Influence of respiratory motion in body diffusion weighted imaging under free breathing.

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Introduction

As diffusion weighted imaging (DWI) theoretically aims to detect random notion over small distance, such as Brownian motion, breath-hold scan has been considered the only way to aroid the artifacts from the bulk motion of subjects. However recent report mentions that nom breath hold scan is feasible [1].

Purpose

To evaluate signal intensity change on DWI by an artificial respiratory motion on the moving phantom model.

Materials and Methods

The moving phantom (160×230×75mm W,D,H) consists of three tubes (diameter:30mm height:100mm) with enclosed water (ADC:2.12×10^{-3}mm^2/sec), oil and liquid detergent (ADC:1.28×10^{-3}mm^2/sec), surrounding by agar (ADC:1.75×10^{-3}mm^2/sec)(Fig1). Moving phantom had periodic motion with its stroke of 20mm every 1ec or 10mm every 1sec along F-H direction. Axial DWI was obtained with single shot STIR-EPI-diffusion sequence as follows. TR/TE/TI: 5100/70/180msec, EPI-fcator:47,slices:10, slice thickness / gap: 4/0 mm, FOV:400mm, FOV:70%,half scan percent:60%, matrix:128x128, acquisition time:30msec/slice,scan percent: 80%,RFOV 70%, SENSE-factor:2, slice orientation: axial and coronal, scan mode: multi slice, motion proving gradient: three axes（phase, slice, frequency）, b-factor: 0,500,750,1000sec/mm^2 , number of b-factor: 2. The ROIs for ADC were set at the center of each tube. Additionally, movement of the diaphragm was measured with healthy volunteer.

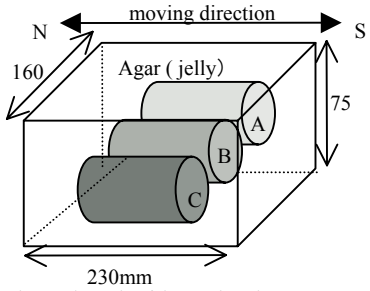

Fig1 Schematic of the moving phantom.
A:water、B:oil, C:liquid detergent

Results

No relation was confirmed with speed and stroke of moving phantom or b-factor. The difference of ADC was less than 10% between static phantom and moving phantom（speeds:16mm/sec）. (Fig2) The diaphragm moved slowly under free breathing in volunteers, and deviation was ranged up to 16mm in F-H direction, and up to 6mm in A-P direction.

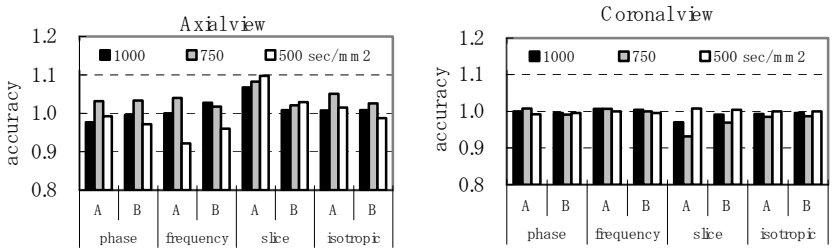

Fig2 Accuracy of ADC between moving phantom (speeds:16mm/sec) and static phantom.
A:detergent B:water

Conclusion

Our results show a stable motion such as calm respiration is completely different from IVIM, which causes signal loss on DWI. Therefore, free breathing DWI is feasible like resent report [1]. Of course, some image blurring was occurred during multiple excitations. However acquisition time of this sequence was very short around 30msec. The maximal displacement was 0.22mm during acquisition and motion artifact should not be severe. The images provided using this method serves high resolution, high quality and high SNR. Because viewing from the other direction was possible, the multi planner reconstruction (MPR) images of an axial scanning image was significant in a diagnosis. (Fig3)

Reference：Radiation Medicine 224,275-282,2004

A) B) C)

Fig3 MPR image of axial scanning clinical images with DWI.
A)CHESS with respiratory trigger B) STIR with respiratory trigger C) MR-Diffusion Neurography