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# The Role of Magnetic Resonance Cholangio-Pancreaticography (MRCP) In Predicting Common Bile Duct Stone in Symptomatic Gall Stone Disease

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***Abstract:*** Common bile duct stones may be discovered preoperatively, intra-operatively or postoperatively. The standard preoperative workup for patients presenting with symptoms attributable to choledocholithiasis includes liver function test and an abdominal ultrasound. These tests, combined with clinical examination and history, constitute the entire workup for most patients. As there is no exactly known preventive measures, early detection and treatment is the most justifiable intervention to reduce mortality and morbidity. With the advancement of medical sciences many newer techniques are coming up for detection of biliary tract diseases. Among the imaging techniques currently advocated for evaluating the biliary tree, ultrasonography is most frequently used in the initial evaluation of patients with symptoms and sign referral to the pancreato-biliary systems. Magnetic resonance cholangio-pancreatography (MRCP) is a non-invasive imaging test with excellent overall sensitivity and specificity for demonstrating the level and presence of biliary obstruction. MRCP has emerged as an accurate, non invasive diagnostic modality for investigating the biliary and pancreatic duct and has been recommended in some circles as the preoperative procedure of choice for the detection of CBD stones.

***Key words*:** Symptomatic gall stone disease, common bile duct stones, MRCP.

## I. Introduction:

Incidence of CBD stones in patients with gallstones diseases varies between 5% and 15 %, with an incidence of unsuspected stones up to 5 % when routine cholangiography is performed.[1-5] Although CBD stones may be silent, the development of complications, such as cholangitis and acute pancreatitis, is associated with major morbidity and mortality. Therefore, the detection and treatment of common duct stones is mandatory. Age of the patients, the observation of bile duct dilatation or stones on ultrasonography, cholangitis, and raised serum bilirubin and Gamma glutamyl transpeptidase levels are described as predictive criteria for CBD stones. [6-9]

Diagnosis of choledocholithiasis is not always straightforward and clinical evaluation and biochemical tests are often not sufficiently accurate to a firm diagnosis. Imaging tests particularly ultrasounds are used routinely to confirm the diagnosis. Liver function test (LFT) can be used to predict the CBD stones. Elevated serum bilirubin and alkaline phosphatise reflects biliary obstruction but these are neither highly sensitive nor specific for CBD stones. Excepting obvious jaundice, a raised GGT level has been suggested to be the most sensitive and specific indicator of CBD stones. A value greater then 90U/L has been proposed to indicate a high risk of choledocholithiasis. However, laboratory data may be normal in as a third of patients with choledocholithiasis, warranting further evaluation of the CBD by imaging studies to clarify the diagnosis.[10]

As there are no exactly known preventive measures, early detection and treatment is the most justifiable intervention to reduce mortality and morbidity. With the advancement of medical sciences many newer techniques are coming up for detection of biliary tract diseases. Among the imaging techniques currently advocated for evaluating the biliary tree, ultrasonography is most frequently used in the initial evaluation of patients with symptoms and sign referral to the pancreato-biliary systems. However, when choledocholithiasis is primarily suspected, direct opacification of the biliary tree is needed. It is in respect that magnetic resonance cholangio-pancreatography (MRCP) is considered to be very useful since it depicts the biliary tree non invasively and without the injection of contrast medium.[11]

This study is being undertaken to determine the diagnostic accuracy of magnetic resonance cholangio-pancreatography in the detection of common bile duct stones in patients with symptomatic gallstones disease but who are otherwise classified into very low risk group of having common bile duct stone according to clinical, laboratory, and sonographic findings.

## II. Materials and Methods

**Materials:**

The present study was conducted in the department of General Surgery in collaboration with Radiodiagnosis Department, NEIGRIHMS, Shillong, Meghalaya, India. A total of 50 cases of gallstone disease

with a suspicion of concomitant choledocholithiasis were studied, irrespective of age, caste, marital status, social status, religion etc during the period from October, 2010 to September, 2012.

