

ORIGINAL RESEARCH

A Comparative Study on Diagnostic Accuracy of Ultrasonography and MRCP in Cases of Obstructive Jaundice

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ABSTRACT

Background: In this study, we wanted to compare the accuracy of magnetic resonance cholangio-pancreatography (MRCP) with that of ultrasonography in cases of obstructive jaundice, and evaluate the cause of obstruction in case of obstructive jaundice.

Methods: This was a hospital based prospective study conducted among 30 patients who presented with obstructive jaundice/pancreaticobiliary disease to the surgical out-patient department (OPD) and referred for MRCP to the Department of Radiology, Adesh Medical College and Hospital, Mohri, India. The study was conducted over a period of 6 months from 1st March 2022 to 31st August 2022 after obtaining informed consent from the study participants.

Results: For MRCP, sensitivity, specificity, positive predictive value and negative predictive value were 100 % each. Mass could be visualized in 90 % ultrasound (USG) and MRCP. Stricture was identified and localized in 90 % cases of USG while 100 % cases of MRCP. MRCP showed “double duct signs” in all the cases. MRCP was also able to comment on metastasis to lymph nodes and liver thus helping in staging and planning treatment. There was similar result between USG and MRCP in cases of periampullary carcinoma, choledochal cyst and carcinoma head of pancreas. All modalities were showing 100 % sensitivity and positive predictive value in these cases in diagnosing cause of obstruction. Overall sensitivity of USG and MRCP remained 68.57 % and 97 % respectively. Positive predictive value was 100 % with each modality.

Conclusion: MRCP with modern apparatus can demonstrate anatomy and pathology in case of obstructive jaundice with almost equal or even better extent as compared to USG. Moreover, MRCP can better comment about entire extra luminal extent as well as lymph node metastasis in case of malignant pathologies, thus help in planning the treatment.

Keywords: Ultrasonography, Magnetic Resonance Cholangio-pancreatography, Obstructive Jaundice.

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INTRODUCTION

Obstructive jaundice is the commonest presentation in patients with biliary obstruction. The role of imaging is crucial for detection of site and cause of obstruction. In case of malignant obstruction, characterization of the lesion and staging of the tumour is crucial to decide optimal management of the disease. These patients in general are subjected to diagnostic US followed by CECT. It has been proposed that when complete MR imaging is performed including T1 and T2 weighted images and Gadolinium enhanced MR along with MRCP, it has the capacity to provide all in one evaluation of the suspected obstructive lesions, obviating the need for any other investigation such as computed tomography/percutaneous transhepatic cholangiography/endoscopic retrograde cholangio-pancreatography (CT/PTC/ERCP). Obstructive jaundice affects a significant portion of the world-wide population. In most of the cases, medical history, physical examination, clinical and laboratory data can determine the presence of obstructive jaundice. However, the expanding spectrum of therapeutic options for patients with obstructive jaundice makes it necessary for the radiologist to precisely assess the aetiology, location, level and extent of the disease.^[1] Evaluation of suspected obstructive jaundice has traditionally involved variety of imaging modalities including ultrasonography, computed tomography and invasive cholangiography. These techniques have limitations and hence the need for invasive procedures like endoscopic retrograde cholangio-pancreatography (ERCP) and percutaneous transhepatic cholangiography. Magnetic resonance cholangio-pancreatography is a newer non-invasive imaging modality that provides excellent visualization of the hepatobiliary system.^[2,3] This study was undertaken to assess the role of USG and MRCP in the evaluation of obstructive jaundice. Detection, characterization, and comparative evaluation of various cases of obstructive jaundice were done by USG and MRCP.

Aims and Objectives

To evaluate and compare the accuracy between MRCP and ultrasonography in cases of obstructive jaundice.

To know the **cause** of obstruction in cases of obstructive jaundice.

