Available Online at http://www.recentscientific.com

ISSN: 0976-3031

International Journal of Recent Scientific Research
Vol. 6, Issue, 4, pp.3642-3650, April, 2015

International Journal of Recent Scientific Research

RESEARCH ARTICLE

MRI COMBINED WITH MRCP VERSUS HELICAL CT IN EVALUATION OF PATIENTS WITH OBSTRUCTIVE JAUNDICE

Raguraman P[1,2,3*]

[1]Department of Radiology, JIPMER Puducherry , India
[2]Department Of Radiology, GLOBAL HEALTH CITY Chennai, India
[3]Department Of Radiology, Assistant Professor, AVMC&RI Puducherry , India

ARTICLE INFO

Article History:

Received 14th, March, 2015
Received in revised form 23th, March, 2015
Accepted 13th, April, 2015
Published online 28th, April, 2015

Key words:

Biliary pathologies, pancreatic lesions, MRCP, CT

ABSTRACT

Objective: To evaluate the diagnostic accuracy between Helical CT &MRI with MRCP in the patients suspected of obstructive jaundice.

Material and Methods: Fifty patients attending the hospital of all age groups and both sexes, suspected obstructive jaundice, were examined first by USG and followed by Helical CT and MRI with MRCP, and findings were correlated with ERCP and biopsy report.

Results: Out of 50 patients 37patients had obstructive jaundice and rest had non obstructive cause of jaundice and excluded from studies. Out of this, MRI with MRCP was 98 % accurate in diagnosis when results were compared in all cases. Helical CT didn't help in case of CBD stricture, in evaluating Pancreatic duct into Chronic pancreatitis and in lower end of CBD pathology.

Conclusion: CT is the cheap and easily available modality so, it is the primary diagnostic modality for suspected patients of biliary and pancreatic pathology, but MR with MRCP has high diagnostic value.

INTRODUCTION

Obstructive Jaundice has been documented as one of the leading cause of increased morbidity. It has been mainly diagnosed by imaging modalities **(**HO JT *et al*,1999). The main goals of any imaging procedure in obstructive jaundice are to confirm the presence of obstruction, its location, extent, probable cause, and it should also attempt to obtain a map of biliary tree that will help the surgeon to determine the best approach to each individual case .Among these Ultrasonography(USG) and Helical Computed Tomography (CT) are initial modalities of investigations. Recently Magnetic Resonance Imaging with Magnetic Resonance Cholangiopancreatography (MRI with MRCP) is emerging as an exciting tool for noninvasive evaluation of patients with obstructive jaundice. Familiarity with normal gross and radiological anatomy is a prerequisite to understand the broad spectrum of disorders that affect the biliary and pancreatic system **(**HO JT *et al*, 1999)

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 (Gibson N. Robert *et al*, 1986). In case of malignant obstruction, characterization of the lesion and staging of the tumor 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 CT/PTC/ERCP (Robinson *et al*, 1997)

MATERIALS AND METHODS

This study on “Mri Combined With Mrcp Versus Helical Ct In Evaluation Of Patients With Obstructive Jaundice” has been carried out in the Department of Radiodiagnosis, JIPMER, Pondicherry University. A total no of thirty six patients suffering from various diseases of biliary tract and pancreas of all age groups and either sex were included in this study.

Most of the patients were diagnosed clinically either as cholecystitis, pancreatitis, or obstructive jaundice.

All the patients had undergone USG and most them have diagnosed on USG prior to Helical CT and MR examination.
The study protocol was approved by the ethical committee at Pondicherry University and all the patients gave informed consent to participate. Patients were excluded if considered unsuitable for MRI-MRCP and Helical CT examination, due to

*Corresponding author: **Raguraman P.**
Department of Radiology, JIPMER Puducherry, India

claustrophobia or renal insufficiency preventing the use of contrast enhanced CT.

For study purpose we trend to refrain patients from ERCP or biliary drainage prior to MR and CT procedures to avoid artifacts in this examinations. Median time between CT and MR examination was 4 days (0-10 days).

METHODS

Helical CT was performed on a Philips Brilliance 6 Multislice CT Scanner, Netherlands. Patients were asked to drink 800 ml of diluted oral contrast 1 hour before procedure and 200 ml of diluted oral contrast immediately before procedure. Unenhanced CT with 10mm collimation of the upper abdomen was performed to locate the pancreas. Contrast (50 ml, 300mg I/ml) was then injected intravenously The scans were taken from diaphragm to iliac crest on 5mm collimation,5mm reconstruction interval, pitch of 1.5,and FOV of 30-40 cms. The images were reformatted up to smaller intervals.

MRI-MRCP was performed on Siemens Magnetom Avanto System 1.5 Tesla MRI Scanner, Germany. All images were obtained with breath holding and parameters were individualized to optimize each for a suspended breath hold of about 20s.All conventional sequences were acquired in axial plane. Detailed parameters of each sequence are summarized below.

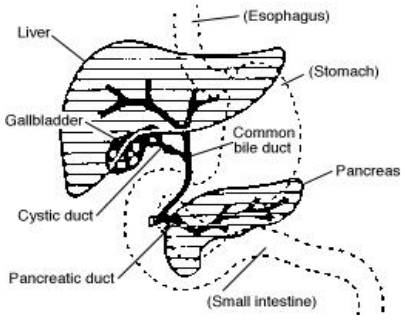


Figure 1 Normal anatomy of biliary tract.

OBSERVATION AND RESULTS

Our study was conducted to determine the role of Helical CTand MRI with MRCP in the evaluation of patients with obstructive jaundice. This study included 36 patients. The youngest patient of our study was 3 months old and the oldest was 85 years. The mean age of patients with benign lesions was 37.4 years and that with malignant lesions was 46.5 years. All the lesions were detected by both CT and MRI with MRCP. CT characterized 15 patients had benign cause of obstructive jaundice, out of which, 1 case (6.6%) turned out to be malignant. Out of 21 cases characterized as malignant by CT, 2 cases (9.5%) turned out to be benign.

