

Clinical Evaluation of Respiratory-triggered 3D Magnetic Resonance Cholangiopancreatography with Navigator Echoes Compared to Breath-hold Acquisition Using Compressed Sensing and/or Parallel Imaging

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ABSTRACT

Aim: To investigate image quality of respiratory triggered 3D MRCP with compressed parallel and sensing imaging in clinical setting.

Study design: Cross-sectional study

Duration and place of study: Study was conducted in the duration of 1st July 2021 to 31st December 2021 at Department of Radiology, Chandka Medical College Hospital, Larkana.

Methodology: Ninety patients with age between 40-70 years were enrolled.

The patients got three various kinds of MRCP 3 dimensional as a protocol of their diagnosis plan. Four point scoring system was adapted for quality assessment.

Results: The mean age of the patients was 66.9±8.6 years. There were almost similar number of males and females. Minimally invasive-intraductal papillary mucinous carcinoma was presented only in 2.22%. Comparison of three magnetic resonance cholangiopancreatography techniques showed that signal quality, was better as longer time involved in 1st magnetic resonance cholangiopancreatography case while blurring was also seen in breath holding magnetic resonance cholangiopancreatography.

Conclusion: Better imaging quality of ductal system is obtained through respiratory triggered 3D magnetic resonance cholangiopancreatography against breath hold.

Keywords: Magnetic resonance cholangiopancreatography, 3D Imaging, Compressed Sensing, Parallel imaging

INTRODUCTION

Magnetic resonance cholangiopancreatography (MRCP) is used for the evaluation of gastrointestinal system which is non-invasive technique. Slowly moving or stationary fluids including pancreatic of bile juice lowers the better quality imaging and to avoid this problem, few negative contrast agents are used.^{1,2} 3D MRCP gives extra advantages by providing high signal to noise ratio and also upgrades the duct anatomy.

High quality image and ductal system visualisation is attained through 3D MRCP in contrast to previous imaging methods such as endoscopic retrograde cholangiopancreatography and percutaneous transhepatic cholangiography^{3,4}. Though, this technique mainly use T2 weighted sequence which cause blurring effects due to body motion or irregular respiratory cycle, ultimately hinders the diagnostic accuracy and image degradation^{5,6}.

Imaging quality can be accelerated by parallel imaging or compressed sensing^{7,8}. Compressed sensing acquires less data by manipulating incoherent sampling, and reconstruction algorithm image sparsity.^{9,10} Auto-calibrated reconstruction is a type of parallel imaging which makes certain k corrections before Fourier transformation. Limited number of studies has investigated the role of CS or PI in MRCP^{5,10-13}.

For that reason, present study was designed to image quality of respiratory triggered 3D MRCP with compressed parallel and sensing imaging in a clinical setting.

MATERIALS AND METHODS

A cross-sectional study was conducted from 1st July 2021 to 31st December 2021 at Department of Radiology, Chandka Medical College Hospital, Larkana. After IRB permission, 90 patients of the age of 40-70 years were enrolled in present study. The patients got three various kinds of MRCP 3 dimensional as a protocol of their

Received on 03-07-2022

Accepted on 13-10-2022

diagnosis plan. Informed consent was taken from each patient. A respiratory stimulated 3D-MRCP having navigator echoes, holding breath MRCP having PI reconstruction-alone and the second one in addition to CS with PI. A 32 channel torso with phase coil array was applied. The parameters for the first MRCP were standardized. TR was adjustable, depending on respiration rate. The TE was 700 ms and matrix was 320×320 with a flip angle as 90° having an echo of train length as 140 with excitation-number as 0.5. The FOV of 320mm and a thickness of slice as 1.4 mm were applied with 68 slice number. PI as well as CS factors were applied as 2.0×1 and 1.5 respectively. In the first MRCP, complete sequence acquirement was gained within approximate 15 minutes under the respiration rate as 15/min. In second and third MRCP parameters: TR was ~2000 while TE was 1186 with matrix of 256 × 256, and a flip angle of 90°. The length of echo train was 160 and excitation number as 0.50. FOV was 300 mm with slice thickness of 1.6 mm having 54 slice numbers. The acceleration factor was 2. The PI factors were as 2.8×2.0 for second MRCP while 2.0×1.0 for third MRCP. In second and third MRCP complete sequence was gained in 23 seconds. The demographic as well as clinical information of each patient was recorded. Four point scoring system was adapted for quality assessment. Where 1 is poor visualization, or limited diagnostics and 2 is partial or blurred visualization, 3 is partially or not clear, 4 is fully clear. Data was analyzed by SPSS version 25.

RESULTS

The mean age of the patients was 66.9±8.6 years with 40-70 years. There were almost similar number of males and females in this study (Table 1). The diagnosis of patients presented that branch duct IPMN was seen in 37.7% cases while minimally invasive-intraductal papillary mucinous carcinoma was presented only in 2.22%. Adenomyomatosis was presented 11.11% cases while gall bladder (GB) stones were seen in 18.88% cases (Table 2).

The present study showed that there were highest cases of cholecystectomy in patients such as 24.4% with many of the

patients involved in having gall stones (Fig. 1). Comparison of three MRCP techniques showed that signal quality, was better as longer time involved in 1st MRCP case while blurring was also seen in breath holding MRCP. CS and PI showed better results with less blurring and better image quality (Fig. 2).