MATERIALS AND METHODS

This was a hospital based prospective study conducted among 30 patients who presented with suspicion of obstructive jaundice/pancreaticobiliary disease attending surgical OPD and referred for MRCP to the Department of Radiology, Adesh Medical College and Hospital, Mohri, India over a period of 6 months from 1st March 2022 to 31st August 2022 after obtaining informed consent from the study participants.

Inclusion Criteria

Patients of suspected cases of obstructive jaundice with clinical and laboratory features suggestive of obstructive jaundice that is referred for MRCP to Department of Radiology.

Patients willing to enrol in the study after giving the informed consent.

Exclusion Criteria

Patients with pre-hepatic/hepatic jaundice.

Patients not giving the consent for study.

Patients with contraindication for MRCP such as patients with any electrically, magnetically, or mechanically activated implant.

Cardiac pacemaker, insulin pump bio stimulator, neurostimulator, cochlear implant and hearing aids.

Intracranial aneurysm clips (unless made of titanium)

Ferromagnetic surgical clips or staples

Metallic foreign body in the eye

Metal shrapnel or bullet

Patients with claustrophobia.

In all these cases, detailed history and clinical examination, biochemical lab investigations and liver function test and ultrasound examination were done prior to MRCP evaluation.

Statistical Methods

Microsoft word & excel was used to generate graphs & tables. Data analysis was done using rates, ratios and percentages of different diagnosis and outcome made by MRCP was computed and compiled. For descriptive studies & correlation study - Statistical Package for Social Sciences (SPSS) will be used. Statistical methods include chi-square test, Fischer's exact test, sensitivity, specificity, positive and negative predictive values. Quantitative data was presented with the help of mean and standard deviation. Comparison among the study groups was done with the help of paired t test as per results of normality test. Qualitative data was presented with the help of frequency and percentage table. Association among the study groups was assessed with the help of chi-square test. 'p' value less than 0.05 was taken as significant.

RESULTS

Table 1: Demographic Distribution

Pathology	Sex	Years								Total
		1-10	11-20	21-30	31-40	41-50	51-60	61-70	71-80	
Choledocholithiasis	m			1		3				4
	f		2		3	3				8
Cholangiocarcinoma	m				1		1		1	3
	f				1	3	1	2		7
Periampullary carcinoma	m			1		2				3
	f						1		1	2
Choledochal cyst	m									0
	f		2		1					3
Carcinoma gallbladder	m					1				1
	f									0
Carcinoma head of pancreas	m							1		1
	f									0
Total		0	4	2	6	12	3	3	2	32
Age and Sex Distribution (n = 30)										

There were 12 (40 %) males and 18 (60 %) females in this study. Incidence of choledocholithiasis, cholangiocarcinoma and choledochal cyst were more in females than males while carcinoma gallbladder, carcinoma head of pancreas and periampullary carcinoma were more common in males. Age was ranging from 12 - 78 years with mean age of 46.5 years and most common age group was 41 - 50 [12 patients (38 %)] years. Congenital causes were commoner in younger age group. None of the malignant cause was found before 30 years except single case of periampullary carcinoma.

Table 2: Distribution of Cases (N = 30)

Sl. No.	Pathology	No of Patients	Percentage (%)
1	Choledocholithiasis with cholelithiasis	10	31
2	Choledocholithiasis without cholelithiasis	2	6
3	Cholangiocarcinoma	10	31
4	Periampullary carcinoma	5	16
5	Choledochal cyst	3	10
6	Carcinoma gallbladder	1	3
7	Carcinoma head of pancreas	1	3
	Total	32*	100

*2 cases of choledochal cyst were also having associated choledocholithiasis. Thus, total cases were 30 but total pathologies were 32. The most common cause of obstructive jaundice was choledocholithiasis accounting for (37 %) followed by cholangiocarcinoma (31 %).

