OPEN ACCESS
Saudi Journal of Medicine
Abbreviated Key Title: Saudi J Med
ISSN 2518-3389 (Print) |ISSN 2518-3397 (Online)
Scholars Middle East Publishers, Dubai, United Arab Emirates
Journal homepage: http://scholarsmepub.com/sjm/

Original Research Article

Spectrum of Magnetic Resonance Cholangiopancreatography Findings in Acute Cholecystitis

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DOI:10.21276/sjm.2019.4.8.6 | **Received:** 30.06.2019 | **Accepted:** 14.08.2019 | **Published:** 17.08.2019

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Abstract

Objectives: To highlight spectrum of findings on Magnetic Resonance Cholangiopancreatography (MRCP) in patients with acute cholecystitis. To determine length of hospital stay in operated cases. ***Method:*** This retrospective observational study was conducted in Radiology department at our hospital in Dhahran, from August 2016-2018. All patients who presented with acute cholecystitis, obstructive liver pattern or deranged liver tests, and underwent MRCP (on a 1.5 Tesla scanner) were evaluated. Patients with chronic cholecystitis, previous hepatobiliary surgery, pregnant patients and those contraindicated to MRI were excluded. Patterns of MRCP findings were categorized as: (i) acute cholecystitis with normal CBD, (ii) acute cholecystitis with dilated CBD and cause identifiable, (iii) acute cholecystitis with dilated CBD and cause not identifiable. Any associated biliary ductal variants or anomalies (e.g., pancreas divisum, choledochal cyst, low insertion of CBD) were also documented. Operated cases were followed to determine length of hospital stay after open or laparoscopic procedures. Chi-square and t-test were used to determine association. ***Results:*** Of the 104 patients, majority (60%) were females. The mean age was 43 years. Two-thirds of patients were having normal CBDs (68.3%), while nearly one-third (31.7%) had dilated CBDs, and half of these (16.4%) showed an identifiable cause of obstruction. Thirteen patients (12.5%) had associated anomalies. The length of hospital stay was seen significantly less in laparoscopic than with open cholecystectomies (p=.0005). ***Conclusion:*** Magnetic resonance cholangiopancreatography is helpful to identify causes and anomalies in patients with acute cholecystitis patients having deranged or obstructive liver function.

Key words: Acute cholecystitis, Magnetic resonance imaging, obstructive jaundice.

INTRODUCTION

Acute cholecystitis is inflammation of the gallbladder that develops over hours. It is a potentially serious condition and usually needs to be treated in the hospital [1]. If the diagnosis is confirmed, early surgery is indicated. Acute cholecystitis can be classified into calculous cholecystitis (with gallstones) and acalculous cholecystitis (without gallstones). Gallstones cause blockage to the flow of bile and account for 90% of cases. Acute calculous cholecystitis is caused by an obstruction of the cystic duct, leading to distention of the gallbladder compromising its blood flow and lymphatic drainage and causing mucosal ischemia and necrosis. Acalculous cholecystitis can occur by accidental damage to the gallbladder during major surgery, serious injuries or burns, sepsis (systemic infection), severe malnutrition or AIDS (Acquired Immunodeficiency Syndrome). Accurate and timely diagnosis is important to initiate adequate management. The condition can be life threatening and may require surgery. Removal of the gallbladder (i.e., cholecystectomy) can be performed by open abdominal excision or laparoscopically [2]. The benefit of laparoscopy is that the incisions are small and patients usually have less pain and scarring after the procedure [3]. Also, emergency laparoscopic cholecystectomy is found cost effective [4].

In patients with acute cholecystitis, identification of a common bile duct (CBD) stone before cholecystectomy is of concern for surgeons, gastroenterologists, and radiologists, particularly if the liver function tests are found to be deranged or patients have an obstructive liver pattern on blood tests [Fig.1].

