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Role Of MRCP In Suspected Case Of Obstructive Jaundice In Correlation With Computed Tomography/ Ultrasonography

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Abstract:

Background & Objective: The main objective of the current study is to determine the accuracy of MRCP over USG / CT in evaluation of patients having obstructive jaundice.

Material & Methods: The study was performed in the department of Radio-Diagnosis at Indore Madhya pradesh , over the period of two years from February - 2020 to August - 2021. Fourty patients were included in this study. All the patients were referred to the department of radio diagnosis with the elevated levels of serum bilirubin and clinically suspicion of obstructive jaundice. Ultrasonography then CT and then MRCP were done in all these patients. Three radiologists analysed the images separately and evaluated the cause and site of obstruction in these patients. The accuracy of each modality was later analyzed statistically and then correlation was made with the histopathological reports or surgical findings.

Pathophysiology: 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 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.

Results: Out of the Fourty patients, eighteen patients had benign causes of obstructive jaundice while twenty two patients had malignant causes of obstructive jaundice. For diagnosing the causes of obstructive jaundice on MRI with MRCP has a higher diagnostic accurancy of 95% than helical CT with accuracy of 92.5% and USG with diagnostic accuracy of 62.07%.The sensitivity of MRCP is higher than that of helical CT and USG in diagnosing the cause of obstructive jaundice. For diagnosing the site of obstruction with MRCP had an accuracy of as high as 100% while CT had 88% and USG 55%. The Role of the MRCP when compared to CT / USG was statistically more significant ($p<0.05$).

Conclusion: While Diagnosing Of Obstructive Jaundice And To Evaluate The Cause, Location And Extention Of The Lesion Mrcp Being A Non Ionizing And A Non Invasive Procedure Seems To Be A Better Choice Over Other Radiological Procedures Like Usg/Ct Or Ercp. The Only Drawback Of Mrcp Is The Cost Involved And The Availability. The Limitation Of The Study Is The Small Study Sample Size And No Ercp Correlation For These Patients Was Done.

Keywords: MRCP, CT

Introduction:

Obstructive Jaundice has been documented as one of the leading cause of increased morbidity. It has been mainly diagnosed by imaging modalities. Our main goals of any Imaging procedure in case of obstructive jaundice are to confirm the presence of level of obstruction, its extent, location, probable cause, and it should also attempt to obtain a map of the biliary tree that will help the operating surgeon to determine ,whats the best approach for 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 non-invasive evaluation of patients having obstructive jaundice.

MRCP is a relatively new Magnetic Resonance imaging technique which has evolved over the period of the time in the imaging of biliary tract and pancreatic ducts and has emerged as an a non-invasive , accurate means of visualization of the biliary tract and pancreatic duct without injection of contrast media1.

Since its introduction by Mr Wallner et al in 1991, MR Cholangiopancreatography has undergone a wide range of evolution. With the development of the higher magnetic field strength with newer pulse sequences like RARE (Rapid Acquisition and Relaxation Enhancement) ,HASTE (Half Fourier Acquisition Single Shot Turbo Spin Echo) and Magnetic Resonance Cholangiopancreatography with its high resolution, rapidity, multiplanar reconstruction capability and virtually without artifact display of anatomy and pathology ,is proving to be the imaging of choice for these patients.2,3

MRCP can shows the entire biliary tract as well as pancreatic duct without any mode of intervention and use of any oral or IV contrast. The quality of images obtained is comparable with those of direct cholangiography procedure like ERCP, which is considered as a standard of reference in pathologies of ducts4. The diagnostic accuracy of Magnetic resonance cholangiopancreatography suggests that, it has potential to replace the more invasive procedures like diagnostic ERCP, which should only be used in cases where intervention is being required.

It has proved the effectiveness in evaluating bile duct stricture, dilatation and choledocholithiasis. In patients having stenosis of biliary-enteric anastomosis ,malignant obstruction this non-invasive imaging technique demonstrates the site and extent of the stenosis, the degree of proximal dilatation, the presence and size of biliary stones, and associated findings.3,5

The principle of MRCP is based on use of heavily T2 weighted fast spin echo sequences. As a result, stationary or slow moving fluid in biliary & pancreatic duct gives high signal intensity, while solid organs have low signal intensity. On these images, the fluid of the biliary and pancreatic ducts gives the cholangiogram and pancreatogram.2,3,6,7,8

Other imaging modalities used in the diagnosis of biliary tree and pancreatic duct are Ultrasonography, Computed Tomography, IV cholangiography and Endoscopic Retrograde Cholangio-pancreatography (ERCP) and Percutaneous Transhepatic Cholangiography (PTC). For patients with suspected ductal pathology each modality offers advantages and disadvantages that are unique to the specific technology.

Drawbacks with ultrasonography and CT are, they do not accurately define site and extent of biliary strictures. Ultrasonogrpahy has limitations in diagnosing choledocholithiasis, where as MRCP offers diagnostic accuracy of

>90%. IV cholangiography has limitations, in 30-40% of cases there is incomplete opacification of biliary system9. PTC and ERCP requires biliary intervention and use of contrast agent.

Magnetic Resonance Cholangiopancreatography (MRCP) has few added advantage as follow:-

- Non-invasive imaging modality
- No ionizing radiation needed
- No need of contrast media
- Multiplanar imaging capability
- No post procedure complications
- It can be done in critically ill patients
- It can show biliary tract proximal as well as distal to the level of obstruction.

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MRCP plays a major role in the overall evaluation of biliary & pancreatic duct lesions and modality is expected to provide information that will help identify the nature of the disease (infection, tumor, calculus & others), show the location and extent of involvement, suggest the type of pathology, guide biopsy and drainage procedures, indicate method of therapy (medical and/or surgical), suggest surgical approach and help assess response

to the therapy. Rapid technical developments in coil design, gradient hardware, and pulse sequences have continued to improve quality and diagnostic capability while reducing the data processing time.

In this present study we have prospectively studied 40 patients by MRCP, Helical CT and ultrasonogrpahy who were suffering from various diseases of biliary tract and / or pancreas and tried to evaluate the efficacy of MRCP as an imaging modality of choice.

Methodology:

This study on "ROLE OF MRCP IN SUSPECTED CASE OF OBSTRUCTIVE JAUNDICE IN CORRELATION WITH COMPUTED TOMOGRAPHY/ ULTRASONOGRAPHY." has been carried out in Index Medical College Indore (Madhya Pradesh) at the Department of Radiodiagnosis. A total no of fourty patients suffering from different diseases of pancreas and biliary tract , of different age groups and either sex were included in this particular study.

