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Role of Magnetic Resonance Cholangiopancreaticography (MRCP) in the Evaluation of Patients with Biliary Tract Obstruction

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Running Title: *MRCP of biliary tract obstruction*

Abstract: ***Objective: our study of main objective was to Evaluate the diagnostic value of MRCP in the studying the site and cause of obstructive jaundice with determine the accuracy of MRCP as well as correlate the MRCP finding with patients' clinical profile and Biochemical changes. Material and Method: A prospective observational study was performed on 41 patients who have positive clinical signs and symptoms of right sided upper abdominal pain, jaundice, fever, nausea and vomiting with itching. These patients evaluated for biliary obstruction with the help of MRCP findings. Results: In the present study, overall mean age was 53.17 ± 15.79 years.97.56% had pain, 95.12% had icterus, 80.49% had fever and 63.41% had itching types of complaint observed during the study. Sensitivity for benign and malignant pathologies were respective as 100% and 95%. Conclusion: MRCP is highly accurate and superior diagnostic modality in establishing diagnosis of obstructive biliary pathologies.***

Keywords: MRCP, obstructive jaundice, diagnostic value, biliary obstruction, clinical profile

1. Introduction

Obstructive jaundice or biliary tract disorders are often common complaint of patients, and the majority of these patients turned out to have cholelithiasis.[1]

Choledocolithiasis is the most prevalent cause of biliary blockage, although tumours and trauma (such as damage after gall bladder surgery) are other potential reasons.2 Jaundice, light - colored faeces, dark urine, itching, upper right quadrant abdominal pain, fever, nausea, vomiting, and abnormal liver function are symptoms that patients with suspected biliary blockage may have.[3]

In order to devise an efficient interventional approach, endoscopists and surgeons require reliable methods for detecting pancreatic and common bile duct (CBD) illness in patients. This highlights the importance of developing safer, more sensitive diagnostic procedures with little invasiveness.[4]

In order to accomplish this, we have utilised a wide range of diagnostic methods, both invasive and non - invasive. As a general rule, when we first look into pancreaticobiliary disease, [4] we employ non - invasive methods such as ultrasound and CT scans (both abdominal and pelvic). When a patient presents with right upper quadrant pain or jaundice, the initial imaging examination should be endoscopic ultrasonography (EUS). [3] Despite their low price and ease of availability, these approaches aren't particularly sensitive. Ultrasonography, for instance, fails miserably when it comes to detecting common duct calculi. Tumours, calculi, sclerosing cholangitis, and chronic pancreatitis are among the prevalent disorders that may require invasive procedures for diagnosis.[5]

The need for radiological imaging in biliary obstruction are: - [6, 7]

- To confirm the presence of biliary system obstrucation (i.e., to discriminate surgical versus medical jaundice)
- To determine the level of the obstruction,
- To identify the specific cause of the obstruction.
- To provide harmonizing information relating to the underlying diagnosis (e. g., staging information in cases of malignancy).

Correct methods to detect CBD and pancreatic disease in patients with obstructive jaundice are important for treating surgeon to carry out appropriate treatment. In order to diagnose biliary diseases, surgeons prefer to employ a diagnostic technique that is non - invasive, safe, and highly sensitive. This is because the therapeutic approach for biliary obstruction might vary significantly depending on the underlying reason.

Magnetic resonance cholangiopancreatography (MRCP) is a safe and non - invasive diagnostic technique that does not use radiation. It provides multiplanar images and does not require operator intervention. MRCP serves as an alternative

to endoscopic retrograde cholangiopancreatography (ERCP). It evaluates the structure and obstruction of the biliary and pancreatic ducts.8 Since its inception in 1991, MRCP approaches have received enhancements. Magnetic Resonance Cholangiopancreatography (MRCP) utilises T2 - weighted sequences extensively. These sequences effectively enhance the signal of fluid - filled structures that are either stationary or moving slowly, such as bile and pancreatic ducts.9 This leads to a noticeable improvement in the contrast between the ducts and the surrounding background. The latest software available offers rapid, high - quality MRCP sequences such as a strongly T2 - weighted turbo - spin - echo (TSE), single - shot rapid acquisition with relaxation enhancement (RARE), and half - fourier single - shot TSE (HATSE). These sequences produce distinct projectional pictures that closely resemble those obtained from ERCP operations.[10]

The radiological investigations available for the diagnosis of obstructive jaundice can be categorized into noninvasive ultrasonography, CT scan & MRCP and invasive ERCP and Percutaneous transhepatic cholangiography (PTC).[6, 7]

2. Material and Method

The study was carried out at R. D. Gardi Medical College and C. R. Gardi Hospital, Ujjain. subject to approval by ethical committee, in the Department of Radio - diagnosis.