Inclusion criteria (present at time of admission to the hospital or in the previous 15 day) were one or more of the following:

i. Elevation of biochemical parameters of cholestasis. (alkaline phosphatise->670U/L, Gamma glutamyl transpeptidase->90U/L, SGOT, SGPT, serum bilirubin)
ii. Clinical or enzymatic pancreatitis (serum amylase->90U/l).
iii. Common bile duct diameter >6.5 mm at Ultrasonography.

Exclusion criteria:

i. Patients with choledocholithiasis detected by abdominal sonography.
ii. Unwilling patients.

**Methods:**

Informed written consent was taken from all the patients. A detailed clinical history was taken for every case. A thorough general physical and systemic examination was done using a pre-designed proforma. All cases of suspected choledocholithiasis were subjected to a series of investigations including complete haemogram, liver function test, serum amylase, kidney function test, X- ray chest, abdominal ultrasonography and followed by Magnetic resonance cholangio-pancreatography (MRCP).

Magnetic resonance cholangio-pancreatography examination was carried out using Harmonic MRI machine with 1T unit from Siemens. Patients were kept nil orally for 6-8 hrs prior to the examination. Images were obtained using coronal, axial and oblique thin multi-slice half Fourier turbo spin echo sequence (HASTE). All the pulse sequences acquired in breath-hold except T2 HASTE transverse gated sequences. In addition, maximum intensity projections were generated from each multi-slice data set. The images were analyzed for bile duct dilatation, intra-luminal filling defects and stricture.

The common bile duct was considered dilated if diameter is more than 6.5mm.

Calculus was diagnosed when round, ovoid or irregularly shaped signal voids were identified within the lumen of the gallbladder or biliary tree in at least two planes.

The final diagnosis was established after surgical extraction of CBD stones. Stone removal was the gold standard.

## III. Results and Observations

The study sample comprised of 50 cases of Gallstone disease with suspicion of CBD stones, who attended the Surgery department, NEIGRIHMS Hospital, Shillong, Meghalaya during the period of October, 2010 till September, 2012.

Magnetic resonance cholangio-pancreatography was performed in all the cases. All the patients were planned for exploratory laparotomy and presence of CBD stones confirmed by intra operative palpation of CBD. Depending upon the intra operative presence/absence of CBD stones, decisions were made whether to do only cholecystectomy, or cholecystectomy with open choledocholithotomy, or only CBD exploration.

**Outcomes;**

1. Gender.

Table 1: showing gender distribution.

| Sex | No. of patients | Percentage |
|---|---|---|
| Male | 15 | 30 |
| Female | 35 | 70 |
| Total | 50 | 100 |

There was female preponderance of 70%, against 30% male counterpart in the study.

2. Age incidence.

Table 2: showing age distribution.

| Age(Yrs) | No.of patients | Percentage | Mean ± SD | Max | Min | Range |
|---|---|---|---|---|---|---|
| 35-40 | 2 | 4 | 55.00 ± 6.44 | 62 | 38 | 24 |
| 41-45 | 5 | 10 | | | | |
| 46-50 | 4 | 8 | | | | |
| 51-55 | 4 | 8 | | | | |
| 56-60 | 25 | 52 | | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| >61 | 10 | 20 | | | | |
| Total | | | | | | |

Average age of the patient was found to be 55.00years with a minimum and maximum age of 38 years and 62 years with an age range of 24 years.

**3. MRCP.**

Table 3: showing MRCP findings with respect to clinical presentation.

| MRCP findings | Clinical presentation | | Total |
|---|---|---|---|
| | Obstru.jaundice | No jaundice | |
| GB cal | 2 | 11 | 13 |
| GB cal with CBD cal | 31 | 3 | 34 |
| CBD cal | 3 | 0 | 3 |
| Total | 36 | 14 | 50 |

Note; GB cal; Gallbladder calculus, CBD cal; Common bile duct calculus.

