be further investigated on its biological basis. Theoretically, both Fast ADC and F may reveal the perfusion ability of tissue. However, large Std. deviation of Fast ADC questioned the reliability. Lower F of cervical cancer was consistent with contrast enhancement imaging. But lower F of endometrial cancer showed unreasonable hypothesis between F and contrast enhancement perfusion.

CONCLUSION

IVIM may be of better performance comparing with standard ADC. The utility of stretched exponential model was still in challenge.