Out of 16 cases characterized benign by MRI with MRCP imaging, only 1 case (6.2%) turned out malignant, which was characterized benign by CT too. Out of 20 cases characterized as malignant by MR with MRCP, 1 case (5%) turned out to be benign.

Table 1

Sequence	TR (ms)	TE (ms)	No. of slices	Slice Thickness (mm)	Gap (mm)	Matrix	FOV (mm)
T1w 2D FLASH (axial, mbh)	110	4.72	20	6	1.8	154x256	350
T1w 3D FLASH (axial, fat sat)	5.98	2.91	1	3.5	-	135x250	350
T2w TSE(axial.bh)	4000	103	20	6	1.8	144x256	350
T2wTRIM(axial RT)	2000	79	20	6	1.8	175x320	350
T2w HASTE (coronal thick slab)	4500	754	1	40	-	308x384	300
T2w HASTE (coronal thin slab)	1240	88	15	4	4	218x256	400
T2wTRUFI (axial bh)	3.57	1.51	50	4	-	192x256	380
T2w TRUFI (coronal bh)	3.57	1.51	25	4	6	243x256	400
Localizer	7	2.66	3	8	4	154x256	400

For calculation of statistics “Graph pad In sat 3” version software was used. P value was calculated using Fisher’s exact test.

It is inferred that for diagnosing benign causes the Sensitivity, Specificity, PPV, NPV, Accuracy was 87.5%,95%,93.3%,90.5%,91.6%, and 93.7%,95%,93.7%,94%,94.4%, for CT and MRI respectively.

Table 2 showing Age distribution of various pathologies in studied population

Age Group	No. Of Patients	Percent
Children(0-12yrs)	2	5
Adolescent& young adults(13-30yrs)	5	14
Adults(31-30yrs)	23	64
Geriatric patient(>60yrs)	6	17

Table 3 showing Sex incidence in the studied population

Sex	No. Of Patients	Percent
Females	17	47
Males	19	53
Total	36	100

Table 4 Benign versus Malignant causes of obstructive jaundice in the Studied population.

Type of Lesion	No. Of Patients	Percent
Benign	16	44
Malignant	20	56
Total	36	100

Table 5 Various causes of obstructive jaundice studied in the population

Pathology	No of Cases	Percent
Anatomic variants	3	8
CBD calculi	4	11
GB and CBD calculi	4	11
Benign Stricture	4	11
Cholangitis	1	3
Ca Head of Pancreas	1	3
PeriampullaryCa	8	22
Cholangiocarcinoma	4	11
Ca GB	4	11
Klatskins tumor	2	6
Metastatic compression	1	3
Total	36	100

It is inferred that for diagnosing malignant causes the Sensitivity, Specificity, PPV, NPV, Accuracy was 95%,87.5%,90.4%,93.3%,91.6% and

95%,93.7%.95%,93.7%,94.4% for CT and MRI respectively.

Table 6 Benign causes of obstructive jaundice in the studied population

Pathology	No. of cases	Percent
Anatomic variant	3	19
CBD calculi	4	25
CBD with GB calculi	4	25
Cholangitis	1	6
Benign stricture	4	25
Total	16	100

Table 7 Malignant causes of obstructive jaundice in the studied population

Pathology	No. of cases	Percent
PeriampullaryCa	8	40
Ca headof Pancreas	1	5
Cholangiocarcinoma	4	20
Ca GB	4	20
Klatskins tumor	2	10
Metastatic compression	1	5
Total	20	100

Table 8 Distribution of benign and malignant lesions in different age groups

Age range	Total no. of cases	Benign cases		Malignant cases	
		Number	Percent	Number	Percent
0-12	2	2	100	0	0
13-30	5	5	100	0	0
31-60	23	7	30.5	16	69.5
>60	11	5	45.5	6	54.5

Table 9 Final diagnoses of 16 benign cases

Final diagnosis	No. of cases	Percent
Extrahepatic biliary atresia	1	6.25
Choledochal cyst	2	12.5
CBD benign stricture	4	25
CBD stones	4	25
CBD & GB stones	4	25
Cholangitis	1	6.25
Total	16	100

Table 10 Final diagnosis of 20 malignant cases

Final diagnosis	No. of cases	Percent
Adenocarcinoma duodenum	8	40
Adenocarcinoma pancreas	1	5
HilarCholangiocarcinoma	2	10
CBD Cholangiocarcinoma	4	20
Adenocarcinoma GB	4	20
Metastatic Adenocarcinoma infiltrating CBD	1	5
Total	20	100

Table 11 Benign cases shown by both the modalities

Final diagnosis	Helical CT	MRI with MRCP
Extrahepatic biliary atresia [1]	Benign [1]	Benign [1]
Choledochal cyst [2]	Benign [2]	Benign [2]
CBD benign stricture [4]	Benign [2],Malignant [2]	Benign [4]
CBD stones [4]	Benign [4]	Benign [4]
CBD & GB stones [4]	Benign [4]	Benign [4]
Cholangitis [1]	Benign [1]	Malignant [1]
Total	16	16

[ ] numeric within bracket indicates no of cases. From above table it is inferred that CT diagnosed two benign strictures cases as malignant and MR showed one benign case of cholangitis as malignant.

