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Pre-Operative Magnetic Resonance Cholangiopancreatography (MRCP)... Is it of Value for Cholecystectomy Patients?

RADWA ELSHARBATLY, M.D.*; ASMAA HUSSEIN HABIB, M.D.*;
MOHAMED YEHIA ELBARMELGI, M.D.** and AALAA SOBHI, M.D.*

The Departments of Diagnostic & Interventional Radiology and General Surgery**, Faculty of Medicine, Cairo University*

Abstract

Background: Post-cholecystectomy choledocholithiasis recurrence is a common complication among patients due to lack of pre-operative assessment of biliary tract stones. Also concomitant pathologies (eg. Gall bladder abscess, etc) necessitate proper pre-operative assessment which in many settings can't be achieved by the standard pre-operative ultrasound.

Aim of Study: The purpose of this study was to assess the ability of pre-operative MRCP to decrease many of the post-operative complications.

Patients and Methods: Between May 2023 & February 2024, 148 patients presented with acute cholecystitis (based on clinical and ultrasound data) had pre-operative MRCP examination. All the patients had normal liver function tests, bilirubin levels and had no evidence of biliary dilatation by US.

Results: Out of 148 patients (76 males & 72 females), 34 patients had common bile duct stone, 14 had extra-hepatic biliary (common hepatic and common bile ducts) stones while 16 had intra-hepatic biliary tract stones. None of the common hepatic, CBD or intra-hepatic biliary stones were detected by ultrasound.

Conclusions: Magnetic resonance cholangiopancreatography (MRCP) was found of great value in pre-operative detection of choledocholithiasis, possible complications and in decreasing post-operative symptoms of choledocholithiasis.

Key Words: *Magnetic resonance cholangiopancreatography – Acute cholecystitis – Choledocholithiasis – Liver enzymes – Ultrasound.*

Introduction

UP to one third (3-33%) of patients undergoing cholecystectomy for choledocholithiasis, will also have CBD stones **[1,2]**. So, the incidence of post cholecystectomy choledocholithiasis recurrence will be higher. Many of the surgeons are now minded by detecting biliary tract stones as well as possible complications before surgery. Due to the low accuracy of the ultrasound in detecting the biliary tract stones and in addition to the MRCP being a non-invasive method to identify biliary stones and possible complications, the MRCP is starting to gain more popularity than the diagnostic endoscopic retrograde cholangiopancreatography ERCP (being an invasive method) especially in cases of early biliary tract obstruction/dilatation diagnosis **[3]**. Thus in cases of acute cholecystitis, pre-operative ultrasound along with the biochemical markers (liver function tests and bilirubin levels) might not be sufficient to exclude biliary tract stones and/or possible complications. That is partially explained by the biochemical markers being biased by the transient hepatocellular injury associated with the inflammatory cholecystitis **[4]**. Thus this study aims mainly to delineate the ability of MRCP to influence the peri-operative management.

Patients and Methods

This study was conducted at Kasr Al-Ainy, Cairo university hospital, in a period of 10 months started May, 2023 till February, 2024 after Kasr Al-Ainy ethical & scientific committee approval (obtained at April, 2023).

148 patients (76 males & 72 females), presented to the general surgery emergency department as well as outpatient clinic with symptoms & clinical signs of calcular cholecystitis. All of the forementioned patients were referred to the diagnostic radiology department for pre-operative assessment.

All the referred patients underwent diagnostic ultrasound and had pre-operative laboratory assessment of the liver function tests as well as bilirubin levels. These selected patients had the following criteria to be enrolled in the study:

Correspondence to: Dr. Radwa Elsharbatly, The Department of General Surgery, Faculty of Medicine, Cairo University

Inclusion criteria:

- The included patients were all adults (age range 26-65 years old).
- Having normal liver function tests.
- Diagnosed with gall bladder stones by ultrasound.
- No evidence of biliary dilatation by ultrasound.

Exclusion criteria:

- Generally claustrophobic patients, patients with pacemakers or intra-cranial metallic coils were excluded for MRI safety rules.
- While specifically, patients clinically jaundiced, had elevated bilirubin levels or had evidence of intra-hepatic biliary dilatation by ultrasound or diagnosed with emphysematous cholecystitis were excluded.