Table 3: Laboratory Findings in Patients with Extra Hepatic Biliary Obstruction

Pathology	Icterus	Pain	Pruritus	Lump	Fever	Hepatomegaly	Itch Mark
Choledocholithiasis	12	12	6		6	1	6
Cholangiocarcinoma	10	2	10		5		10
Periampullary carcinoma	5	1	4		2	2	4
Choledochal cyst	3	2	3	1			3
Carcinoma gallbladder	1		1			1	1
Carcinoma head of pancreas	1		1		1		1
Total	32	17	25	1	14	4	25
%	100	53	78	3.1	44	12.5	78

Signs and Symptoms in Patients with Extra Hepatic Biliary obstruction

Pathology	Bilirubin (> 1 mg%)	SGOT (> 35 U/L)	SGPT (> 40 U/L)	Alkaline Phosphatase (> 200 u/l)
Choledocholithiasis	12	12	10	12
Cholangiocarcinoma	10	9	9	10
Periampullary carcinoma	5	5	4	5
Choledochal cyst	3	3	3	3
Carcinoma gallbladder	1	1	1	1
Carcinoma head of pancreas	1	1	1	1
Total	32	31	28	32

Most common presenting symptom was icterus (100 %) followed by pruritus (78 %), pain (53 %) and fever (44 %) respectively. S. bilirubin and serum alkaline phosphatase were raised in all (100 %) cases. SGOT was raised in 97 % cases while SGPT was raised in 88 %

cases.

Table 4: Comparison of Two Imaging Modalities in Patients with Cholangiocarcinoma (N = 10) *NV = Not visualized

			USG (N = 12)		MRCP (N = 12)	
			N	%	N	%
CBD	Dilated		9	75	12	100
	No. Of stones	NV*	8	68	0	0
		Single	2	25	7	58
		Multiple	2	17	5	42
	Site of obstruction	Proximal	0	0	0	0
		Mid	0	0	0	0
		Distal	2	17	7	58
All		2	17	5	42	
IHBR	Dilated	8	67	2	92	
GB	Absent		1	8	1	8
	Visualized		11	92	11	92
	Calculi		9	75	10	83
MPD	Dilated	0	0	0	0	
Comparison of Two Imaging Modalities in the Patients with Choledocholithiasis (N = 12)						
			USG (N = 10)		MRCP (N = 10)	
			N	%	N	%
Gallbladder	Visualized		10	100	10	100
	Calculi		8	80	10	100
CBD	D		8	80	9	90
IHBR	D		8	80	10	100
Comparison of Two Imaging Modalities in the Patients with Cholelithiasis (n = 10)						
			USG (N = 10)		MRCP (N = 10)	
			N	%	N	%
CBD	Mass		9	90	9	90
	Site	Proximal	2	20	2	20
		Mid	1	10	2	20
		Distal	6	60	5	50
	Stricture		9	90	10	100
IHBR	Dilated	10	100	10	100	
MPD	Dilated	1	10	1	10	
Gall bladder	Absent		1	10	1	10
	Calculi		1	10	2	20
	Contracted		2	20	0	0

USG could detect dilatation of common bile duct (CBD) in 75 % of the cases while MRCP could diagnose 100 % of the cases of CBD dilatation. This may be due to imaging in early stage when the CBD has not much dilated. USG could find out only 42 % cases of CBD calculi while MRCP were diagnostic in 100 % cases. Site of obstruction could be accurately detected in all cases in MRCP while it could be mentioned in 34 % cases only in USG. Dilatation of intra hepatic biliary radicals (IHBR) could be commented upon in 92 % of the cases with MRCP. Both USG and MRCP were very good at visualizing gallbladder; USG

missed one case of gallbladder calculus out of ten, while MRCP diagnosed all cases. There were 10 cases of cholelithiasis. For USG sensitivity, specificity, positive predictive value, and negative predictive value were 80 %, 100 %, 100 %, and 80 %. For MRCP, sensitivity, specificity, positive predictive value and negative predictive value were 100 % each. Mass could be visualized in 90 % of USG and MRCP. Stricture was identified and localized in 90 % of the cases of USG while 100 % cases of MRCP.

