Original Research Article

Clinical Study of Obstructive Jaundice Patients with Special Reference to Ultrasonography and MRCP (Magnetic Resonance Cholangio Pancreatography) as Diagnostic Tools in Relation to Operative Findings

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ABSTRACT

Background
Obstructive jaundice has a variety of etiologies ranging from choledocholithiasis, inflammatory conditions, and strictures to malignancies. The correct diagnosis of the cause is detrimental in timely intervention and treatment.
Aim
To compare the diagnostic accuracy of USG and MRCP in relation to operative findings.
Methods
This prospective study included 200 patients who were referred to the radiology department of MKCG MCH during June 2022 – June 2024 with clinical features of obstructive jaundice. USG and MRCP was conducted by experienced radiologists on all the patients. The characteristics of obstruction were evaluated for both benign and malignant lesions through USG and MRCP. The patients were followed up and the radiological findings were correlated with operative findings from surgical intervention and pathological diagnosis from biopsy or surgical specimen.
Results
For choledocholithiasis, MRCP showed higher sensitivity (94.4%) and specificity (95.5%) compared to USG (88.9% and 90.9% respectively), with MRCP having an overall accuracy of 95% vs 90% for USG. Similar trends were observed for biliary strictures, bile duct cysts, cholangiocarcinoma,and pancreatic malignancy, where MRCP consistently outperformed USG in terms of sensitivity, specificity and overall accuracy.

Conclusion
The study concludes MRCP as a superior diagnostic tool compared to USG for detecting various benign as well as malignant biliary and pancreatic conditions. Further the study supports the integration of MRCP into standard diagnostic protocols for obstructive jaundice, advocating for further research to address its limitations and explore additional diagnostic techniques to enhance the accuracy and effectiveness of imaging in obstructive jaundice.
Keywords: Obstructive jaundice, USG, MRCP.

INTRODUCTION
Jaundice is a common dramatic and often puzzling sign that has baffled many clinicians. The diagnosis and management of patients with jaundice can be one of the more perplexing and challenging problems confronting physicians and surgeons. The diagnosis may be elusive, and the treatment less straightforward. During the last decade our evolving ability of imaging the biliary tract and facilitating the diagnostic evaluation of jaundiced patients has led to the development of logical algorithms for clinical management. Innovative techniques for access to the biliary tract have resulted in new and creative means of development, prompting revaluation of existing treatment principles for patients with biliary obstruction. In addition an improved understanding of the pathophysiology of hyperbilirubinemia has influenced therapeutic regimens and has contributes to more rational approaches for patient care (Kahng and Roslyn). [1]

The ultrasonographic detection of a dilated biliary tract is the first step in the investigation of patients with biochemical evidence of cholestatic jaundice. In icteric patients its accuracy in the diagnosis of extra hepatic bile duct obstruction exceeds 90%. Though its diagnostic yield is higher, however in mildly jaundiced patients it may miss minimal dilatation of the intrahepatic biliary tree. As ultrasound examination does not give accurate information on the exact site and extent of lesion causing the extra hepatic obstruction, further investigation with computed tomography (CT) and magnetic resonance cholangiopancreatography (MRCP) or ERCP is required in most patients. [2]

The diagnosis of biliary tract diseases has been revolutionized with the advent of MRCP. And a detailed imaging of the entire biliary tree (intra and extra hepatic) and pancreatic ductal system is possible without the administration of contrast in the vast majority (>90%) of patients.[3,4]

An important function of this study is to explore the optimal and appropriate usage of USG and MRCP utilizing our patient population and an evidence –based review of the clinical literature.

AIMS AN OBJECTIVES
1. To determine the role of USG and/or MRCP as diagnostic tools in patients of obstructive jaundice.
2. To examine the diagnostic accuracy of USG and/ or MRCP and the extent to which USG and /or MRCP helps in evaluation and surgical planning in patients with obstructive jaundice.
3. To study clinical effectiveness of USG and MRCP in relation to operative findings.
4. To determine whether USG and MRCP may help to prevent unnecessary interventional procedures thereby reducing morbidity and mortality.