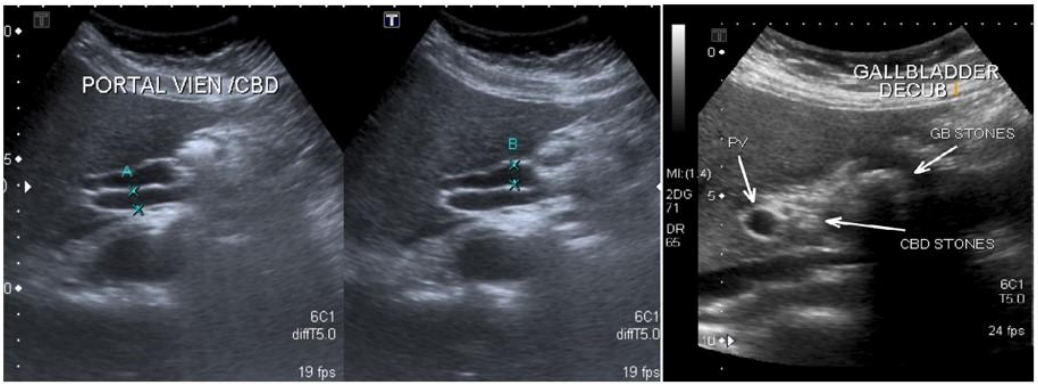

Fig-1: Ultrasound images of two selected patients, one with dilated CBD (left and middle images) and obscured distal CBD, and the other showing mildly dilated CBD with stones in it and within GB (right sided image). CBD- Common Bile Duct, GB-Gallbladder, PV- Portal Vein

Ultrasound is the preferred imaging modality for the evaluation of clinically suspected acute cholecystitis [5], and to exclude its mimics [6]. In patients with calcular cholecystitis, presence of a CBD stone (choledocholithiasis) or dilatation may guide clinicians to adopt a different approach for patient management. For example, they may opt surgery in case of no stone or dilatation or they may proceed with an initial ERCP (Endoscopic Retrograde Cholangiopancreatography) in case of stone or other obstruction. Although ultrasound may be able to detect a dilated or obstructed CBD, it may also detect a stone or intraluminal debris or sludge in some cases. However, it remains limited in delineating the entire length of the CBD mostly due to obscuration by bowel gases. Moreover, fatty or large-built patients may cause further limitations in assessment, and irritable or uncooperative patients (not holding breath adequately during the scanning) may contribute to difficulty in evaluation. In addition, ultrasound is operator dependent and requires both expertise and experience to evaluate difficult or challenging cases.

Magnetic resonance cholangiopancreatography (MRCP) has the ability to accurately detect choledocholithiasis in patients with acute cholecystitis [7]. Its multiplanar cross-sectional imaging and exquisite tissue characterization have greatly benefitted such patients. Time, cost, claustrophobia and certain contraindications to magnets are a few of its limitations. Patient cooperation (to avoid movement or breathing artifacts), and at times intravenous contrast administration may be needed to outline any mass (cholangiocarcinoma, periampullary or pancreatic head carcinoma) or for differentiation of certain imaging findings. MRCP is a non-invasive and safe option [8], when compared to ERCP for imaging a biliary tree and biliary obstruction [9] and has largely replaced ERCP as the gold standard for diagnosis of choledocholithiasis and obstructive jaundice [10], achieving nearly similar sensitivity (90-94%) and specificity (95-99%) without utilizing ionizing radiation, intravenous contrast, or the complications inherent to ERCP. It also helps to delineate any congenital biliary malformation (e.g., choledochal cyst, low CBD insertion), and to document any concomitant complications (e.g., acute pancreatitis, changes pertaining to cholangitis) [11]. These additional information and visual anatomy of the biliary tree prior to surgery help clinicians to plan management and offer better patient counselling and help surgeons to adopt better operative approach.

Various studies in the literature have discussed the role of MRCP in diagnosis of biliary obstruction [12] and to document complications of acute cholecystitis [13]. However, imaging patterns or spectrum of MRCP findings have not been categorically described. Therefore, we aim to highlight the role of MRCP in such patients and to demonstrate commonly encountered imaging findings and the contribution of MRCP towards patient management.

