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RESEARCH ARTICLE

COMPERATIVE STUDY OF DIAGNOSTIC ACCURACY OF MRCP WITH ULTRASONOGRAPHY IN CHOLEDOCOLITHIASIS WITH POST ERCP CORRELATION

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ABSTRACT

Introduction: Choledocholithiasis is an important and curable cause of obstructive jaundice. Besides jaundice it causes many complications as pancreatitis, ascending cholangitis etc. Clinical and haematological findings can raise the suspicion of choledocholithiasis in patients of obstructive jaundice but the clinician have to rely on imaging findings for final diagnosis. Multiple non-invasive & invasive methods have been used for the diagnosis of calculi in the bile duct including ultrasonography, MRCP and ERCP. All the test have their own advantages and disadvantages. Sensitivity, specificity and other statistical parameters for performance varies from test to test. The aim of the study was to review USG & MRCP, then correlate the results with ERCP and finally to assess the accuracy, sensitivity and specificity of USG, MRCP and ERCP in detecting choledocholithiasis.

Material And Methods: The study was conducted in the Department of Radio Diagnosis and Imaging, Sagar Hospitals, Bangalore. Patients admitted or attending OPD in Sagar Hospitals with suspected obstructive jaundice or as a known case of obstructive jaundice. Every patient suspicious of choledocholithiasis was investigated with USG & MRCP. Final correlation was done with ERCP/ post-intervention findings. The study was performed on all patients after written informed consent. The study was carried out over a period of 26 months from October 2010 to December 2012. Total number of 70 Consecutive patients fulfilling all the criteria of the study population were selected.

Results: Out of 70 patients 40 (57%) patients were female and 30 (43%) patients were male. Age of the patients were between 11 to 87 yrs with mean age 49 yrs. Ultrasound could not identify Common bile duct calculus in 26 patients (26 false negative patients). The sensitivity, specificity, positive and negative predictive values of ultrasonography in detecting CBD stones in the present study were 48%, 90%, 92% and 40.9% respectively. The sensitivity, specificity, positive and negative predictive values of MRCP in detecting CBD stones in the present study were 97.8%, 82.8%, 92% and 95% respectively. The sensitivity and specificity values of ERCP in detecting CBD stones in the present study were 100%, 100%, 100% and 100% respectively.

Conclusion: This study shows that MRCP has a diagnostic accuracy which is almost similar to ERCP in the diagnosis of choledocholithiasis. Hence MRCP can be used as a primary tool for detecting or excluding CBD stones non invasively and without use of contrast media and ionizing radiation.

INTRODUCTION

Primary choledocholithiasis denotes de novo formation of stones, often made of calcium bilirubinate (pigment stones) within the ducts. [1] Choledocholithiasis is an important and curable cause of obstructive jaundice. Besides jaundice it causes many complications as pancreatitis, ascending cholangitis etc. Clinical and haematological findings can raise the suspicion of choledocholithiasis in patients of obstructive jaundice but the clinician have to rely on imaging findings for final diagnosis. The etiologic factors are often related to diseases causing strictures or dilation of the bile ducts, leading to stasis. [2] Migration of the stones from the gall bladder to the common bile duct constitute secondary choledocholithiasis. [3] Whereas primary choledocholithiasis is relatively rare outside endemic region (east Asia), secondary choledocholithiasis is quite common representing the worldwide distribution of gall stone disease.[4] Bile duct stones are found in 8% to 18%of patients with symptomatic gall stones. [5] Passage of gallstones into the CBD occurs in 10-15% of patients with cholelithiasis. The incidence of common duct stones increases with increasing age of the

patient, so that up to 25% of elderly patients may have calculi in the common duct at the time of cholecystectomy. Undetected duct stones are left behind in -1-5% of cholecystectomy patients.[6]

Multiple non-invasive & invasive methods have been used for the diagnosis of calculi in the bile duct including ultrasonography (USG), Computded Tomography (CT) with intravenous contrast agents, Magnetic resonance imaging (MRI), Magnetic resonance cholangio-pancreatography (MRCP), Endoscopic retrograde cholangio-pancreatography (ERCP) and Percutaneous transhepatic cholangiography (PTC). Some methods like Intravenous cholangiography and OCG (oral cholangiography) are obsolete at present.[4] Sonography is often used as the first line imaging modality in patients with suspected choledocholithiasis. [7] However sonography of the common bile duct is particularly limited by operator dependence. MRCP provides excellent anatomic details and contrast resolution [8], also without use of ionizing radiation [9,10]

