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A COMPARATIVE STUDY OF ULTRASONOGRAPHY AND MRCP IN DIAGNOSING OBSTRUCTIVE JAUNDICE

Radiology

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ABSTRACT

Background: Obstructive jaundice, caused by bile flow obstruction, presents significant clinical challenges. While ultrasonography (USG) is widely used for initial diagnosis, it has limitations in visualizing deep structures like the distal common bile duct and pancreas. Magnetic Resonance Cholangiopancreatography (MRCP), introduced in 1991, offers a non-invasive, radiation-free alternative for detailed visualization of the biliary and pancreatic systems. **Aims & Objectives:** This study aimed to compare the diagnostic effectiveness of USG and MRCP in identifying the cause of obstructive jaundice. Additionally, the study sought to evaluate the role of both modalities in detecting post-surgical complications, with an emphasis on diagnostic accuracy, sensitivity, and specificity. **Methods:** A cross-sectional study of 90 patients with suspected obstructive jaundice was conducted at the Department of Radiodiagnosis, Heritage Institute of Medical Sciences, Varanasi, from November 2022 to May 2024. Patients underwent USG followed by MRCP. Data were analyzed using SPSS version 26.0, and the chi-square test was applied to assess statistical significance ($p < 0.05$). **Results:** MRCP showed higher diagnostic accuracy (95.56%) and sensitivity (81.82%) compared to USG's detection rate of 65.5% for obstructive pathologies. MRCP identified more cases of bile duct injuries (13.3%) and bile leaks (41.1%). USG, though useful for initial screening, was less effective in detecting complications. Most participants were female (68.89%) and aged 51-60, with yellowish discoloration of the skin as the most common symptom (76.67%). **Conclusion:** MRCP is superior to USG for diagnosing obstructive jaundice and post-surgical complications, offering greater sensitivity, specificity, and diagnostic accuracy. While USG is a cost-effective screening tool, MRCP is essential for confirming findings, assessing biliary obstructions, and planning surgery, leading to better patient outcomes.

KEYWORDS

Obstructive jaundice; MRCP; USG; Diagnostic accuracy; Bile duct obstruction

INTRODUCTION

Obstructive jaundice, characterized by bile flow blockage from the liver to the intestines, poses significant clinical challenges.[1] While patient history and lab results provide clues, imaging is essential for identifying the cause and precise location of the obstruction.[2] Ultrasonography (USG) is frequently the first imaging modality used due to its wide availability, cost-effectiveness, and non-invasive nature. It is particularly useful in detecting gallstones and biliary dilation. However, USG's limitations become evident when visualizing deep structures like the distal common bile duct and pancreas, especially in patients with obesity or bowel gas interference.[3] Magnetic Resonance Cholangiopancreatography (MRCP), introduced in 1991, transformed biliary and pancreatic imaging.[4] Unlike USG, MRCP uses advanced magnetic resonance techniques to create detailed images of the bile ducts, pancreas, and surrounding tissues without radiation or contrast agents.[5] This non-invasive technique excels in identifying bile duct obstructions, strictures, and stones, as well as post-surgical complications such as bile leaks and strictures. MRCP's ability to visualize the entire biliary tree, including proximal and distal obstructions, has made it the gold standard in hepatobiliary imaging.[6]

Although USG is often the first line of investigation, MRCP offers superior diagnostic accuracy, especially in complex cases. MRCP eliminates many of the limitations of USG, providing a more complete map of the biliary system, which is crucial for surgical planning. Moreover, MRCP minimizes the need for invasive diagnostic procedures like Endoscopic Retrograde Cholangiopancreatography (ERCP), which carries risks of complications.[7,8]

This study aims to compare the diagnostic effectiveness of USG and MRCP in patients with obstructive jaundice. By analyzing their respective strengths and weaknesses, the research will assess whether USG, despite its limitations, can serve as a complementary tool to MRCP, or if MRCP alone should be prioritized for accurate diagnosis and treatment planning. Ultimately, this comparison aims to enhance diagnostic protocols, improve patient outcomes, and optimize imaging strategies in the management of obstructive jaundice.