Study Design: Observational study**.**

Duration of the study: June 2022 to June 2024

Material Required: MRI Scan machine: GE SignaSDe 3.0Tesla

Source Data:
Patients referred to the department of radio - diagnosis from various in - patients and out - patient departments of R. D. Gardi Medical College and C. R. Gardi Hospital, Ujjain (M. P.) having clinically right sided upper abdominal pain, jaundice, fever, nausea and vomiting with itching.

Sample Size Calculation

Sample size:
To calculate the sample size based on sensitivity and specificity with 95% confidence level, we could use the following information's based on the following formula: **n= z2*P* (100 - P) /d2**
Therefore, the final sample size was41.

Inclusion criteria for the study:
Patients showing positive clinical signs and symptoms of right sided upper abdominal pain, jaundice, fever, nausea and vomiting with itching.

Procedure:
Patient showing positive clinical signs and symptoms of right sided upper abdominal pain, jaundice, fever, nausea and vomiting with itching who are referred to the Radiology department for MRI - MRCP and full fill the inclusion criteria.

Methods
Patients referred to the Department of Radio - diagnosis from the various in - patient and out - patient departs of our hospital was considered for the study. After explaining the details of the research project and taking the proper consent, the relevant clinical data were collected, in accordance with the case - record proforma. All the patients were considered for the study irrespective of the onset or duration of the clinical signs and symptoms. The patient will be taken for the MRI - MRCP. The findings were carefully observed under the local expertise and relevant observations was made. This was followed by the careful and detailed statistical analysis and calculations. We were observed following outcomes in the study: Signs/Duration of symptoms, Sex/Age wise distribution and Diffential diagnosis

Statistical method
Statistical analysis was carried out with the help of IBM SPSS 26.0 version. Categorical data were represented as frequency with percentage whereas quantitative data were represented as mean with standard deviation. <0.05 of any p - value considered as a statistical significant. Sensitivity and specificity was calculated by Medcalc 22.0 version (Microsoft inc.)

3. Observation and Results

		Mean/N	SD/%
Age		53.17	15.79
Gender	Female	22	53.66
	Male	19	46.34
Etiology	Benign	21	51.22
	malignant	20	48.78

A prospective study of 41 patients was conducted at Ruxmaniben Deepchand Gardi Medical College and Chandrikaben Rashmikant Gardi Hospital, Surasa Ujjain, to evaluate the role of magnetic resonance cholangiopancreatography in outdoor and admitted patients who clinically presented with biliary tract obstruction. All the patients performed with Magnetic Resonance imaging with MRCP to establish the definitive diagnosis. The observations of the study are as follows:
Table: 1 Demographic Characteristic

In the present study, overall mean age was 53.17 ± 15.79 years. In the present study, age group was categorised into five groups as followings: <20 years (4.88%), 21 - 40 years (7.32%), 41 - 60 years (58.54%), 61 - 80 years (26.83%) and >80 years (2.44%). Most common age group was 41 - 60 years whereas least common age group was >80 years observed during the study. In benign pathologies, age group distribution shown as followings: <20 years (9.52%), 21 - 40 years (9.52%), 41 - 60 years (57.14%), 61 - 80 years (19.05%) and >80 years (4.76%). Most common age group was 41 - 60 years observed among benign pathologies. In Malignant pathologies, age group distribution shown as followings: 21 - 40 years (5%), 41 - 60 years (60%) and 61 - 80 years (35%). Most common age group was 41 - 60 years observed among Malignant pathologies. In the present study, 53.70% were females whereas 46.30% were males observed during the study. In benign pathologies, 61.90% were

females whereas 38.10% were males observed during the study. In Malignant pathologies, 45% were females whereas 55% were males observed during the study.