Table 5: Comparison of Two Imaging Modalities in the Patients with Choledochal Cyst (N = 3)

		USG (N = 5)		MRCP (N = 5)	
		N	%	N	%
CBD	Dilated	5	100	5	100
IHBR	Dilated	5	100	5	100
MPD	Dilated	4	80	5	100
Visualization of mass	Visualized	3	60	5	100
Comparison of Two Imaging Modalities in Patients with Periampullary Carcinoma (N = 5)					
		USG (N = 1)		MRCP (N = 1)	
		N	%	N	%
CBD	Dilated	1	100	1	100
IHBR	Dilated	1	100	1	100
MPD	Dilated	1	100	1	100
Visualization of mass	Visualized	1	100	1	100
Comparison of Two Imaging Modalities in the Patients with Carcinoma Head of Pancreas (N = 1)					
		USG		MRCP	
		N	%	N	%
CBD	Dilated	3	100	3	100
	Calculi	1	33	2	66
IHBR	Dilated	2	66	3	100
	Calculi	0		0	0
MPD	Dilated	0	0	0	0

MRCP showed “double duct signs” in all the cases. MRCP was also able to comment on metastasis to lymph nodes and liver thus helping in staging and planning treatment. Both modalities were equally diagnostic for site and cause of the biliary obstruction. But due to single case in the study, nothing much can be commented. For diagnosis of choledochal cyst; sensitivity & positive predictive value was 100 % each in all modalities. 33 % and 66 % of associated CBD calculi were diagnosed by USG and MRCP respectively.

Table 6: Final Diagnosis: Comparison for Cause of Obstruction

		USG		MRCP	
		N	%	N	%
GB	Mass	1	100	1	100
	Calculi	1	100	1	100
CBD	Infiltrating mass	1	100	1	100
	Stricture	1	100	1	100
IHBR	Dilated	1	100	1	100

Comparison of Two Imaging Modalities in the Patient with Carcinoma of Gallbladder (N = 1)

	N	USG		MRCP	
		N	%	N	%
Choledocholithiasis	12	5	42	11	92
Cholangiocarcinoma	10	9	90	10	100
Periampullary carcinoma	5	2	40	5	100
Choledochal cyst	3	3	100	3	100
Carcinoma gallbladder	1	1	100	1	100
Carcinoma head of pancreas	1	1	100	1	100

Final Diagnosis: Comparison for Level of Obstruction					
	N	USG		MRCP	
		N	%	N	%
Choledocholithiasis	12	5	42	11	92
Cholangiocarcinoma	10	9	90	9	90
Periampullary carcinoma	5	2	40	5	100
Choledochal cyst	3	3	100	3	100
Carcinoma gallbladder	1	1	100	1	100
Carcinoma head of pancreas	1	1	100	1	100