MATERIALS AND METHODS

Study Design

This cross-sectional study was conducted at the Department of Radiodiagnosis, Heritage Institute of Medical Sciences, Varanasi, over an 18-month period from November 2022 to May 2024.

Sample Selection

A total of 90 patients with clinical and laboratory findings suggestive of obstructive jaundice were included. Patients were referred for USG and MRCP evaluations during the study period. The sample size was calculated using Buderer's formula, considering a 10% dropout rate, resulting in a final sample size of 90.

Inclusion Criteria

- Patients with clinical features and lab results indicating obstructive jaundice.

Exclusion Criteria

- Contraindications to MRI (e.g., pacemakers, metallic implants).
- Claustrophobic patients.
- Patients refusing consent.

Equipment

- **MRI**: Philips Achieva dStream 3.0 T
- **USG**: Samsung Hs40

Study Tools & Procedure

Patients underwent a thorough clinical assessment followed by USG using curvilinear and linear transducers (2.5 to 9 MHz) based on body habitus. MRI and MRCP were performed using Philips Achieva dStream 3.0 T. Data were collected through a structured proforma after obtaining informed consent from all participants.

Ethical Consideration

The study received approval from the Institutional Ethics Committee (Approval no. HIMS/IEC/107/2022) on 18/11/2022.

Data Analysis

Data were analyzed using SPSS version 26.0. Quantitative data were expressed as mean ± standard deviation, and categorical variables were compared using the chi-square test. A p-value <0.05 was considered statistically significant.

RESULTS

Table 1: Demographic and Symptom Distribution of Study Participants

Parameter	Frequency	Percentage (%)
AGE GROUPS		
18-20 Years	2	2.22
21-30 Years	6	6.67
31-40 Years	10	11.11
41-50 Years	22	24.44
51-60 Years	23	25.56
61-70 Years	12	13.33
71-80 Years	4	4.44
GENDER		
Male	28	31.11
Female	62	68.89
SYMPTOMS		
Abdominal Pain	56	62.22
Yellowish Discoloration of Skin/Sclera	69	76.67
Dark Urine	25	27.78
Fever	29	32.22
Itching	36	40.00
Loss of Weight	19	21.11
Clay Colored Stool	43	47.78

The demographic distribution (age and gender) and the prevalence of symptoms among the study participants is shown in Table 1. The majority of participants were between 51-60 years and female, with the most common symptom being yellowish discoloration of the skin/sclera.

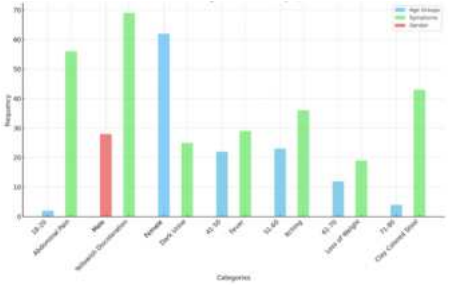


Table 2 Comparative Analysis of USG and MRCP Findings in Diagnosing Obstructive Jaundice

Finding Type	USG Finding	USG Percentage (%)	MRCP Finding	MRCP Percentage (%)
Present	59	65.5	86	95.56
Absent	31	34.5	4	4.44
Total	**90**	**100.0**	**90**	**100.0**

A comparison between USG and MRCP findings in diagnosing obstructive jaundice is shown in Table 1. MRCP detected a higher percentage of obstruction (95.56%) compared to USG (65.5%), highlighting its greater sensitivity in identifying obstructive causes. The absence of findings was more frequent in USG (34.5%) than MRCP (4.44%).