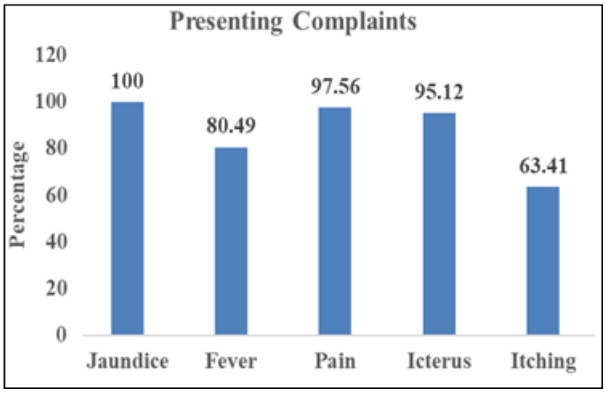

Figure 1: Presenting Complaints

Out of 41 patients, 97.56% had pain, 95.12% had icterus, 80.49% had fever and 63.41% had itching types of complaint observed during the study.

Table 2: Different Biliary Pathologies

		Frequency	Percent
Gall Bladder	Contracted	6	14.64
	Distended	32	78.05
	Normal	1	2.44
	NA	2	4.88
Gall Bladder Lumen	Calculus	15	36.59
	Mass	4	9.76
	Normal	15	36.59
	NA	3	7.32
	SL	4	9.76
Gall Bladder wall	Distended	1	2.44
	Normal	28	68.29
	NA	3	7.32
	Thickened	8	19.51
	T/M	1	2.44
Common Duct	Contracted	5	12.20
	Distended	30	73.17
	Normal	6	14.63
RIGHT IHBR	Mild	25	60.98
	Moderate	11	26.83
	Severe	5	12.20
LEFT IHBR	Mild	23	56.10
	Moderate	13	31.71
	Severe	5	12.20
Common Hepatic Duct	Contracted	5	12.20
	Distended	36	87.80
Proximal Common bile duct	Contracted	8	19.51
	Distended	31	75.61
	Normal	2	4.88
Distal Common bile duct	Contracted	9	21.95
	Distended	27	65.85
	Normal	5	12.20
Main Pancreatic duct	Distended	9	21.95
	Normal	32	78.05

Among gall bladder pathologies, 78.05% were distended, 14.64% were contracted, 2.44% were normal and 4.88% were not available. Among gall bladder lumen pathologies, 36.59 % were calculus, 9.76 % were mass, 9.76% were sludge, 36.59 % were normal and 7.32% were not available. Among gall bladder wall pathologies, 2.44 % were distended, 19.51 % were thickened, 2.44% were thickened mass, 68.29 % were normal and 7.32 % were not available. Among Common Duct pathologies, 73.17% were distended, 12.20% were contracted and 14.63% were normal. Among intra hepatic bile duct, severity of right side as followings: 60.98% had mild, 26.83% had moderate and 12.20% had severe level observed during the study.56.10 % had mild, 31.71% had moderate and 12.20% had severe level observed among left IHBR during the study. Among common hepatic duct pathologies, 12.20% were contracted and 87.80% were distended observed during the study. Among proximal common bile duct pathologies, 19.51% were contracted, 75.61 % were distended and 4.88% were normal observed during the study. Among proximal common distal duct pathologies, 21.95% were contracted, 65.85 % were distended and 12.20 % were normal observed during the study. Among **Main Pancreatic duct** pathologies, 21.95% were distended and 78.05 % were normal observed during the study. In the present study, overall mean CBD size was 15.64 ± 14.60mm.

Sensitivity and Specificity of USG and Histopathological Diagnosis for etiology

In the present study, USG of sensitivity, specificity, positive predictive value, negative predictive value, accuracy and AUC were respectively as 66.67%, 95%, 93.33%, 73.08%, 80.49% and 0.808 were evaluated based on histopathological findings.

Sensitivity and Specificity of Malignant

In the present study, MRCP of sensitivity, specificity, positive predictive value, negative predictive value, accuracy and AUC were respectively as 95%, 100%, 100%, 95.46%, 97.56% and 0.975 were evaluated based on histopathological findings.