Table 12 Malignant cases shown by both the modalities

Final diagnosis	Helical CT	MRI with MRCP
Adenocarcinoma duodenum [8]	Malignant [7] , Benign [1]	Malignant [7] , Benign [1]
Adenocarcinoma pancreas [1]	Malignant [1]	Malignant [1]
HilarCholangiocarcinoma [2]	Malignant [2]	Malignant [2]
CBD Cholangiocarcinoma [4]	Malignant [4]	Malignant [4]
Adenocarcinoma GB [4]	Malignant [4]	Malignant [4]
Metastatic Adenocarcinoma infiltrating CBD [1]	Malignant[1]	Malignant [1]
Total	20	20

[ ] numeric within bracket indicates no of cases. From above table it is inferred that CT and MRI diagnosed one malignant cause as benign

Table 13 Comparison of diagnostic values of Helical CT and MRI with MRCP in benign causes of obstructive jaundice

Modality	TP	FP	TN	FN	SEN (%)	SPE (%)	PPV (%)	NPV (%)	Accuracy (%)
HELICAL CT	14	1	19	2	87.5	95	93.3	90.5	91.6
MRI with MRCP	15	1	19	1	93.7	95	93.7	94	94.4

From the above table it is inferred that for diagnosing the benign cause of obstructive jaundice accuracy of Helical CT is 91.6% compared to 94.4% accuracy of MRI with MRCP.The sensitivity of MRI with MRCP is more compare to that of Helical CT in diagnosing benign causes of obstructive jaundice, but the specificity remains the same for both.

MRI with MRCP is more sensitive than Helical CT in diagnosing the benign cause of obstructive jaundice, as the difference is statistically significant, p value is < 0.001.

Both MR and CT had equal chance of excluding the benign cause of obstructive jaundice, but it is statistically insignificant as the p value is > 0.05.

MR with MRCP is more accurate than Helical CT in diagnosing benign causes as the difference is statistically significant, p value is < 0.018.

Table 14 Comparison of diagnostic values of Helical CT and MRI with MRCP in malignant causes of obstructive jaundice

Modality	TP	FP	TN	FN	SEN (%)	SPE (%)	PPV (%)	NPV (%)	Accuracy (%)
HELICAL CT	19	2	14	1	95	87.5	90.4	93.3	91.6
MRI with MRCP	19	1	15	1	95	93.7	95	93.7	94.4

From the above table it is inferred that for diagnosing the malignant cause of obstructive jaundice accuracy of Helical CT is 91.6% compared to 94.4% accuracy of MRI with MRCP.The sensitivity of MRI with MRCP is similar to that of Helical CT in diagnosing malignant causes of obstructive jaundice, but the specificity varies with each other.

MRI with MRCP and Helical CT is equally sensitive in diagnosing the cause of obstructive jaundice but it is statistically insignificant as the p value is >0.05.

MRI with MRCP is more specific than CT in excluding the malignant cause of obstructive jaundice as the difference is statistically significant, p value is < 0.001.

MRI with MRCP is more accurate than Helical CT in diagnosing the malignant causes, asthe difference is statistically significant, and p value is < 0.0180.

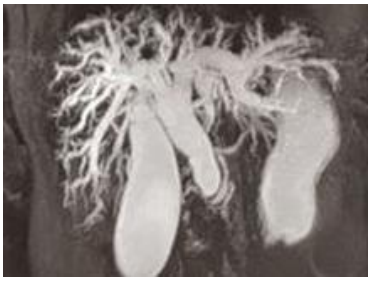


Figure 2 MRCP - Moderately dilated CBD with Benign stricture at distal end.

Figure 3 Helical CT - Reconstructed image with moderately dilated CBD with Benign stricture at dista end.

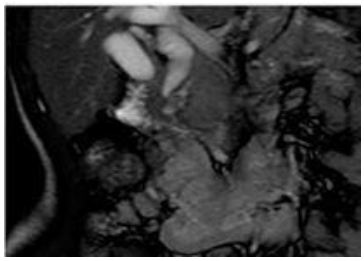


Figure 4 MRCP - Moderately dilated CBD with Benign Stricture in a case of horse shoe kidney

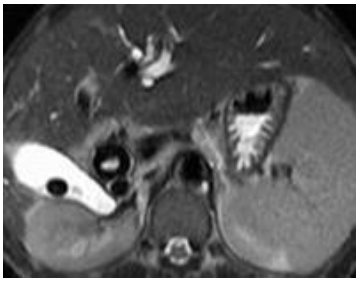


Figure 5 MRI - Calculus both in GB and CBD seen as rounded hypo intensities.

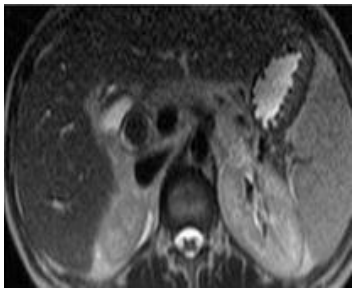


Figure 6 MRI - Calculus at the level of distal CBD seen as rounded hypo intensity within its lumen

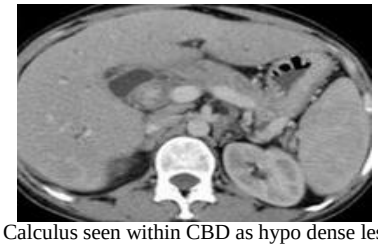


Figure 7 CT - Calculus seen within CBD as hypo dense lesion with thin hyper dense peripheral rim

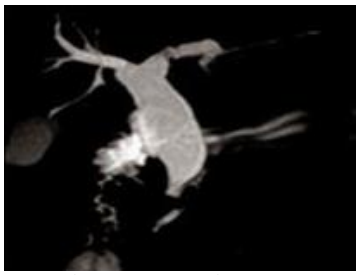


Figure 8 MRCP - Fusiform dilatation of CBD in Type 1 Choledochal cyst.

