Clinical evaluation of 3D half-Fourier RARE for MRCP : Comparison of 2D single thick slice, 2D multiple slice, 3D multiple slice, and 3D multiple thin slice MRCP.

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Introduction

Magnetic resonance cholangiopancreatography (MRCP) is evolving as an effective non-invasive imaging technique for examining patients with suspected pancreatic or biliary disease. The two dimensional (2D) half-Fourier RARE sequence is one of optimal pulse sequences for the standard MRCP (1). However the 2D half-Fourier RARE sequence have several limitations such as lower spatial resolution in the slice-selection direction. Three dimension (3D) volume acquisition technique allows generation of multiplanar thin slices without interslice gap. 3D half-Fourier RARE sequence may have potential advantages relating to signal to noise ratio and visualizing fine ducts over 2D method. In this study, we evaluate the 3D half-Fourier RARE-MRCP sequence in comparison with single thick slice and multiple slice 2D half-Fourier RARE-MRCP.

Material and Methods

The prospective evaluation was carried out in 55 consecutive patients (30 male and 25 female; mean age 59.3, range 13-89) referred for MRCP because of suspected abnormalities of the pancreatobiliary system between March and October 1998. The diseases included 15 cholecysto- and/or choledocholithiases, 4 mucin-producing tumors, 5 acute or chronic pancreatitis, 3 pancreas cysts, 2 pancreas cancers, 2 cholangiocarcinomas,2 hepatolithiases, 2 adenomyoses of GB, 2 papilla vater tumors, 2 cholangitis, 7 normal, and 9 others. All examinations were performed on a 1.5-T magnet (VISART/Hyper; Toshiba, Tokyo, Japan). A QD phased-array coil was used to improve the signal-to-noise ratio. The used sequence was a single-shot fast advanced spin echo (FASE) with inter-echo train spacing of 12.5msec. A CHESS pulse was applied prior to each excitation pulse to suppress fat signal. The imaging protocol consisted of the following pulse sequences: (a) 2D single thick slice MRCP : TR/effective TE =∞/250 msec, echo train length (ETL)=212, single shot, matrix=384x384, slice thickness=40-60mm, FOV=35cm, imaging time=3sec. (b) 2D multiple slice MRCP : TR/effective TE =∞/250 msec, ETL=148, single shot, matrix=256x256, slice thickness=5mm, number of slice=8-12, slice gap=0 mm used a interleave technique, imaging time=24-36sec in a single breath hold. (c) 3D multiple slice MRCP : TR/effective TE =3000/250 msec, ETL=148, single shot, matrix=256x256, slab thickness=40-60mm , effective slice thickness=5mm, FOV=35cm, imaging time=24-36sec in a single breath hold. (d) 3D multiple thin slice MRCP : TR/effective TE =8000-10000/250 msec, ETL=212, single shot, matrix=384x384, slab thickness=40-60mm, effective slice thickness=2mm, imaging time=4min24sec-6min with a intermittent breath hold or a respiratory triggered technique. The source and maximum intensity projection (MIP) images except 2D single thick slice method were evaluated by two experienced radiologists. For the subjective analysis, the degrees of conspicuity of main pancreatic duct (MPD), common bile duct (CBD), cystic duct (CD), common hepatic duct (CHD), intrahepatic bile duct (IHBD) were evaluated. The motion related artifacts were also evaluated. The responses were ranked by the following 3-point scales : for conspicuity, 1=poor, 2=moderate, 3=good ; for artifacts, 1=severe, 2=mild, and 4=absent. Qualitative image ranking data were analyzed with the Wilcoxon signed-rank test..