All the enrolled patients had given written informed consents and were scheduled for pre-operative MRCP examination after explaining the full details of the examination. No sedation was used.

MRCP scans were performed on a Siemens 1.5T scanner using a T2-weighted images Turbo Spin Echo sequence acquired with a non-breath-hold in the coronal & axial planes, T2/SPAIR sequences in axial & coronal planes with 2D & 3D reconstruction of the biliary system. On admission all patients underwent ultrasound examination, had blood samples withdrawn (complete blood picture, liver function, renal function, serum bilirubin level as well as ESR & coagulation profile).

Data was coded and entered using the statistical package for social science SPSS version 26. Data was checked for normality using Shapiro-Wilk test. Data was summarized using number and percent for qualitative variables, mean and standard deviation for quantitative normally distributed variables. Comparison between groups was done using Chi-square test or fisher's exact test where appropriate for qualitative variables. Percent of agreement was calculated. *p*-value less than or equal to 0.05 was considered as statistically significant.

Results

In this study 148 patients underwent MRCP examination prior to cholecystectomy. Out of 148 patients 72 were females (48.65%) and 76 were males (51.35%).

All the enrolled patients had US examination and laboratory assessment for bilirubin levels, liver enzymes as well as the routine pre-operative CBC & coagulation profiles. All of them had normal biochemical levels, none had been clinically jaundiced, while all had a clinical diagnosis of calcular cholecystitis.

US Findings:

All examined patients had gall bladder stones by US and signs of acute inflammation. None of the patients' ultrasound examination results showed biliary dilatation, biliary tract stones, CBD or pancreatic duct stones or evidence of gall bladder mucocele. Only 2 (1.4%) patients had US evidence of extra-hepatic biliary stones (common hepatic duct) while 2 other patients were diagnosed to have gall bladder abscess by US.

MRCP Findings:

Of the examined patients 16 (10.8%) had intra-hepatic biliary stones (Fig. 1), 48 patients had extra-hepatic duct stones (including the common hepatic and common bile duct) (Fig. 2) [14 (9.5%) within the common hepatic ducts & 34 (22.9%) within the CBD].

In addition to that, 4 (2.7%) patients had MRCP findings of GB abscess (Fig. 3), 4 patients also had-pancreatic duct stones (Fig. 4) and 2 (1.4%) had signs of GB mucocele (Fig. 5).

An extra benefit of the MRCP examination is the detection of the cystic duct insertion. We detected 24 (16.2%) patients having low cystic duct insertion, while 12 (8.1%) patients had spiral posterior insertion and 10 (6.75%) patients had spiral anterior insertion with the rest of patients 102 (68.9%) had classic cystic duct insertion as shown in Table (1).

The above collected data viewed the following agreement rates between the US & MRCP findings with a significant *p*-value in the ability of the MRCP study in detecting the extra-hepatic biliary stones as well as the gall bladder abscess reaching 0.00 & 0.001 respectively:

- No Intra-hepatic biliary stones were detected by ultrasound, however, 16 (10.8%) were detected by MRCP, with ultrasound and MRCP agreement rate of 89.2%; as shown in Table (2).
- 2 (1.4%) Extra-hepatic (common hepatic duct) stones were detected by ultrasound while no CBD stones were detected by ultrasound, however, 48 (32.4%) extra-hepatic stones were detected by MRCP, (14 (9.5%) within the common hepatic duct and 34 within the CBD) with ultrasound and MRCP agreement rate for the extra-hepatic biliary tract stones of 69% as shown in Table (3).
- No Biliary dilatation was detected by neither ultrasound nor MRCP, with ultrasound and MRCP agreement rate of 100%; as shown in Table (4).
- No Pancreatic duct stones were detected by ultrasound, however, 4 (2.7%) were detected by MRCP, with ultrasound and MRCP agreement rate of 97.3%; as shown in Table (5).