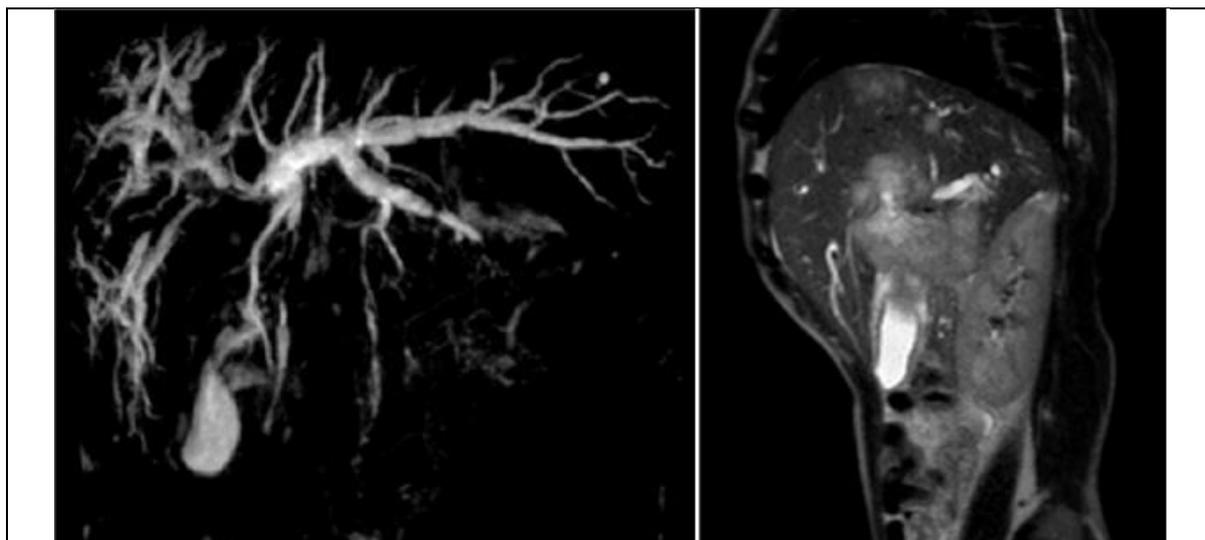


Figure 1:Cholangiocarcinoma - Mrcp Image Reveals Well Defined, Lobulated Heterogenous Hypointense Lesion Infiltrating Liver And Causing Common Bile Duct Dilatation.