Sensitivity and Specificity of Benign

In the present study, MRCP of sensitivity, specificity, positive predictive value, negative predictive value, accuracy and AUC were respectively as 100%, 95%, 95.46%, 100%, 97.56% and 0.975 were evaluated based on histopathological findings.

Table 3: Diagnosis

	USG	MRCP	Histopathological
CHDL	9	12	12
Ca GB	6	6	6
CA - Head of Pancreas	3	3	3
CC	4	4	3
CC (Klatskin)		1	3
CDC	2	2	2
Cholangitis		1	1
Hydatid Disease	1	1	1
Peri - ampullary growth.	3	5	5
Stricture	3	6	5
Undiagnosed	10	0	0

USG Findings:

- In the present study, carcinoma call bladder, carcinoma head of pancreas, hydatid disease and CDC were accurately identified with MRCP method.
- In the present study, 75% CHDL, 60% periamupullary growth and 60% strincture were correctly identified with the help of USG method.

- In the present study, CC (klatskin) and Cholangitis was not identified based on USG method.
- In the present study, 24.39% of cases undiagnosed based on USG method compared to histopathological findings.

MRCP Findings:

- In the present study, CHDL, carcinoma call bladder, carcinoma head of pancreas, Cholangitis, Peri - ampullary growth, hydatid disease and CDC were accurately identified with USG method.
- In the present study, CC and strincture were overestimated with the help of MRCP method.
- In the present study, 33.33% CC (klatskin) detected compared to histopathological findings.

4. Discussion

Biliary obstruction because of the wide etiology possesses a significant challenge in diagnosis. Imaging plays a key role in diagnosis, helps in accurate evaluation and management of the patient with biliary obstruction.

Even though MRCP offers many advantages currently it still has a few drawbacks like, low spatial resolution, imaging in the physiologic non - distended state, which decreases the sensitivity to subtle ductal abnormalities, image artifacts of various types and lack of therapeutic option.

To overcome some of these drawbacks, a number of new modern techniques are being used, which allow the acquisitions of higher quality diagnostic imaging with lower incidence of technical pitfalls.3D MRCP is one of the breakthrough improvements in the MRCP techniques. The purpose of the study was to evaluate suspected cases of biliary obstruction with the help of MRCP. [11]

In the present study, we were enrolled 41 patients whom suspected as biliary obstruction visiting at department of radio diagnosis, Ruxmaniben Deepchand Gardi Medical College and Chandrikaben Rashmikant Gardi Hospital, Surasa Ujjain. These patients selected based on inclusion and exclusion criteria.

Demographic Characteristics

In the present study, overall mean age was 53.17 ± 15.79 years.41 - 60 years age group was more common whereas >80 years age group was least common observed during the study. According kumari M. et al. [12] study, 46 - 60 years of age group was more common whereas >75 years age group was least common observe during the her study observations. This result was comparable to the study conducted by Siva Prasad A et al [13] being biliary disease in 62% in the age group >40 year and 6% in the age group of less than 18 years and by Awadhesh Pratap Singh Kushwah in year 2015 who found the peak incidence in 51 - 60 year of age. [14] Nehal Diwanji et al in 2016 found that the peak incidence of pancreato - biliary disease was seen in 61 - 70 years of age. [15]

Study	Mean
Present Study	53.17 ± 15.79
Aggag MF et al. [16]	52.17 ± 10.5
Farid S. et al. [17]	52
Rahman SU et al. [11]	47.5 ± 16.57
Shukla et al. [18]	48.5

Out of 41 patients, 53.66% were females whereas 46.34% were males observed during the study. Kumari M. et al. also observed similar findings with the present study. She was observed that 55% were females whereas 45% were male. [12]

Study	Male to female ratio
Present Study	0.86: 1
Kumari M. et al. [12]	0.82: 1
Goyani et al [19]	0.76: 1
Huis et al [20]	0.69: 1
Rahman SU et al. [11]	0.71: 1
Kaur A et al. [21]	0.85: 1
Sharma et al [22]	1.29: 1