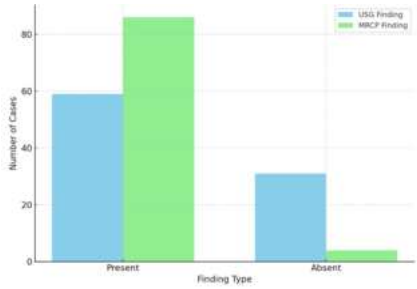
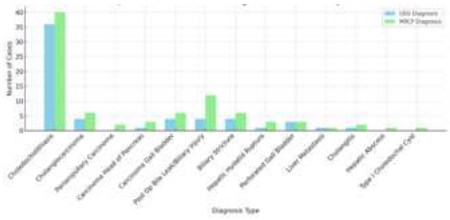
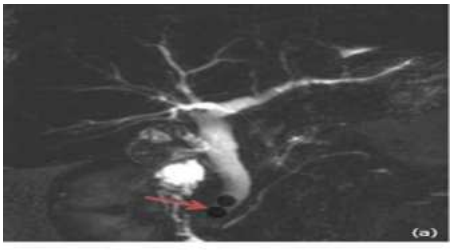


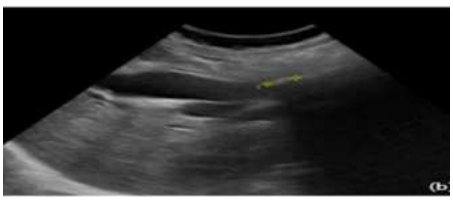
Table 3 Comparative Analysis of Diagnoses of Obstructive Jaundice via USG and MRCP

Diagnosis	Number of Cases on USG (Frequency %)	Number of Cases on MRCP (Frequency %)	P-value
Choledocholithiasis	36 (40.0%)	40 (44.4%)	0.20
Cholangiocarcinoma	4 (4.4%)	6 (6.7%)	0.44
Periampullary Carcinoma	0 (0.0%)	2 (2.2%)	0.13
Carcinoma Head of Pancreas	1 (1.1%)	3 (3.3%)	0.86
Carcinoma Gall Bladder	4 (4.4%)	6 (6.7%)	0.44
Post Operative Bile Leak/Biliary Injury	4 (4.4%)	12 (13.3%)	0.03
Biliary Stricture	4 (4.4%)	6 (6.7%)	0.44
Hepatic Hydatid with Intrabiliary Rupture	1 (1.1%)	3 (3.3%)	0.86
Perforated Gall Bladder	3 (3.3%)	3 (3.3%)	1.00
Liver Metastasis	1 (1.1%)	1 (1.1%)	1.00
Cholangitis	1 (1.1%)	2 (2.2%)	0.69
Hepatic Abscess with Biliary Communication	0 (0.0%)	1 (1.1%)	0.42
Type I Choledochal Cyst	0 (0.0%)	1 (1.1%)	0.42

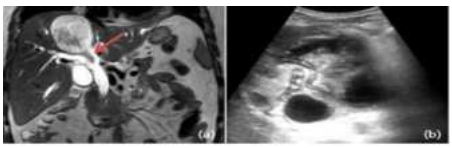
Diagnoses of obstructive jaundice using USG and MRCP modalities is shown in Table 3. While both modalities detected similar conditions, MRCP showed a higher frequency of detection in some cases, such as post-operative bile leak and biliary injury, with a statistically significant p-value (0.03), indicating MRCP's higher diagnostic accuracy in these specific instances.

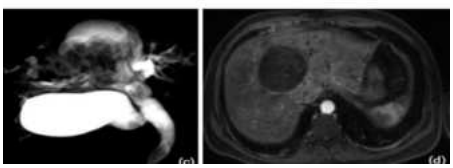




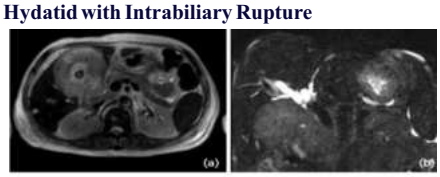


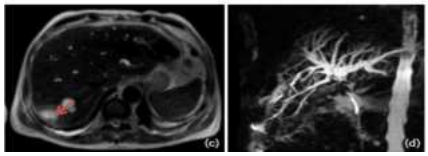
Choledocholithiasis



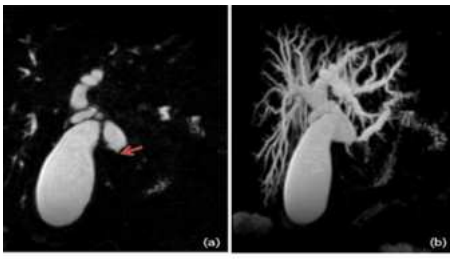


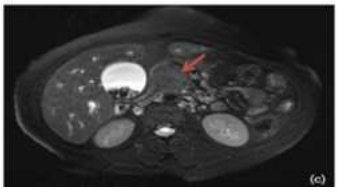
Hepatic Hydatid with Intrabiliary Rupture