Most of these patients were clinically diagnosed as obstructive jaundice.

All the patients had sent to ultrasonography and most of them have diagnosed on ultrasonograohy prior to Helical CT and MR examination.

The protocol for was approved by the ethical committee at index medical college. All the patients had given there informed consent to participate. Patients were excluded if considered unsuitable for MRI-MRCP and Helical CT examination, due to 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 MRCP procedure was 4 days (0-10 days).

Patient preparation for USG :

- All the patients were instructed to come with empty stomach on the day of procedure.

Patient preparation for Helical CT:

- All the patients were instructed to come with empty stomach on the day of procedure.
- All patients renal functional status were noted before undergoing contrast CT.
- All patients clinical history were elicited to rule out previous contrast reactions/allergies.

Patient preparation for MRI with MRCP.

- All the patients were instructed to nil per oral for atleast 6 hours prior to examination.
- All the metallic belongings(object) were removed prior to the examination.

Methods:

USG was performed using a seimens acuson x 300 and GE voluson s8. Both curvilinear as well as linear probes were used in our study. Images of the biliary tree were saved for review purpose.

Helical CT was performed on a siemens 64 slice Scanner. Patients were instructed to drink 800 ml diluted oral contrast agent 1 hour before procedure and 200 ml of diluted oral contrast agent immediately before procedure. Unenhanced CT with 1mm collimation of the upper abdomen was performed to locate the pancreas. Contrast was then injected intravenously The scans were taken from diaphragm to iliac crest on 5mm collimation, The images were reformatted upto smaller intervals.

MRI-MRCP was performed on GE SIGNA EXPLORER 1.5 Tesla MRI Scanner.. All images were obtained with the breath holding and the parameters were individualized, for optimization each for a suspended breath hold of approx. 15 second .All the sequences were acquired in axial plane.

The following Parameters were studied for Ultrasonography, CT Scan and MRCP;

1. Level of obstruction (4 Anatomical Segments)

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- Hepatic
- Supra pancreatic
- Pancreatic
- Ampullary

2. Presence of calculi in bilary duct

- Non visualized
- Definitely visualized.

3. CBD status

- Smooth tapering
- Abrupt end
- Rounded
- Irregular

4. Classification of dilatation of intra hepatic biliary radicals

- Minimal
- Moderate
- Marked

5. Gall bladder pathology including size ,wall thickness and stones.

6. Dilatation of pancreatic duct.

7. Pancreatic atrophy, calcifications, and pseudocysts.

8. Presence of masses(with or without enhancement-for Helical CT only)

9. Invasion of viscera, fascial planes.

10. Presence of metastasis.

Classification of imaging findings as benign or malignant is based on following scale described below

Definitely Benign:

Biliary duct dilatation with a visible stone in the duct.

Probably Benign:

Cystic dilatation of bile duct. Pancreatico-biliary duct dilatation considered benign(i.e. Sign of chronic pancreatitis).

Inconclusive:

Not confidently diagnosed as benign or malignant.

Probably Malignant:

Iso-Hypo enhancing mass(for CT only) with indirect signs of tumor such as duct dilatation with ductal cut-off adjacent to the mass or atrophic distal parenchyma or pancreato biliary dilatation considered malignant without sign of a mass or lesion in pancreatic head without duct dilatation.

Definitely Malignant:

Mass in the pancreatic head with consistent duct dilatation. Isolated CBD dilatation with an abrupt narrowing located cranial to the level of mass lesion.

Ultrasonography, MRI and CT scans were analysed separately. All examinations were analysed by eminent radiologist experienced in body CT and MRI. Final diagnosis was established with per operative or histopathological correlation .Among these twenty six patients underwent surgery, five patients underwent cytology, and remaining with other modalities of investigation. In our study Probably benign lesions were considered as benign category and probably malignant lesions were considered as malignant category.

Results:

Our study was conducted to determine the role of MRCP in the evaluation of patients having obstructive jaundice in correlation with Helical CT /USG. This study included 40 patients which were referred to our radiology department . The youngest patient of our study was 4 year old and the oldest was 85 years old. The mean age of patients with benign lesions was 37 years and that with malignant lesions was 55 years. All the lesions were detected by both CT and MRI with MRCP. CT characterized 20 patients had benign cause of obstructive jaundice, out of which, 4 case turned out to be malignant. Out of 15 cases characterized as malignant by CT, 2 cases turned out to be benign.

Out of 18 cases characterized benign by MRI with MRCP imaging, only 1 case turned out malignant, which was characterized benign by CT too. Out of 22 cases characterized as malignant by MR with MRCP, 1 case turned out to be benign.

For calculation of statistics ,open statics source was used to calculate sensitivity, specificity, NPV, PPV and diagnostic accuracy. p-value was calculated by

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chi-square test, p-value less than 0.05 was considered as statistically significant.

It is inferred that for diagnosing the causes of obstructive jaundice the Sensitivity, Specificity, PPV, NPV, Accuracy was

for US 87% 30.7%,60.8%,66.66% and 62.&%

for CT 88.8%,95.4%,94.12%,91.3%and 92.5%

for MRI was 94.4%,95.4%,94.4%,95.4% and 95% percent respectively

Table-1 : Table showing Age distribution of Study Subjects

Age Group	No. of Patients	Percent
<12 years	3	7.5
13-30 years	7	17.5
31-60 years	17	42.5
60 Years	13	32.5

In the study it was observed that majority i.e. 42.5% of the patients with obstructive jaundice were between 31 to 60 years of age. The youngest patient was 4 year old with cholelithisais and the oldest was 85 years old male with GB carcinoma.