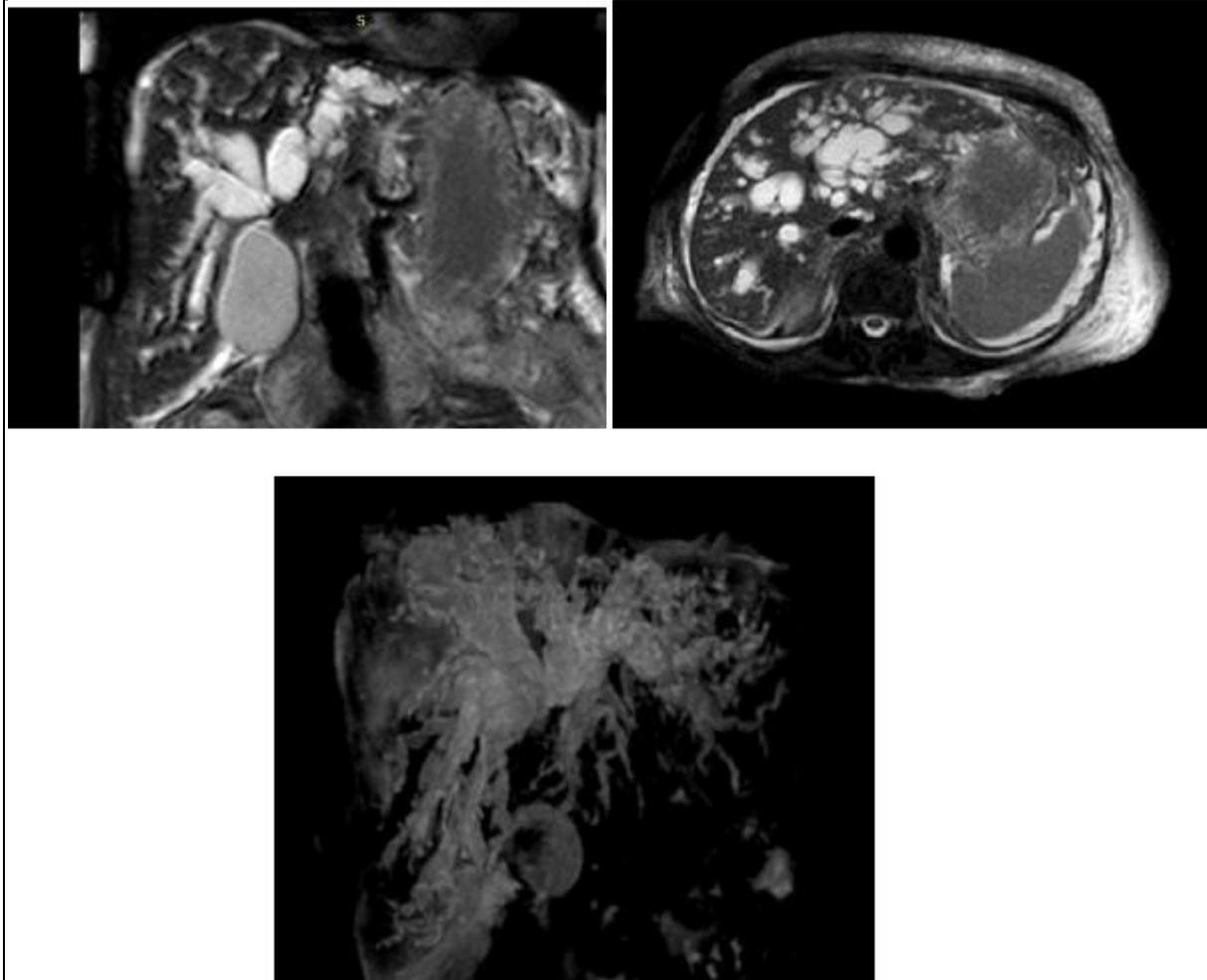


Figure 2:Choledochal Cyst- Mrcp Image Reveals Cystic Dilatation Of The Intrahepatic Biliary Radicals

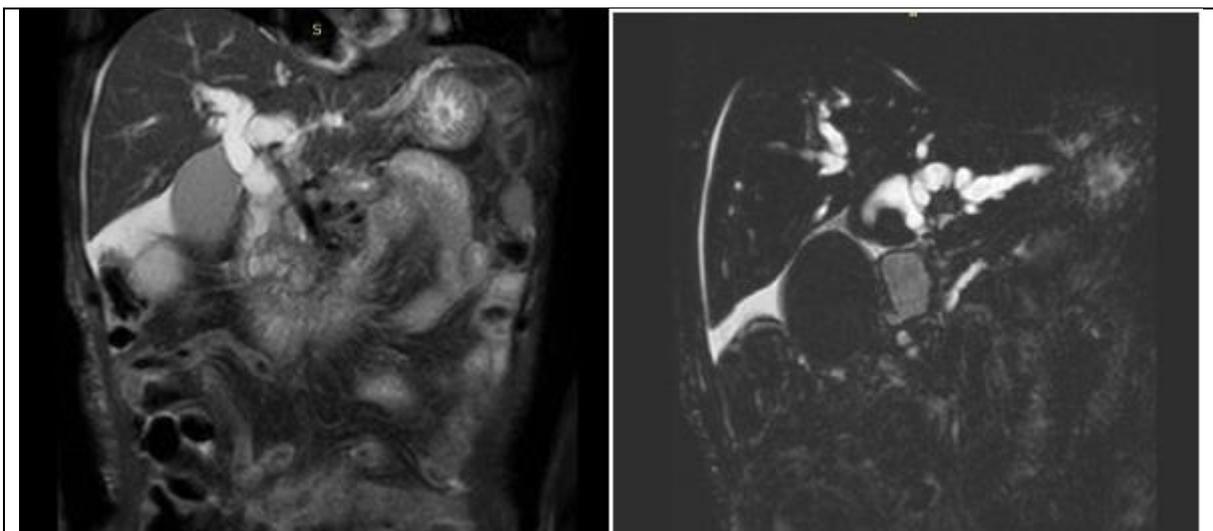


Figure 3:Periampullary carcinoma- mrcp images reveals heterogenously intense lesion with spiculated margins causing dilatation of common bile duct, main pancreatic duct and intra hepatic biliary radicals