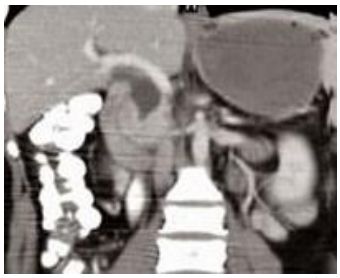


Figure 9 Helical CT - Reconstructed image showing fusiform dilatation of CBD in Type 1 Choledochal cyst.

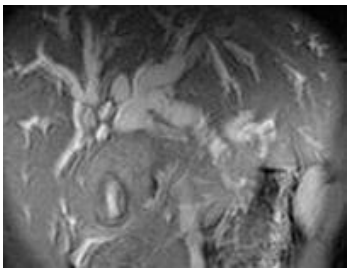


Figure 10 MRI - GB Carcinoma with biliary obstruction.

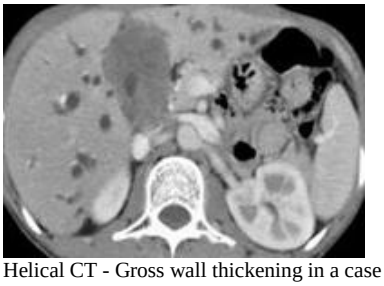


Figure 11 Helical CT - Gross wall thickening in a case of GB carcinoma with biliary obstruction.

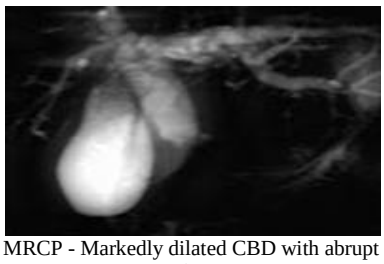


Figure 12 MRCP - Markedly dilated CBD with abrupt irregular termination at distal end with soft tissue density surrounding it in Cholangiocarcinoma.

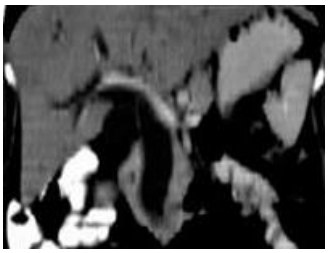


Figure 13 Helical CT - Moderately dilated CBD with abrupt irregular termination in Cholangiocarcinoma.

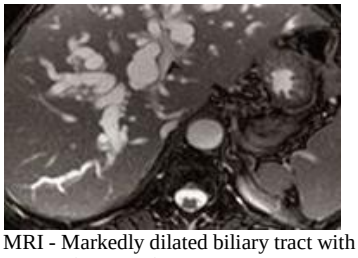


Figure 14 MRI - Markedly dilated biliary tract with abrupt termination at the confluence of hepatic ducts in Klatskins tumor.

Figure 15 Helical CT - Markedly dilated biliary tract with abrupt termination at the confluence of hepatic ducts in Klatskins tumor.

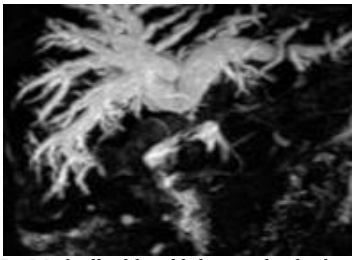


Figure 16 MRCP - Markedly dilated biliary radicals abruptly terminating at the confluence of hepatic ducts in Klatskins tumor.

Figure 17 MRCP - Biliary obstruction and dilatation upto ampulla with irregular end and shouldering in Ampullary carcinoma.

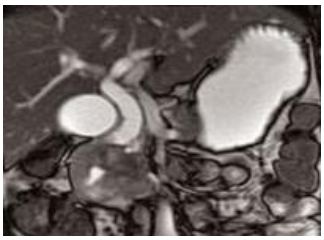


Figure 18 MRCP - Gross wall thickening of duodenum infiltrating distal CBD at ampulla with biliary dilatation in Periampullary carcinoma.

Figure 19 Helical CT - Gross wall thickening of duodenum infiltrating distal CBD at ampulla with irregular abrupt termination of the same in Periampullary carcinoma.

Figure 20 MRCP - Markedly dilated biliary system and pancreatic duct with distal irregular margins of CBD in pancreatic head carcinoma.

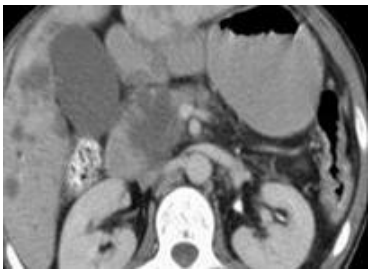


Figure 21 Helical CT - Hypo dense enhancing lesion in head of the pancreas with biliary dilatation in pancreatic head carcinoma

