Value of Magnetic Resonance Cholangiopancreatography Signs in the Detection of Choledocholithiasis

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ABSTRACT:

BACKGROUND:

Common bile duct stones may be small or large, single or multiple, the incidence increases with age. Biliary stones present almost always as low signal intensity on MR images. Therefore, the stone is identified as a round or oval- shaped "signal void" within the common bile duct (CBD), surrounded by the high signal intensity bile, CBD stone can present as sharp cutoff of a CBD at the ampulla, often with a well-marginated “meniscus” configuration, CBD stone may be associated with CBD dilatation and/or dilated intrahepatic biliary tree.

OBJECTIVE:

To evaluate MRCP signs in detecting CBD stones in patients with obstructive jaundice.

PATIENTS AND METHODS:

The study included 50 patients with jaundice suspecting to have CBD stones as a cause of their complaint ,MRCP parameters include: CBD diameter, meniscus sign ,Status of intrahepatic and extrahepatic ducts, Gall bladder status, Pancreatic duct status Statistical analyses for the results were done.

RESULTS:

MRCP diagnose choledocholithiasis in 49(98%) out of 50 patients with a sensitivity of 98%, Accuracy =98%, the specificity of MRCP in diagnosing choledocholithiasis in our study was 95%, P value= 0.001. MRCP show filling defect in 31 patients (3 of them show multiple filling defects) giving Accuracy =62%, sensitivity rate 62%, specificity rate 90%, P value= 0.0001. MRCP show meniscus sign in 18 patients giving Accuracy =36%, sensitivity rate 36%, specificity rate 95%, P value= 0.0001. MRCP show CBD dilatation in 48 patients giving Accuracy =96%, sensitivity rate 96%, specificity rate 95%, P value= 0.001.

CONCLUSION:

MRCP is a non–invasive investigation with high sensitivity, specificity, positive and negative predictive values in detection of CBD stones. Gathering well-defined radiological signs of CBD stones in MRCP allows good diagnostic accuracy. CBD dilatation is the more sensitive sign of detecting CBD stone while meniscus sign is more specific sign for detecting CBD stone in MRCP.

KEYWORDS: CBD stone, obstructive jaundice, MRCP.

INTRODUCTION:

Cholelithiasis is a common disease requiring general surgery, in which gallstones account for the vast majority of procedures [1]. For patients with gallstones, approximately 5–15 % of cases are associated with choledocholithiasis [2-6]. Common bile duct stones may be small or large, single or multiple [7]. The incidence increases with age [8]. These are classified to primary stones that form in the bile ducts and secondary stones that formed within the gallbladder and migrate down the cystic duct into the common bile duct, 90% of bile duct stones are secondary stones, 10% are primary stones, The secondary stones are usually cholesterol stones, whereas the primary stones are usually of the brown pigment type [7]. The primary stones are associated with biliary stasis and infection. The causes of biliary stasis that lead to the development of primary stones include biliary stricture, papillary stenosis, tumors. Duct stones may occur many years after a cholecystectomy [9,10]. The patient may be asymptomatic but usually has bouts of pain, jaundice and fever,they may cause obstruction, complete or incomplete, or they may manifest with cholangitis or gallstone pancreatitis [11].

Diagnosis of choledocholithiasis is not always straightforward and clinical evaluation and biochemical tests are often not sufficiently accurate to establish the diagnosis [12].

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Endoscopic retrograde cholangiopancreatography (ERCP) is the gold standard for both diagnosis and treatment of CBD stones. However, the procedure is associated with an overall complication rate of 5%-10% and mortality rate of 0.02%-0.50%. Ductal cannulation is difficult or impossible in patients who have undergone previous surgery, which includes Billroth type II gastrectomy and hepaticoenterostomy. In addition ERCP is an invasive procedures that may cause serious complications [13].

MRCP has emerged as an accurate, non-invasive diagnostic modality for investigating the biliary and pancreatic ducts and has been recommended in some circles as the preoperative procedure of choice for the detection of CBD stones [12]. MRCP began to replace endoscopic retrograde cholangiopancreatography (ERCP) for preliminary assessment of suspected biliary obstruction, including CBD stones [14]. MRC provides excellent anatomic detail [15, 16]. MRCP is well recognized to have high sensitivity and specificity (over 90%) for the detection of common bile duct (CBD) calculi [17]. MRCP showed a high accuracy in the diagnosis of choledocholithiasis [18-20]. In particular, Freitas ML reported that its accuracy is comparable to that of ERCP, and its sensitivity and specificity was shown to reach 95 % [21, 22].

AIM OF STUDY:

To evaluate MRCP signs in detecting CBD stones in patients with obstructive jaundice.

