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Comparative Study to Assess Diagnostic Reliability of Ultrasound and 3T-MRCP in Patient of Obstructive Jaundice

Manoher Singh Rathore[1], Vishakha Rathore[2], Amit Kumar[3], Gaurav Kapoor[4], Neeraj Gour[5*] and Deepak Kumar Jain[6]

[1]Department of Radiodiagnosis, Rajiv Gandhi Cancer Hospital and Research Center, New Delhi, India.
[2]Department of Gynaecology, P.D Hinduja Hospital, Mumbai, India.
[3]Department of Radiodiagnosis, Max Superspeciality Hospital, Delhi India.
[4]Department of Radiodiagnosis, Rockland Superspeciality Hospital, Delhi, India.
[5]Department of Community Medicine, SHKM GOVT Medical College, Haryana, India.
[6]Department of Oncology, Tata Memorial Hospital, Mumbai, India.

Authors' contributions

This work was carried out in collaboration between all authors. Author MSR designed the study, wrote the protocol, and wrote the first draft of the manuscript. Author NG did analytical part of study and helped in drafting of manuscript. Authors AK and VR did proofread of whole manuscript after final preparation. Authors GK and DKJ done revision of manuscript before final publication. All authors read and approved the final manuscript.

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ABSTRACT

Background: Evaluation of jaundice patients should include proper history and examination, laboratory investigation and imaging investigations (non invasive like Ultrasound (U\S), CT and MRI or invasive like ERCP and PTC).
Aim of Study: The aim of this prospective study is to evaluate the diagnostic reliability of U\S and MRI-MRCP in patients of obstructive jaundice in clinical practice.

**Corresponding author: Email: drneeraj_g04@yahoo.com;*

Materials and Methods: This is a prospective study performed on 60 patients (31 male and 29 female) with an average age of 55.53 +/- 17.57 years presented with obstructive jaundice for whom abdominal ultrasound (U\S) and magnetic resonance imaging (MRI) and magnetic resonance cholangiopancreatography (MRCP) on 3 Tesla was performed in the departments of radiology in Max super speciality teaching hospital, saket, Delhi, India from May 2012 to May 2013. The final diagnosis was achieved by endoscopic retrograde cholangiopancreatography (ERCP) and \or surgery and confirmed by histopathology.

Results: The most common cause of obstructive jaundice in our study was common bile duct stones (51.65%) followed by tumors (33.3%) then benign strictures (10.0%), choledochal cyst (3.33%). In this study, MRI-MRCP could differentiate surgical from medical jaundice in all cases, while U\S could differentiate surgical from medical jaundice in 91.25% of cases. MRI-MRCP correctly defines the level of obstruction in all cases (100%). While U\S correctly define the level of obstruction in only 78% of the total cases. MRI-MRCP correctly suggests the most possible cause of obstruction in 96.25% of cases. While USG is correctly suggests the most possible cause in only 76.3%.

Conclusion: So that USG as a screening modality is useful to confirm or exclude biliary dilatation & to choose patients for MRCP examination. MRI-MRCP is a useful non-invasive and essential method in the preoperative evaluation of patients with obstructive jaundice. In addition MRI-MRCP was superior to U\S or ERCP in studying the extent & staging of malignant lesions.

Keywords: Ultrasound; MRI; MRC; obstructive jaundice.

1. INTRODUCTION

Obstructive jaundice is strictly defined as a condition occurring due to block in the pathway between the site of conjugation of bile in liver cells and the entry of bile in to the duodenum through the ampulla. The block may be intrahepatic or extrahepatic in the bile duct [1].

Choledocholithiasis and pancreaticobiliary malignancies (pancreatic head cancer, ampullary cancer, and cholangiocarcinoma) are the two most common causes of extrahepatic obstruction.

The advent of transabdominal ultrasound has revolutionized the imaging of hepatobiliary system as it can be used for direct visualization of pathology. Ultrasound has become the primary screening investigation with advantages of rapidity, low cost, wide availability, free of radiation hazard and visualization of adjacent organs. USG also allow an accurate differentiation between liver parenchymal disease and extrahepatic obstruction (sensitivity 65%, specificity 92%, PPV 92%, NPV 98%) [2]. The major disadvantage of USG is that the procedure is highly operator dependent.

