Free-breathing dynamic contrast MR imaging using DISCO with navigator technique for the pancreatobiliary regions

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Target Audience: The scientists, physicians, and technologists who are involved in abdominal MR imaging using Gd-contrast medium.

Introduction: Dynamic contrast study has provided useful information of the abdominal vasculature, organs and their lesions. The navigator technique for free breathing MR imaging can be utilized for dynamic contrast studies with 3D FSPGR, LAVA flex and its feasibility has been demonstrated previously[1]. However, further improvement of speed of imaging has been required. Newly developed fast imaging technique, Differential Sub-sampling with Cartesian Ordering (DISCO) has features of 3D time-resolved imaging, k-space under-sampling and view-sharing reconstruction[2] and can be used in combination of navigator technique for free breathing dynamic contrast study.

Accordingly, the purpose was to evaluate feasibility of dynamic contrast study under free-breathing in combined use of navigator technique for the evaluation of the pancreatobiliary lesions using DISCO.

Methods: The current study was approved by the institutional review board. *Population:* Twenty-seven patients (17 men, 10 women, mean 74 years old, 58-86 years old), who underwent Gd-contrast enhanced MR imaging for evaluation of the pancreatobiliary regions at 3T (Discovery MR 750, GEHC) with 32 channel multicoil were included. Informed consent was obtained from all the patients. *MR imaging: Navigator technique:* The cylindrical navigator tracker (10cmx1cm) was placed at the top of the right hemidiaphragm to monitor the motion of the hemidiaphragm. Navigator echo was acquired at every 200ms using one of the fixed receiver coils during dynamic study, and imaging data were acquired around at upper highest level of the right hemidiaphragm with acceptance window for +/- 1~2 mm (Fig1, arrow). *3D imaging:* During dynamic contrast study, continuous acquisitions of data with DISCO were performed. Imaging parameters were as follows, TR 4.1ms, Matrix 320x192, FOV35~40cm, slice thickness 2.4~3mm, a number of slices 90~136, slice overlap 50%, ARC factor 2x1.4-2x2. Number of view sharing areas was set up as 4[2]. Approximate coverage of the pancreatobiliary regions and most areas of the liver were made and temporal resolution for each phase was approximately set up as within 4-8 seconds with breath hold. Total of 11~16 phases were set up approximately for 120seconds. Five to 10 seconds after intravenous injection of Gd-chelate (Gd-chelate, 0.1mmol/kg, injection 3ml/sec), the initial acquisition using DISCO under free-breathing with navigator technique started basically in the coronal plane. *Evaluation:* Total scan time and imaging time for each phase in dynamic studies were measured.

Fig1 Navigator technique

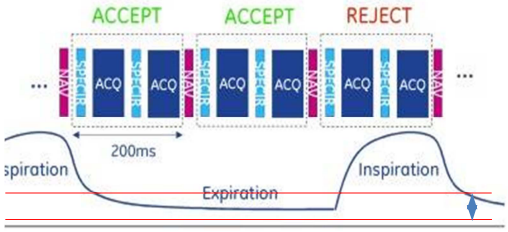


Fig2 Serial changes of imaging time after contrast

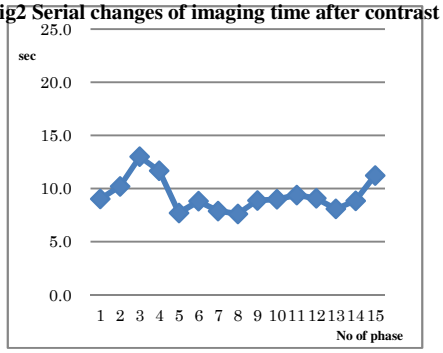


Fig3 Continuous free breathing dynamic images

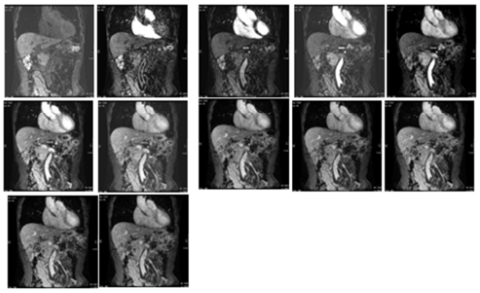
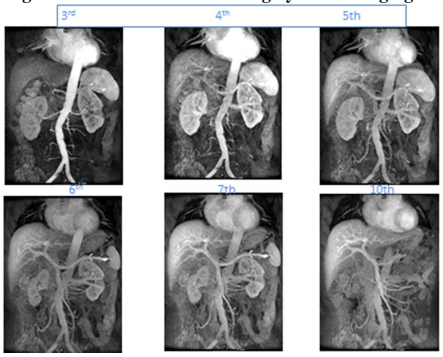


Fig4 Serial MIP of free breathing dynamic imaging



Results: Imaging time in dynamic studies tended to prolong in the 1st or 2nd phase after arrival of contrast medium to the abdominal aorta. In later phases, imaging time tended to be stabilized. Average imaging time for each phase was 11.2+/-4.4sec. Total scan time was 123.4+/-45sec. In most of cases imaging time for each phase was acceptable for dynamic study. However, in eight cases, imaging time in some phases was over 15 seconds. Longest imaging time was 45 seconds in one case. Most of images were diagnostic (fig 3). Post imaging reconstruction such as MIP provided MR angiographic information with acceptable differentiation of aortic, portal and venous structures (Fig4).

Discussion: With navigator technique, dynamic contrast MR imaging for the evaluation of the pancreatobiliary regions including the liver can be successfully obtained with acceptable image quality under free-breathing. Free-breathing technique may be useful for the elderly patients, unconscious patients or children who cannot hold their breaths. In the current study using DISCO, temporal resolution with navigator technique is acceptable for selecting the required time points for arterial, portal and equilibrium phases with acceptable spatial resolutions. Potential limitations might be as follows: 1) the contrast mechanism after Gd-chelate administration may be affected due to view sharing reconstruction; 2) in some cases, instability of data acquisition especially in early dynamic phases resulted in prolongation of imaging time provably due to irregular breathing and/or contamination of noise from contrast media in the aorta resulting in unstable navigator technique.

Further study may be required to improve stable acquisitions of free breathing dynamic contrast study.

Conclusion: With navigator technique, dynamic contrast MR imaging for evaluation of the pancreatobiliary diseases can be performed with acceptable image quality and temporal resolutions under free-breathing.

References 1 T. Masui et al. 2014 ISMRM, 2 Saranathan et al., JMRI, 2012;35:1484–1492