MATERIALS AND METHODS

This study was a prospective clinical study aimed at evaluating the role and diagnostic accuracy of ultrasonography (USG) and magnetic resonance cholangiopancreatography (MRCP) in patients presenting with obstructive jaundice. The primary objective was to assess the clinical presentation, diagnostic imaging findings, and pathological diagnosis, and to correlate these with operative findings to determine the effectiveness of USG and MRCP in avoiding unnecessary interventional procedures.

Study Setting

The study was conducted at MKCG Medical College and Hospital, a tertiary care teaching hospital with a dedicated radiology department equipped with advanced imaging facilities, including USG and MRCP. The hospital provides comprehensive medical care and receives a high volume of patients with obstructive jaundice, making it an ideal setting for this study.

Patient population

The study included 200 patients suspected for obstructive jaundice who presented to the outpatient department (OPD) or were admitted to the hospital between June 2022 – June 2024. Inclusion criteria were as follows:
- Both male and female patients aged 18 years and older.
- Patients with a provisional diagnosis of:
  - Choledocholithiasis
  - Postoperative biliary strictures
  - Bile duct cysts
  - Cholangiocarcinoma
  - Periampullary and pancreatic malignancies

Exclusion criteria
- Patients with choledocholithiasis who had already undergone endoscopic sphincterotomy and stone extraction.
- Patients with advanced malignancies of the biliary tract and pancreas.
- Patients with contraindications to MR scanning, such as:
  - History of cardiac pacemakers
  - Intraocular metallic foreign bodies
  - Cerebral aneurysm clips
  - Caval and intravascular implants
  - Claustrophobia

Findings of Imaging studies mainly Ultrasound and MRCP were correlated with operative findings. The overall usefulness of USG and MRCP were determined keeping intraoperative findings as a contrast parameter and as the final end point of correlation.

OBSERVATION AND ANALYSIS
- **Baseline patient characteristics –** A total of 200 patients who had attended the OPD were included in the study after excluding the patients who were met with exclusion criteria. The age range of the patients were 18 -85 years, with a mean age of 52.8 ± 20.2. And all the patients had jaundice as a common symptom and majority of them had associated pain abdomen and dark urine.

PARAMETERS	VALUES

Age (mean ± SD)	52.8 ± 20.2
Sex- n(%)	
Male	110 (55%)
Female	90 (45%)
Clinical presentation- n(%)	
Jaundice	200 (100%)
Abdominal pain	140 (70%)
Pruritus	60 (30%)
Dark urine	150 (75%)
Pale stool	130 (65%)
Table 1: **Diagnostic Accuracy of USG**	

Table 1 compares the diagnostic performance of ultrasonography (USG) for various conditions causing obstructive jaundice. The sensitivity, specificity, and accuracy were calculated for conditions such as choledocholithiasis, biliary strictures, bile duct cysts, cholangiocarcinoma, and pancreatic malignancy. USG showed high accuracy, particularly for bile duct cysts (97.5%) and cholangiocarcinoma (95%). However, its sensitivity was slightly lower for biliary strictures (76.9%) and pancreatic malignancy (80.6%).

Diagnosis	True Positives (TP)	False Positives (FP)	True Negatives (TN)	False Negatives (FN)	Sensitivity (%)	Specificity (%)	Accuracy (%)
Choledocholithiasis	80	10	100	10	88.9	90.9	90
Biliary Strictures	50	5	130	15	76.9	96.3	90
Bile Duct Cysts	15	2	180	3	83.3	98.9	97.5
Cholangiocarcinoma	30	3	160	7	81.1	98.2	95
Pancreatic Malignancy	25	4	165	6	80.6	97.6	95
Table 2: Diagnostic Accuracy of MRCP							

Table 2 provides the diagnostic accuracy metrics for magnetic resonance cholangiopancreatography (MRCP). MRCP demonstrated higher sensitivity and specificity compared to USG for all conditions, with accuracy rates above 93% for all categories. The highest accuracy was observed for bile duct cysts (98.5%) and pancreatic malignancy (97.5%), indicating that MRCP is a highly reliable imaging modality for diagnosing causes of obstructive jaundice.