Figure 1: Pie Diagram showing Age distribution of the subjects

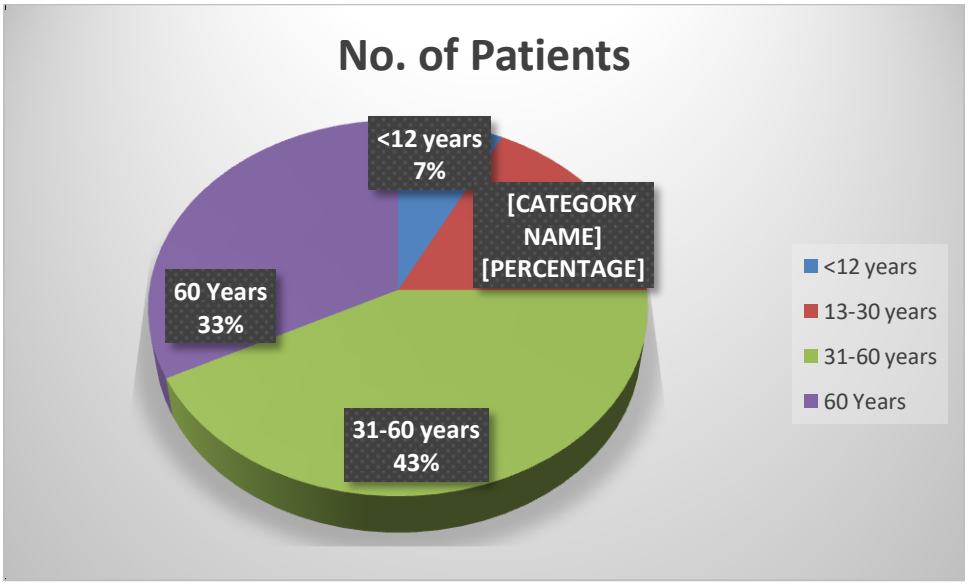

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Table 2: Table showing sex distribution of the study subjects

Sex	No. of Patients	Percent
Male	21	52
Female	19	48
Total	40	100

In the study it was observed that majority i.e. 52.% of the patients with obstructive jaundice were males. It is evident that there is males are predisposed in hepatobiliary diseases.

Figure 2: Pie Diagram showing sex distribution of the patients

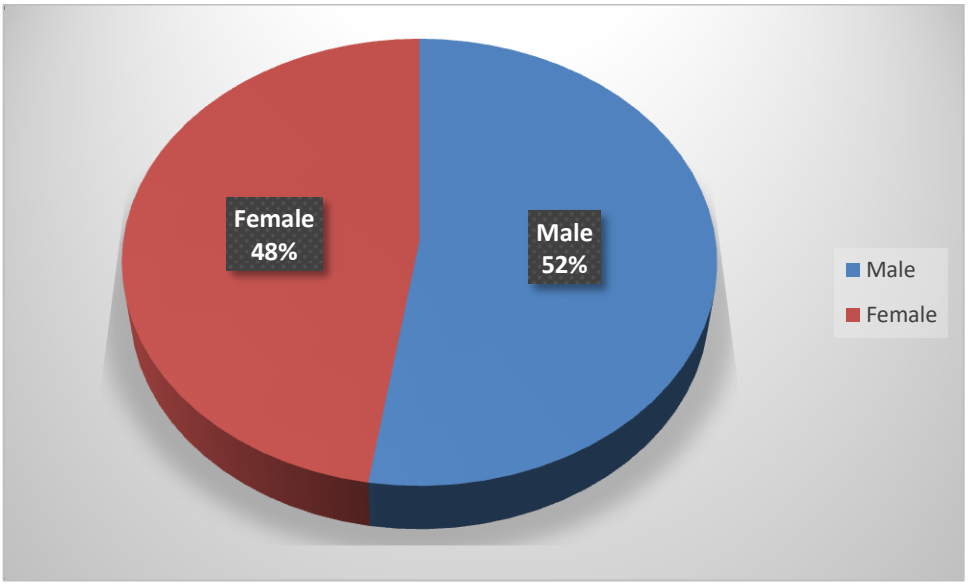

Table 3: Table showing type of lesion causing obstructive jaundice among the study subjects

Type of Lesion	No. of Patients	Percent
Benign	18	45
Malignant	22	55
Total	40	100

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In the study it was observed that the most common cause for obstructive jaundice is malignancy i.e. in 55% of cases.

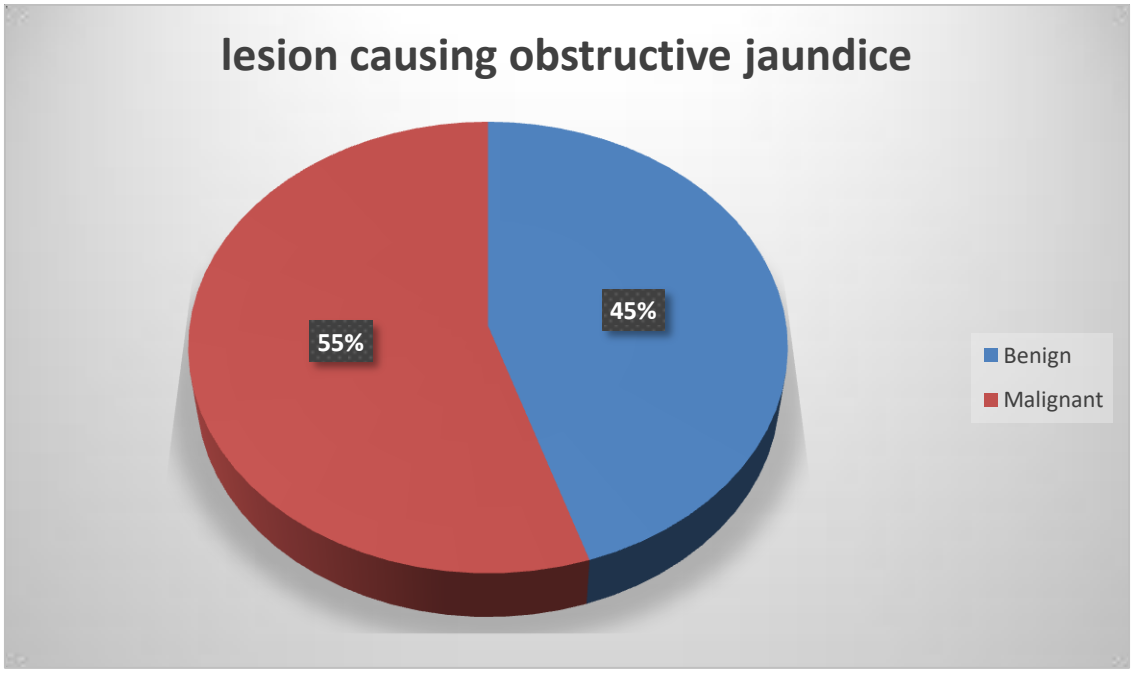

Figure 3: Pie diagram showing type of lesion causing obstructive jaundice

Table showing types of lesion in male patients

Type Of Lesion	No. of male Patients	Percent
Benign	11	52.5
Malignant	10	47.5
Total	21	100