Results

Results of qualitative analysis was shown in Table 1. In comparison of capability to demonstrate pancreato biliary ducts, 3D multiple thin slice MRCP was the best for detecting MPD, CHD, CD, and IHBD among four sequences. In comparison of capability to demonstrate CHD and IHBD, 3D multiple slice MRCP within a single breath hold is superior than 2D multiple slice method. However, there was no statistical difference between 3D multiple slice method and 2D multiple slice method for demonstrating CBD and CD . In comparison of motion related artifact, 2D single thick slice method was the best and 3D multiple thin slice method was the worst among four sequences, and 2D multiple slice method was superior to 3D multiple slice method.

Discussion and Conclusion

As far as breath-hold multiple slice MRCP, 3D half-Fourier RARE sequence is superior to 2D half-Fourier RARE for demonstrating fine biliary ducts such as IHBD and CHD because of high signal to noise ratio. Multiple thin slice MRCP using 3D half-Fourier RARE with intermittent breath hold or respiratory triggered technique has shown improved image quality on successful cases, but the method tended to be more susceptible to patients' motion than 2D half-Fourier RARE-MRCP. Visualization of portal and/or splenic vein obscures the biliary and/or pancreatic duct on MIP-reconstructed MRCP images by 3D half-Fourier RARE sequence. In this situation, the targeted MIP technique and/or the source images evaluation is effective to avoid this problem.

In conclusion, we recommend that 3D half-Fourier RARE sequence is the optimal MRCP sequence. However, 2D single thick slice MRCP showed the best image quality in uncooperative patients.

Reference

1. Irie H, et al. Radiology 1998;206:379-387

Table 1. Qualitative Analysis Results.

	2D single thick slice	2D multiple slice	3D multiple slice	3D multiple thin slice
Main pancreatic duct	2.1 ± 0.6	1.6 ± 0.6	1.5 ± 0.6	2.3 ± 0.8
Common bile duct	2.5 ± 0.5	2.4 ± 0.7	2.5 ± 0.7	2.6 ± 0.7
Common hepatic duct	1.9 ± 0.7	1.9 ± 0.7	2.2 ± 0.8	2.4 ± 0.8
Cystic duct	1.5 ± 0.5	1.6 ±0.7	1.6 ± 0.6	2.0 ± 0.8
Intrahepatic bile duct	1.7 ± 0.6	1.6 ± 0.6	1.6 ± 0.7	2.2 ± 0.7
Motion artifact	2.9 ± 0.3	2.8 ± 0.2	2.5 ± 0.6	2.6 ± 0.6

Values are mean ± standard deviation

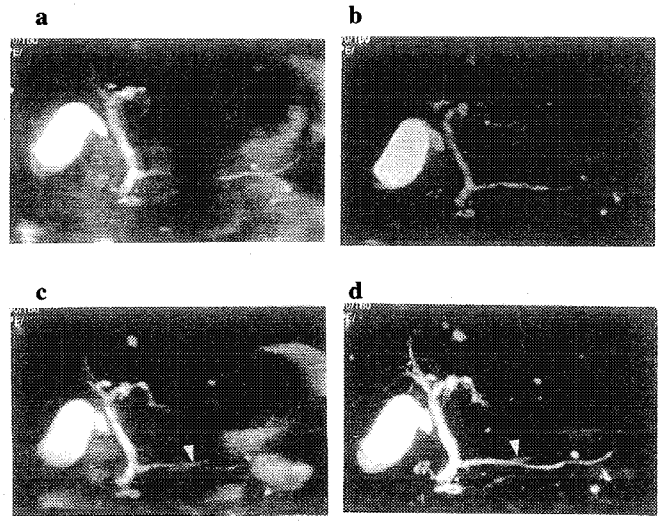

Figure: A 80-year-old male patient with chronic pancreatitis caused by pancreatic duct malfusion. 2D single thick slice MRCP (**a**) and MIP-reconstructed MRCP images by 2D multiple slice (**b**), 3D multiple slice (**C**), and 3D multiple thin slice method (**d**). Splenic vein obscures pancreatic duct on MIP image by 3D half-Fourier RARE sequence (arrowheads).