Diagnosis	True Positives (TP)	False Positives (FP)	True Negatives (TN)	False Negatives (FN)	Sensitivity (%)	Specificity (%)	Accuracy (%)
Choledocholithiasis	85	5	105	5	94.4	95.5	95
Biliary Strictures	55	3	132	10	84.6	97.8	93.5
Bile Duct Cysts	17	1	183	2	89.5	99.5	98.5
Cholangiocarcinoma	32	2	161	5	86.5	98.8	96.5
Pancreatic Malignancy	28	2	167	4	87.5	98.8	97.5
Table 3: Comparison of USG and MRCP with Operative Findings (Choledocholithiasis)							

Table 3 compares the findings of USG and MRCP with intraoperative results specifically for choledocholithiasis. MRCP showed higher sensitivity (94.4%) and specificity (95.5%) compared to USG (88.9% and 90.9%, respectively). The overall accuracy of MRCP (95%) was also higher than that of USG (90%). These results suggest that MRCP is more reliable for diagnosing choledocholithiasis compared to USG.

Parameter	USG Positive	USG Negative	MRCP Positive	MRCP Negative
True Positive	80	10	85	5
False Positive	10	100	5	105
False Negative	10	-	5	-
True Negative	100	-	105	-
Sensitivity (%)	88.9	-	94.4	-
Specificity (%)	90.9	-	95.5	-
Accuracy (%)	90	-	95	-
Table 4: Comparison of USG and MRCP with Operative Findings (Biliary Strictures)				

Table 4 presents the diagnostic performance of USG and MRCP for biliary strictures in relation to intraoperative findings. MRCP outperformed USG with a sensitivity of 84.6% and specificity of 97.8%, compared to USG's sensitivity of 76.9% and specificity of 96.3%. The accuracy of MRCP was 93.5%, higher than USG's 90%. This indicates that MRCP provides more accurate diagnoses for biliary strictures, aiding in better surgical planning.

Parameter	USG Positive	USG Negative	MRCP Positive	MRCP Negative
True Positive	50	15	55	10
False Positive	5	130	3	132
False Negative	15	-	10	-
True Negative	130	-	132	-
Sensitivity (%)	76.9	-	84.6	-
Specificity (%)	96.3	-	97.8	-
Accuracy (%)	90	-	93.5	-
Table 5: Comparison of USG and MRCP with Operative Findings (Bile Duct Cysts)				

For bile duct cysts, this table shows that MRCP has higher sensitivity (89.5%) and specificity (99.5%) compared to USG (83.3% and 98.9%, respectively). The accuracy of MRCP (98.5%) was also superior to that of USG (97.5%). These findings confirm that MRCP is a more precise diagnostic tool for bile duct cysts, ensuring better alignment with operative findings. (Table 5)

Parameter	USG Positive	USG Negative	MRCP Positive	MRCP Negative
True Positive	15	3	17	2
False Positive	2	180	1	183
False Negative	3	-	2	-
True Negative	180	-	183	-
Sensitivity (%)	83.3	-	89.5	-
Specificity (%)	98.9	-	99.5	-
Accuracy (%)	97.5	-	98.5	-
Table 6: Comparison of USG and MRCP with Operative Findings (Cholangiocarcinoma)				

Table 6 highlights the diagnostic performance for cholangiocarcinoma. MRCP demonstrated higher sensitivity (86.5%) and specificity (98.8%) compared to USG (81.1% and 98.2%, respectively). The accuracy of MRCP (96.5%) was also better than that of USG (95%). These results suggest that MRCP is more effective than USG in accurately diagnosing cholangiocarcinoma, which is critical for surgical planning and treatment.

Parameter	USG Positive	USG Negative	MRCP Positive	MRCP Negative
True Positive	30	7	32	5
False Positive	3	160	2	161
False Negative	7	-	5	-
True Negative	160	-	161	-
Sensitivity (%)	81.1	-	86.5	-
Specificity (%)	98.2	-	98.8	-
Accuracy (%)	95	-	96.5	-
Table 7: Comparison of USG and MRCP with Operative Findings (Pancreatic Malignancy)				

Table 7 compares the diagnostic performance for pancreatic malignancy. MRCP showed higher sensitivity (87.5%) and specificity (98.8%) compared to USG (80.6% and 97.6%, respectively). The accuracy of MRCP (97.5%) was also higher than USG (95%). These findings indicate that MRCP is more reliable for diagnosing pancreatic malignancies, providing better diagnostic clarity and aiding in effective surgical planning.