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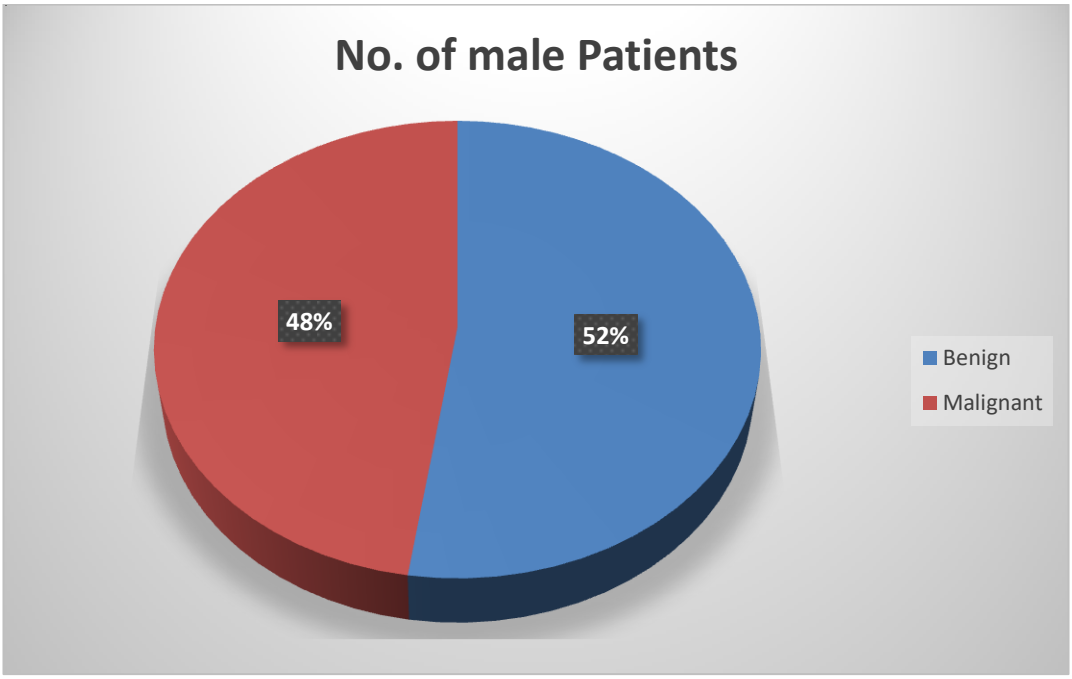

Table 4: Table showing benign causes for Obstructive jaundice among the subjects

Benign Causes	No of cases	Percent
CBD calculi	5	27.7
CBD with GB calculi	6	33.33
Benign stricture	3	16.66
Anatomic variant	3	16.66
Cholangitis	1	5.55
Total	18	100

In the study it was observed that the most common benign cause for obstructive jaundice was CBD with calculi and GB calculi 33% i.e. . Least common cause for obstruction was cholangitis 5%.

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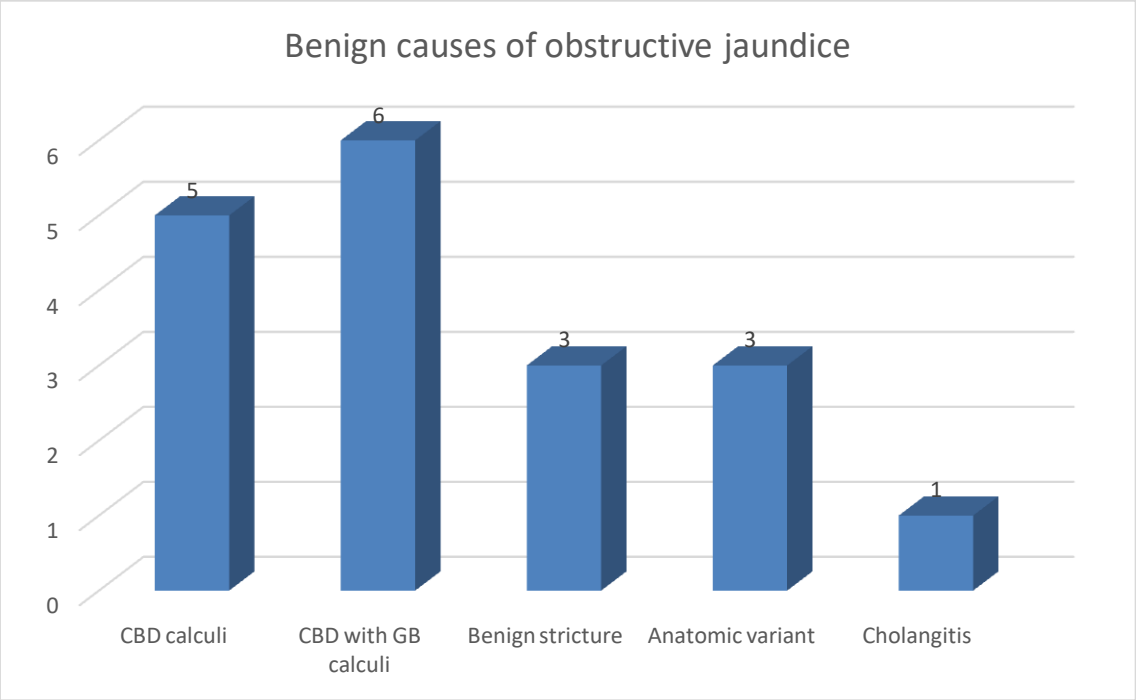

Figure 4: Bar diagram showing the benign causes of Obstructive Jaundice

Table 5: Table showing malignant causes for Obstructive jaundice among the subjects

Malignant Causes	No of cases	Percent
Periampullary Ca	5	22.7
Cholangiocarcinoma	5	22.7
Ca GB	4	18
Klatskins tumor	4	18
Ca head of Pancreas	3	13
Metastatic compression	1	4.5
Total	22	100

In the study it was observed that the most common malignant cause for obstructive jaundice was periampullary carcinoma and Cholangiocarcinoma i.e. 22.7 %.