- No GB Mucocele was detected by ultrasound, however, 2 (1.4%) were detected by MRCP, with ultrasound and MRCP agreement rate of 98.6%; as shown in Table (6).
- 2 (1.4%) GB Abscess were detected by ultrasound, however, 4 (2.7%) were detected by MRCP, with ultrasound and MRCP agreement rate of 98.6%; as shown in Table (7) & (Fig. 6).

Table (1): Cystic duct insertion by MRCP.

Cystic duct insertion	Frequency
Spiral posterior insertion	12
Spiral anterior insertion	10
Low cystic duct insertion	24
Classic insertion	102

Table (2): Intra-hepatic stone detection among ultrasound and MRCP.

	Ultrasound			Agreement	*p*-value*
	Yes	No			
MRCP:					
Yes	0 (0%)	16 (10.8%)	16 (10.8%)	89.2%	NA
No	0 (0%)	132 (89.2%)	132 (89.2%)		
	0 (0%)	148 (100%)	148 (100%)		

Table (3): Extra-hepatic stone detection among ultrasound and MRCP.

	Ultrasound			Agreement	*p*-value*
	Yes	No			
MRCP:					
Yes	2 (1.4%)	46 (31%)	48 (32.4%)	69%	0.00
No	0 (0%)	102 (100%)	100 (67.5%)		
	2 (1.4%)	148 (100%)	148 (100%)		

Table (4): Biliary dilatation detection among ultrasound and MRCP.

	Ultrasound			Agreement	*p*-value*
	Yes	No			
MRCP:					
Yes	0 (0%)	0 (0%)	0 (0%)	100%	NA
No	0 (0%)	148 (100%)	148 (100%)		
	0 (0%)	148 (100%)	148 (100%)		

Table (5): Pancreatic duct Stones detection among ultrasound and MRCP.

	Ultrasound			Agreement	*p*-value*
	Yes	No			
MRCP:					
Yes	0 (0%)	4 (2.7%)	4 (2.7%)	97.3%	NA
No	0 (0%)	144 (97.3%)	144 (97.3%)		
	0 (0%)	148 (100%)	148 (100%)		

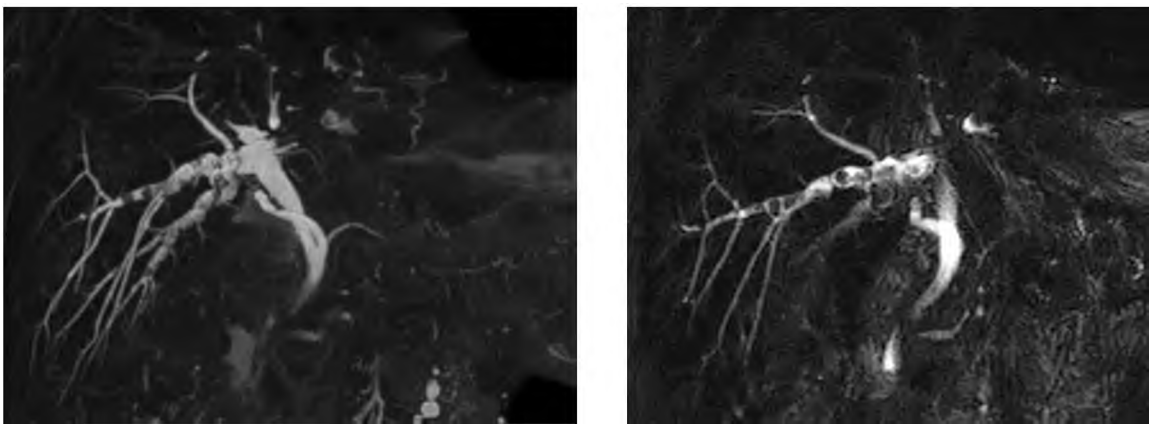
Table (6): GB mucocele detection among ultrasound & MRCP.

	Ultrasound			Agreement	*p*-value*
	Yes	No			
MRCP:					
Yes	0 (0%)	2 (100%)	2 (1.4%)	98.6%	NA
No	0 (0%)	146 (100%)	146 (98.6%)		
	0 (0%)	148 (100%)	148 (100%)		

Table (7): GB Abscess detection among ultrasound and MRCP.