MRCP uses signal produced by fluid within ducts that can create images of the biliary system and pancreatic ductal system. The MRCP techniques take advantages of the long spin-spin (t2) relaxation times of the static bile and pancreatic duct fluid.[11] Earlier magnetic resonance sequences such as gradient recalled echo & fast spin echo provided MRCP images, but these long sequences often suffered from motion artifact and poor spatial resolution. Now images are created with one of several magnetic resonance sequences that use heavy T2 weighting. [11] With single shot fast spin echo (SSFSE) [12], half Fourier single shot turbo spin echo (HASTE) and rapid acquisition relaxation enhanced (RARE) sequences are commonly used. [13]

ERCP is a technique that combines the use of endoscopy and fluoroscopy and is used for diagnosis and treatment of choledocholithiasis. Through the endoscope, the endoscopist can inject radiographic contrast into the ducts in the biliary tree and pancreas so they can be seen on X-rays. [14] ERCP can provide clear images of the hepatobiliary and pancreatic ducts. Multiple non-invasive & invasive methods have been used for the diagnosis of calculi in the bile duct. Some are used as screening method and some as confirmatory. All these tests have their own advantages and disadvantages. Sensitivity, specificity and other statistical parameters for performance varies from test to test. Purpose of this study is to choose one method which is both reliable and causes no or minimum harm to the patients. The main aim of the study was to review USG & MRCP, then correlate the results with ERCP and finally to assess the accuracy, sensitivity and specificity of USG, MRCP and ERCP in detecting choledocholithiasis.

MATERIAL AND METHOD

The study was conducted in the Department of Radio Diagnosis and Imaging, Sagar Hospitals, Bangalore . Patients admitted or attending OPD in Sagar Hospitals with suspected obstructive jaundice or as a known case of obstructive jaundice. Patients were enrolled in this study from Sagar Hospital coming with obstructive jaundice features either clinically or biochemical analysis. This study was conducted in Dept. of Radiology at Sagar hospital, Every patient suspicious of choledocholithiasis was investigated with USG & MRCP. Final correlation was done with ERCP/ post-intervention findings. The study was performed on all patients after written informed consent. The study was carried out over a period of 26 months from October 2010 to December 2012. Total no of 70 patients. Consecutive patients fulfilling all the criteria of the study population were selected . The patients were divided into

Two Subgroups

(A) Patients with common bile duct stones at USG
(B) Patients without common bile duct stones at USG, and

Comprising Two Subgroups

(1) MRCP positive for calculus
(2) Negative USG & MRCP

Patients with clinical & hematological findings corroborative to obstructive jaundice were included in the study. Certain exclusion criteria were set prior to the collection of samples as; Patients incompatible with standard MRI protocol examination. Magnetically activated implanted devices, Cardiac pacemakers, insulin pumps, neuro¬stim¬u¬lators, cochlear implants. Patients with severe claustrophobia. 1.5 Tesla MRI machine of PHILIPS MS (INTERA /ACHIEVA) and 1.5 tesla SIEMENS MS (AVENTO) installed in sagar hospitals, with workstation and software. USG machine of GE VOLUSON @ 730 (transducer –2.5-12 MHz) and USG machine of GE LOGIQ 500 (transducer –-2.5- 12 MHz) were used in the study.

All the patients were initially worked up with ultrasound examination using supine and left lateral decubitus approach All the patients underwent MRCP examination. Heavily T2 weighted single shot FSE sequences and thick slab high resolution 3D MRCP sequences were done with secondary reformation. Subsequently all the patients underwent ERCP and size, location, number of stones was assessed. Any other causes of obstruction were assessed. Findings in USG, MRCP and ERCP were compared and correlated. We calculated the sensitivity, specificity, PPV, NPV and other relevant statistical parameters

For USG Patients were preferentially examined in the fasting state. The proximal common duct is examined by sagittal scans with the patient in the supine as well as in the left posterior oblique position. The scanning is started in the sagittal plane, in the mid-clavicular line subcostally, and is continued using slight changes in position of the transducer and varying angulations of the sound beam, until the main portal vein and the common duct are identified.