Magnetic resonance cholangiopancreatography (MRCP) is a relatively new MR imaging technique to noninvasively evaluate the patients with pancreaticobiliary disease. MRCP permits evaluation of the pancreaticobiliary tract and gall bladder without the use of contrast material and is thus preferred in patients where use of contrast is restricted or contraindicated.MR cholangiopancreatography at 3.0 T enhances image quality, improving SNR twice over that at 1.5 and produces higher-resolution image data sets with reduced acquisition times. The suppression of fluid signal in the gastrointestinal tract occurs more effectively at 3.0 T that leads to better visualization of the hepatobiliary and pancreatic ducts. Thisimprovement may increase use of the modalityfor specific diagnostic applications (eg, detection of primary sclerosing cholangitis). The relation of the pancreatic parenchyma tothe ductal system is better visualized on 3.0T than in those obtained at 1.5 T. particularly visualization of side branches is improved at 3.0 T. Furthermore, distalarborization and intrahepatic bile duct variation are more easily detected at 3.0 T.

As there is no available literature to date, comparing both MRCP at 3 T and Ultrasound in obstructive jaundice, we intend to evaluate the diagnostic accuracy of these two non-invasive, non-ionising, indirect imaging techniques like MRCP at 3 T and transabdominal ultrasonography in obstructive jaundice.

1.1 Objectives

- To study radiological findings of various benign and malignant pathologies causing obstructive jaundice using both ultrasound and MRCP performed on a 3T scanner.

- To assess the level and extent of biliary obstruction in various benign and malignant diseases, using both modalities.
- To assess and compare the diagnostic accuracy of MRCP at 3T with Ultrasound

2. MATERIALS AND METHODS

2.1 Study Design

Prospective analytical-observational study.

2.2 Study Sample

In this study 60 patients with clinical or biochemical features suggestive of obstructive jaundice who presented between may 2012 to may 2013.

2.3 Sampling Method

Non-randomized purposive sampling method has been adopted for the collection of sample.

2.4 Study Location and Duration

The study was conducted in the department of Radiodiagnosis, Max Super Speciality Hospital, Saket, New Delhi between May 2012 to May 2013.

2.5 Inclusion and Exclusion Criteria

2.5.1 Inclusion criteria

All patients who were referred to Radiology Department with strong clinical suspicion of biliary obstruction with altered LFT, were included in the study. All these patients underwent screening ultrasound examination before undergoing Magnetic Resonance Cholangiopancreatography (MRCP) at 3 Tesla as a part of study.

2.5.2 Exclusion criteria

- Patients with pacemaker
- Patients with claustrophobia
- Uncooperative patients.
- Patients with metallic implant in & around the area of interest.

2.6 Methods

2.6.1 Ultrasonography

The examination was performed on LOGIQ E-9 (GE- healthcare), and VOLUSON 730 pro (GE HEALTHCARE). Curvilinear low frequency (3-5MHz) probe was used for scanning. Detailed examination of the liver, gall bladder, biliary radicals, pancreas and adjacent organs was carried out. Patients were examined preferably after a fasting period of minimum 6 hours to promote gastric emptying and filling of gall bladder. Patients were also trained to hold breath for 30 seconds.

2.6.2 MRI and MRCP

The examination was done using 3T Discovery 750 MRI unit by GE Healthcare USA. The patient was placed on the MR table in supine position with arms placed above the head. Patient was explained to stay still and avoid movements. All patients were subjected to a detailed MR examination.

2.7 Study Protocol

Post processing of the source images obtained by using maximum intensity projection and multiplanar reformation algorithms.

2.8 Data Analysis and Ethical Consideration

The Ultrasound and MRCP were interpreted independently by two different Radiologists and they were blinded to other imaging findings.

Various features of obstructive jaundice like presence and level of obstruction, cause of obstruction, extent of obstruction and other associated findings were studied on both Ultrasound and MRCP.

Parameters	MRCP+ MR						
	T2 AX FS	T2 AX FRFSE	T2 COR FS	T2 COR FRFSE	MRCP 3D	T1 LAVA	FIESTA
TR	3000	3000	3000	10000	3000	3.8	700
TE	66	105	62.9	86.4	610	1.1	7.8
Bandwidth (KHz)	62.50	83.30	6	86.5	83.30	166.6	62.50
Thickness (mm)	5	5	5	6	1.5	1.5	5
Frequency	228	384	256	256	288	292	192
Phase	224	224	-	-	224	160	256
Nex	3	2	3	2.5	1	1	8

2.9 End Point

Final diagnosis of patients was achieved by ERCP / Clinico-Histopathological / Surgical correlation.

3. RESULTS

A descriptive comparative analysis of imaging findings in each modality was compared and results derived.

