Comparison of respiratory-triggered and breath-hold partial Kz high special resolution 3D FSE MRCP using ASSET for the evaluation of the pancreatobiliary system

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Introduction: MRCP can provide useful information for the evaluation of the pancreatobiliary system. Recently, respiratory triggered (RT) 3D FSE with parallel imaging technique has been utilized for obtaining high spatial resolution MRCP. To accelerate the further reduction of imaging time, partial Kz, which is interpolation of the data in the z axis can be combined with parallel imaging such as array spatial sensitivity encoding technique (ASSET) for the acquisition of 3D FSE MRCP. With use of ASSET and partial Kz, breath-hold (BH) 3D MRCP may also provide information of pancreatobiliary system in a short period of time, approximately 30 seconds, with relatively high spatial resolution. Because of using short TR for breath holding technique, fast recovery (FR) of saturated spins by application of the 180 and -90 degrees radiofrequency pulses at the end of 3D FSE sequence was performed for the increase of signal intensity of the fluids. The purpose of the study was to compare the abilities of partial Kz BH 3D FR FSE MRCP and RT 3D FR FSE MRCP in combined use of ASSET for the evaluation of the pancreatobiliary system.

Materials and Methods: Seven-three consecutive patients were included for the current study, who underwent MRCP of the pancreatobiliary abnormalities (33 males and 40 females; median age, 62 years, ranged form 22 years to 86 years). Of 73 patients, 22 patients underwent ERCP and 15 patients underwent surgery or laparoscopic resections of the gallbladder after MR imaging. ***MR Imaging*** All MR imaging was performed with a 1.5-T system (HD twin speed; GE Medical Systems, WI) using an 8 channel body phased array coil. RT 3D FR FSE and BH 3D FR FSE images were obtained. Scans for MRCP was acquired in an oblique coronal plane with the following imaging parameters; RT 3D FR-FSE 3000-8000/490ms [TR/effective TE]; field of view, 30 x 30-35 x 35 cm; matrix, 352 x 256 (with ZIP 512); bandwidth, 31.5 kHz; section thickness, 1 mm (ZIP2, apparent 0.5mm); 72-90mm-thick volume; fast recovery pulse, and image time,1.5-5 minutes, reduction factor 2; BH 3D FR-FSE the same as RT method except TR, 1500ms; eTE, 475ms; matrix, 256x224; 60mm thick volume and image time, 28-32sec, reduction factor 2.

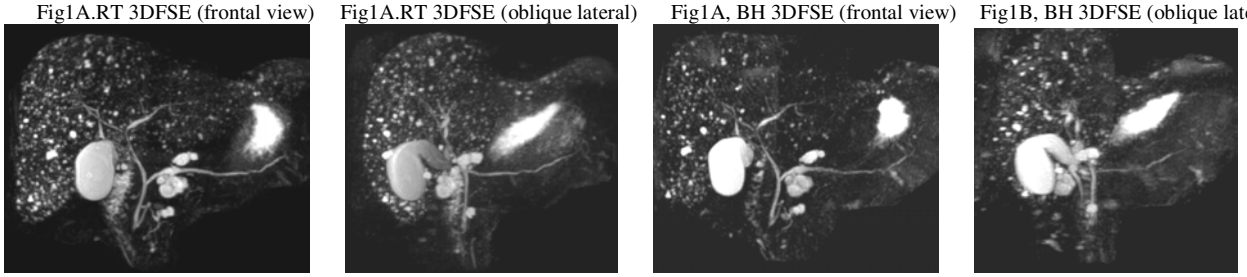
Imaging process Post processing of the source images obtained with RT and BH 3D FR FSE sequence was performed by using multiplanar volume reformation (MPVR) with MIP. ***Evaluation*** All images were evaluated on a display monitor. The image quality, blurring or ghosting effects were evaluated using ten-point scale (1, severe to 10, absent). Overall quality of images was ranked as 1, poor to 10, excellent. The delineation of the pancreatobiliary ducts were also evaluated regarding the following points: the first- and second-, hepatic bile ducts; the extrahepatic bile duct, the gallbladder and cystic duct. The following grading system was used: 5, excellent for complete delineation to 1, not visualized). Scores were statistically compared with pared Student T test. Existence or absence of pathologies was evaluated using 10 point-scale (1; absence to 10; existence) and scores equal to and higher than 6 were regarded as positive pathology.

Results; In 73 patients, BH 3D MRCP in 7 patients and 4 patients in RT 3D MRCP were undiagnostic. Blurring artifacts were less prominent on BH 3D MRCP than on RT 3D MRCP (RT:BH; 8.5, 8.8, $p<0.05$, Table). RT and BH 3D FSE MRCP provided competitive over all image quality (8.5:8.4)(Fig1,2). Pancreatic ducts and intrahepatic bile ducts were visualized well on RT 3D MRCP than on BH 3D MRCP (Table 1) (5.4 for 3rd branches and 8.1 for 2nd branches with RT 3D FSE, respectively, $p<.05$, Table 1).. When breath holding and respiratory triggering worked well, identical information was obtained from each MRCP (Fig1, 2). Extrahepatic bile ducts were equally visualized with two MRCP sequences although the cystic duct was visualized better with BH 3D FSE (Table 1). Pathologies, obtained from information with two MRCP were competitive (Table 2).

Summary and conclusion

Spatially high resolution MRCP can be obtained using 3D FR FSE in combined use of ASSET and partial Kz using an 8 channel phased array coil. BH 3D FR FSE MRCP with acceptable image quality may be obtained, which may provide competitive information to RT 3D FR FSE MRCP. Compared with BH 3D MRCP, RT 3D MRCP requires longer imaging time however, the information of high spatial resolution MRCP is useful and acquisition time less than five minutes may be acceptable in clinical settings. Thus, when RH 3D MRCP is not diagnostic, BT 3D MRCP may be additionally obtained for the evaluation.

Fig1A.RT 3DFSE (frontal view) Fig1A.RT 3DFSE (oblique lateral) Fig1A, BH 3DFSE (frontal view) Fig1B, BH 3DFSE (oblique lateral)



Note: Intraductal papillary mucinous tumor & hepatic cysts

Table 1 Image Quality and Visualization of the Pancreatobiliary System

N=73			Hepatic			Extrahepatic bile duct					Pancreatic		
	Blurring	Quality	1st	2nd	3rd	U	M	L	GB	Cystic	Head	Body	Tail
RT	8.5	8.5	9.6	8.1*	5.4*	9.9	9.6	8.9	7.7	7.6	8.7*	8.3*	8.1*
BH	8.8 *	8.4	9.5	6.9	3.4	10	9.8	8.9	8.5	8.4 *	7.1	6.8	6.6

1st, 2nd and 3rd indicates 1st, 2nd and 3rd branches of hepatic ducts. U,M, L stands for upper, middle, and lower portion, respectively. GB and cystic indicates gallbladder and cystic duct, respectively. * P<0.05

Table 2 Pathology

N =22	Diagnosis	ERCP	RT MRCP	BH MRCP
Gallstone	5	5	5	5
Bile duct stone	3	3	3	3
Cystic lesions in the pancreas	3	2	3	3
Pancreatic Ca	5	5	5	5
Pancreatic Divisum	2	2	2	2
Stenosis of Pancreatic duct	1	1	1	1