METHODS

This retrospective observational study was conducted in the radiology department at our hospital in Dhahran from August 2016-2018. All patients (N=104) who underwent MRCP after initial diagnosis of acute cholecystitis (on initial ultrasound imaging) and had deranged liver function (laboratory) tests were included. Patients with chronic cholecystitis, post-surgery or intervention (biliary stenting) cases, pregnant patients, and those contraindicated to MRI were excluded. As the study was retrospective and did not involve disclosure of any patient information and privacy, the ethics committee of our hospital waived the need for patient consent. The study was conducted in accordance with the Helsinki Declaration. All clinical and radiologic information were kept strictly confidential. A literature review was performed using an electronic search (Google Scholar, PubMed). Demographic information

regarding age and gender of all patients was collected. Clinical information and MRI findings were acquired through patients' clinical notes, Hospital Information System (HIS) and Radiology Information System, and the Picture Archiving and Communication System (RIS/ PACS). Information about clinical presentation and follow up were recorded from the clinical notes on HIS.

Routine MRCP studies were performed on a 1.5 Tesla scanner (General Electric/ GE, Optima 450 W GEM, 2013, Florence, South Carolina, USA). Intravenous contrast (gadolinium-based agent, Dotarem, 0.1 mmol/kg; Guerbet, France) was used only in few cases having suspicion of mass or infection. Imaging sequences included Coronal Single Shot Fast Spine Echo (CSSFSE) with respiratory gating (thickness 5mm, spacing 1.0), Axial (Ax) 2D FIESTA FAT SAT with respiratory gating (thickness 5mm, spacing 1.0), Ax T2 Propeller with respiratory gating (thickness 5 mm, spacing 1.0), 3D MRCP with respiratory gating (thickness 0.8 mm, spacing 0.0), Coronal (Cor) T2 CUBE (multiplanar 3D) with respiratory gating (thickness 1.6 mm, spacing 0.0), and Cor T2 (thin) with respiratory gating (thickness 2.0 mm, spacing 0.2). If needed, Ax DWI with respiratory gating (thickness 5 mm, spacing 1.0), and Ax 2D or 3D Dual Echo T1 breath-hold in-phase and out-phase (thickness 5 mm, spacing 1.0) were acquired.

Patterns of MRCP findings were categorized as: - (i) acute cholecystitis (calculus or acalculus) with normal CBD, (ii) acute cholecystitis with dilated CBD and cause identifiable, (iii) acute cholecystitis with dilated CBD and cause not identifiable. Any associated biliary ductal variants or anomalies (like pancreas divisum, choledochal cyst or low insertion of CBD) were also documented. Imaging was interpreted by two general/ body radiologists (each having more than 7 years of experience), and final diagnoses were made by consensus reporting. Operated cases were followed to determine length of hospital stay after open or laparoscopic procedures. Non-operated cases included acalculus cholecystitis or debilitated non-surgical candidates (requiring cholecystostomy tube insertion), mild changes of cholecystitis (with suspicion of recent stone passage and subsequent improvement), and suspected cancer patients (cholangiocarcinoma or peri-ampullary carcinoma that required either oncologic referral to nearby specialist hospital or underwent ERCP stenting).

The statistical analysis was carried out using Statistical Package for Social Sciences (SPSS, version 22). Chi-square test and t-test were used to determine association and p-values less than 0.05 were considered significant.

RESULTS

Of the 104 patients, 60% (n=62) were females, and 40% (n=42) were males. The mean age was 43 years (Std. deviation- 16.8).

Thirteen patients (12.5%) were having associated anomalies. Acute cholecystitis patients (57 calculus, 5 acalculus patients) with normal CBDs, dilated CBDs (with identifiable causes), and dilated CBDs (without identifiable causes) were found in 68.3%, 16.4% and 15.3% respectively.

Identifiable causes include CBD stones (choledocholithiasis), choledochal cyst, benign stricture and masses (ampullary, periampullary) [Fig. 2 & 3].