DISCUSSION

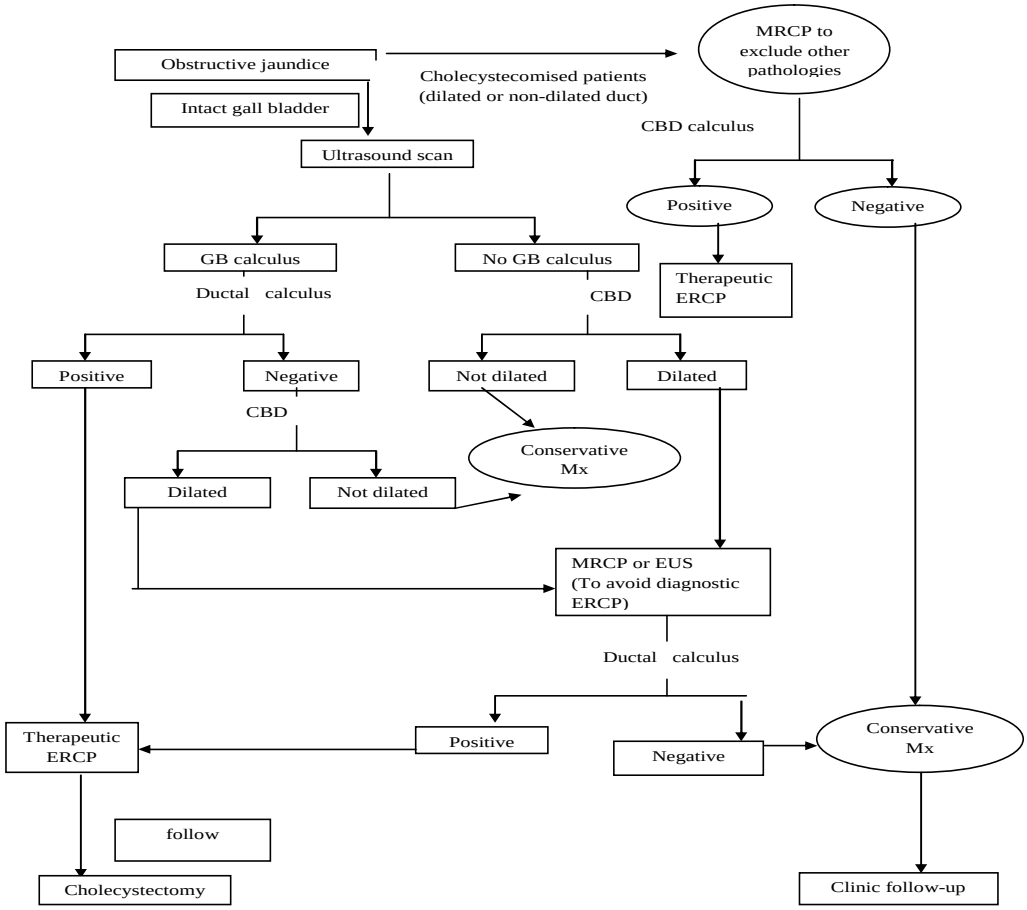
Diagnosing patients with suspected biliary or pancreatic pathologies in their early stage is almost importance in patient care and management. Knowledge of the advantages and disadvantages of each technique are needed to determine the appropriate work up of patients with these pathologies.

With the introduction of MR Cholangiopancreatography in addition with conventional MRI, diagnosing biliary and pancreatic ductal pathologies invasive procedure like ERCP can be avoided solely for the purpose of diagnosis (Anderson N. Stephan *et al*,2006).

In our study we have studied 36 patients suffering from various causes of obstructive jaundice.

The youngest patient was 3 months old presented with biliary atresia and oldest patient was 85 yrs old with choledocholithiasis.Maximum number of patients (64%) were adults in the age group of 31-60yrs with 53% sufferers were males.All of our cases presented with jaundice and abdominal pain.Most common sign encountered in our study was icterus.

USG was done in all the patients prior to Helical CT and MRI with MRCP.USG was able to detect gall bladder calculi in all of the caseswith 100% accuracy .USG showed difficulty in obstruction ,based on characters of distal CBD , such as rounded ending of CBD abruptly. Histopathology examination of the resected specimen revealed benign nature of obstruction



Algorithm for the management of biliary Calculus to reduce thenumber of diagnosticERCP (56).

picking up distal CBD calculus in two patients, diagnosed clearly with CT and MR with 100% accuracy.This shows that MRwith MRCP is superior to USG in detecting CBD calculi and other distal CBD pathologies.Our study is in concordance with Guibad *et al* 1994; In their study they found an accuracy of 100% in detecting CBD calculi on MRCP in cases with equivocal sonographic and CT results.

In imaging of benign lesions(n=16) MR with MRCP diagnosed CBD with GB calculi in all 8 patients with such a final diagnosis and CT also showed the same in all and both the modalities showing 100% accuracy in detecting CBD and GB calculi. MR with MRCP showed calculus region as an area of signal void,and CT showed it as hyperdense lesion. Our study is in concordance with Soto *et al* 2000;In their study they found sensitivity of 94% and specificity of 100% for detecting bilary calculi in MRCP (Soto *et al*, 2000).In their study they found the sensitivity of diagnosing CBD calculus was 87% and our study showed that CT is more superior than their study (Stephan *et al* 2006).

Stricture disease was diagnosed in 4 patients MR with MRCP clearly showed benign nature of stricture in all four cases approaching 100% accuracy . MRCP showed clearly the length of the stricture segment very well and differentiated stricture as as malignant and benign. Among these in Helical CT two patients were diagnosed to have malignant nature of in those two cases which CT reported as malignant..Our study is in concordance with Bhatt *et al*; In their study they found 100% accuracy for MRCP in diagnosing benign CBD strictures(Bhatt *et al*, 2005).One case of cholangitis has been diagnosed wrongly as CBD growth in MR with MRCP,which histology proved it as a benign lesion.

Anatomic variants of 3 cases have been diagnosed on Helical CT and MR with MRCP. One case of biliary atresia and two cases of choledochalcysts.Both showed diagnostic accuracy of 100%.Our study is in concordance with Bhatt *et al*;In their study they found 100% accuracy for MRCP in diagnosing anatomical variants(Bhatt *et al*, 2005).

In imaging of malignant lesions (n=20), 8 cases of periampullary growth was diagnosed with histopathologicalcorrelation.Among these 7 patients were diagnosed to have periampullary growth in MR with MRCP, and Helical CT. Conventional MRI sections aided a lot in arriving final conclusion. In two of these cases MRCP demonstrated “double duct” sign which helped more in arriving final diagnosis. One patient was diagnosed to have stricture disease among the periampullary growth patients, due to technical fault and due to patient non-cooperation in both the modalities.Hence the diagnostic accuracies of both the modalities approaching 88%.Our study is in concordance with Anderrson *et al* 2005;In their study they found 90%accuracy

for MR and 80%accuracy for CT in diagnosing periampullary growth(Anderson *et al*, 2005)

In 4 patients with extrahepaticcholangiocarcinoma MR with MRCP diagnosed all four cases with a 100% accuracy with the help of conventional MRI,while CT clearly showed growth in 2 cases and with suspicion in remaining 2 cases, thus approaching 100% accuracy for MR with MRCP compared to 88-90%accuracy in CT.When studying correlation between imaging findings and final diagnosis we found a stricture with malignant characteristics at MRCP to be the most predictive sign of malignancy.Our study is in accordance with Andersson *et al* 2005; found that among MR with MRCP strictures with malignant characteristics at MRCP were the only independent predictor of malignancy[50].In these respects MRCP was more accurate than CT imaging.