Table 3 tells about the distribution of clinical presentation with relation to MRCP. Clinically, 36 patients were identified as having obstructive jaundice out of 50 patients. MRCP could identify common bile duct stone in 34 patients out of 36 pts with obstructive jaundice showing a sensitivity of 95%, with a false negative of 6%.

4. Table: showing MRCP findings with biochemical blood parameters.

| MRCP findings | Blood parameters | | Total |
|---|---|---|---|
| | Elevated | Normal | |
| GB cal | 2 | 11 | 13 |
| GB cal with CBD cal | 32 | 2 | 34 |
| CBD cal | 3 | 0 | 3 |
| Total | 37 | 13 | 50 |

Table 4 shows the distribution of blood parameters with relationship to MRCP. MRCP could identify 35 patients with CBD stones out of 37 pt who has elevated blood parameters. MRCP has a sensitivity of 95.05%, and a false negative of 5%.

5. Correlation of MRCP with surgical findings.

Table 5: showing comparison of MRCP with surgical findings

| MRCP | Surgical findings | | | Total |
|---|---|---|---|---|
| | GB cal. | GB cal with CBD cal | CBD cal | |
| GB cal. | 13 | 0 | 0 | 13 |
| GB cal with CBD cal. | 0 | 34 | 0 | 34 |
| CBD cal. | 0 | 0 | 3 | 3 |
| | | | | |

| | | | | |
|---|---|---|---|---|
| Total | 13 | 34 | 3 | 50 |

Note: GB cal; Gallbladder calculus, CBD cal; Common bile duct calculus.

All the 50 cases underwent open surgery either a cholecystectomy or cholecystectomy with common bile duct exploration or only a common bile duct exploration, depending upon the findings of MRCP and supplemented by intra operative findings. Then comparison was made between MRCP findings and surgical findings. The distributions of the patients according to MRCP and surgery findings are summarised in the above table.

6. Comparison of MRCP with respect to surgical findings.

| MRCP (CBD stone present) | Finding at surgery (Presence of CBD stones) | | Total |
|---|---|---|---|
| | Positive | Normal | |
| Positive | 37 | 0 | 37 |
| Normal | 1 | 12 | 13 |
| Total | 38 | 12 | 50 |

A comparison of MRCP and surgical findings is made on table 6. It shows 37 true positive, 12 true negative, 1 false negative, 0 false positive cases. The sensitivity of MRCP is 97.5%, specificity 100%, positive predictive value of 100%, and Negative predictive value of 90.9%. It has a false negative of just a mere of 2.5 %( 1pt.) It was due to small CBD stone (3mm).

7. Diagnostic performance of MRCP.

| MRCP | Surgery |
|---|---|
| Positive | 37(97.5%) |
| Negative | 1(2.5%) |
| Total | 38(100%) |

Furthermore, table 7 shows the predictive accuracy of MRCP in diagnosing common bile duct stone in gallstone disease patients with suspected common bile duct stone. When comparing with surgical findings, MRCP has a sensitivity of 97.5% and a false negative rate of 2.5% only. Therefore considering all the above values, it may be concluded that MRCP is the gold standard in confirmation of common bile duct stone in gallstone disease patients with suspected cause of surgical jaundice due to common bile duct stone.

## IV. Discussion:

Choledocholithiasis may occur in upto 3%-10% of all cholecystectomy patients[12], or as high as 14.7% in some series.[13] This includes some patients without classic preoperative findings suggestive of choledocholithiasis. Of these asymptomatic patients, it is believed about 15% will eventfully become symptomatic and require further interventional treatment.[14] Over the last few years MRCP has become an increasingly important tool in the diagnostic evaluation of the pancreaticobiliary system and it has gained rapid acceptance by endoscopist and surgeons because of the familiar image format .[15]