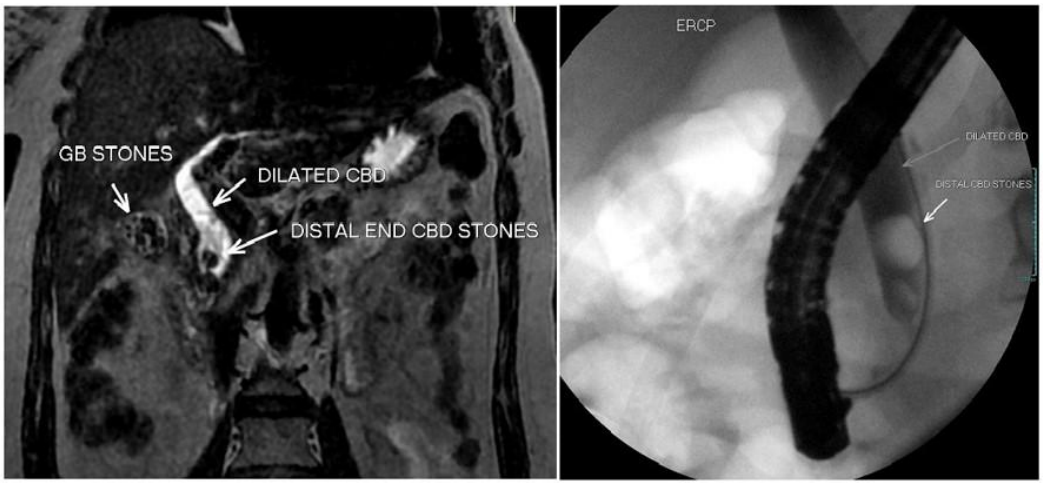

Fig-2: Selected coronal T2 reformat image (image on left) showing dilated CBD with two stones (and stones within the GB as well). Selected spot film fluoroscopic image during ERCP of same patient (image on right) showing filling defects corresponding to stones within the distal CBD. GB- Gallbladder, CBD- Common Bile Duct, ERCP- Endoscopic Retrograde Cholangiopancreatography

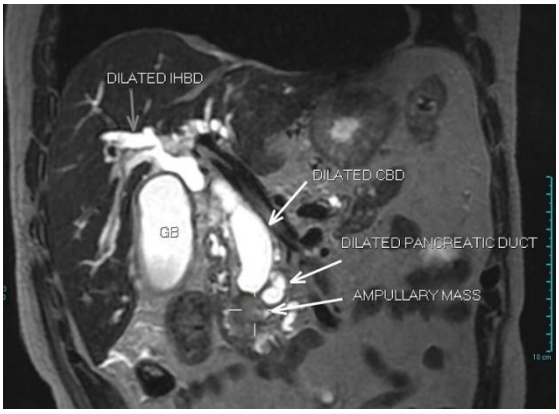

Fig-3: Coronal T2 reformat image of a selected patient showing an ampullary mass with dilated IHBD, GB, CBD and pancreatic duct. IHBD- Intra-hepatic biliary Duct, GB- Gallbladder, CBD- Common Bile Duct

Associated anomalies were not seen significantly associated (p- value= .53) with the imaging patterns [Table.1].

Table-1: Distribution of imaging pattern with associated anomaly

	Imaging Findings	Associated Anomaly		Total
		Not present	Present	
MRCP	A	62 (87.3%)	9 (12.7%)	71 (100.0%)
	B	16 (94.1%)	1 (5.9%)	17 (100.0%)
	C	13 (81.3%)	3 (18.8%)	16 (100.0%)
Total		91	13	104 (100.0%)

Forty patients underwent laparoscopic surgery, and 30 patients had open cholecystectomies. The length of the hospital stay was seen significantly less in laparoscopic cases (p=.0005).

Table-2: Distribution of surgeries and length of stay

Surgery type	Length of stay		Total
	Less than 3 days	More than 3 days	
Laparoscopic	31	9	40
Open	9	21	30
Total	40	30	70