Prior to MRCP to ensure that the gall bladder, hepatobiliary and pancreatic ducts are filled with fluid and at their maximum distension, the patient would need to fast. It is recommended that the patient be nil per oral for at least four hours prior to commencing the examination. Throughout this period, the patient is permitted to drink clear fluids only (namely water), and routine medication is allowed as per normal. the adult patient should be lying supine on the MRI table positioned appropriately over the posterior half of the body array coil and also such that their feet will be entering the bore of the magnet first. All the data was recorded and entered into Microsoft excel file for evaluation. Standard statistical method for evaluation of accuracy, specificity & sensitivity of USG, MRCP and ERCP/ post intervention for diagnosis of choledocholithiasis were used.

RESULTS

70 patients were selected for this comparative study after taking proper consent. Among 70 patients 50 patients found to have choledocholithiasis. Rest 20 patients found to have obstructive jaundice due to causes other than choledocholithiasis. Out of 70 patients 40 (57%) patients were female and 30 (43%) patients were male. Age of the patients were between 11 to 87 yrs with mean age 49 yrs. In the present study total 70 patients undergone conventional USG study. Out of these 70 patients with history of obstructive jaundice. Choledocholithiasis was detected in 24 patients on USG (Table 1).

Table 1 Diagnosis Of Choledocholithiasis By Usg

Test	Disease present	Disease absent
POSITIVE	24	2
NEGATIVE	26	18

Chi Square = 16.545, P valve is < 0.001

Ultrasound diagnosed 13 cases of calculi in the proximal CBD, 10 in the middle CBD and 3 in the distal CBD. Ultrasound also detected abnormalities other than choledocholithiasis of which 3 cases were Choledochoceles, 5 CBD masses, 4 GB masses and 2 liver masses. Ultrasound could not identify Common bile duct calculus in 26 patients (26 false negative patients). The sensitivity, specificity, positive and negative predictive values of ultrasonography in detecting CBD stones in the present study were 48%, 90%, 92% and 40.9% respectively.46 patients were positive for choledocholithiasis on MRCP (Table 2) .

Table 2 Diagnosis Of Choledocholithiasis By Mrcp

Test	Disease Present	Disease absent
POSITIVE	46	1
NEGATIVE	4	19

Chi Square = 49.01, P valve is < 0.001

MRCP diagnosed 13 cases of calculi in the proximal CBD, 23 cases in the middle CBD and 10 cases in the distal CBD. MRCP also detected other various abnormalities of which 3 cases were choledochocele, 9 were CBD masses, 4 GB masses and 2 liver masses. There was one false positive on MRCP. The sensitivity, specificity, positive and negative predictive values of MRCP in detecting CBD stones in the present study were 97.8%, 82.8%, 92% and 95% respectively.

ERCP detected calculi in 50 patients (Table 3). This was subsequently confirmed with per operative and post operative follow ups. On ERCP calculi were seen in proximal CBD in 13 cases, 26 cases in the middle CBD and 11 cases in the distal CBD. ERCP identified calculi in 4 patients in whom MRCP was negative. ERCP also detected other abnormalities of which 3 cases were of choledochocele and 9 were of CBD

Table 3 Detection Of Calculus By Usg, Mrcp And Ercp

S.NO	Modality	No. Of calculi
1	Calculus detected on USG, MRCP and ERCP	26
2	Calculus not detected on USG but on MRCP and ERCP	20
3	Calculus not detected on USG and MRCP but on ERCP	4

masses. The sensitivity and specificity values of ERCP in detecting CBD stones in the present study were 100%, 100%, 100% and 100% respectively. The sensitivity, specificity, positive and negative predictive value for ERCP was 100% even for small (1-5mm) bile duct stones in our study.