2 patients were diagnosed to have klatskinstumour , and the accuracy of two modalities remain 100% .Our study is in concordance with in their study they found accuracy of 100% for MRCP alone in diagnosing klatskinstumour(Bhatt *et al*, 2005) But CT was not able to show exact extent of two lesions as MRI did. Thus our study is in concordance with JK Han *et al* ; they inferred that Spiral CT less accurate than cholangiography in evaluvation of klatskins tumor in relation to extent of tumour as CT has less z axis resolution.

One case has been diagnosed to have extrinsic malignant nodal compression in both the modalities approaching 100% accuracy in both.

Among four patients with GB Carcinoma MR with MRCP diagnosed all four cases with 100% accuracy, while CT showed positive finding in 3 cases, with accuracy of 75% and one case it diagnosed as malignant hilar obstruction. Conventional MRI added a lot once again in arriving final diagnosis. Among these, two patient had liver metastasis shown clearly by both the modalities.Our study is in concordance with in their study they found an accuracy of 100% for MRCP alone in diagnosing GB Carcinoma(Bhatt *et al*, 2005).

ERCP correlation was got with one patient and findings were correlated with MRCP and found that , MRCP findings findings were comparable to that of ERCP.Finding of our study is in concordance with in their study they found that MRCP images equivalent and better to ERCP(Barish *et al* 1995; Pavone *et al* 1988).

ERCP is considered the standard of reference for imaging patients with obstructive jaundice, as it provides high resolution images of biliary tree and pancreatic duct. A great advantage of ERCP is its ability to perform therapeutic interventional procedures, including stone removal, stricture dilatation, and stent placement which will relieve obstruction.It requires a highly skilled and experienced endoscopist.Technical limitations can lead to unsuccessful examination.It may fail to show biliary tree proximal to severe obstruction.It is associated with significant post procedure morbidity and mortality.It cannot be performed in critically ill patients(Sica *et al*, 1999, Jose *et al*, 1999).

Considering few limitations of Helical CT and USG and invasiveness and complications of ERCP,MRCP alone can become the imaging modality of choice in imaging patients with obstructive jaundice,and it becomes still more superior on adding conventional MRI sections to it because, it is

Future

With interventional MRI, MRCP should play an important role in diagnostic and therapeutic applications in biliary tract and pancreatic pathology.

SUMMARY AND CONCLUSION

This study was conducted in the department of Radiodiagnosis, JIPMER, over a period of 2 years and consisted of thirty six patients of different ages and both sexes.Our study sought to define the role and efficacy of Helical CT and MR with MRCP in evaluation of patients with obstructive jaundice.

In our study, age ranged from 3 months to 85 years with mean age of 42 years.Most of our case was in the age group of 31-60 years.Males accounted for 53% of cases with male to female ratio 1:0.9.

Among the benign cause of obstructive jaundice CBD calculi were the most common finding constituting about 50% of benign causes and it is detected as an isolated or in association with other pathology. Both CT and MR showed 100% accuracy in detecting calculus disorders.

Among the malignant causes periampullary carcinoma is the most common cause and constitutes about 40% of malignant causes. Both CT and MR showed with 95% sensitivity in detecting malignant pathologies. But it is still MRCP that has potential role in delineating the malignant cause of obstructive jaundice, approaching almost 100% in accuracy.

During our study we observed that MRI with MRCP has 94% accuracy in delineating the cause of obstructive jaundice.Compared with Helical CT, MRI with MRCP is equally sensitive and more specific in differentiating the causes of obstructive jaundice as malignant.MRI with MRCP is very accurate than CT in identifying the various benign pathologies , and this modality has shown a dramatic role in identifying anatomic variants including choledochal cysts.With the help of conventional MRI, MRCP has added its advantage of diagnosing malignant pathologies to a extent that it was even possible to stage the malignant tumors.

This single modality(MRI with MRCP) apart from demonstrating the causes of obstructive jaundice, can be used to demonstrate the involvement of vascular structures with different sequences at a single setting with MR angiography thus saving time and discomfort to the patient.

MR Cholangiopancreatography is very accurate in demonstrating calculi at the distal end of CBD as an area of signal void, also in demonstrating strictures as the cause of dilatation of biliary radicals. It showed the length of stricture segment very well and differentiated stricture as malignant and

benign. The benign strictures were smooth tapered margins, were as in malignant strictures there was an abrupt and irregular character of narrowed segment with or without shouldering. MRCP is superior to CT in this regard.

With the help of source image , we can very well show the exact location and extent of malignant tumours (like Ca GB , Klatskintumour , Cholangiocarcinoma, Ca pancreas) , there by providing a guide map for segmental resection .MRCP is more superior than CT in this regard. Adding conventional axial T1 and T2 weighted sequences it is easy to stage the tumor.

Based upon our study following conclusions can be drawn;

MR with MRCP is an accurate, non invasive means of evaluating the patients with obstructive jaundice. It is useful in children, critically ill patients with ease. It is useful in failed ERCP cases and it also shows biliary tree very well proximal as well as distal to the level of obstruction. It is better to Helical CT and USG in showing the distal CBD as well as pancreatic duct.

