Combined T2-weighted and MRCP 3D Imaging of the Abdomen Using a Dual-Contrast Single-slab 3D-TSE Pulse Sequence

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Introduction: T2-weighted images are commonly used for lesion detection and characterization in the abdomen, and heavily T2-weighted images (i.e., MRCP – MR cholangiopancreatography) are commonly used to assess the bile and pancreatic ducts. In many cases, both types of images are required for diagnostic evaluation of a given patient. Single-slab, three-dimensional turbo/fast spin-echo (3D-TSE) pulse sequences with variable-flip-angle refocusing RF pulses [1,2] (e.g., SPACE [Siemens] or 3D FSE CUBE [GE]), when combined with navigator-based respiratory triggering, provide a sufficiently high sampling efficiency to permit high-resolution, T2-weighted 3D imaging of the abdomen in a clinically-reasonable acquisition time [3,4]. The purpose of this work was to explore the feasibility of acquiring both T2-weighted and MRCP images within the same 3D-TSE acquisition.

Methods: To permit the acquisition of both T2-weighted and heavily T2-weighted images, a two contrast version of the single-slab 3D-TSE pulse sequence was developed. As illustrated in the example of Fig. 1, which used a total echo train length (ETL) of 350, a variable-flip-angle evolution is used to obtain T2 weighting [1,2], and this is followed by high, constant flip angles to obtain strong T2 weighting for MRCP. This dual-contrast flip-angle evolution was implemented in a SPACE single-slab 3D-TSE pulse sequence, and evaluated in 4 healthy volunteers on a 1.5T whole-body scanner (Avanto, Siemens Medical Solutions). Typical pulse-sequence parameters included: TR 4-5 s (depending on respiratory rate); FOV 38 x 27-30 x 16-18 cm; matrix 320 x 170-178 x 70-94; ETL 372-396; echo-train duration 1 s; fat suppression; parallel acceleration factor 2 or 3; averages 2; navigator-based respiratory triggering. For the first contrast, the center of k space was sampled at 240-250 ms (considering the effect of the variable flip angles, this yields a contrast similar to that for a conventional echo-train with a TE of 100 ms) and for the second contrast the center of k space was sampled at 750-760 ms. Informed written consent was obtained from all subjects prior to imaging.

Results: The high sampling efficiency provided by using short (600 µs), non-spatially-selective refocusing RF pulses in single-slab 3D-TSE imaging yielded coverage of the abdomen with spatial resolution of 1.2 x 1.6 x 1.9 mm in acquisition times of 5-7 minutes, depending on respiratory rate. This permitted high-quality, multiplanar reconstructions of both the T2-weighted and MRCP data sets. Representative results from one of the subjects are shown in Fig. 2 (T2-weighted) and Fig. 3 (MRCP).

Conclusions: By using a very long flip-angle train that includes variable and constant flip-angle segments, T2-weighted and heavily T2-weighted (MRCP) high-resolution, 3D image sets of the abdomen can be obtained with a single 3D-TSE acquisition in a clinically-acceptable acquisition time of 5-7 minutes. This approach has the potential to improve the quality and efficiency of diagnostic evaluation of the abdomen using MRI. Future studies will focus on evaluation of the proposed method in subjects with disease.