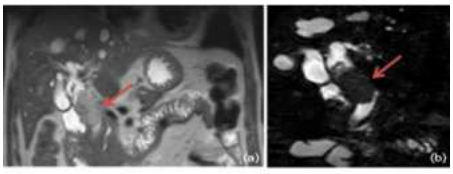


Carcinoma Gall Bladder with Hepatic Metasis





Periampullary Carcinoma

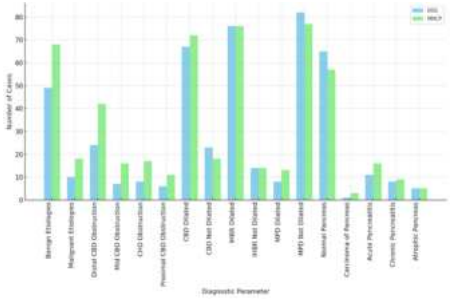


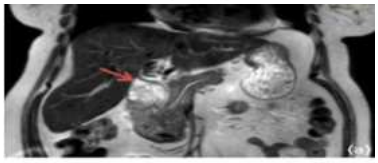
Cholangiocarcinoma

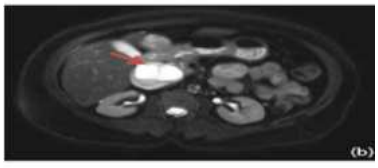
Table 4 Comparative Analysis of Benign/Malignant Etiologies, Obstruction Levels, and Key Diagnostic Parameters in USG and MRCP"

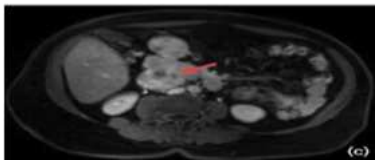
Parameter	USG (Frequency %)	MRCP (Frequency %)	HPE/Surgical Findings (Frequency %)	P-Value	Odds Ratio (OR)	95% CI
Benign Etiologies	49 (84.44%)	68 (79.07%)	68 (75.6%)	0.04	-	-
Malignant Etiologies	10 (15.56%)	18 (20.93%)	22 (24.4%)	0.037	-	-
Distal CBD Obstruction	24 (53.3%)	42 (48.8%)	-	0.008	0.42	0.22 - 0.76
Mid CBD Obstruction	07 (15.5%)	16 (18.6%)	-	0.072	0.39	0.15 - 1.02
CHD Obstruction	08 (17.7%)	17 (19.7%)	-	0.083	0.42	0.17 - 1.02
Proximal CBD Obstruction	6 (13.3%)	11 (12.7%)	-	0.308	0.51	0.18 - 1.43
CBD Dilated	67 (74.5%)	72 (80.0%)	-	0.48	1.37	0.68 - 2.7
CBD Not Dilated	23 (25.5%)	18 (20.0%)	-	0.37	1.21	0.48 - 2.29
IHBR Dilated	76 (84.4%)	76 (84.4%)	-	1.0	-	-
IHBR Not Dilated	14 (15.6%)	14 (15.6%)	-	1.0	-	-
MPD Dilated	8 (8.9%)	13 (14.4%)	-	0.353	-	-
MPD Not Dilated	82 (91.1%)	77 (85.6%)	-	0.353	-	-
Normal Pancreas	65 (72.2%)	57 (63.33%)	-	0.429	1.351	-
Carcinoma of Pancreas	1 (1.1%)	3 (3.33%)	-	1.000	0.659	-
Acute Pancreatitis	11 (12.2%)	16 (17.78%)	-	1.000	0.847	-
Chronic Pancreatitis	8 (8.8%)	9 (10.0%)	-	1.000	-	-
Atrophic Pancreas	5 (5.56%)	5 (5.56%)	-	0.668	0.616	-

A comprehensive comparison of various benign and malignant conditions, levels of obstruction, and other diagnostic parameters between USG and MRCP shown in Table 4. Statistical significance and confidence intervals are also included where applicable.