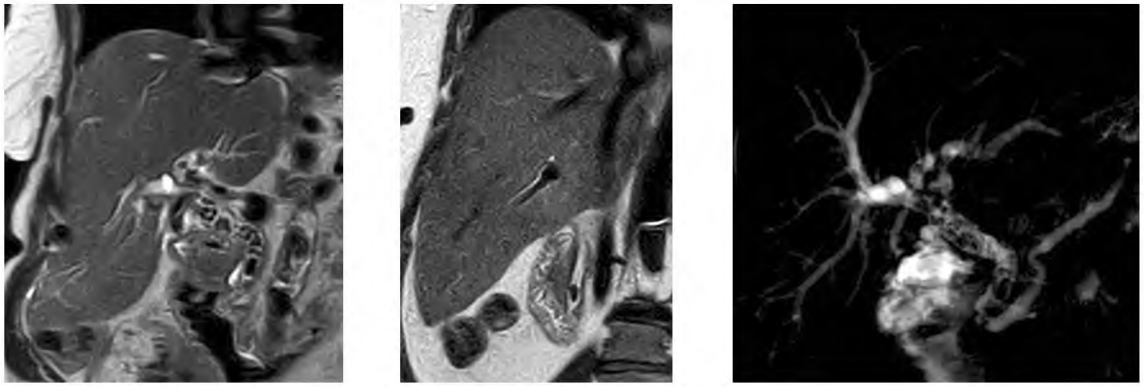
	Ultrasound			Agreement	*p*-value*
	Yes	No			
MRCP:					
Yes	2 (50%)	2 (50%)	4 (2.7%)	98.6%	0.001
No	0 (0%)	144 (100%)	144 (97.3%)		
	2 (1.4%)	146 (98.6%)	148 (100%)		

*: Fisher's exact test.

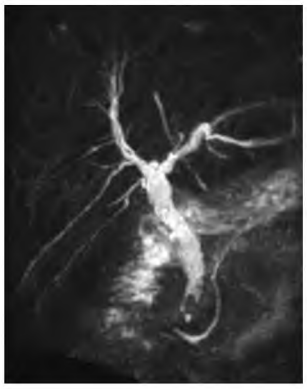


(A) (B)

Fig. (1): 3D reformatted MRCP images (A & B) showing intra-hepatic biliary radicles stones.



(A) (B) (C)



(D)

Fig. (2): Coronal T2 WI (A, B) & 3D reformatted MRCP images (c, d) showing extra-hepatic biliary radicles (common hepatic & common bile ducts) stones.

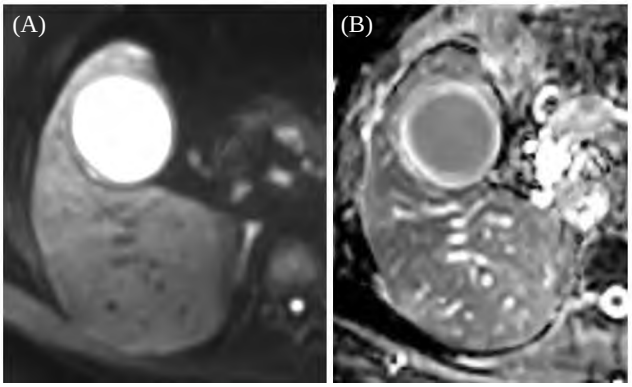


Fig. (3): DWI (A) & ADC map (B) Images showing gall bladder abscess.