Both USG and MRCP demonstrated the mass as well as gallbladder calculi. Stricture was demonstrated in both modalities. Additional finding of liver infiltration was found in MRCP which was helpful in planning the treatment. All modalities showed similar result and showed 100 % sensitivity and positive predictive value for the level of obstruction in choledochal cyst, carcinoma gallbladder and carcinoma head of pancreas. In choledocholithiasis, MRCP was 92 % correct in diagnosing level of obstruction. USG was a poor modality in these cases as it was correct in 42 % only. Overall sensitivity of USG and MRCP was 82.85 % and 97 % respectively and positive predictive value was 100 % in each modality for diagnosis of level of obstruction. There was similar result between USG and MRCP in cases of periampullary carcinoma, choledochal cyst, and carcinoma head of pancreas. All modalities were showing 100 % sensitivity and positive predictive value in these cases in diagnosing cause of obstruction. USG was 90 % correct in cases of cholangiocarcinoma while MRCP were 100% correct. For choledocholithiasis USG was correct in 42% cases while MRCP was 92 % correct. In gallbladder related pathologies, MRCP was most efficient followed by USG. Overall sensitivity of USG and MRCP remained 68.57 % and 97 % respectively. Positive predictive value was 100 % with each modality.

DISCUSSION

Maximum number of cases were seen in the age group of 41 - 50 [N = 12 (39 %)] years with mean age of 46.5 years. Our results are similar to a study done by Shivanand et al. (2015) where the mean age of study population was 46.6 years.^[4] Upadhaya et al. (2006) studied 100 patients, out of which, 46 % were male and 54 % were female.^[5] Ferrari et al. studied 131 patients. Distribution of male patients in Ferrari et al. (2005) was 47 % while that of female patients was 53 %.^[6] S. bilirubin and serum alkaline phosphatase were raised in all (100 %) cases. SGOT was raised in 97 % of the cases while SGPT was raised in 88 % of the cases. In this study, USG detected obstructive jaundice in 82.85 % cases while MRI/MRCP detected obstructive jaundice in 97 % of the cases. Al-Obaidi et al. (2007),^[7] and Dixit et al. (1993),^[8] reported sensitivity of USG to be 91 % in the detection of presence of obstruction. In this study, ultrasound could identify the level of obstruction in 82.85 % of the patients correctly while MRCP identified the correct level in all 97 % of the cases. USG was unable to demonstrate the level of obstruction in few cases because of excessive bowel gases, obesity, previous operations & no intra or extra hepatic duct dilatation on USG. Al-Obaidi et al. (2007) and Kumar M et al. (1998),^[9] found accuracy of 86.2 % and 86 % respectively for USG in detection of level of obstruction. Our results (88.1 %) for USG are almost similar with their studies. In our study, MRCP could accurately diagnose the cause of obstruction in 97 % patients of the total 30 patients of obstructive jaundice, while USG based interpretation was correct in 68.57 % patients. Overall sensitivity of MRCP in our study for presence (97 %), level (97 %) and cause (97 %) of biliary obstruction is similar to the study of Pavone P et al. (1997),^[10] who found sensitivity of 100 %, 100 % and 94.6 % in presence, level and cause of obstruction respectively. The present study included 12 cases of choledocholithiasis which constituted 37 % of the total causes. Majority of the patients [8 (67 %)] were female and were between 31 – 50 years age group. The most common presenting symptoms were jaundice and pain abdomen (both 100 %). S. bilirubin, SGOT and SAP were elevated in all cases while SGPT was raised in all but one case. 7 (58 %) cases showed single calculus lying at lower end of common bile duct (CBD) while 5 (42 %) cases showed multiple calculi. USG could diagnose only 5 (42 %) cases while MRCP was 100 % diagnostic. In a study by Reinhold C (1996), cystic duct and its insertion in to the common hepatic duct are seen routinely on MRCP.^[11] In the present study, there were 10 cases of cholangiocarcinoma - 7 cases were of lower end cholangiocarcinoma, 1 each of hilar cholangiocarcinoma and mid CBD