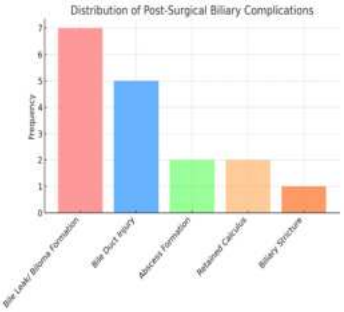


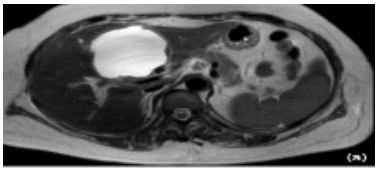
Carcinoma Head of Pancreas

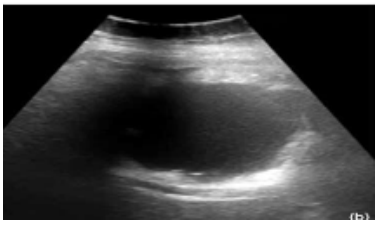
Table 5 Distribution of Post-Surgical Biliary Complications

Post Surgical Biliary Complications	Frequency	Percentage (%)
Bile Leak/ Biloma Formation	7	41.1%
Bile Duct Injury	5	29.4%
Abscess Formation	2	11.7%
Retained Calculus	2	11.7%
Biliary Stricture	1	5.8%

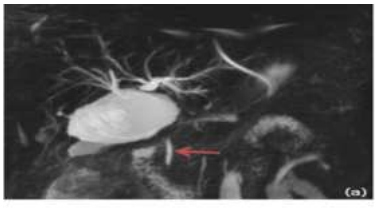
Table 5 shows the distribution of biliary complications following surgery. The most common complication observed was bile leak or biloma formation (41.1%), followed by bile duct injury (29.4%). Other complications such as abscess formation, retained calculus, and biliary stricture were less frequent.

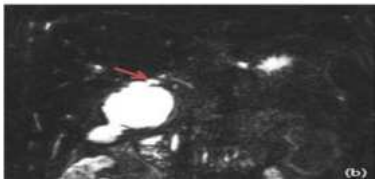






Post-Surgical Biloma Formation



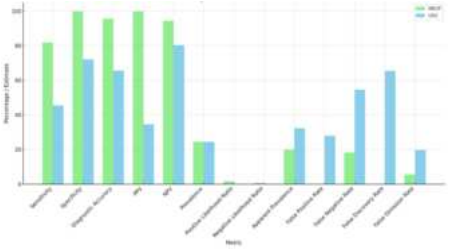


Post Surgical Bile Duct Injury

Table 6 Comparative Diagnostic Statistics for MRCP and USG

Metric	MRCP Estimate (%)	USG Estimate (%)
Sensitivity	81.82	45.45
Specificity	100	72.06
Diagnostic Accuracy	95.56	65.56
Positive Predictive Value (PPV)	100	34.48
Negative Predictive Value (NPV)	94.44	80.33
Prevalence	24.44	24.44
Positive Likelihood Ratio	1.62	-
Negative Likelihood Ratio	0.75	0.18
Apparent Prevalence	20	32.22
False Positive Rate	0	27.94
False Negative Rate	18.18	54.55
False Discovery Rate	0	65.52
False Omission Rate	5.56	19.67

Table 6 compares the diagnostic performance of MRCP and USG across key metrics. MRCP outperforms USG in sensitivity, specificity, and diagnostic accuracy, while USG has higher false positive and false negative rates, emphasizing the superior diagnostic reliability of MRCP.