PATIENTS AND METHODS:

This prospective cross sectional study was conducted at the MRI unit of AL-Imamain Al-Kadhimain medical city from the period between September 2015 to September 2016. The study included 50 patients who were referred from the GIT center and general surgery unite including in and outpatients suffering from obstructive jaundice suspecting to have CBD stones as a cause of their complaint.

Inclusion criteria: include one or more of the following: 1. A history or presence of any of the following: Intermittent jaundice, Cholangitis which was defined as the presence of fever, chills, colicky right upper quadrant pain and leukocytosis, post biliary pancreatitis, post cholecystectomy syndrome. 2. Total bilirubin which was > 1.2 mg dL, alkaline phosphatase which was > 220 IU/L. and 3. A CBD diameter of > 7 mm at sonography or CBD stones which were suspected/ diagnosed at sonography.

Exclusion criteria: include all cases of obstructive jaundice where the cause proved to be other than CBD stones (e.g. CBD strictures, carcinoma head of pancreas, periampullary carcinoma, cholangiocarcinoma and any congenital anomaly) and any contraindication to MRI.

The demographic criteria and relevant clinical history (age, gender, clinical presentation as jaundice, fever, right upper quadrant pain, past medical and surgical history, investigation) were recorded

MRCP protocol and data analysis: A satisfactory written consent form must be taken from the patient before entering the scanner room, then ask the patient to remove all metal object including keys, coins, wallet, any cards with magnetic strips, jewelry, hearing aid and hairpins, then ask the patient to undress and change into hospital gown, instruct the patient to hold their breath for the breath hold scan and breathe gently for the gated scans (it's advisable to coach the patient two to three times before starting the scan), the patients should fast for 4-6 hours before the exam and explain the procedure to the patient and answer questions.

The images were acquired with a 1.5 Tesla MRI scanner (PHILIPS ACHIEVA MEDICAL SYSTEM), the patients well positioned in the supine position with head pointing towards the magnet (head first supine) and place the body coil over the upper abdomen, securely tighten the body coil using straps to prevent respiratory artifacts, putting a pillow under the head and cushions under the legs for extra comfort ,center the laser beam localizer over xiphoid process of sternum, MRCP breath-hold 48 second or MRCP – 4D trigger 21 second were performed, MRCP non breath hold(MRCP-3D) take about 327sec. which is a long time but give a raw data.

Fat suppressed (SPIR) Turbo Spin-Echo (TSE) sequence is used to acquire MRCP. Imaging parameters, are as follows: TR=2000 millisecond, TE=700 millisecond, Echo Train Length (ETL)=123. Images are acquired on the coronal plane with a 3-mm partition thickness. Imaging volume is positioned to image both the pancreatic and the biliary ducts using as scout view an axial T2w (TR/TE: 3000/120) TSE sequence. A field of view of 240 mm. Image matrix size 184x256, respiratory triggering is used in order to reduce motion artifacts.

Image reconstruction with multiple projections is performed at the console, after the entire source images have been acquired, either with 2D or 3D techniques. Different reconstruction techniques can be used: MIP (Maximum Intensity Projection), Targeted MIP and MPR (Multiplanar

Reformations), then the data is transferred to our control unit and study MRCP sequence , analyzing the data to observe the causative agent and identify the cause using our parameters that includes: CBD diameter, signal void in CBD (meniscus sign), status of intrahepatic and extrahepatic ducts, Gall bladder status including: distention, wall thickness and stones (number and size) and Pancreatic duct status.

In cases of MRCP positive criteria (CBD stone) are reported and send to their referral then we follow the patient with help of his/her doctor to confirm our results by means of Endoscopic retrograde Cholangipancreaticography (ERCP) or surgery, Other proportion of patients with obstructive jaundice with initial negative MRCP criteria of CBD stone with no identifiable cause are also followed with help of his/her doctor to see how many of them have CBD stone not detected on MRCP by repeating the MRCP or ERCP if obstructive jaundice persist.

Statistical analysis: SPSS version 24.0 was used for statistical analysis. General and radiological characteristics were presented with descriptive statistics. A P-value of less than 0.05 was considered significant.

RESULTS:

The study included 50 patients with clinical, biochemical or radiological suspicions of choledocholithiasis. Their ages ranged from 20 to 65 year, with a mean age of 43 year, 42 patients (82%) were females and 8 patients (18%) were males.