The age group range from 1-85 years with majority of cases in 61-70 year. The mean age of the patients was 55.53 +/- 17.57 years. In our study out of 60, Thirty one patients (51.66%) were males and twenty nine (48.33%) were females (Figs. 1 and 2).

In this study choledocholithiasis comprised maximum number of cases, {n=31 (51%)} (Table 1) Mass lesions {n=13 (41.9%)}, comprised the second most common cause and total were 20 cases with hilar (n=4) and distal CBD cholangiocarcinoma (n=3) forming a majority of these masses. Benign biliary stricture (secondary to iatrogenic or inflammatory) as a cause of obstruction was seen in 6/60(10%) cases. Choledochal cyst as a cause of obstruction was seen only in 2/60 (16.13%) cases. One atypical case leading to biliary obstruction was Mirizzi's syndrome, in which large stone in cystic duct causes compression of CHD result in obstructive jaundice (Table 1).

On Sonographyintra and extrahepatic biliary radicles were delineated in all except one patient i.e. 98.77% (Table 2). Excessive bowel gases hindered evaluation of the hepatobiliary system in one patient. However, there was increasing difficulty in visualizing the common hepatic duct and common bile duct. Distal CBD was seen in only 38% of our patients on sonography (Table 2).

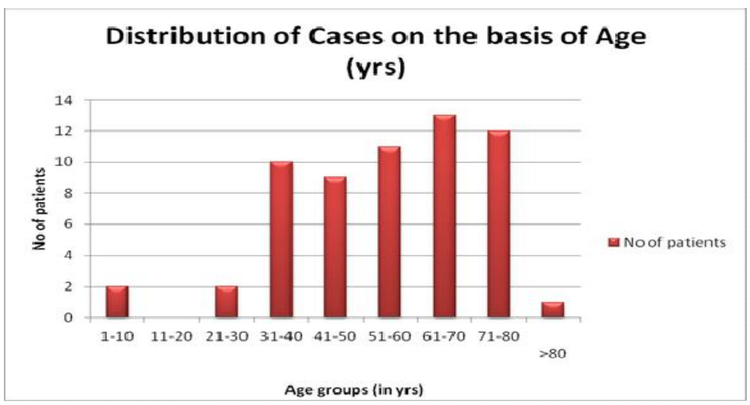

Fig. 1. Distributin of cases on the basis of age
Abbreviation:-Yrs: years,

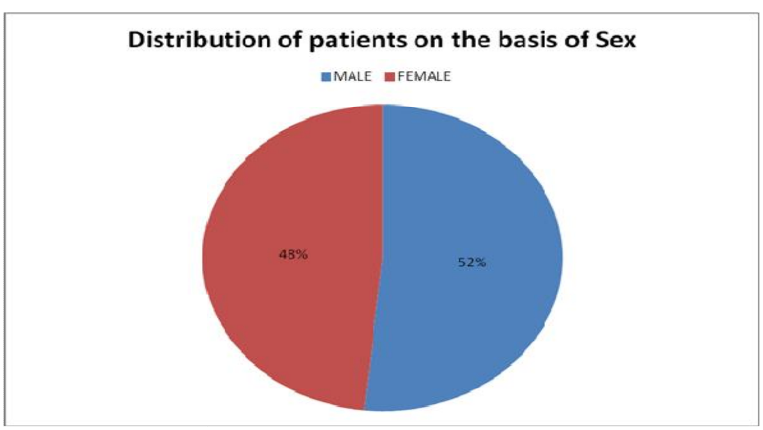

Fig. 2. Distribution of cases on the basis of sex

Intrahepatic biliary radicles and right and left hepatic ducts were visualized on MRCP in all patients and were found to be dilated. Dilated intrahepatic biliary radicles were seen in 98.6% patients on ultrasound and 100% patients on MRCP.

While confluence and common hepatic duct was seen in 58 and 56 patients respectively out of 60 on MRCP. Obstructing hilar masses were present in four patients causing complete cut off at CHD. Ultrasound was able to show confluence in 59 and CHD in 56 patients. Near complete obstruction prevented visualization of the distal ducts in four patients on MRCP (Table 2).

The most common site of obstruction detected by both modalities was supra-pancreatic CBD (Table 3). Level of obstruction is picked up more accurately by MRCP than Ultrasound. However, difference between these two modalities found to be non-significant (p value-0.66).

In this study 12 out of 14 cases were unclassified by Ultrasound (Table 4). This is because of excessive bowel gases and obese body habitus hindered evaluation of the hepatobiliary system. In 2 cases there were false results produced by ultrasound.