cholangiocarcinoma and one cholangiocarcinoma involving both upper and mid CBD. Male: female ratio was 3 : 7. Age group was ranging from 35 to 78 years. In a study by Reinhold C et al. (1996), 14 patients were proven to have malignant bile duct obstruction. MRCP diagnosed the presence of malignant bile duct obstruction with a sensitivity and specificity of 98 %. In addition, MRCP correctly characterized the type of neoplasm in 9 (64 %) patients with malignant bile duct obstruction.^[11] Our results were also almost similar to this study. On the basis of MRCP alone, the possibility of malignant bile duct obstruction was given in 9/10 cases. In 9 cases, mass was directly seen as an area of altered signal intensity and in 1 case there was a stricture only which was diagnosed as benign. Reiman et al.^[12] in 1987 had reported the significance of MRCP in differentiation of inflammatory pancreatic mass from neoplasm. They reported that a smooth dilatation of MPD was seen in 85 % of the patients with carcinoma and 27 % of the patients with chronic pancreatitis. Irregular dilatation was seen in 73 % of patients with chronic pancreatitis and only 15 % of patients with carcinoma. In the present study, pancreatic masses demonstrated smooth dilatation of the MPD with abrupt termination. The main pancreatic duct was seemed to be obstructed by pancreatic carcinoma. According to Pavone et al.^[10] MRCP provides “cholangiographic” images of the biliary tree comparable to ERCP and PTC and requires neither biliary intervention nor contrast medium administration. Visualization of the intrahepatic and extra hepatic bile ducts is obtained in all cases, also above a stenotic tract. The evaluation of single slice allows demonstration of communication of the multiple cysts, which is mandatory for the differential diagnosis with cystic disease of the liver and multiple abscesses. In our study, there were 3 cases of choledochal cyst. Age was ranging from 12 - 40 years with 2 patients below the age of 20 years. All patients presented with icterus and pruritus with 2 patients having pain abdomen. Billirubin was raised in all with SAP > 900 IU/L in all cases.

CONCLUSION

USG being a readily available, cost effective and radiation free technology with moderate to high degree of accuracy for the site and the cause of extra hepatic biliary obstruction will sustain its role as primary screening modality for evaluation of pancreatobiliary tree. MRCP is a highly sensitive and specific non-invasive modality for diagnosis of level and cause of obstruction in obstructive jaundice. It is a radiation free technology. No contrast media is required, so it can be used in patient with allergy to the contrast. The detailed information acquired by MRCP can help in planning the treatment, for example: 1) In case of choledocholithiasis, if the size of the stones is found to be small enough to remove endoscopically, then the patient can be subjected to ERCP, and if larger, then patient can be directly taken for surgery without being unnecessarily exposed to invasive procedure and radiation. 2) In case of malignancy, MRCP can demonstrate the entire extent of the disease and additional findings such as lymph nodes and liver metastasis and involvement of adjacent viscera in a better way, thus, help in staging. Patients whose tumour is unresectable can then be subjected to ERCP for palliative drainage and relief of obstruction. However, availability and cost may restrain its extensive use for the evaluation of the patient with obstructive jaundice. Another restraint with MRCP is that it cannot be used in patients with some medical implants containing ferromagnetic objects like cardiac pacemaker, internal defibrillatory devices, orthopaedic implants, intracranial aneurysm clips, ocular implants etc. MRCP with modern apparatus can also demonstrate anatomy and pathology in case of obstructive jaundice with almost equal or even better extent. Moreover, MRCP can better comment about entire extra luminal extent as well as lymph node metastasis in case of malignant pathologies, thus help in planning the treatment.

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