MRCP diagnose choledocholithiasis in 49 (98%) out of 50 patients with accuracy of 98%, sensitivity of 98%, specificity of 95%, Positive predictive value (PPV) = 91.7%, Negative predictive value (NPV) = 92.5%. MRCP show filling defect in 31 patients (3 of them show multiple filling defects) giving accuracy =62%, sensitivity rate 62%, specificity rate 90%, Positive predictive value (PPV) = 66.6%, Negative predictive value (NPV) = 67.6%. MRCP show meniscus sign in 18 patients giving accuracy =36%, sensitivity rate 36% , specificity rate 95%, Positive predictive value (PPV) = 65%, Negative predictive value (NPV) = 64%, as shown in table 1.

Table no. 1: Filling defect, meniscus sign and final diagnosis of CBD stone by MRCP.

	Filling defect in CBD		Meniscus sign in CBD		Final diagnosis of CBD stone by MRCP	
	No.	%	No.	%	No.	%
(+) ve	31	62	18	36	49	98
(-) ve	19	38	32	64	1	2
Total	50	100	50	100	50	100
Accuracy	62		36		98	
Sensitivity rate	62		36		98	
Specificity rate	90		95		95	
PPV	66.6		65		91.7	
NPV	67.6		64		92.5	

MRCP show dilated intrahepatic biliary tree in 31 patients, CBD dilatation in 48 patients pancreatic duct dilatation in only 2 patients, these findings with their accuracy, sensitivity, specificity are shown in table 2.

Table no. 2: Biliary and pancreatic ducts dilatation in MRCP.

	Intrahepatic biliary tree		Extrahepatic biliary tree		Pancreatic duct	
	No.	%	No.	%	No.	%
Dilated	31	62%	48	96%	2	4%
Non dilated	19	38%	2	4%	48	96%
Total	50	100%	50	100%	50	100%
Accuracy	62%		96%		2%	
Sensitivity rate	62%		96%		4%	
Specificity rate	64%		95%		1%	
PPV	38%		92%		66%	
NPV	45%		92%		51%	
False positive	36%		5%		99%	
False negative	38%		4%		96%	
P value	0.0001		0.001		0.01	

Seven patients had history of cholecystectomy, 40 patients show gall stones, (37 (92%) patients had multiple gall stones and 3 (8%) patients had single stone), 3 patient show no gall stone, 5 (12%) patients show distended gall bladder while in 38 (88%) patients the gall bladder was not distended. The gold standard is surgery or ERCP

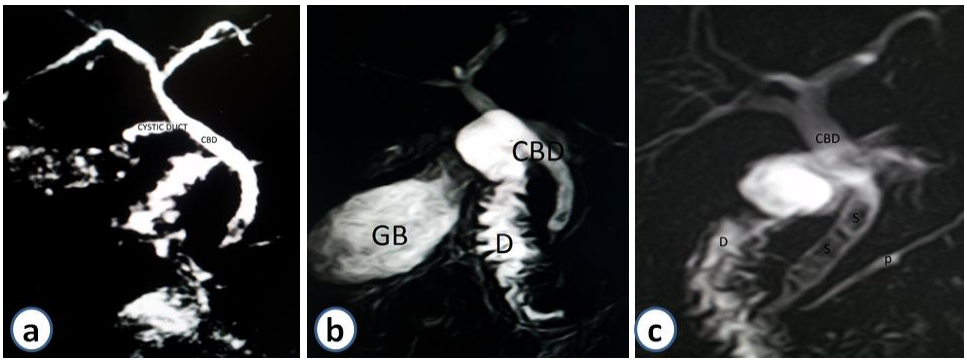

Figure 1: a: 45 year old female presented with jaundice for 1 week duration, MRCP shows 2 lower CBD stones as filling defects, there is mild dilatation of intrahepatic and extra-hepatic bile ducts. B: 43 year old female presented with jaundice for 5 days duration MRCP shows lower CBD stone as filling defect, with evidence of meniscus signs, there is moderate dilatation of intrahepatic and extra-hepatic bile ducts C: 33 year old female presented with jaundice for 8 days duration MRCP shows multiple CBD stones as filling defect and evidence of meniscus signs, there is severe dilataion of the intrahepatic and extra-hepatic bile ducts with mild dilatation of the pancreatic duct.

DISCUSSION:

CBD stone represents the main indication for MRCP study because of the ability of this technique in assessing the presence, the site of the stone. Stone may cause obstruction so the advantages of MRCP are mainly related to routine visualization of bile ducts above and below the obstruction with a very consistent demonstration of intrahepatic biliary branches. In high obstructions MRCP provides a complete map of the biliary system. Finally, MRCP offers evaluation of bile ducts with physiological filling condition as opposite to ERCP where overfilling or underfilling of contrast medium injection may modify the real anatomical situation [15].

Regarding gender: In this study 42 (82%) patients were females and 8 (18%) patients were males. The female to male ratio was 4.5:1 these results were approximately similar to the results obtained by Calvo MM et al [23].