The inherent multiplanar capability of MRI with MRCP makes MR superior to other modalities in characterizing the lesion. The diagnostic accuracy of MRI with MRCP suggests that it has the potential to replace or limit the use of invasive procedures like diagnostic ERCP, which should be used only in cases where intervention is being contemplated.

MRI with MRCP is extremely sensitive in detecting lesions in the biliary and pancreatic duct. The only major hiccups in MRCP replacing all other modalities in the evaluation of pancreatobiliary ductal pathologies presently are expense, lesser availability, and the inability to take percutaneousbiopsies. In conclusion in this prospectively collected data of patients, MRI combined with MRCP isequivalent to Helical CT in delineating the cause of obstructive jaundice as malignant, but it superior to Helical CT in diagnosing benign causes of obstructive jaundice .This difference was mainly explained by the MRCP in imaging malignant/benign biliary and/or pancreatic duct strictures and to bile duct calculi. But still MRCP alone is more accurate than Helical CT in delineating the cause of obstructive jaundice. Dynamic contrast enhanced MRI did not add any better performance to cross sectional MRI combined with MRCP without contrast.

BIBLIOGRAPHY

Andersson M, Kostic S, Johansson M, Lundell L, Asztely M, *et al*: MRI combined with MR cholangiopancreatography versus helical CT in the evaluation of patients with suspected periampullary tumors: a prospective comparative study.ActaRadiologica 2005; 46: 16-27.

Ann S Fulcher, Mary Ann Turner *et al* Half-Fourier RARE MR Cholangiopancreatography: Experience in 300 subjects. Radiology 1998; 207: 21-32.

Ballantyne *et al*: Imaging The Pancreato-Biliary System with Magnetic Resonance Cholangiopancreatography.JR Coll Physicians Edinb 2003; 33:21-27.

Bhatt C, Shah P.S, Prajapati H.J, *et al*: Comparison of Diagnostic Accuracy between USG and MRCP in Biliary and Pancreatic Pathology. *Ind J RadiolImag* 2005; 5:2:177-181.

Caroline Reinhold and Patrice M. Bret: Current status of MRCP. AJR1996; 166: 1285-1295.

Catherine Westbrook and Carolyn Kaut: MRI in Practice.

Cesar S. Pedrosa, Rafael Casanova, *et al*: Computed Tomography in Obstructive Jaundice. Radiology 1981; 139: 635-645.

CT and MR Imaging of the Whole Body, Fourth Edition, Volume Two; 1341-1486.

D.R. Brine, E.L. Soulen. Pancreaticobiliary carcinoma associated with a large choledochal cyst: Role of MRI and MR Cholangiopancreatography in diagnosis and preoperative assessment. Abdominal imaging.1999; 24:292-294.

David D, Stark, William G. Bradley, JR: Magnetic Resonance imaging, Third Edition, Volume One; 42, 472-502.

David *et al*: Pitfalls in the interpretation of MR Cholangiopancreatography. AJR1998; 170: 1055-1059.

G.J. Robinson *et al*: MRCP in obstructive jaundice. Radiology 1997, Imaging, Science & Oncology, 124.

Geraldine Revelon *et al*: Primary Sclerosing Cholangitis: MR imaging findings with pathologic correlation.AJR 1999; 173: 1037-1042.

Grainger &Allisons Diagnostic Radiology.A Textbook of Medical Imaging, Third Edition, Volume 2, 1997.

Gray's Anatomy, 37th edition, Churchill Livingstone, Edinburgh, 1989.

Harrison's Principles of Internal Medicine, Volume 2, 14th edition, 1998.

Hiroshi Kondo *et al* MR Cholangiography with volume rendering: Receiver operating characteristic curve Analysis in patients with choledocholithiasis. AJR 2001; 175:1183-1189.

Hiroyuki Irie, Hiroshi Honda *et al*: Value of MR cholangiopancreatography in evaluating choledochoal cyst.AJR 1998; 171: 1381-1545.

HO JT, Yap CK: Value of using HASTE sequence, Ann Acad. Med Singapore. May 1999; 28(3): 366-70.

J.A. Larena *et al*: MRCP in the evaluation of pancreatic duct Pathology. *The Br J Radiology*1998; 71: 1100-1104.

J.C. Varghese *et al*: The Diagnostic Accuracy of Magnetic Resonance Cholangiopancreatography and Ultrasound compared with direct Cholangiography in the detection of Choledocholithiasis. Clinical Radiology 1999; 54:604-614.

J.C. Verghese *et al*: A prospective comparison of MRCP with ERCP in the evaluation of patients with suspected biliary tract diseases. Clinical Radiology1999; 54: 513-520.

Jorge A, soto *et al*: MRCP: Findings on 3D fast spin-echo imaging. AJR1995; 165: 1397-1401.

Jorge E Lopera *et al*: Malignant Hilar and perihilar Biliary Obstruction: Use of MR cholangiography to define the extent of biliary ductal involvement and plan percutaneous interventions. Radiology 2001; 220:90-96.

Jose C. Varghese *et al*: Role of MRCP in patients with failed or inadequate ERCP.AJR 1999; 173:1527-1533.

Joseph K.T. Lee, Stuart S. Sagel *et al*: Computed Body Tomography with MRI correlation, 3rd edition, volume 2, Philadelphia, 1998.

K. Liberpoulos *et al*: The role of MRCP in the study of biliary diseases, Radiology 1997.Imaging, Science & Oncology, 22.

Kelly Van Epps, Fintan Regal: MRCP using Haste Sequence.

Clinical Radiology 1999; 54: 588-594.

Koenraad J. Mortele and Pablo Ros: Anatomic variants of Biliary Tree: MR Cholangiographic findings and Clinical Applications. AJR 2001; 177: 389-394.