Parameter	USG Positive	USG Negative	MRCP Positive	MRCP Negative
True Positive	25	6	28	4
False Positive	4	165	2	167
False Negative	6	-	4	-
True Negative	165	-	167	-
Sensitivity (%)	80.6	-	87.5	-
Specificity (%)	97.6	-	98.8	-
Accuracy (%)	95	-	97.5	-
Table 8				

Taking operative findings as true positives following parameters are defined as -

Sensitivity – the ability of the test to identify the true positive cases out of those who are actually having the disease found intra operatively

Specificity - the ability of the test to identify the true negative cases out of those who are actually not having the disease found intra operatively

Accuracy - the accuracy is the proportion of correct predictions (both true positives and true negatives) among the total number of cases examined.

Figure 1: Sensitivity

Figure 1: Specificity

Figure 1: Accuracy
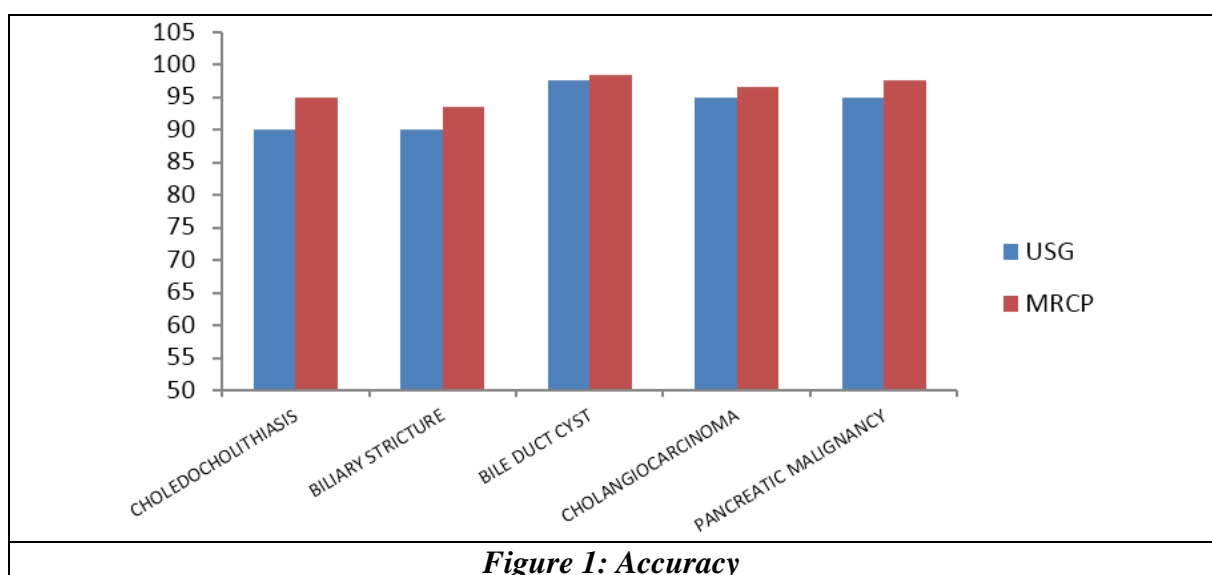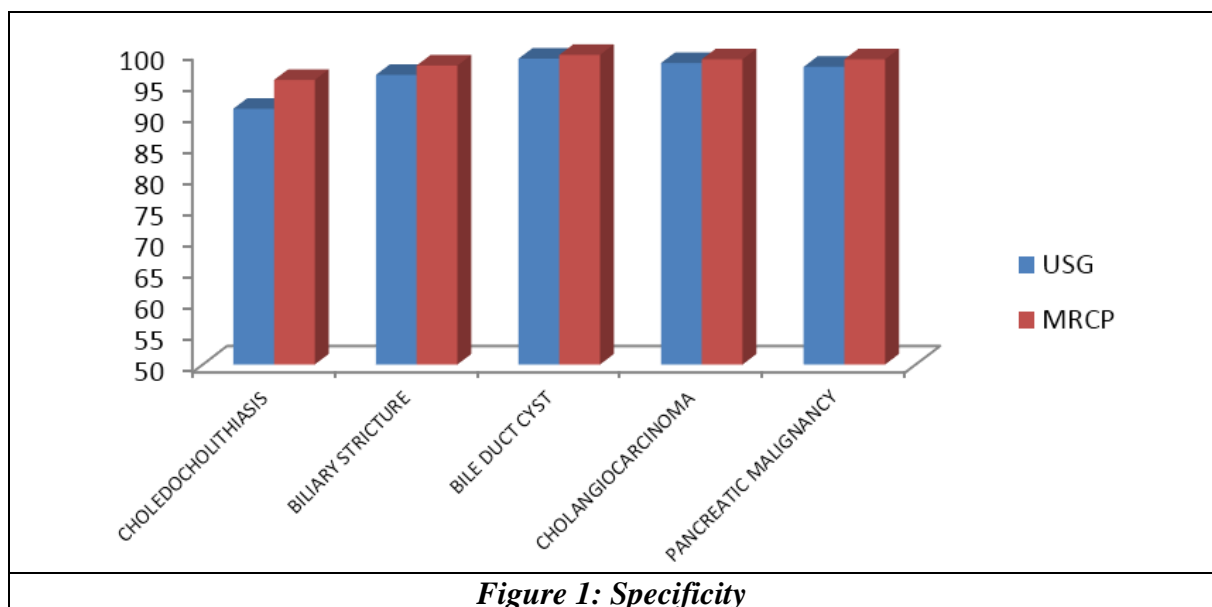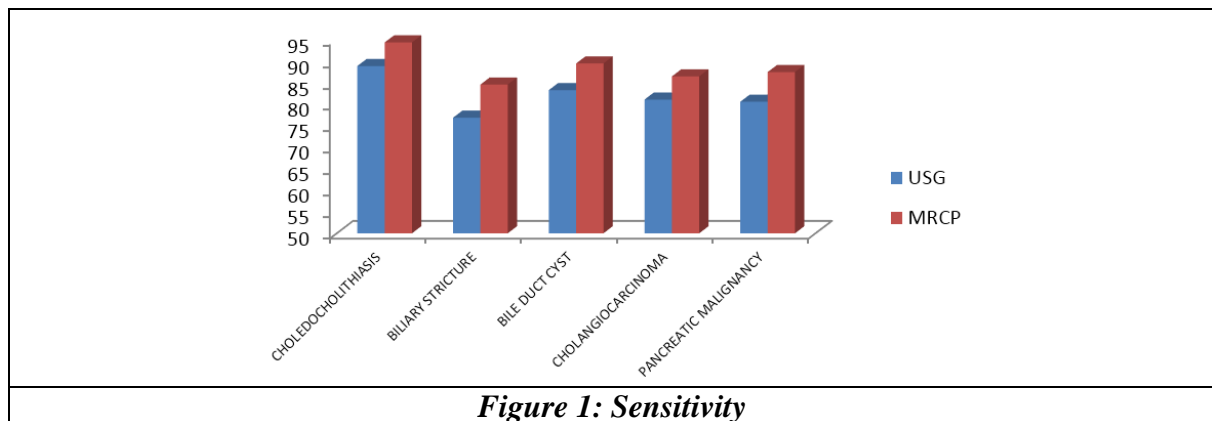
DISCUSSION