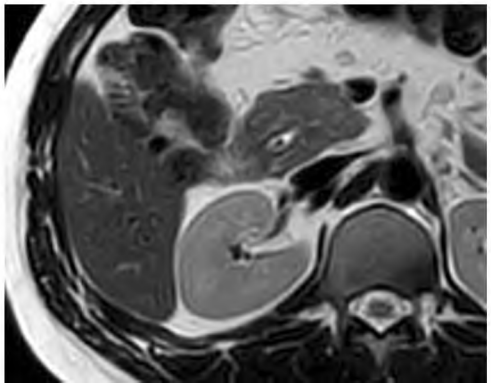
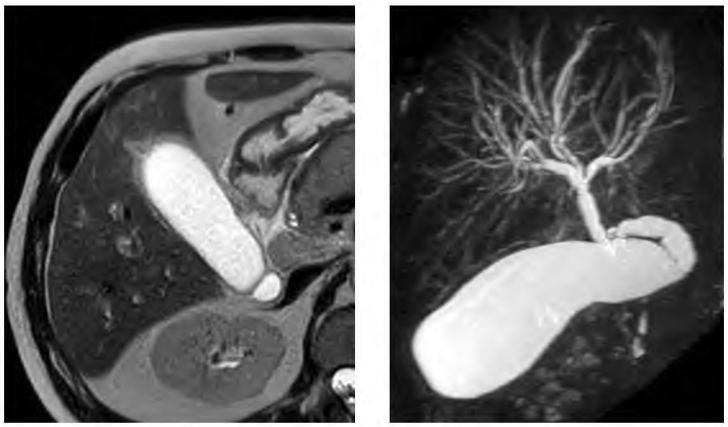


Fig. (4): Axial T2 image showing pancreatic duct stone.



(A) (B)

Fig. (5): Axial T2 WI (A) & reformatted 3D MRCP images (B) Showing gall bladder mucocele.

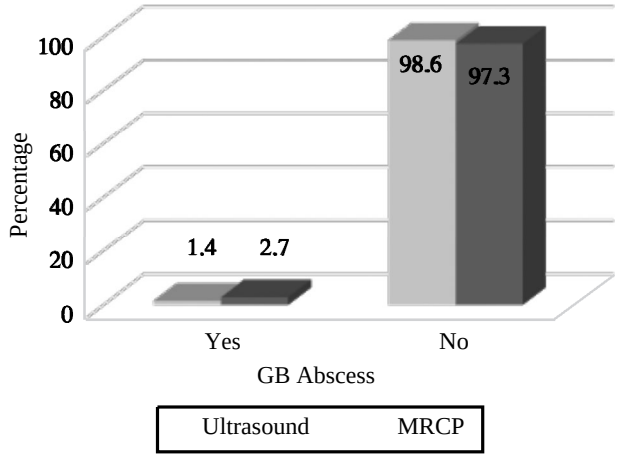


Fig. (6)

Discussion

To assess the probability of post cholecystectomy choledocholithiasis as well as pre -operative complications, 148 patients clinically diagnosed with calcular cholecystitis underwent pre-operative magnetic resonance cholangiopancreaticography examination.

We concluded that MRCP is of higher benefit in patients scheduled for cholecystectomy for calcular gall bladder disease. Also ultrasound was proven to be of limited value specifically as regards the pre-operative assessment of biliary tract stones.

The MRCP benefits were achieved through its ability to assess the variant biliary tract anatomy, exclusion or detection of the intra-hepatic, extra-hepatic common hepatic as well as CBD stones and also by detecting concomitant pathologies as gall bladder abscess or mucocele.

All these assessed points were of great help decreasing many of the post cholecystectomy complications as recurrent symptoms of biliary stones, avoiding intra-operative surgical surprises as gall bladder abscess or mucocele which require prior management and also in avoiding faulty ligation/ injury of the common bile duct in patients with variable cystic duct insertion.

Our study findings were found consistent with, Peng et al. *[5]* which reported in 2005in his study that of 243 acute biliary colic cases and 142 patients with acute cholecystitis, all previously underwent prior laparoscopic cholecystectomy, 7.7 and 16.5% had choledocholithiasis, respectively.

All patients presented clinically with calcular cholecystitis symptomshad preoperative trans-abdominal ultrasound, which has been considered to be a reliable modality in diagnosing calcular gall bladder disease. However, this technique mostly provides limited data as regards the CBD screening and almost rarely helps direct inspection of the CBD stones according to Varghese JC, et al. *[6]*. These data was found also consistent with our study were trans-abdominal ultrasoundhad limited ability to identify CBD stones in any of our patients.