Ultrasound was able to diagnose suspected biliary obstruction in 46/60 cases while MRCP accurately diagnose suspected biliary obstruction in 58/60 patients (Table 5). However, difference between these two modalities was found to be non-significant (p value- 0.992).

The common benign cause of obstructive jaundice was choledocholithiasis n = 31and 20/60 cases were malignant, ultrasound detected 15/20 cases while MRCP detected 19/20 cases (Table 5). However, this difference was found to be non-significant (p value- 0.913).

In (**) patients Mirrizi's syndrome was excluded as proximal hepatobiliary system was visualized in 59 out of 60 cases and Excessive bowel gases hindered evaluation of the proximal hepatobiliary system only in one patient (Tables 6 and 7).

4. DISCUSSION

In this study, there was a declining trend observed in the ability of sonography to visualize the biliary tree as we moved distally (Table 2). Visualization of the proximal ducts was possible in 91.6% cases and dropped to 63.3% for distal CBD. Decreasing diagnostic performance of

Table 1. Final etiologic classification of cases

Diagnosis	Number of patients (N=60)	
1. Choledocholithiasis	31	
2. Mirizzi syndrome	1	
3. Tumors	20	
Cholangiocarcinomahilar	4	} (7)
Distal CBD	3	
Infiltrating Gb mass	5	
Periampullary carcinoma	1	
Pancreatic head mass	4	
Malignant lymph nodes	3	
4. Benign stricture	6	
5. Choledochal Cyst	2	
Total (N)	60	

Table 2. Distribution of cases on the basis of dilataton of biliary tree

S. no.	Biliary tree	USG		MRCP	
		Visualization	Dilatation	Visualization	Dilatation
1	IHBR	59/60	59/60	60/60	60/60
2	Rt. Hepatic Duct	59/60	59/60	60/60	60/60
3	Lt. Hepatic duct	59/60	59/60	60/60	60/60
4	Confluence	59/60	58/60	58 /60	58/60
5	Common Hepatic Duct	56/60	55/60	56/60	55/60
5	Proximal CBD	55/60	49/60	56/60	52/60
6	Distlal CBD	38/60	33/60	56/60	52/60

Abbreviation: Rt: right, Lt: left, CBD: common bile duct

Table 3. Distribution of the cases on the basis of level of biliary obstruction

S. no.	Level of biliary obstruction	USG		MRCP	
		No. of pt.	%	No. of pt.	%
1	Hilar	13	23.33%	13	23.33%
2	Supra- pancreatic	30	50%	40	66.66%
3.	Intra pancreatic	3	5.0%	6	10%
	Total	47	78.33%	60	100%

Abbreviation: S.NO; serial number, No; number, Pt; patient

Table 4. Distribution of cases on the basis of cause of obstruction

S. no.	Cause of obstruction	USG		MRCP	
		No. of pt.	%	No. of pt.	%
1	Choledocholithiais	25	41.6%	30	50%
2	Benign billiary stricture	3	5%	6	10%
3.	Choledochal cyst	2	3%	2	3%
	Infiltrating Gb mass	5	8.3%	5	8.3%
	Peri-ampullary carcinoma	0	0%	1	1.6%
	Cholangiocarcinoma	5	8.3%	6	10%
	Pancreatic head carcinoma	3	5%	4	6.6%
	Malignant lymph node	2	3%	3	5%
	Mirrizi's syndrome	1	1.6	1	1.6%
	Unclassified/false results	(14)*	23%	(2)	3%

Abbreviation: Gb; Gall bladder

Table 5. Comparison of diagnosis in patients of the suspected biliary obstruction

SL no	Cause of obstruction	USG	MRCP	Final diagnosis (ERCP/histopath/surgical/clinical)
1.	Choledocholithiais	25	30	31
2.	Benign billiary stricture	3	6	6
3.	Choledochal cyst	2	2	2
4.	Infiltrating Gb mass	5	5	5
5.	Peri-Ampullary carcinoma	0	1	1
6.	Cholangiocarcinoma	5	6	7
7.	Pancreatic head of carcinoma	3	4	4
8.	Malignant lymphnode	2	3	3
9.	Mirizzi's syndrome	1	1	1
	Total	46	58	60

Abbreviation: USG; ultrasound, MRCP; megnatic resonance cholangiopancreaticography

sonography was because of difficulty in visualizing the distal CBD and the pancreatic region mainly due to interference by bowel gases.

Previous studies have reported limited sonographic assessment of the distal CBD and pancreas in as many as 30-50% of the cases [3]. Similar observations were also made by Vicary et al. [4] who opined that limitation in sonographic evaluation of the distal biliary tree and pancreas was due to bowel gases besides the operator's experience.