The primary aim of this study is to evaluate the diagnostic accuracy of ultrasonography (USG) and Magnetic Resonance Cholangiopancreatography (MRCP) in patients with obstructive jaundice, and to compare these imaging modalities with operative findings.

The clinical symptoms reported by the patients are in line with the typical presentation of obstructive jaundice. Jaundice, characterized by yellowing of the skin and eyes due to elevated bilirubin levels, was present in all patients (100%), underscoring its significance as the primary symptom. Abdominal pain was reported by 70% of the patients, reflecting the common association with underlying conditions such as gallstones or tumors causing the obstruction. Dark urine and pale stools were reported by 75% and 65% of the patients, respectively, indicating impaired bile flow. Pruritus, or itching, was experienced by 30% of the patients, which is a result of bile salts depositing in the skin. Study by **Shimu et al. (2023)[5]** prospectively included 72 patients with clinical features of biliary obstructive disease referred to the DCIMCH radiology department. The study did not specify detailed demographic data but included a diverse patient population based on clinical presentation. **Singh et al. (2014)[6]** prospective study included 50 patients referred to the radiology department with clinical features of biliary obstructive disease. The demographics of the patients were not specified in detail, but they were selected based on presenting symptoms of obstructive jaundice.**Irom et al. (2022)[7]** did a prospective study included 36 patients with clinical features of obstructive jaundice referred to the department of radio-diagnosis. The study did not detail the demographic characteristics but included patients based on clinical presentation.