When compared to endoscopic retrograde cholangio-pancreatography (ERCP) or Percutaneous transhepatic cholangiography (PTC) the accuracy is very similar; MRCP has a sensitivity and specificity of 91% and 98% respectively for choledocholithiasis.[16,17,18] Further it does not carry the 5-30% failure rate associated with ERCP. It also spares the morbidity, (1-7%) and mortality (0.2-1%) of ERCP and is twice as cost effective.[19, 20] MRCP has a high diagnostic accuracy (97%), similar to that at direct cholangiography, in the diagnosis of choledocholithiasis. It has the potential to replace diagnostic ERCP and select patients with choledocholithiasis for therapeutic ERCP.[21] MRCP provides anatomical detail of the biliary tract and has a sensitivity of 81% - 100% and specificity 92% - 100% in detecting choledocholithiasis. The accuracy of the

MRCP in diagnosing CBD stones is comparable with that of ERCP and intraoperative cholangiography (IOC). It thus avoids the need for a potential high risk, invasive procedure in more than 50% of patients, allowing selective use of ERCP or surgical CBD exploration in those patients who require a therapeutic intervention. These results have led some practitioners to consider MRCP the new gold standard for biliary imaging.[22, 23]

Steven N. Hochwald et al[24] conducted a retrospective study to determine accuracy of MRCP to predict the presence or absence of choledocholithiasis. MRCP had sensitivity of 95%, a specificity of 89%, and an accuracy of 92%. Therefore they concluded that MRCP is an accurate, noninvasive test for evaluating the CBD duct for the presence or absence of calculi in patients suspected of having CBD stones.

Varghese JC et al[18] studied the diagnostic accuracy of MRCP and ultrasonography in the diagnosis of choledocholithiasis in a large group of patients with bile duct stones confirmed at direct cholangiography. They found that MRCP had a sensitivity, specificity and diagnostic accuracy of 91%, 98%, and 97%.US had sensitivity, specificity and diagnostic accuracy of 38%, 100%, and 89% respectively in the diagnosis of choledocholithiasis.

Basile L et al[25] carried out a study with the main objective to evaluate the sensitivity and the specificity of MRCP respect to direct cholangiography (endoscopic retrograde cholangio-pancreatography and percutaneous transhepatic cholangiography). The sensitivity and specificity of MRCP, in diagnosis of normal biliary tree is 100% and 90%, for dilated biliary tree is 93%, 92%, and in bile duct obstruction sensitivity was 88%. MRCP diagnosed the presence of choledocholithiasis with a sensitivity of 74% and specificity of 95 %.

Joo Hee Kim et al[26] conducted a study to determine the diagnostic accuracy of MRCP in the detection of common bile duct stones in patients with symptomatic gallstones. They concluded that MRCP is highly accurate in the detection of CBD stones in all patients, regardless of risk, and should be considered in patients with a moderate to high risk of CBD stones before cholecystectomy.

Borashi P et al[27] studied the diagnostic value of MRCP for detecting CBD stones in candidates for laparoscopic cholecystectomy. The sensitivity, accuracy, positive predictive value, and negative predictive value of MRCP for choledocholithiaisis were 90%, 96%, 94%, 95%, and 93%, respectively. They concluded that MRCP is a highly effective diagnostic modality for evaluation of patients with risk factors for CBD stones prior to laparoscopic cholecystectomy.

Kejriwal R et al[28] retrospectively analyzed all patients with cholelithiasis who underwent MRCP between 2001 and 2003 for suspected choledocholithiasis. They concluded that in patients with strong indication for choledocholithiasis MRCP was able to reliably exclude clinically relevant choledocholithiasis and is therefore recommended as the preoperative diagnostic imaging tool of choice.

Sperlongano P et al[29] studied the diagnostic accuracy of MRCP in patients with suspected choledocholithiasis, but with negative ultrasonography findings. The study groups consists of 48 patients and were assigned to two main groups -

1. Patients with CBD stones at US (15/48: 31%)
2. Patients without evidence of CBD stones on US (33/48: 69%)

with comprising two subgroups –

B 1) MRCP – positive for stones (7/33: 21%)

B 2) negative US and MRCP (26/33:79%)

MRCP showed 100% sensitivity and 100% specificity.