MRCP was better in showing the distal biliary tree. The distal CBD was visualized in 56/60 patients (98.6%) as against 38/60 (63.3%) patients by sonography.

In four cases, non-visualization of the distal CBD on MRCP was caused by complete cut-off at the level of hilum due to malignant masses. Regan et al. [5] in a prospective study on MRCP demonstrated biliary dilatation in 100% cases.

A recent meta-analysis of 67 published controlled trials by Romagnuolo et al. [6] has shown both sensitivity of 95% and specificity of 95% for detecting the presence of biliary obstruction.

Table 6. Showing diagnostic performance of USG for different causes of obstructive jaundice

Cause of obstruction	True +ve	False +ve	False –ve	True -ve	Sensiti-vity (%)	Specificity (%)	PPV (%)	NPV (%)	Accuracy (%)
Stone	25	2	6	21	80.65%	91.3%	92.59%	77.77%	85.67%
Malignant obstruction	15	1	5	31	75.0%	96.88%	93.75%	86.11%	86.46%
Benign stricture	3	1	3	40	50%	97.56%	75.0%	91.48%	91.66%
Cyst	2	0	0	44	100%	100%	100%	100%	100%
Mirizzi's syndrome	1	0	0	58**	100%	100%	100%	100%	100%

Abbreviation: +ve; positive, -ve; negative; NPV; Negative predictive value, ppv; positive predictive value. % percentage

Table 7. Showing diagnostic performance of MRCP for different causes of obstructive jaundice

Cause of obstruction	True +ve	False +ve	False –ve	True –ve	Sensiti vity (%)	Specificity (%)	PPV (%)	NPV (%)	Accuracy (%)
Stone	30	1	1	28	96.77	96.55%	96.77%	96.55%	96.66%
Malignant obstruction	19	0	1ston	40	95.0	100%	100%	97.56%	98.33%
Benign stricture	6	0	0	54	100%	100%	100%	100%	100%
Cyst	3	0	0	57	100%	100%	100%	100%	100%
Mirizzi's syndrome	1	0	0	59	100%	100%	100%	100%	100%

4.1 Level and Cause of Obstruction

In our study, MRCP was accurate in defining the level of obstruction in all cases. The ability for detecting the level of obstruction was higher for MRCP as compared to ultrasound, which correctly defined level of obstruction only in 78% cases. Kumar M et al. [7] and Honickman SP et al. [8] have found a variable range of accuracy ranging from 27-95% for detecting the level of obstruction by ultrasound.

Romognuolu et al. [6] found an accuracy of 95% for MRCP in detecting the level of obstruction.

In this study the most common site of obstruction was suprapancreatic in 30 out of 60 (50%) patients (Table 3). This is in concordance with the study done by SP Pandit et al. [9].

Choledocholithiasis comprised maximum number of cases, {n = 31 (51%)} in this study (Table 5). Mass lesions {n = 13 (41.9%)}, comprised the second most common cause with hilar (n = 4) and distal CBD cholangiocarcinoma (n = 3) forming a majority of these masses. Benign biliary stricture (secondary to iatrogenic or inflammatory) as a cause of obstruction was seen in 6/60(10%) cases. Choledochal cyst as a cause of obstruction was seen only in 2/60 (16.13%) cases. One atypical case leading to biliary obstruction was Mirizzi's syndrome, in which large stone in cystic duct causes compression of CHD result in obstructive jaundice.

Previous studies [1] have also shown choledocholithiasis and pancreaticobiliary malignancies to be the most common cause of obstructive jaundice.

In this study, Ultrasound was found to have overall accuracy of 76.3% (46/60 cases) for detecting the cause of obstruction (Table 5). Honickman et al. [8] with other authors [3,10] have reported ultrasound accuracies of 23-88%.

MRCP correctly detected cause of obstruction in 58 out of 60 cases in our study (Table 5). There were only 2 cases (small distal CBD calculus and distal CBD cholangiocarcinoma) in which MRCP could not identify the cause of obstruction correctly. In our study, the diagnostic accuracy of MRCP in determining the cause of obstruction was 96.6%.