Regarding CBD stones in MRCP: In our study, MRCP had accuracy of 98%, sensitivity rate of 98% in the demonstration of common duct stones and a specificity rate of 95%. The positive predictive value of MRCP was 91.7%, whereas the negative predictive value was 92.5%. This is very close to results obtained by Ankur Mandelia et al [24] which had (sensitivity rate 95 % and specificity rate 90 % and accuracy of 98% , The

positive predictive value 95% , whereas the negative predictive value was 90%), on the other

hand our result is by far higher than the results obtained by Nandalur et al [25] which showed (sensitivity rate 50 % and specificity rate 60 % and accuracy of 50%) the possible explanation for this difference may be related to that he included stones under 3 mm while in our study smallest stone is 6mm .

Regarding filing defect in MRCP: In our study, MRCP had accuracy of 62%, sensitivity rate of 62% in the demonstration of common duct stones as filling defect and a specificity rate of 90%. The positive predictive value of MRCP was 66.6%, whereas the negative predictive value was 67.6%. This is very close to results obtained by Guarise et al [26] which showed (sensitivity rate 60 % and specificity rate 92 % and accuracy of 60%) and similar to results obtained by Romagnuolo et al [27] which showed (sensitivity rate 63 % and specificity rate 89 % and accuracy of 62%).

Regarding meniscus sign in MRCP: MRCP in this study had accuracy of 36%, sensitivity rate of 36% in the demonstration of common duct stones as meniscus sign and a specificity rate of 95%. The positive predictive value of MRCP was 65%, whereas the negative predictive value was 64%. This is very close to results obtained by Calvo et al [23] which showed (sensitivity rate 40 % and specificity rate 90 % and accuracy of 42%) and similar to results obtained by Medical Services Advisory Committee [16] which showed (sensitivity rate 36 % and specificity rate 96 % and accuracy of 37%).

Regarding intrahepatic biliary dilatation in MRCP: In our study MRCP had accuracy of 62%, sensitivity rate of 62% and a specificity rate of 64% in the demonstration of intrahepatic biliary dilatation. The positive predictive value of MRCP was 38%, whereas the negative predictive value was 45%. This is very close to results obtained by Ankur Mandelia et al [24] which showed (accuracy of 60% ,sensitivity rate 60 % and specificity rate 64 %) and similar to results obtained by Medical Services Advisory Committee [16] which showed (accuracy of 62%, sensitivity rate 62 % and specificity rate 65 %).

Regarding CBD dilatation in MRCP: In our study MRCP had accuracy of 96%, sensitivity rate of 96% in the demonstration of CBD dilatation and a specificity rate of 95%. The positive predictive value of MRCP was 92%, whereas the negative predictive value was 92%. This is very close to results obtained by Ankur Mandelia et al [24] which showed (sensitivity rate 94 % and specificity rate 94 % and accuracy of 95%) on the other hand our result is higher than that obtained by Martin et al[28] where the sensitivity and specificity of CBD dilatation as a predictor of CBD stones was 55% and 38% while accuracy was 60% the possible explanation for this difference may be related to that he took patient with CBD stone regardless whether jaundiced or not.

Regarding pancreatic duct dilatation in MRCP: MRCP in this study had accuracy of 2%, sensitivity rate of 4% in the demonstration of pancreatic duct dilatation and a specificity rate of 1%. The positive predictive value of MRCP was 66%, whereas the negative predictive value was 51%. This is very close to results obtained by Calvo et al [23] which showed (accuracy of 2% sensitivity rate 8 % and specificity rate 2%) but our result is lower than the result obtained by Sanket et al [29] which showed (accuracy of 62% sensitivity rate 62 % and specificity rate 98%) the possible explanation is that he took patient with chronic pancreatitis due to gall stones.

Regarding gall bladder status in MRCP: forty patients show gall stones (37(92%)patients had multiple gall stones and 3(8%) patients had single stone),3 patient show no gall stone. 5(12%) patients show distended gall bladder while 38(88%) patients gall bladder was not distended. This is very close to results obtained by O`Regan et al [30] which showed (94% had multiple gall stones and 6% show singles gall stone,13% patients show distended gall bladder and 87% gall bladder not distended) and very close to result obtained by Merkle et al [31] which showed (92% had multiple gall stones and 8% show singles gall stone,11% patients show distended gall bladder and 89% gall bladder not distended).

CONCLUSION:

MRCP is a non–invasive investigation with 100% sensitivity and specificity in detection of CBD stones. Gathering well-defined radiological signs of CBD stones in MRCP allows good diagnostic accuracy. CBD dilatation is the more sensitive sign of detecting CBD stone in MRCP while meniscus sign is more specific sign for detecting CBD stone in MRCP.

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