Some studiesas Wong HP et al., also suggested that roughly one-third of CBD stones that could be identified by ultrasound occur in non-dilated biliary systems, which can be very challenging *[7]* and that was also consistent with our study findings where ultrasound was unable to detect any of the CBD stones detected in the MRCP examination.

MR imaging (MRI) was first considered in 1986 for diagnosing biliary disease, and then it was only used for demonstrating the dilated biliary ducts anatomy and possibly the level of an obstruction *[8]*. Yet, recent advances and refinement of MR cholangiographic sequences caused the MRI to be considered as reliable diagnostic tool for detecting biliary stones *[9]* along with other associated pathologies.

Also the prospective study of 57 patients by Wong HP et al. *[7]* concluded that Magnetic resonance cholangiopancreaticography is a reliable evaluation technique for the detection of choledocholithiasis and had the upper hand over trans-abdominal ultrasound and that was also consistent with our study findings.

That's why MRCP is increasingly considered as a reliable non-invasive diagnostic method for pre-operative detection/exclusion of biliary tract stones, anomalies as well as associated pathologies (e.g. Abscess &mucocele) *[10]*. That would also help reducing the pre-operative need for invasive procedures (e.g. ERCP) giving a better detailed state of the patient's biliary tract anatomy which also decreases the associated surgical risks *[11]*.

Yet, while ERCP is still considered as the gold standard for diagnosing biliary & pancreatic ducts pathologies, MRI also still not widely suggested as a diagnostic tool due to economic considerations.

But a comparative observational study of 60 patients done by Kumar A. et al., found that no significant difference between MRCP and ERCP in diagnosing biliary and pancreatic ducts stones/ pathologies among other pathologies *[11]*. That was also partially consistent with our study findings, reinforcing the fact that MRCP is of great value in assessing biliary tract stones. And that would also help decreasing the surgical risks and the need for laboratory preparations as well as the needed sedation for ERCP procedure.

Also Hekimoglu K. et al. *[12]* reported in his prospective study, which included 269 patients whom underwent MRCP examination before ERCP, that MRCP is increasingly considered as a non-invasive alternative to ERCP and the diagnostic results

of MRCP and ERCP are comparable with high accuracy in various hepatobiliary pathologies. They also concluded that MRCP had a 88.9% sensitivity and a 100% specificity for diagnosing biliary stone disease.These data were also consistent with our results which increasingly add to the valuable diagnostic potentials of MRCP.

Again Verma D. et al., stressed upon the importance of the MRCP as a non-invasive diagnostic tool for biliary tract stones detection when compared to the endoscopic ultrasound (EUS) **[13].** That was also consistent with our point of view as regards the variable diagnostic benefits of the non-invasive MRCP examination.

At last, our average number of patients enrolled in the study had the benefit of including variable pathologies and conditions. Yet, addition of proper and long term follow up may have reinforced the collected data and added much to its value.

Conclusion:

Pre-operative magnetic resonance cholangiopancreaticography is recommended as a reliable and non-invasive tool for the detection or exclusion of intra-hepatic, extra-hepatic as well as CBD stones along with other related pathologies. Instead of the need for surgical/CBD exploration, MRCP is better in deciding if it's necessary or not to explore the CBD and also helps avoiding retained CBD stones or recurrent post-cholecystectomy biliary obstruction.

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فحص القنوات المرارية للكبد و البنكرياس بالرنين المغناطيسى قبل عمليات استئصال الحويصلة المرارية.... هل يفيد المرضى ؟

الكثير من مرضى الحصوات المرارية يعانون من ارتجاع اعراض الحصوات حتى بعد استئصال الحويصلة المرارية وذلك بسبب وجود حصوات اخرى بداخل القنوات المرارية الداخلية والخارجية للكبد. لذلك يهدف هذا البحث لاثبات دور فحص القنوات المرارية للكبد والبنكرياس بالرنين المغناطيسى فى تحسين نتائج ما بعد عمليات استئصال الحويصلة المرارية وتقليل فرص ارتجاع اعراض المرض.