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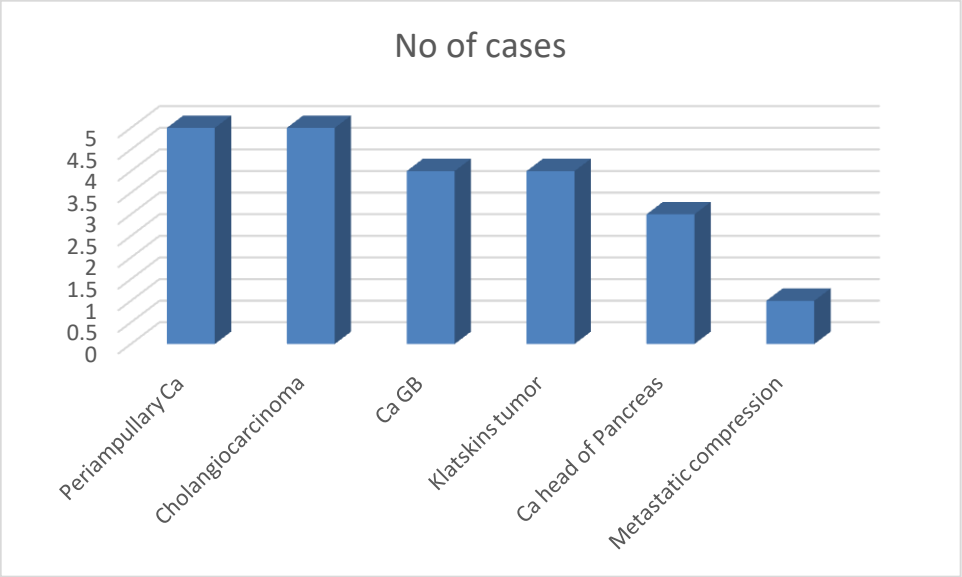

Figure 5: Bar diagram showing the malignant causes of Obstructive Jaundice

Table 6: Table showing distribution of Benign and Malignant Lesions with respect to age

Age Group	Benign Cases		Malignant Cases		Total cases
0-12	2	66.6	1	33.3	3
13-30	5	71.5	2	28.5	7
31-60	8	47	9	53	17
>60	3	23	10	77	13
Total	18		22		40

In the study it was observed that malignant lesions were common after 0yrs i.e. in 77% of cases while Benign lesions were more common in the age group 13 to 30 years i.e. 71.5%.

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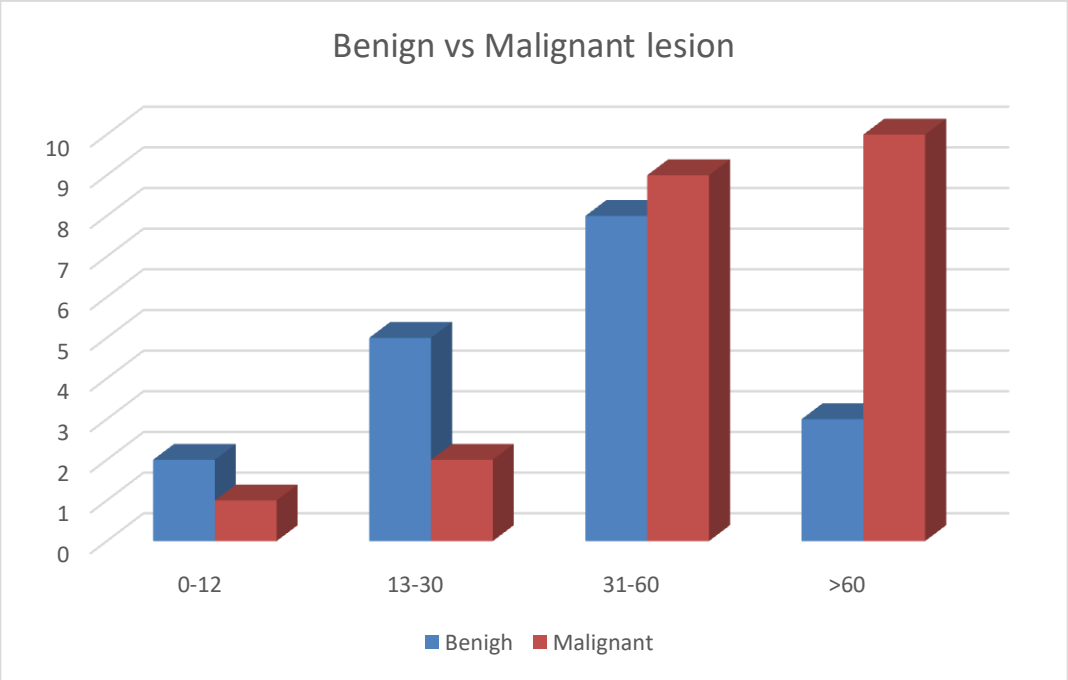

Figure 6: Bar diagram showing distribution of Benign and Malignant Lesions with respect to age.

Table 7: Table showing Histopathological diagnosis among benign cases

Histopathological Diagnosis	No of cases	Percent
CBD benign stricture	4	25
CBD stones	5	27.5
CBD & GB stones	5	27.5
Choledochal cyst	2	12.5
Extra hepatic biliary atresia	1	6.25
Cholangitis	1	6.25
Total	18	100

In the study it was observed that the most common benign cause for obstructive jaundice based on histopathology was large bile duct calculi/stones in 55% of cases.

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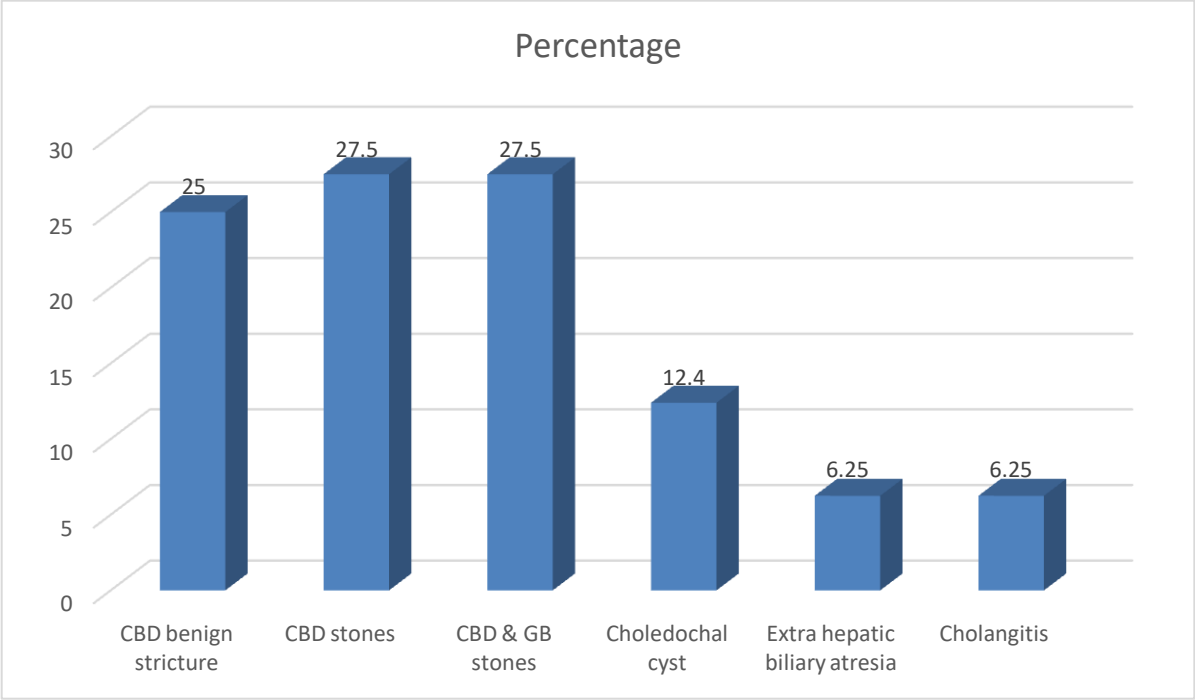