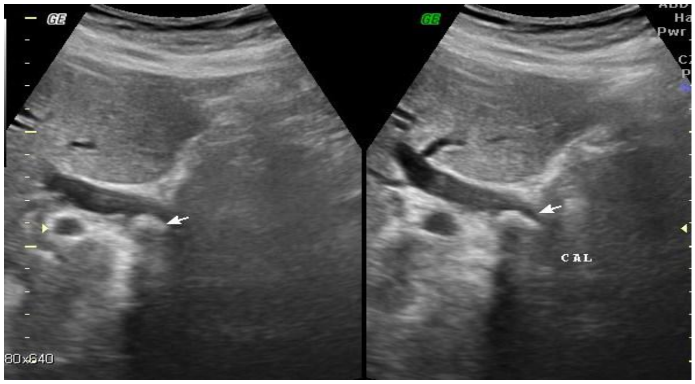

Fig. 3a. Ultrasound shows a caluculus in Distal CBD seen as Echogenic Focus with posterior acoustic shadowing with ppstream dilatation of CBD

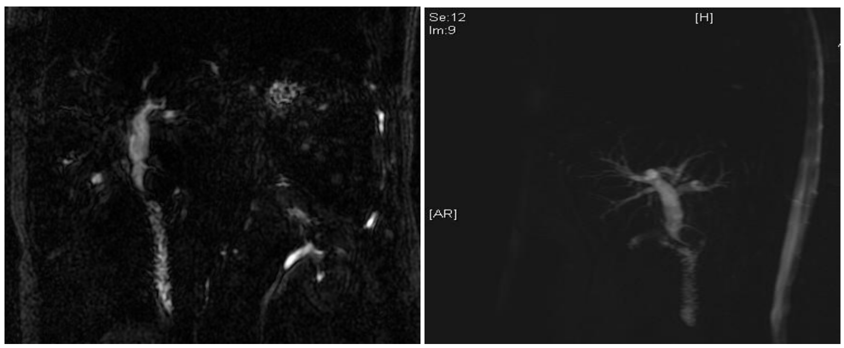

Fig. 3b,c:MRCPand thin slab SSFSE showing large well define filling defect at distal CBD

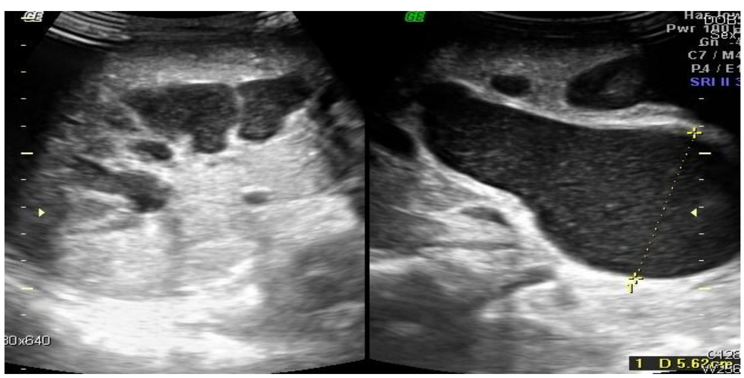

Fig. 4a. Ultrasound in another patient showing cystic dilatations of IHBR as well as extrahepatic biliary system (type IV choledochal cyst)

Vaishali et al. [11] found the overall diagnostic accuracy of 89.65% for detection of cause of obstruction. Christophe Aube et al. [12] found sensitivity of 90.5% and specificity of 87.5% of MRCP in etiological diagnosis.

In this study most common benign cause of biliary obstruction was choledocholithiasis comprising 31/60 cases (Table 5). Eleven patients had calculi involving proximal, mid and distal CBD and 18 patients had calculi only in distal CBD. In two patients stones were also found in common hepatic duct as these patients had multiple calculi at different levels.

Ultrasound detected 25 out of 31 cases of choledocholithiasis, and showed a diagnostic accuracy 85.67% with a sensitivity of 80.9% and specificity of 91.3% (Table 6). Two false positive cases were due to abnormal refraction of the CBD wall and six false negative cases were due to hindering of distal CBD evaluation by bowel gas shadows, obese body habitus and small size (< 3 mm) calculi (Figs. 3a, 5a).

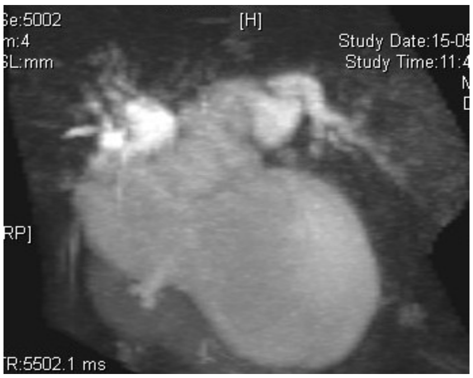

Fig. 4b. MRCP 3 D image of similar patient showing type IV choledochal cyst as cystic dilatation of intraand extrahepatic biliary system

Ferrari FS et al. [13] in their study showed diagnostic accuracy of 80.15%, with a sensitivity of 71.08% and a specificity of 95.83% which were in concordance with our study.