DISCUSSION

We found important clinical implications of our study. Firstly, we observed that most of the patients were having isolated cholecystitis without CBD dilatations. Three cases of Mirizzi syndrome were diagnosed in our study, 2 of these were showing cystic duct stones and one showing stone near gallbladder neck-cystic duct junction, all associated with minimal intrahepatic biliary duct dilatations. All of these three cases were diagnosed on initial ultrasounds and confirmed on MRCPs. Except for these three cases of Mirizzi syndromes, rest of cases were not having biliary ductal dilatations. This is important as many of patients could have been avoided MRCP imaging particularly if the CBD was not seen dilated on ultrasound, and kept under observation for monitoring liver function tests. Transient increases in liver function or cholestatic picture may result from either recent stone passage through CBD or due to compression upon adjacent cystic duct-common hepatic duct and CBD by inflammatory process involving the gallbladder. Studies have shown that patients with normal and dilated (obstructed) CBD may show a different altered liver function tests with relatively variable threshold values. Chen JE and colleagues found that in patients with acute cholecystitis who had a normal CBD diameter, normal or even mildly elevated bilirubin levels below a calculated threshold may obviate preoperative MRCP [14]. Their results showed a significant difference in the total and direct bilirubin levels of patients who had positive (1.94 vs 4.02 mg/dL, respectively; p = 0.013) and negative (0.71 vs 2.13 mg/dL, respectively; p = 0.02) findings for CBD stone on MRCP. Chisholm PR et al demonstrated statistically significant odds ratios for transaminases >3 times the upper limit of normal, alkaline phosphatase above normal, lipase >3 times the upper limit of normal, total bilirubin ≥1.8 mg/dL, and CBD diameter >6 mm, to predict choledocholithiasis [15]. Boys JA *et al*. demonstrated that increasing CBD diameter of 6-9.9 mm were associated with 14% incidence of CBD stones, while > 10mm with 39% [16]. Therefore, it is suggested that clinical assessment and laboratory parameters are very important to foresee CBD stones or obstruction, and to refer patients for imaging.

Secondly, we observed commonest cause of a dilated CBD associated with calculus cholecystitis to be stones (i.e., choledocholithiasis). Presence of choledocholithiasis with acute cholecystitis has always been an area of interest for the surgeons, and may even be important for patient's management as presence of CBD stones may warrant an initial endoscopic retrograde cholangiopancreatography (ERCP) to remove CBD stones. Qiu Y *et al*. suggested routine preoperative MRCP for diagnosis of associated choledocholithiasis prior to cholecystectomy for patients with gallstones is important for the surgical decision and treatment efficacy [7]. However, Al-Jiffry BO *et al*. found that a direct laparoscopic cholecystectomy in patients with deranged liver function and normal CBD ultrasound avoided nearly 42% of unnecessary MRCPs [17]. We believe that incident dilated CBD in patients with acute cholecystitis may be strategic and sometimes justified to channel patients either to surgery (if no cause of obstruction identifiable and recent passage of stone is suspected clinically and on laboratory test) or ERCP (if stones or mass detected). Although not seen frequently on ultrasound (due to obscuration by bowel), ppresence of a double-duct sign (i.e., dilated CBD and pancreatic duct) can be sign of tumor. Sinha R and his colleagues found a 48% incidence of malignancy among patients with this specific sign, particularly in jaundiced patients [18]. Scanning time may be reduced for such patients by adopting limited sequences. Although we did not include pregnant patients with acute cholecystitis, however, this subset also appears to benefit from MRCP (if indicated) considering non-ionizing modality [19]. Kang SK *et al*. demonstrated that in hospitalized patients with suspected choledocholithiasis, performance of non-contrast abdominal MRI with HASTE was similar to contrast-enhanced MRI with 3D-MRCP, offering potential for decreased scanning time and improved patient tolerability [20].

Third important aspect of our study was observation of associated congenital biliary anomalies encountered on MRCP in these patients. Although not statistically significant, these findings might be clinically strategic, as presence and documentation of such anomalies not only help to adopt a more careful approach during surgery but also for patients counselling and prognosis. For example, presence of choledochal cyst and choledochocele on MRCP may help surgeons to better orientate patients about their problems and counselling. Also, identification of a low-lying CBD or variant of CBD insertion may guide clinicians to adopt a more careful operative approach while ligating cystic duct, avoiding any biliary ductal damage or leak afterwards. Nasr MM presented safe surgical technique to minimize dissection and risk of injury related to the traditional laparoscopic cholecystectomy [3]. Length of hospital stay was seen significantly less in laparoscopic (30 patients) than with open (40 patients) cholecystectomies (p=.0005). Laparoscopy has now become the first-line approach to perform cholecystectomy in patients with acute cholecystitis [21]. Although for milder disease a conservative management might be an option. Loozen CS noted that cconservative treatment of acute calculous cholecystitis during index admission seemed feasible and safe, especially in patients with mild disease [22]. Barreiro Alonso E *et al*. showed that not performing a cholecystectomy within two weeks after a first episode of mild acute biliary edematous pancreatitis or cholecystitis contributed to patient readmission due to recurrent pancreatitis, resulting in avoidable treatment costs [23]. In a recent study presented by Fleming CA et al showed that almost 90% of 157 patients with acute cholecystitis who were managed with a percutaneous cholecystostomy tube (PCT) recovered uneventfully without recurrent sepsis following PCT removal- a viable option for older, comorbid patients who were unfit for surgical intervention and was not associated with significantly increased mortality [24]. Hajibandeh S *et al*. found that extended postoperative antibiotic therapy did not improve postoperative infectious or noninfectious outcomes in patients with mild or moderate acute calculous cholecystitis undergoing emergency cholecystectomy [25].