The demographic data of the 200 patients involved in this study provide a comprehensive overview of the patient population presenting with obstructive jaundice. The age range of the patients was from 18 to 85 years, with a mean age of 52 years, indicating that obstructive jaundice affects a broad age spectrum but is predominantly seen in middle-aged and older adults. The gender distribution showed a higher proportion of male patients (55%) compared to female patients (45%). A study by Study by **Sharma & Ahuja (1999)**involved 429 patients diagnosed with obstructive jaundice over a 10-year period. The mean age of the patients was 62.5 ± 34.2 years, with 229 males and 194 females. **Saraf et al. (2022)[8]** did a prospective cohort study involved 60 patients referred with strong clinical suspicion of biliary obstruction and altered liver function tests. The majority of patients were females in their sixth decade of life. Study by **Patil et al. (2019)[9]** correlational study involved 90 patients confirmed to have features of obstructive jaundice and referred for Ultrasonography and MRCP, followed by ERCP or surgery.

In this study, USG demonstrated high accuracy in detecting biliary obstructions, particularly for bile duct cysts (97.5%) and cholangiocarcinoma (95%). However, its sensitivity was lower for biliary strictures (76.9%) and pancreatic malignancy (80.6%). The sensitivity and specificity for choledocholithiasis were 88.9% and 90.9%, respectively, with an overall accuracy of 90%. **A Study by Patil et al. (2019)[9]** found that the accuracy of ultrasound was 75%, whereas MRCP had an accuracy of 98% in detecting and delineating obstructive biliary pathologies. For choledocholithiasis, USG had a sensitivity and specificity of 80% and 100%, respectively, while MRCP had 100% for both. For malignant pathologies, USG showed a sensitivity and specificity of 73% and 100%, respectively, while MRCP showed 93.3% and 100%.

MRCP showed higher sensitivity and specificity for detecting choledocholithiasis (94.4% and 95.5%, respectively) with an overall accuracy of 95%. For biliary strictures, the sensitivity and specificity were 84.6% and 97.8%, respectively, with an accuracy of 93.5%. The highest diagnostic accuracy was observed for bile duct cysts (98.5%) and pancreatic malignancy (97.5%). **Irom et al. (2022)[7]** did a prospective study included 36 patients with

clinical features of obstructive jaundice referred to the department of radio-diagnosis. The study did not detail the demographic characteristics but included patients based on clinical presentation.MRCP showed a diagnostic accuracy of 94.4%, higher than CT (91.6%) and USG (30.56%). The study emphasized that USG is a good screening modality to confirm biliary obstruction, while MRCP is highly useful for the pre-operative evaluation of obstructive jaundice cases.

CONCLUSION

This study provides a comprehensive evaluation of the diagnostic accuracy of ultrasonography (USG) and Magnetic Resonance Cholangiopancreatography (MRCP) in patients with obstructive jaundice, with a particular focus on comparing these imaging modalities with operative findings. The results demonstrate that MRCP is a superior diagnostic tool compared to USG, offering higher sensitivity, specificity, and overall accuracy for detecting various biliary and pancreatic conditions, including choledocholithiasis, biliary strictures, bile duct cysts, cholangiocarcinoma, and pancreatic malignancy. While USG remains a valuable initial screening method due to its accessibility and cost-effectiveness, MRCP's detailed and comprehensive imaging capabilities make it the preferred modality for accurate diagnosis and effective surgical planning. These findings underscore the importance of incorporating MRCP into the diagnostic workflow for obstructive jaundice to enhance patient outcomes and optimize treatment strategies. The study highlights the need for further research to validate these findings across larger, multi-center cohorts and to explore the economic implications and long-term clinical benefits of MRCP.

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