Reproducibility of Diffusional Kurtosis Imaging for rectum in vivo

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Target audience

Diagnostic Radiologist, Radiographer, Gastroenterologist, Magnetic resonance Engineer.

Purpose

To assess the reproducibility of diffusional kurtosis imaging(DKI) for rectum under normal physiological status with background body signal suppression.

Methods

This prospective study was approved by our institutional review board and informed consent. Twenty-seven healthy volunteers underwent 3-T magnetic resonance imaging twice with an interval of 24 hours to 14 days by using axial fat suppressed single-shot echo-planar DK imaging(five b values) and torso phased-array coil. Parameters maps were obtained for the metric K, a measure of excess kurtosis of diffusion, and corrected diffusion(D), a corrected diffusion coefficient accounting for the non-Gaussian behavior. The intra- and inter-observer consistency were evaluated by using reliability test in SPSS 11.5.

Results

A total of 27 volunteers underwent the scans, providing 54 data points for DK imaging. We were able to undertake analyses on all data. The K and D values measured by two radiologists respectively showed in Table1.Intra-class correlation coefficient (ICC) and the average coefficient of variation(CV) results in intra-observer and short-term reproducibility were of a high level(Table 2).

Table 1 D and K values of 27 volunteers (n=26, $\overline{x} \pm s$)

DKI	D（×10-3mm2/sec）		K	
	Radiologist 1	Radiologist 2	Radiologist 1	Radiologist 2
The 1st scan	1.358±0.183	1.352±0.174	0.993±0. 148	0.981±0.135
The 2nd scan	1.354±0.195	1.366±0.184	1.000±0.152	0.989±0.133

Table 2 intra- and inter-observer consistency.and variability

DKI	ICC	59%CI	CV
Inter-observer D	0.962	93.4%～97.8%	17.8%
Intra- observer D	0.925	87.5%～95.6%	18.5%
Inter-observer K	0.958	92.7%～97.5%	18.9%
Intra- observer K	0.895	82.7%～93.8%	23.6%

Discussion

In this study, we investigated the mean values, variation and reproducibility in an intra- and inter-observer study on 3.0 Tesla MRI of 27 healthy volunteers. we found no matter for metric D or K of the subjects, the reliability test for reproducibility (ICCs) is fairly high, the range is from 0.895-0.962, which suggest that DK imaging is reliable. The CVs ranges from 17.8%-23.6%, not perfectly, but still acceptable. That may be attributed to the normal rectum wall,when it is rather too dilated, is too thin to be measured. In addition, a phenomenon which must deserve our attention is that the reproducibility of metric K was lowest(CV=23.6%). That was because K is a parameter which defines the degree of water distribution that away from Gaussian distribution. Generally, in normal rectum tissue, the changes of rectum muscle fibers direction would cause the changes of tissue's anisotropy, hence the diffusion of water molecules were greatly affected by the direction of rectum muscle fiber.

Conclusion

Reproducibility was investigated only in the short timescale so that physiological variability would be minimized. There were no statistical differences between the DK imaging data acquired with the interval of 24 hours to 14 days. Knowledge of the variability of the DK parameters is important to guide appropriate experimental design and statistical consideration in future experimental studies. The parameters D and K would be the foundation of further experiments and clinical application of DK imaging.