Koichi Hirao *et al*: Evaluation of Aberrant Bile Ducts before Laparoscopic Cholecystectomy.AJR2000;175: 713-720.

Kraren I, Novton *et al*: MR Cholangiography in children and young adults with Biliary Diseases.AJR 1999; 172:1239-1244.

Kyo Y T *et al*: Diagnostic efficacy of Non-Breath Hold MRCP. J. Formos Med. Assoc. 1999 Feb; 98(2): 97-103.

L.Van Hoe, D.Vanbeckevoort, K.Mermuys, W.VanSteenbergen , MR Cholangio-pancreatography, Atlas with Cross-Sectional Imaging Correlation, Second Edition , October 2005.

Laurent Guibaud *et al*: MRCP in Neonates and Infants: Feasibility and preliminary applications.AJR 1998; 170: 27-31.

M.A. Barish and J.A. Soto: MR Cholangiopancreatography: Techniques and clinical applications. AJR1997; 169:1295-1303.

Masako Dhoke *et al*: Anomalies and Anatomic variants of the Biliary Tree revealed by MR Cholangiopancreatography.AJR1999; 173:1251-1254.

Matthew A. Barish *et al*: MRCP: Efficacy of 3-D Turbo spin- echo technique. AJR1995; 165: 295-301.

Mi-Suk Park, Tae kyoungkim, *et al*: Differentiation of Extrahepatic Bile Duct Cholangiocarcinoma from Benign Stricture: Findings at MRCP versus ERCP.Radiology 2004; 233: 234-240.

Moon Gyu Lee *et al*: MRCP of Panreaticobiliary disease: Comparing Single-shot RARE and multislice HASTE sequences AJR1998; 171: 1539-1545.

OluvuerErbst *et al*: MRCP in primary sclerosing cholangitis.AJR 1998; 171: 1027-1030.

Patel JC, McCinnis GC *et al*: The role of intravenous Cholangiography in preoperative assessment for laparoscopic cholecystectomy. *Br J Radiology*1993; 66: 1125-1127.

Patrice M Bret *et al*: Pancreas Divisum: Evaluation with MR Cholangiopancreatography. Radiology 1996;199: 99-103.

Regan *et al*:Choledocholithiasis:Evaluation with MRCP.AJR: 167,December 1996;1441-1445.

Reuther, B. Kiefer, A. Tuchmann, F.X.Pesendorter: Imaging findings of Pancreaticobiliary Duct Diseases with Single-shot MRCP. AJR1997; 168: 453-459.

Robbins Basic Pathology Vth edition, W B Saunders 1992.

Robert *et al*: Normal Intrahepatic Bile Ducts CT Depiction.Radiology 1990; 176: 633-635.

Robert N. Gibson, Eugene Yeung , Jeremy N. Thompson , *et al*: Bile Duct Obstruction : Radiologic Evaluation of Level, Cause, and Tumourresectability . Radiology1986; 160: 43-47.

Schwartz *et al*: Neoplastic Pancreato-biliary Duct obstruction: Evaluation with breath hold MRCP. AJR 1998;170: 1491-1495.

Seung Hong Choi, Joon Koo Han, *et al*: Differentiating Malignant from Benign Common Bile Duct Sticture with Multiphasic Helical CT.Radiology 2005; 236: 178-18

Shanmugam V, Beattie G.C , Yule S , *et al*: Is magnetic resonance cholangiopancreatography the new gold standard in biliary imaging? . *The British Journal of Radiology* 2005;78: 888-893.

Sica, Braver, Cooney *et al* Comparison of endosocpic retrograde Cholangiopancreatography in patients with pancreatitis.Radiology.1999; 210: 605-610.

Soto *et al*: comparision of three dimensional fast spin echo and single and multisection half fourier rapid acquisition with relaxation enhancement sequences.Radiology 2000;215:737-745.

Stephan W. Anderson, Brian C. Lucey *et al*: Accuracy of MDCT in the Diagnosis of Choledocholithiasis .AJR 2006; 187:174-180.

Takayushi Masui *et al*: Evaluation of Pancreas: A comparison of Single Thick-Slice MRCP with Multiple thin-Slice Volume Reconstruction MRCP.AJR1999; 173: 1519-1526.

Threasa H. Reiman , Dennis Balfe , *et al*: Suprapancreatic Biliary Obstruction : CT Evaluation. Radiology 1987; 163: 49-56.

Todani T, WAtanable T, Narusue M *et al*: Congenital bile duct cysts Classification, operative procedures and review of 37 cases, *AM J. Surg*. 1997.

Tomoaki Ichikawa, Hiroki Harodome, *et al*: Pancreatic Ductal Adenocarcinoma: Preoperative Assessment with Helical CT versus Dynamic MR imaging .Radiology1997; 202: 655-662.

Toshiyuki Miyazaki *et al*: MRCP using HASTE sequences. AJR1996; 166: 1297-1303.

Toshiyuki Miyazaki *et al*: Single-shot MRCP of neonates, infants and young children. AJR1998; 170: 33-37.

Van Hoe *et al*: Normal vaterian Sphincter Complex-Evaluation of Morphology and Contractility with dynamic Single shot MRCP.AJR 1998; 170: 1497-1500.

W Schima, R. Prokesch t al. Biliary Wall stent Endoporsthesis in Malignant hilar obstruction: Long term results with regard to the type of obstruction. Clinical Radiology 1997; 52: 213-219.

Wendy W.M. Lam *et al*: MRCP and CT cholangiogrpahy of paediatric patients with Choledochal Cysts.AJR 1999; 173:401-405.

Young Kon Kim, Chong Soo Kim, Jeong Min Lee, *et al*: Value of Adding T1 – Weighted Image to MR Cholangiopancreatography for Detecting Intrahepatic biliary Stones.AJR 2006;187:267-274.