Figure 7: Bar diagram showing Histopathological diagnosis among benign cases

Table 8: Table showing Histopathological diagnosis among malignant cases

Histopathological Diagnosis	No of cases	Percent
Adenocarcinoma duodenum	8	36
CBD Cholangiocarcinoma	4	18
Adenocarcinoma GB	4	18
Hilar Cholangiocarcinoma	2	9
Adenocarcinoma pancreas	2	9
Metastatic Adenocarcinoma infiltrating CBD	2	9
Total	22	100

In the study it was observed that the most common benign cause for obstructive jaundice based on histopathology was large bile duct calculi/stones in 55% of cases.In the study it was observed that the most common malignant cause for obstructive jaundice based on histopathology was Duodenal Adenocarcinoma in 36% of cases followed by Cholangiocarcinoma and Gall bladder carcinoma in 18% of cases.

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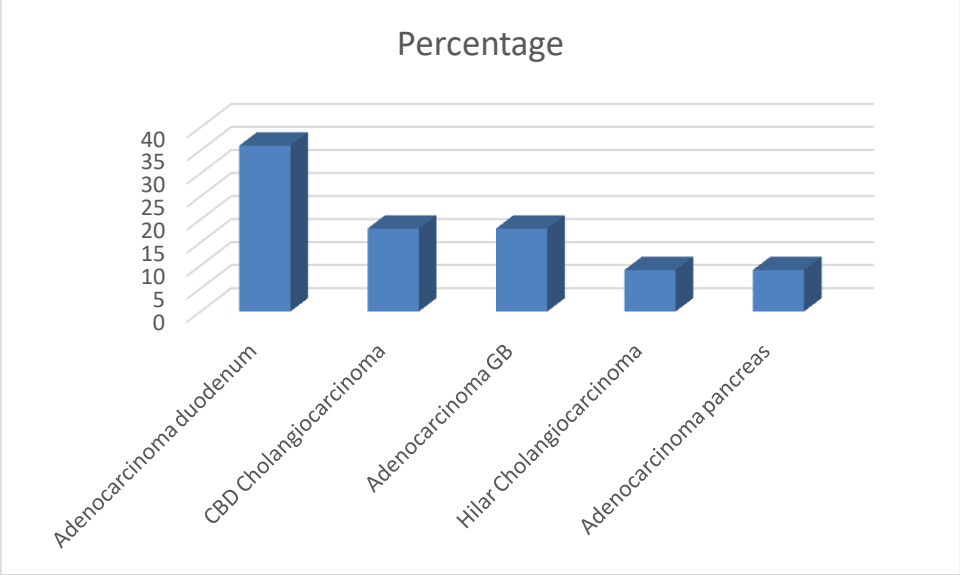

Figure 8: Bar diagram showing Histopathological diagnosis among malignant cases

Table 9: Table showing diagnosis by Helical CT scan and Histopathological diagnosis.

		Histopathological diagnosis			Significance
		Benign	**Malignant**		
Helical CT	**Benign**	16 (TP)	1 (FP)	17	X2 = 28.81,
	Malignant	2 (FN)	21 (TN)	23	df =1,
		18	22	40	p < 0.00001

		95% Confidence Limit
Sensitivity	88.8%	65.29 - 98.62
Specificity	95.4%	77.16 - 99.88
Positive Predictive Value	94.12%	70.07 - 99.09

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Negative Predictive Value	91.30%	73.91 - 97.49
Diagnostic Accuracy	92.50%	79.61 - 98.43

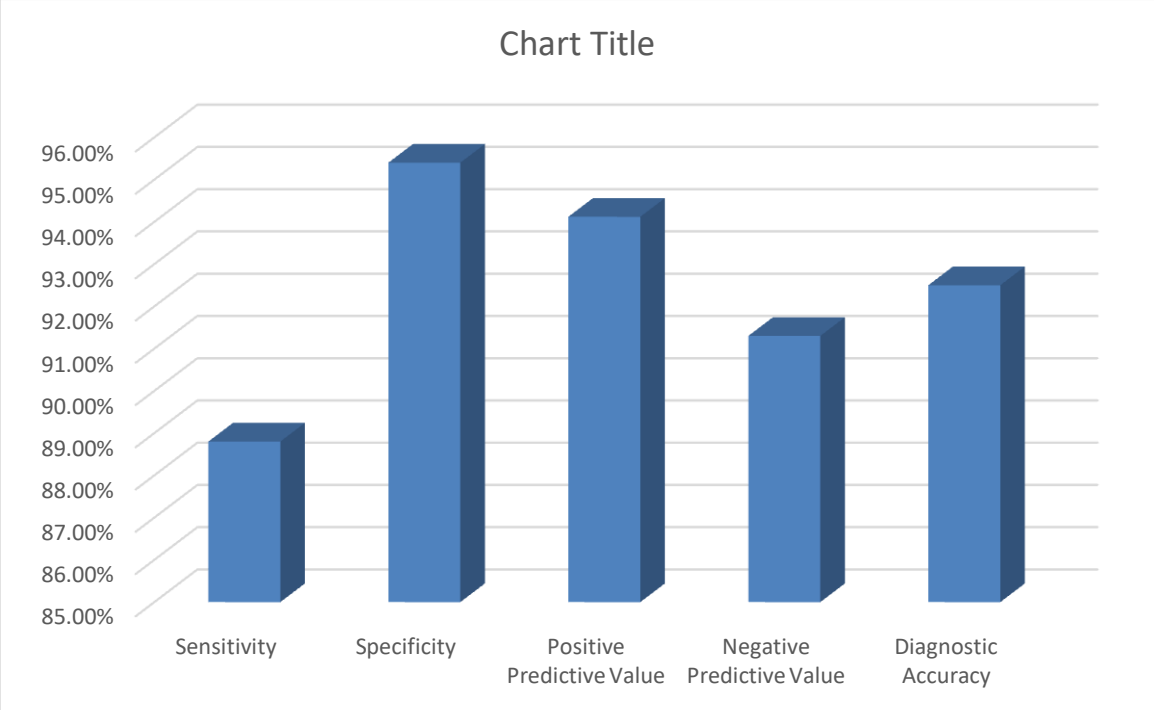

Figure 9: Bar Diagram showing Validity of Helical CT as a Diagnostic Test

Table 10: Table showing diagnosis by MRCP scan and Histopathological diagnosis.