MRCP detected 30/31 cases of CBD calculi (Table 7), only one false negative case was due to small size (<3 mm) of calculus in distal CBD and one false positive case was small cholangiocarcinoma which was considered as stone (Figs. 3b,3c, 4b).

Ferrari FS et al. [13] have found that MRCP has a diagnostic accuracy of 93.89%, sensitivity of 93.97% and specificity of 93.75% in the diagnosis of choledocholithiasis.

Other authors like Mendler MH et al. [14] have also found decreasing sensitivity in detecting stones according to the stone size: 67-100% for stones > 10 mm size, 89-94% for stones measuring 6-10 mm, and 33-71% for bile duct stones < 6 mm in size.

In this study 6 patients have been proved to have postoperative stricture. All of them had previous history of cholecystectomy. Sonography could detect only 3 cases correctly. In one patient benign stricture misinterpreted as malignant, while in 2 cases ultrasound was inconclusive because of difficulty in visualization of distal CBD. One case of malignant stenosis was false positively detected as benign stricture. In our study ultrasound has been found with accuracy 91.6%, sensitivity 50%, specificity 97.5% (Figs. 5b,c) (Figs. 6 a,b).

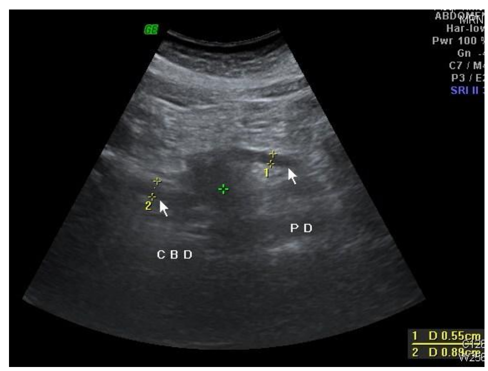

Fig 5a. Ultrasound image shows hypoechoic mass (*) at pancreatic head with dilated PD and CBD

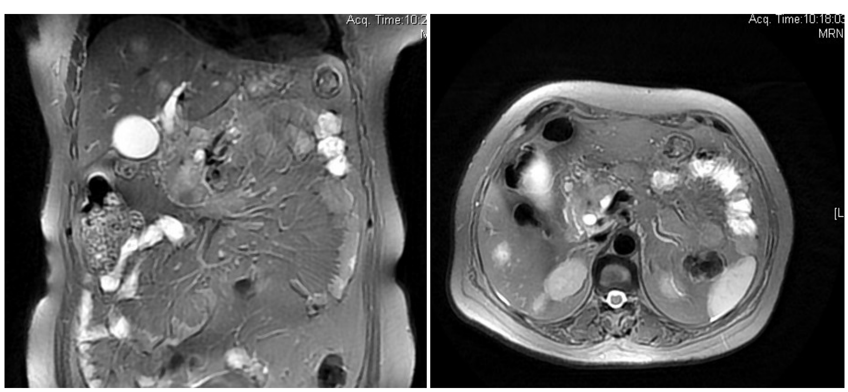

Fig. 5b,c. COR -T2 FRFSE (Fig C)and Axial (Fig D) images showing altered intensity soft tissue mass at pancreatic head with dilated MPD and CBD

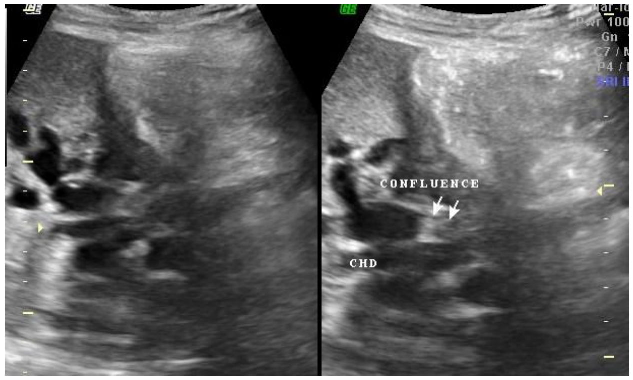

Fig. 6 a,b. Ultrasound image showing echogenic soft tissue mass lesion within the CHD and proximal CBD (double arrow) with upstream dilatation of CHD & IHBR