DISCUSSION

Ultrasonography (USG) and Magnetic resonance cholangiopancreatography (MRCP) are non invasive study to determine billiary duct pathology. ERCP is an invasive modality for evaluation of biliary duct abnormalities. The USG sensitivity and specificity of our study (sensitivity 48%, specificity 90%) is comparably similar to the study done by O' Conor HJ *et al* (sensitivity 45%, specificity 97%).[15] The USG sensitivity and specificity for detection of CBD calculus was lowest in the study done by Gross BH *et al* (sensitivity 25%, specificity 73%). [16] All the studies which have been compared showed specificity of more than 85% except for that in the study by Gross BH *et al* , which had a specificity of 73% (this same Gross BH *et al* study also had very low sensitivity). The probable reasons of this variability could be due to different makes of sonography equipments, high operator dependence and patient factors like body habitus and bowel preparation etc. The MRCP sensitivity and specificity of our study (sensitivity 97.8%, specificity 82.8%) is comparably similar to the study done by Norero ,*et al* (sensitivity 97%, specificity 88%).[17] All the compared studies showed sensitivity of more than 90% and the specificity of more than 80%. However in the study of Stiris *et al*, sensitivity was 87.5%. Our study showed lower specificity (82%) compared to all the other studies. However sensitivity of our study is highest in comparison to other studies. The study by Jorge A Soto *et al* showed a specificity of 100% and sensitivity of 96%. [18] The probable reasons for variability in these statistical parameters could be due different make & quality of MRI equipments, protocol tuning and variations in patient preparation.

Table 4 Sensitivity Of Usg, Mrcp And Ercp In Detecting Cbd Calculus Based On Location In The Cbd

	SENSITIVITY		
	USG	MRCP	ERCP
Proximal CBD	100%	100%	100%
Middle CBD	38.4%	88%	100%
Distal CBD	27.3%	91%	100%

ERCP sensitivity and specificity of our study is very high (sensitivity 100%, specificity 100%). Similarly a study done by Guarise A *et al* showed sensitivity of 90% and specificity of 88%, which is comparable to our study. [19] All the studies showed very high sensitivity and specificity of more than 95%. 70 patients were recruited for this study based on clinical and hematological evidence of obstructive jaundice suspected to be due to choledocholithiasis. All the patients were assessed with USG, MRCP and ERCP; Standard statistical parameters like sensitivity, specificity, PPV, NPV were used to determine the diagnostic accuracy of both the tests and comparison done between them. Z-test and P valve for significance were evaluated for both the tests to determine the significance of individual test. ERCP is highly accurate in diagnosing CBD stones and showed 100% sensitivity and specificity in detecting choledocholithiasis. However it was a invasive procedure associated with few complications. Overall sensitivity and specificity of USG was low in comparison to MRCP and ERCP. However in proximal CBD calculi, USG

was good with high sensitivity and specificity comparable to that of MRCP and ERCP. For MRCP the calculated overall sensitivity, specificity, PPV and NPV were almost comparable to that of ERCP and definitely better than USG study in detection of choledocholithiasis. It was also found to be free of operator dependence. The calculated Z value of MRCP is also high in comparison to conventional ultrasound examination supporting this study.

USG is inexpensive, non invasive modality for choledocholithiasis, however has low sensitivity for detecting distal CBD calculi. It has moderate sensitivity and specificity for mid CBD calculi and high sensitivity and specificity for proximal CBD calcululi. MRCP is also a non invasive study without use of contrast or ionizing radiation which provides excellent anatomic details of pancreatico-biliary system and provides three dimensional assessment. MRCP shows high sensitivity & specificity in detection of choledocholithiasis in comparison to USG despite use of modern harmonic imaging. MRCP shows very high positive predictive value and also negative predictive value. MRCP also shows a very high sensitivity in detection of distal CBD stones which is obscured by bowel gas preventing proper visualization by USG. MRCP can be used in obese and echo poor subjects. There is no operator dependence. Limitations of MRCP are cost, relative unavailability and patients incompatible with standard MRI protocol. Currently one of the limitations for MRCP is resolution due to surface coil. If a coil can be positioned in close proximity to the CBD and pancreas with the help of endoscopic techniques (endoscopic MR coil- similar to endorectal coil for prostate), it can greatly improve the resolution and further increasing the diagnostic accuracy. ERCP is highly accurate in diagnosing CBD stones. It has very high sensitivity and specificity in detection of CBD calculi. However ERCP is invasive and inconvenient for the patient requiring sedation and contrast and also is associated with complications when compared to USG and MRCP.

CONCLUSION

This study shows that MRCP has a diagnostic accuracy which is almost similar to ERCP in the diagnosis of choledocholithiasis. Hence MRCP can be used as a primary tool for detecting or excluding CBD stones non invasively and without use of contrast media and ionizing radiation.

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