		Histopathological diagnosis			**Significance**
		Benign	**Malignant**		
MRI with MRCP	**Benign**	17 (TP)	1 (FP)	18	X2 = 32.3273 df = 1 p < 0.00001
	Malignant	1 (FN)	21 (TN)	22	
		18	22	40	

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		95% Confidence Limit
Sensitivity	94.44%	72.71 - 99.86
Specificity	95.45%	77.16 - 99.88
Positive Predictive Value	94.44%	71.40 - 99.14
Negative Predictive Value	95.45%	75.72 - 99.30
Diagnostic Accuracy	95%	83.08 - 99.39

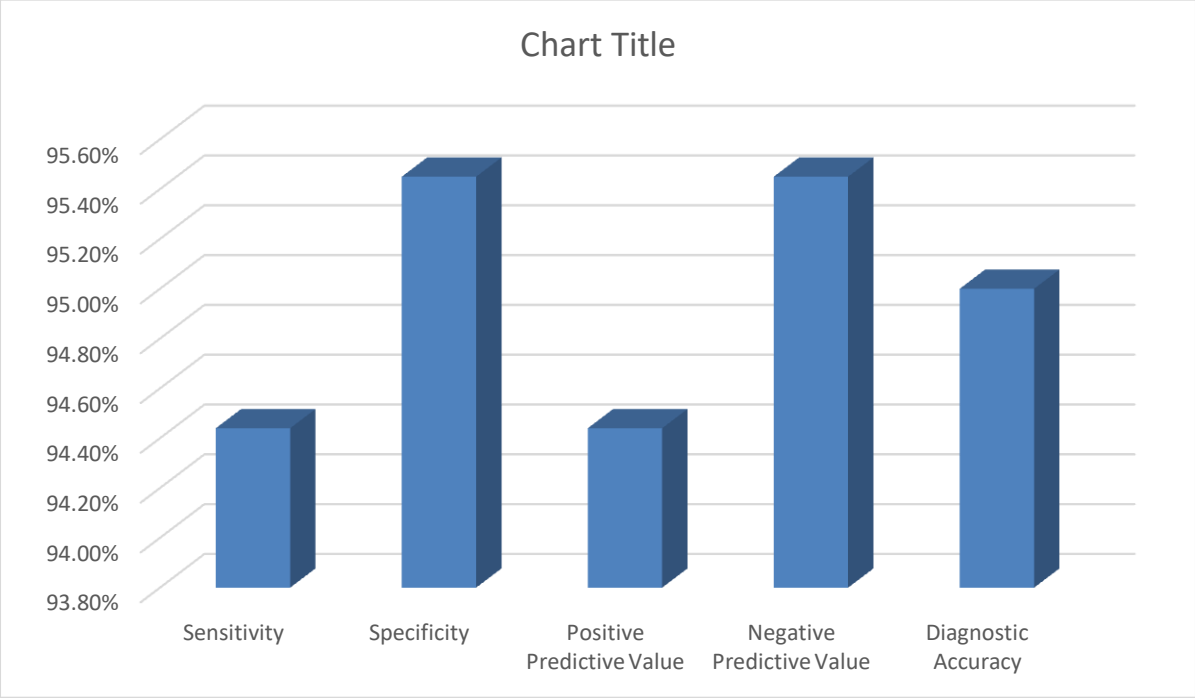

Figure 10: Bar Diagram showing Validity of MRI with MRCP as a Diagnostic Test

Table 11: Table showing diagnosis by USG and Histopathological diagnosis.

		Histopathological diagnosis		
USG		**Benign**	**Malignant**	
	Benign	14	9	23
	Inconclusive	2	9	11
	Malignant	2	4	6
		18	22	

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NOTE: data of inconclusive patients are not included in the below table

		95% Confidence Limit
Sensitivity	87%	61.65-98.54
Specificity	30.70%	9.09 - 61.43
Positive Predictive Value	60.87%	50.87-70.03
Negative Predictive Value	66.67%	30.19-90.24
Diagnostic Accuracy	62.07%	42.26- 79.31

