Free Breathing Dynamic contrast MR imaging of the pancreas and liver with navigator technique

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

Introduction: Dynamic contrast study has provided information for characterization of the lesions and organs in the abdomen. This technique is usually performed with repeated breath-holding after intravenous injection of Gd-chelate contrast medium. Navigator technique has been used under free-breathing for evaluation of the liver for static imaging[1]. It can be utilized for dynamic contrast studies with continuously repeated acquisitions[2]. Data collection for imaging is dependent on efficiency of navigator technique. Imaging time with optimized navigator technique might be prolonged 2 to 3 times compared with that of breath-holding T1 weighted imaging. Previously, navigator based free breathing dynamic study has been performed with relatively low temporal resolutions with small coverage[2]. With modification of k space trajectory, LAVA (GE HC), which is based on 3DSPGR sequence, can be facilitated to be faster with ordinary contrast and image quality (Turbo LAVA). The purpose was to evaluate feasibility of dynamic contrast study during free-breathing with navigator technique for the evaluation of the pancreas and liver.

Methods: The current study was approved by the institutional review board. *Population:* thirty one patients (15men, 16 women, mean 67.5years old, 35-87 years old), who underwent Gd contrast enhanced MR imaging for the pancreas and liver at 3T (Discovery MR 750, GEHC) with 32 channel multicoil were included. Informed consent was obtained from all the patients. Pathologies were cystic lesions in the pancreas, 17cases; solid lesion in the liver,11 (HCC 4, mets 3, Hemangioma 4), cystic lesion in the liver 1, others 6. In 4 cases, lesions were overlapped.

MR imaging: The cylindrical navigator tracker was placed at the top of the right hemidiaphragm. Navigator echo was acquired at every 200ms during dynamic study, and imaging acquisition was performed around upper highest level of the right hemidiaphragm with acceptance window for +/- 2 mm. Pilot precontrast dynamic imaging was obtained to set imaging time within 25 seconds in each patient. Pre and consecutive 5 phases of postcontrast images (Gd-chelate, 0.1mmol/kg, injection 3ml/sec or Gd-EOB-DTPA, 1.5ml/sec) in the axial plane were obtained using fatsat Turbo LAVA (investigational version of LAVA that can achieve 1/3 scan time reduction over conventional LAVA with pulse sequence and parallel imaging optimization) under free-breathing with navigator technique (TR 3.1ms, Matrix 320x192, FOV350mm, slice thickness 3 or 4mm, a number of slices 60-96 covering the liver and pancreas, slice overlap 50%, ARC factor 2). Without navigator technique, imaging time with Turbo LAVA was approximately 7 to 8seconds. The start was determined by fluoro-triggering technique (GEHC). The same acquisition without navigator technique was obtained. *Data analysis;* Evaluation: Imaging time for each phase in dynamic study was measured. Image quality, blurring, recognition of organ, and lesions were evaluated using a five-point scale (1undiagnostic-5 excellent).

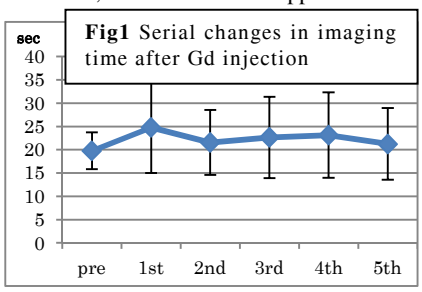

Fig1 Serial changes in imaging time after Gd injection

Results: Imaging time after Gd injection is shown in Fig1. In all cases except two cases, imaging time was prolonged especially in the postcontrast first phase (Fig2). The enhancement was observed initially in the aorta followed by the spleen, and the pancreas. All images in dynamic contrast phases with navigator technique were diagnostic (Image quality; 4.7-4.8, Blurring 4.6-4.9, Lesion recognition 4.6-4.7). The information of both liver and pancreas could be obtained in all cases. All cystic lesions in the pancreas (17 cases), and solid lesions in the liver (11 cases) were identified.

Discussion: With navigator technique, dynamic contrast MR imaging of the pancreas and liver was successfully performed with acceptable image quality and lesion recognitions under free-breathing. Free-breathing technique may be useful for the elderly patients, unconscious patients or children who cannot hold their breaths. The prolongation of the imaging time was recognized in 1st phase of post contrast study probably due to irregular respiration caused by stimulation of administration of contrast media as well as acquisition sounds. With the increased san efficiency of the investigational LAVA sequence, imaging time was reduced less than 2/3 without navigator sequence. The imaging contrast and expected artifacts are identical to conventional LAVA. On the other hand, the former study was performed using conventional LAVA with navigator technique, thus, imaging time was sometimes longer than 35 seconds only with covering the pancreas.

Conclusion: With navigator technique, dynamic contrast MR imaging of the pancreas and liver can be obtained with acceptable image quality and lesion recognitions under free-breathing and can be used for the study of the elderly or unconscious subjects who cannot hold their breaths.

References 1) Nagel SK, Busse RF, JMRI, 2012;36:890-899, 2) Masui T, ISMRM 2013

Fig 2 Cystic lesion in the pancreatic head

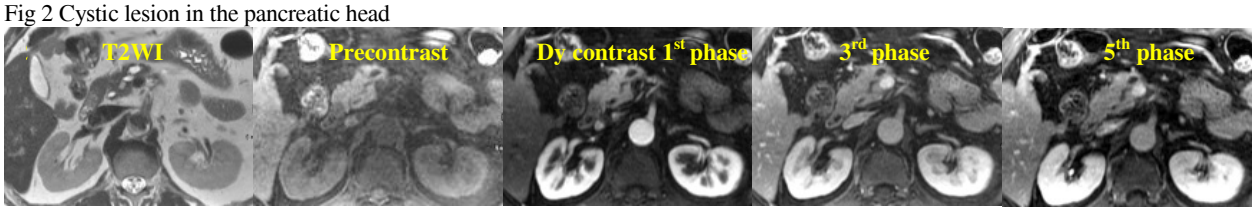

Fig 3 Liver metastases