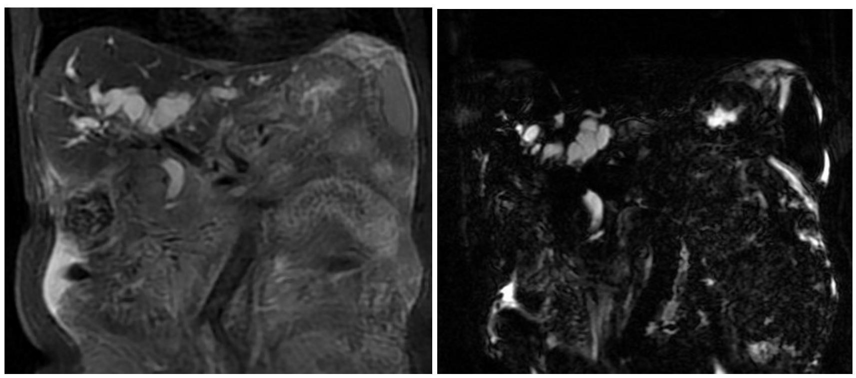

Fig. 6c,d. COR FRFSE (c) and 3D MRCP (d) images showing abrupt cutoff of CHD extending up to prox CBD

In contrast to this study, Pandit SP et al. [9] in their study found accuracy of 31%. In another study Ferrari FS et al. [13] reported a diagnostic accuracy of 78.62%, with a sensitivity of 16.67% and a specificity of 97.29% in sonographic diagnosis of benign biliary stricture. The high specificity was attributable to the capability of USG to detect true negatives in benign stenosis, thus showing the cause of the obstruction by calculi or malignant stenosis. The low sensitivity figures are to be related to intrinsic limitations of the methodology, which, though showing the indirect signs of stenosis, did not allow optimal visualization of the distal CBD and the ampullary region, which is where benign stenosis are often localized (Figs. 6c,d).

In our study MRCP correctly detected all biliary strictures with sensitivity, specificity and diagnostic accuracy of 100%. Our study results were in concordance with Andleeb S et al. [15] who have reported 100% sensitivity and specificity in identification of benign biliary stricture.

In this study 20 out of 60 patients had malignant obstruction. Most common malignant lesion was cholangiocarcinoma, n = 7, followed by infiltrating gall bladder mass n = 5, carcinoma head of pancreas n = 4, Periampullary carcinoma in one patient and 3 cases of malignant lymph nodes at porta and peripancreatic region causing extraluminal compression of CHD and CBD (Table 1).

Ultrasound detected 15 out of 20 cases with overall sensitivity 75%, specificity 96.8% and accuracy 86.4% (Table 6). One false positive case reported because of benign stricture misinterpreted as malignant lesion. Out of five false negative cases in our study, in 4 cases distal CBD and pancreatic region could not be evaluated due to gaseous artifacts and one case of distal cholangiocarcinoma was considered as benign biliary stricture.

The results of this study were lower than those reported by Ghimire et al. [16] who found sensitivity and accuracy of ultrasound to be 97%

and 91% respectively in identification of malignant biliary obstruction and were higher than those reported by Al-Obaidi S et al. [17] (sensitivity 36.3%, specificity 80.7%, and accuracy 73.7%).

In our study MRCP could diagnose 19 out of 60 cases as malignant lesions with sensitivity 95%, specificity 100%, and accuracy 98.3% (Table 7). Only one patient of small cholangiocarcinoma in distal CBD was misdiagnosed as stone.

Our study results of MRCP can be compared with those reported by Little [18] (diagnostic accuracy, sensitivity and specificity of 97%, 93% and 100%).

Two cases of choledochal cysts were reported (Fig 4a). Ultrasound and MRCP detected both the cases correctly and gave information of extent of involvement confidently. Ultrasound is the initial method of evaluation as found in a study done by OH Kim et al. [19]. MRCP result was similar to that observed by Celso Matos (1998) [20].

Hospital based study with small sample size were few of the limitations of this study.

5. CONCLUSION

Ultrasound remains a preliminary imaging modality in the work-up of obstructive jaundice and its diagnostic accuracy has further improved by advancement in technology.

However, MRCP and MRI at 3 T due to its multiplanar 3D imaging capability, higher SNR, superior soft tissue contrast and better definition of internal architecture of lesion allows accurate assessment of presence, level, extent and cause of biliary obstruction.

A protocol based approach depending on the suspected cause of obstruction and preliminary ultrasound should be used to select an appropriate imaging modality so that complete diagnostic information can be provided at minimum cost.

CONSENT

Written informed consent has been sought from all participants of study.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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