Presenting Complaints

In the present study, 97.56% had pain, 95.12% had icterus, 80.49% had fever and 63.41% had itching observed during the study. According to Farid S. et al. study, most of the patients presented with jaundice and abdominal pain. Icterus was the most common sign followed by passing of white stools and itching. [17] Accoring to kaur A. et al. study, 96% cases presented with jaundice, 90% cases presented with pain abdomen, 58% with vomiting, 50% with anorexia, 39% with weight loss, 32% with pruritus and 30% with fever. [21]

Benign and Malignant pathologies

In the present study, Benign and malignant pathologies were found in 51.22% and 48.78% of patients respectively. According to kumari M. et al. study, Benign pathologies were higher than compared to malignant pathologies which was supportive with our study findings. [12] However, other studies by Sharma et al [12], Moghimi et al [23] and Cheema et al [24] found that the malignant lesions were more common than the benign lesions.

Study	Benign	Malignant
Present Study	51.22%	48.78%
Kumari M. et al. [12]	64%	36%
Goyani et al [19]	53.33%	46.66%
Huis et al [20]	74.17%	25.83%

Benign and Malignant pathologies based on demographic characteristic.

In the present study, 41 - 60 years of age group was more common in benign pathologies whereas 41 - 60 years of age group also common in malignant pathologies. >80 years age group was more common among benign pathologies whereas 21 - 40 years age group was more common among malignant pathologies.

In the present study, benign pathologies were more common in females whereas malignant pathologies were more common in males. According to kumari M. et al. study, Benign lesions were most common in the age range of 46 - 60 years (23%) and most of the malignant lesions were

detected in the age range of 31 - 45 years of age group (13%). [12] Goyani et al [19] and various other authors found that the most common age range in the benign and malignant lesions were 1 - 40 years and 41 - 70 years. This change in age pattern could be due to the changing trends of the disease with time.

USG based benign and malignant pathologies

In the present study, USG based benign and malignant pathologies was 36.58% and 39.02 % respectively. According Kaur A. et al. study, 53.57% were benign pathologies whereas 68.18 % were malignant pathologies. [21] Sensitivity and specificity of USG findings based on benign pathologies was respectively as 66.67 % and 95%. Sensitivity and specificity of USG findings based on malignant pathologies was respectively as 75% and 95.24%.

	Benign		Malignant	
Study	Sensitivity	Specificity	Sensitivity	Specificity
Present Study	66.67%	95%	75%	95.24%
Kaur A. et al. [21]	53%	100%	68%	100%
Singh A. et al. [25]	80.77%	95.83%	79.17%	96.15%
Kumari M. et al. [12]	94%	80%	90%	97%

MRCP based benign and malignant pathologies

In the present study, MRCP based benign and malignant pathologies was 53.66% and 48.78% respectively. According kumari M. et al. study, 62% were benign pathologies whereas 35% were malignant pathologies. Overall Sensitivity and specificity was 95% and 100% [12]

Study	Sensitivity	Specificity
Present Study	95%	100%
Farid S. et al. [17]	94%	100%
Kumari M. et al. [12]	97%	85%
Francesco SF et al. [26]	90%	94%

Sensitivity and specificity of MRCP findings based on benign pathologies was respectively as 95% and 100%. Sensitivity and specificity of MRCP findings based on malignant pathologies was respectively as 95% and 100%.

	Benign		Malignant	
Study	Sensitivity	Specificity	Sensitivity	Specificity
Present Study	100%	95%	95%	100%
Kumari M. et al. [12]	94%	100%	100%	94%
Kaur A. et al.21]	100%	100%	95%	100%
Verma et al. [27]	80.77%	95.83%	92.3%	86%

5. Conclusion

Although USG is considered the initial screening modality in the diagnostic imaging of obstructive biliary disease, however, owing to its low sensitivity in most of the benign stenosis and distal CBD disease, MRCP is highly accurate and superior diagnostic modality in establishing diagnosis of obstructive biliary pathologies. MRCP is a medical imaging technique that does not require any invasive procedures, is highly sensitive, and does not use ionising radiation. It is used to assess the structure and abnormalities of the bile ducts and offers important information that is useful for both treatment and prognosis. MRCP is capable of precisely identifying the specific site and underlying cause of biliary blockage. It can also provide a visual assessment of the condition of the biliary system leading up to the total stricture, a capability that is not possible with ERCP.

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