We also encountered few interesting cases of clinical relevance. One patient with clinical suspicion of acute cholecystitis was having border-line wall thickening on ultrasound and non-visualized GB stones. A hepatobiliary iminodiacetic acid/ HIDA scan (also called cholescintigraphy, hepatobiliary scintigraphy or hepatobiliary scan) was performed that was suggestive of acute cholecystitis. Subsequently, MRCP was acquired that revealed a cystic duct stone causing obstruction and inflammation. Therefore, it is suggested that MRCP can be useful for clinically and imaging-wise difficult cases. We used HIDA scan for a couple of patients with ultrasound and MRCP findings of acalculous cholecystitis, to confirm the diagnoses. The utility of hepatobiliary scintigraphy has proven extremely useful in the diagnosis of acute cholecystitis, chronic gallbladder disease, biliary leaks, biliary obstruction, and biliary atresia [26]. Another important aspect of HIDA scan is to estimate ejection fraction of gallbladder, to exclude an entity called biliary dyskinesia, gallbladder dysmotility or functional gallbladder disorder [27]. Although such patients were not the target population in our study, yet this condition should not be overlooked in patients who presents with recurrent right upper quadrant pain mimicking acute cholecystitis [28], having normal gallbladder ultrasounds and still requiring cholecystectomy [27]. We also found two pediatric acute cholecystitis cases (aged less than 14 years), one with CBD stones and having sickle cell disease (SCD) and other one with congenital anomaly (choledochal cyst-type IB). These patients subsequently had MRCP that showed exquisitely the anatomy of biliary tract and definite

diagnoses. Therefore, role of MRCP in children can not be underestimated in such patients particularly with suspected congenital structural abnormality on initial ultrasounds. Gallstone disease in SCD is known presentation in children in Saudi Arabia, for which laparoscopic cholecystectomy is advocated as operative choice [29-31]. Even for adult SCD patients, prophylactic cholecystectomy has been advocated [32].

Single-center, retrospective and small sample size were considered few of our study limitations. However, we feel that clinical, laboratory and ultrasound findings in patients with acute cholecystitis still need to be emphasized to filter subset of patients that could benefit from MRCP. Availability of MRI facility should not be clinical practice to have this study that requires both time and cost to hospital facilities. Although detection of associated anomalies is not uncommon on MRCP, yet some of these can be found on ultrasound (e.g., choledochal cyst), and even if those can not be found (e.g., low CBD insertion), these may be identified on careful laparoscopic approach. For selected or difficult patients, MRCP still remains a good option to delineate biliary anatomy and to diagnose cause of biliary obstruction. Further larger scale studies are needed to define a pathway for adopting MRCP in patients with acute cholecystitis, both in adult and pediatric population, for better patient care and counselling, surgical approach and/ or management options.

CONCLUSION

Magnetic resonance cholangiopancreatography is helpful to identify causes and anomalies in patients with acute cholecystitis patients having deranged or obstructive liver function.

ACKNOWLEDGMENT

We would like to thank our senior colleague Dr. Muhammad Zia Ul Hassan for providing his assistance in reviewing the submitted figures for clarity and correctness.

CONFLICT OF INTEREST

Authors declare that the research was conducted in absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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