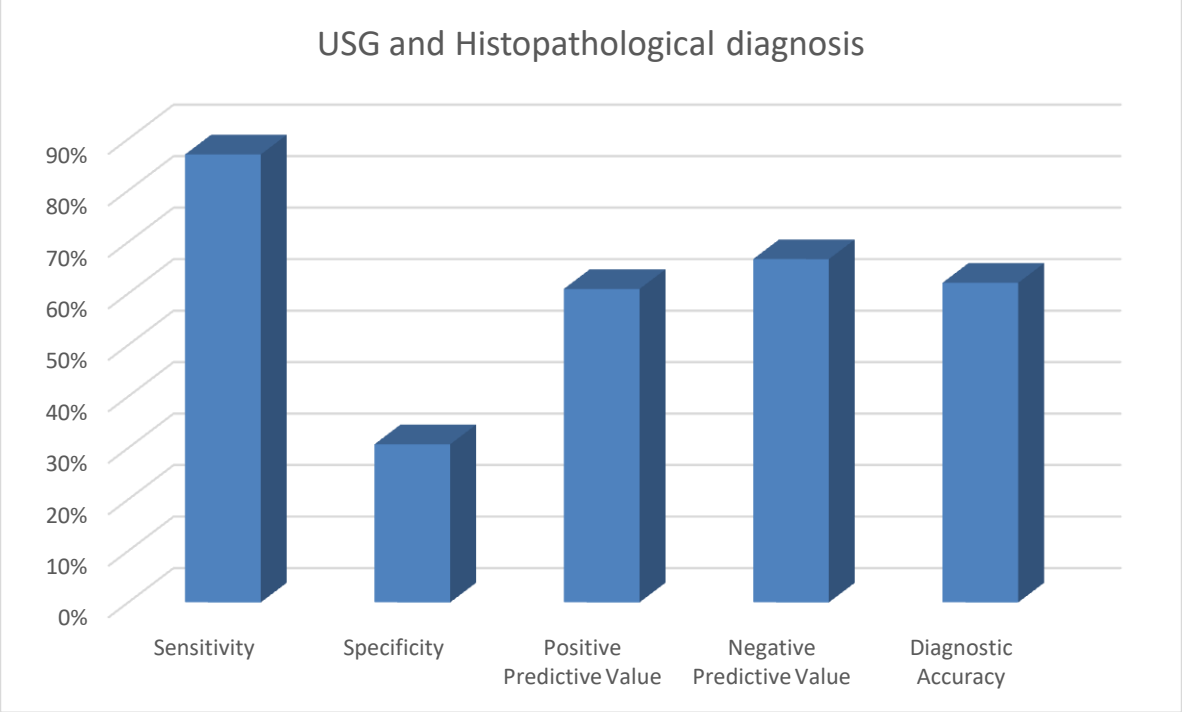

Figure 11: Bar diagram showing diagnosis by USG and Histopathological diagnosis.

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Table 12: Table showing Comparison of diagnostic values of Helical CT and MRCP in causes of obstructive jaundice

	MRCP	Helical CT	USG
Sensitivity	94.4%	88.8%	87%
Specificity	95.4%	95.4%	30.7%
Positive Predictive Value	94.4%	94.12%	60.8%
Negative Predictive Value	95.4%	91.3%	66.6.%
Diagnostic Accuracy	95%	92.5%	62.07%

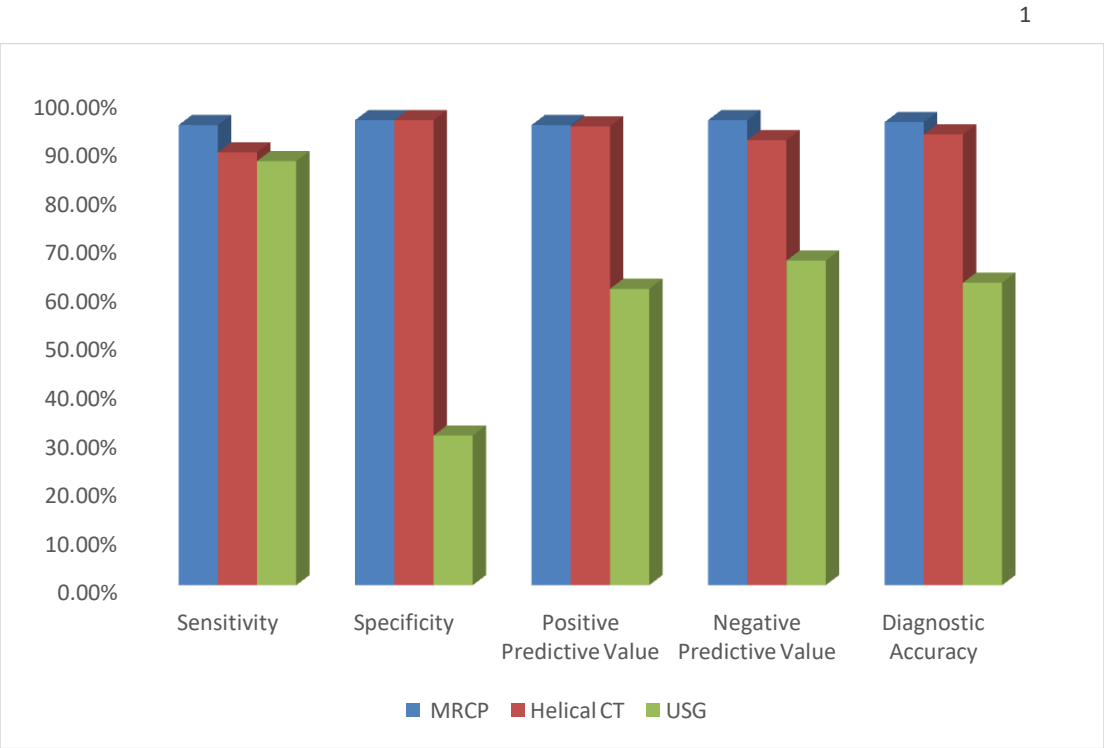

Figure 12: Comparison of diagnostic values of Helical CT and MRI with MRCP in causes of obstructive jaundice

From the above table it can be inferred that for diagnosing the cause of obstructive jaundice, MRCP has a greater diagnostic accuracy of 95% than Helical CT with accuracy is 92.5% and US with diagnostic accuracy of 62%. The sensitivity of MRI with MRCP is greater than that of Helical CT and USG in diagnosing the cause of obstructive jaundice.

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Conclusion:

This study was conducted in the department of Radiodiagnosis, index medical college Indore, over a period of 2 years and consisted of fourty patients of different ages and both sexes. Our study to define the role and efficacy of MRCP in evaluation of patients with suspected obstructive jaundice.

In our study, age ranged from 4 years 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 52% 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 and USG showed 52%.

Among the malignant causes periampullary carcinoma and cholangiocarcinoma is the most common cause and constitutes about 45% of malignant causes. USG showed 43% and both CT and MR showed with 95% with 95% sensitivity in detecting malignant pathologies. Both CT and MR showed with 95% sensitivity in detecting malignant pathologies. But MRCP still has ace role in detecting the malignant causes of obstructive jaundice with accuracy of 100%.

During the period of our study we had observed that MRCP has 95% accuracy in delineating the causes of obstructive jaundice. Compared with USG and 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/USG in identifying the various benign pathologies , and this modality has shown a dramatic role in identifying anatomic variants including choledochal cysts. MRCP has its advantage for diagnosing malignant diseases to an extent that even staging of malignant tumor can be possible.

This single modality (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 detecting 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, where 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, Klatskin tumour, Cholangiocarcinoma, Ca pancreas), thereby 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.

On the basis of our study following conclusions can be made;

MRI 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 multiplanar capability of MRCP makes it more superior then other imaging 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.

In conclusion in this prospectively collected data of patients, MRI combined with MRCP is equivalent to Helical CT in delineating the cause of obstructive jaundice as malignant, but it is 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

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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. From the above table it can be cleared that for diagnosing the causes of obstructive jaundice MRCP has a greater diagnostic accuracy of 95% than helical CT with accuracy of 92.5% and USG with diagnostic accuracy of 62.07%.

The sensitivity of Magnetic Resonance Computed Pancreatography is better as compared to that of helical CT and USG in diagnosing the causes of obstructive jaundice.

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