Multi-slice body diffusion weighted imaging with peripheral pulse unit (PPU) gating

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Purpose:

Diffusion weighted images with respiratory triggering allows us optimal upper abdominal imaging. However, there are some part of poor visualization such as left lobe of the liver and mediastinal structure. This is probably due to cardiac motion which yields intra-voxel incoherent motion. A gating technique with peripheral pulse unit (PPU) has been reported as a capable solution. However, as it employed single slice sequence within single breath-holding, practical scanning for many slices may be difficult because of its long scan time. Here, we conducted multi-slice single-shot EPI sequence with PPU in a free breath. The purpose of this study is to estimate feasibility of this sequence.

Subject and Methods:

Five healthy volunteers were scanned with PPU gated DWI by using 1.5T superconducting scanner (Philips Gyroscan Achieva).

The sequence employed is PPU gated single-shot EPI with b value of 50 mm/sec^2.

Setting of TD window was done with manner as follows.

1) Optimal trigger delay (TD) was estimated with use of single-slice PPU gated sequence.
2) Min TD was set by normal "TD" parameter in application. However, max TD is not supported as normal parameter.
3) To set max TD, we used "RR window" function which is usually used for arrhythmia rejection.
4) RR window has two values such as (-50%, +20%). This value means a permissible zone in percentage from target HR.
5) Large value of (-RR%) decreases max TD.
6) (+RR%) has been set in small value for arrythmia rejection.
7) The range of TD window can be set in relation to HR (Tab. 1).

Other scan parameters are as follows: TR/TE 5000/32ms, slice thickness/gap 4/0mm, number of slices 30, Matrix 128x256, 4NEX, SENSE factor 2, planned scanning time 1min30sec. Both SPIR (CHESS) and STIR (TI=180ms) employed and compared in effect of fat suppression.

	RR Window	TD window
HR50	55,20	380-540
HR60	50,20	380-500
HR70	40,20	380-514
HR80	32,20	380-510

Tab. 1: R-R window and TD that can be acquired in each HR

Results:

We aimed more than three slices per one gating, but usually only two slices could be done. Total scan time is around 4min for 12cm which covers whole part of lateral segment (Fig.1, coronal reformat image). This is enough to cover the area of signal decrease in the liver, but not to enough for whole liver. In lateral segment of the liver, both visualization and relative signal to noise ratio was improved in image with PPU. The heart and mediastinal structure showed same results. In comparison of two different techniques, SPIR (CHESS) based fat suppression is superior in lateral segment of the liver because of higher S/N. But STIR is superior to SPIR in the heart and mediastinal structure because it promises uniform fat suppression (Fig.2).

Conclusions: Multi-slice PPU technique still requires long scan time, but it is useful to visualize the area with signal decrease due to cardiac motion.

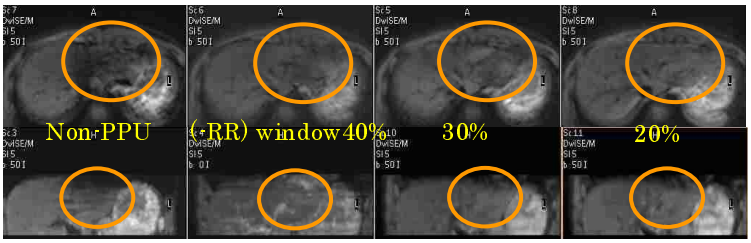

Fig.1: Axial source and coronal reformatted image in lateral segment of the liver in variable (-RR) window.

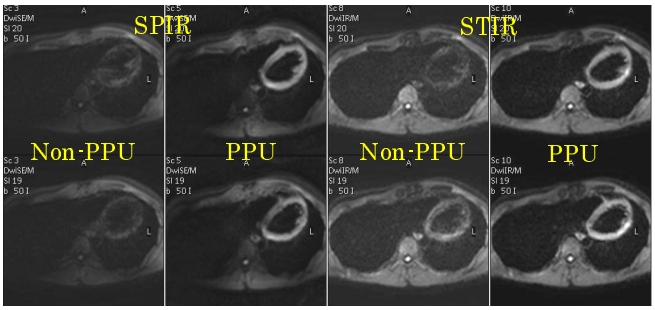

Fig.2: Axial source images with and without PPU in comparison of different fat suppression technique.

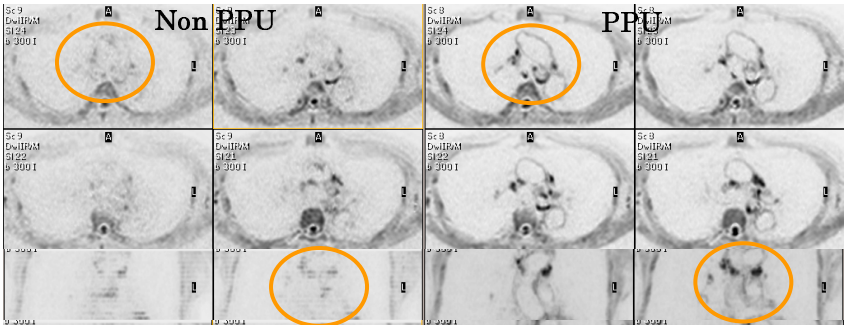

Fig.3: Axial source and coronal reformatted images with and without PPU.