Table 1: Distribution of demographic variables (n=90)

Variable	No.	%
Age (years)	66.9±8.6	
Gender		
Male	44	48.8
Female	46	51.1

Table 2: Distribution of case diagnosis (n=90)

Diagnosis of cases	No.	%
Branch duct-IPMN	34	37.7
IMPN or IPMC	2	2.22
Cyst in pancreas	1	1.11
Dilated pancreatic duct or bile duct	5	5.55
Autoimmune-pancreatitis	6	6.66
Adenomyomatosis	10	11.11
Acute cholecystitis	7	7.77
GB Stones	17	18.88
Pancreatic carcinoma	4	4.44
Hepatobiliary malignoma	5	5.55
Others conditions	5	5.55
Pathological Duct discontinuity	2	2.22

Fig. 1: Clinical presentation of enrolled patients

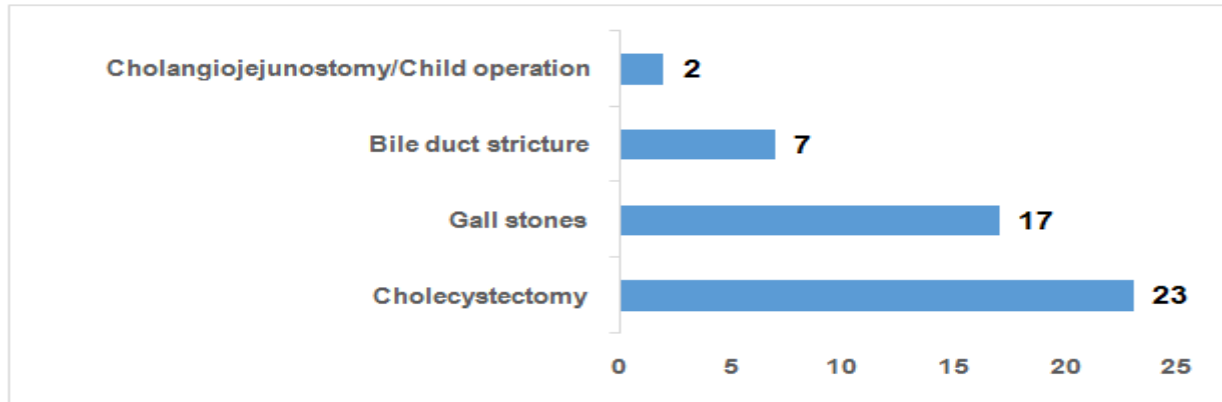
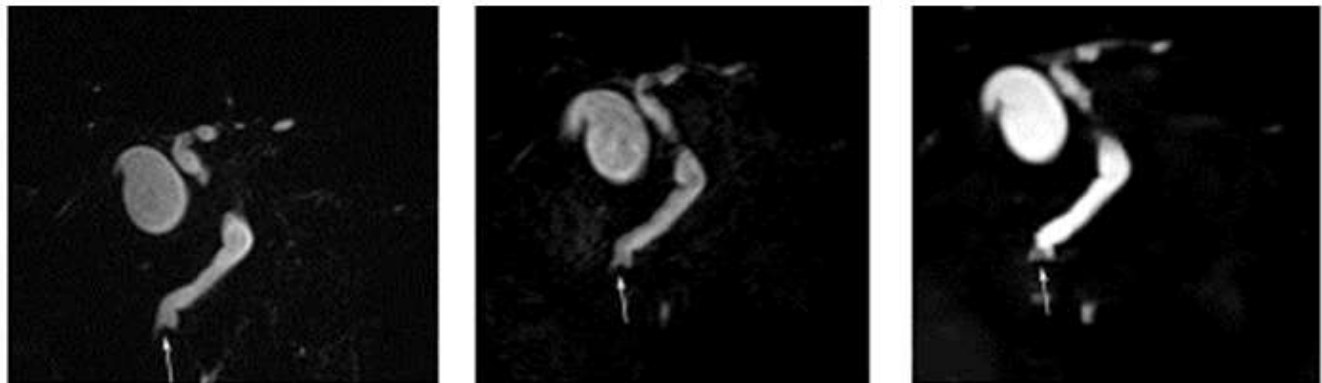


Fig. 2: Comparison of three MRCP types



DISCUSSION

Three dimensional MRCP method is a well-developed clinical technique used to obtain detailed information on pathology and anatomy of central pancreaticobiliary ductal system.¹⁴ Enhanced image quality was a challenging problem in MRCP notably in compliance with patient convenience, improved workflow and increased health care cost. Navigators including compressed sensing and parallel imaging mainly based on under sampling process and fast acquisition is now considered reliable methods that can be used in combination with MRCP.¹⁵⁻¹⁸ Present study compared the respiratory triggered MRCP with breath hold MRCP based on compressed sensing or parallel imaging technique. With a shorter acquisition time, new method showed improved image results with enhanced visualization of pancreaticobiliary ductal system.

Our findings are in agreement with the study by Taron et al.¹⁹ which showed a significant superiority of 3T breath-hold sequences in terms of overall image quality, sharpness, and visualization of the bilio-pancreatic tree. At 1.5T, their study found

a better overall image quality on the conventional sequence although the results were not significant. Furthermore, Zhu et al²⁰. and Yoon et al.²¹ showed a superiority of CS acquisitions at 3T in a single breath-hold compared to conventional acquisitions with regard to overall quality and sharpness criteria.

Consistent with previously reported data, decreased acquisition time for respiratory triggered MRCP was found. Likewise, significant improvement in image quality of main biliary duct such as CHD, RHD, CBD and LHD) was achieved. Clinical application of using navigators enhanced the image quality and also preferentially increased the diagnostic accuracy when pathology is assumed to be in central regions of ductal system. This also reduced the patient's inconvenience of holding breath again and again and allows improved examination with delimited ability of breathing or even without patients' cooperation.

CONCLUSION

Better imaging quality of pancreaticobiliary system is obtained through respiratory triggered 3D MRCP against breath hold. This

approach could also prove valuable in patients who had problem of irregular respiratory cycle.

Conflict of interest: Nil

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