Guarise A et al[30] evaluated the accuracy of MRCP in diagnosing the choledocholethiasis considering ERCP as the gold standard. The authors concluded that MRCP is sufficiently accurate to replace ERCP in patients with suspected choledocholithiasis. The results were related to the size of stones. Iannicell et al[31] evaluated the diagnostic accuracy of MRCP in biliary tree pathology in comparison with percutaneous transhepatic cholangiography, ERCP, surgical findings. They concluded that MRCP proved to be highly accurate as fundamental diagnostic step in patients with clinical and laboratory findings suggestive of biliary disease. The workload of ERCP, invasive method with risk of complication, in the diagnosis stage could therefore be reduced and its use be reserved for therapeutic indication.

Rahman R et al[32] In their study to examine the correlation between MRCP and ERCP findings in patients at a tertiary care hospital. MRCP appeared to have more false negative results for choledocholithiasis and strictures and more false positive results for ductal dilatation and periductal mass detection compared with ERCP.

Wong HP et al[33] in their study of preoperative MRCP to detect choledocholithiasis in acute calculous cholecystitis have concluded that Magnetic resonance cholangiopancreaticography is a reliable evaluation technique for the detection of choledocholithiasis. It reduces the misdiagnosis of retained choledocholithiasis with normal biochemical predictors and prevents the risk of overlooking choledocholithiasis. Our present study was carried out in 50 consecutive patients, admitted in surgery department NEIGRIHMS for gallstones disease with signs and symptoms of obstructive jaundice. Selections of patients were strictly on the basis of inclusion criteria. All the patients underwent open surgery (open cholecystectomy or open cholecystectomy and CBD exploration). Surgical findings were considered as gold standard.

The age of the patients ranged from 35 to 62 years with a mean age of 55 years. This compares favourably with the reports of P. Boraschi et al[27] (age range from 35- 78 years, mean age of 60.5 years.

In Sex distribution, Females (70%) outnumbered male counterpart (30%). Varghese JC et al[18] reported female of 75.25% and males of 24.75%.

The most common presenting symptoms amongst the patients was jaundice 38 patients and 12 patients with upper abdominal pain and off and on fever. MRCP could identify common bile duct stone in 36 patients out of 38 pts with obstructive jaundice showing a sensitivity of 95%, with a false negative of 6%.

Elevated blood parameters were seen in 39 patients out of whom, MRCP could identify 37 patients with CBD stones out of 39 pt who has elevated blood parameters. Thus having a sensitivity of 95.05%, and a false negative of 5%.

All the patients underwent elective open surgery. Intra operative palpation of the CBD done and depending on it decision was made to either do a cholecystectomy alone or cholecystectomy with CBD exploration. According to surgical findings cholelithiasis with CBD calculus was found in 35 patients, cholelithiasis in 10 patients and CBD calculus alone in 5 patients.

There was one false negative by MRCP. One CBD stone was missed by MRCP that was present in a non dilated duct and stone size was less then 3mm in diameter.

In our study, the sensitivity of MRCP in diagnosing choledocholithiasis in a symptomatic gallstone disease patient is 97.5% when correlated with surgical findings. It also has Specificity of 100%, positive predictive value of 100%, and negative predictive value of 90.9%. It is very much comparable with Varghese JC et al[19] who studied the diagnostic accuracy of MRCP and ultrasonography in the diagnosis of choledocholithiasis in a large group of patients with bile duct stones confirmed at direct cholangiography. They reported the sensitivity, specificity and diagnostic accuracy of 91%, 98%, and 97%.

## V. Conclusion:

The present study shows that MRCP is a good non-invasive diagnostic imaging modality for the diagnosis of choledocholithiasis in a suspected concomitant CBD stone with cholelithiasis.

As the present study was limited to 50 cases only and the study being a crossectional descriptive study, a further comparative study (endoscopic retrograde cholangiopancreatography versus MRCP) with more number of cases would be helpful to evaluate the role of MRCP in diagnosing choledocholithiasis.

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