DISCUSSION

The study evaluates that the most participants were between 51-60 years (25.56%) and 41-50 years (24.44%), with females (68.89%) outnumbering males (31.11%). Yellowish discoloration of the skin/sclera (76.67%) was the most common symptom, followed by abdominal pain (62.22%). **Vaishali et al.[9] (2004)** reported a similar distribution, where the highest number of cases occurred in individuals aged 50-60 years. They also found that jaundice (skin/sclera discoloration) was the most frequently reported symptom, followed by abdominal pain, which matches the findings in the present study. **Verma et al.[10] (2011)** observed that in their study population, jaundice was the most common symptom (77.5%) and was more prevalent in females (65%) than males (35%), closely resembling the demographic distribution and symptom patterns seen in the present study.

The study found that MRCP detected obstructions in 95.56% of cases, compared to 65.5% with USG. The absence of findings was higher with USG (34.5%) compared to MRCP (4.44%). **Singh et al.[11] (2014)** found that MRCP detected obstructive jaundice in 90.5% of cases, compared to USG's 60%, which closely aligns with the findings of the present study. **Prusty et al.[2] (2019)** observed that MRCP had a sensitivity of 89.3% for detecting obstructions, whereas USG had a sensitivity of 65.5%, mirroring the higher detection rates of MRCP in the present study. **Guibaud et al.[12] (1994)** reported similar results, where MRCP identified obstructions in 92% of cases compared to 70% detected by USG.

The study found that MRCP detected more cases of choledocholithiasis (44.4%) than USG (40%), and post-operative bile leak/biliary injury was significantly more detected by MRCP (13.3%) compared to USG (4.4%). **Guibaud et al.[12] (1994)** reported that MRCP detected choledocholithiasis in 90% of cases, while USG detected it in only 70%, supporting the present study's findings of higher detection rates with MRCP. **Pavone et al.[7] (1997)** also found that MRCP was more effective than USG in detecting choledocholithiasis, with detection rates of 85% for MRCP compared to 60% for USG, consistent with the present study's results. **Soto et al.[3] (1996)** found that MRCP was more sensitive in detecting post-operative complications such as bile leaks, which aligns with the present study's significant findings on bile leak detection by MRCP.

The study found that MRCP detected more cases of malignant etiologies (20.93%) than USG (15.56%) and showed higher detection of distal CBD obstructions (48.8%) compared to USG (53.3%). A significant difference was noted in distal CBD detection (p-value 0.008). **Kaur et al.[13] (2018)** found that MRCP detected distal CBD obstruction in 86% of cases compared to USG's 50%, closely aligning with the significant findings in the present study for distal CBD obstruction. **Magnuson et al.[1] (1999)** also reported that MRCP was more reliable in detecting malignant obstructions, particularly in cases of distal CBD, with MRCP showing a sensitivity of 90%, which supports the current findings. **Upadhyaya et al.[14] (2006)** found that MRCP was more effective in detecting malignant causes of obstructive jaundice, with a detection rate of 80% compared to 60% with USG, in line with the higher detection rates in the present study.

The present study found that **bile leak or biloma formation** was the most frequent complication (41.1%), followed by **bile duct injury** (29.4%). **Abscess formation** and **retained calculus** each occurred in 11.7% of cases, while **biliary stricture** was the least common (5.8%). In the study by **Magnuson et al.[1] (1999)**, investigating biliary obstructions using magnetic resonance cholangiography (MRC), **bile duct injuries** were reported in 30% of cases, closely matching the 29.4% found in the present study. Additionally, they observed **bile leaks** in 35% of cases, which is comparable to the 41.1% incidence reported here, suggesting a similar risk profile for these complications following surgery. **Soto et al.[3] (1996)** examined complications after incomplete ERCP procedures and found that **bile leaks** occurred in 33% of cases, slightly lower than the 41.1% in this study, while **bile duct injuries** were seen in 28% of cases, very close to the 29.4% found in the present study. These findings reinforce the consistency of post-surgical biliary complications in various clinical contexts. On the other hand, **Pavone et al.[7] (1997)**, who studied patients undergoing laparoscopic cholecystectomy for biliary stones, reported a lower frequency of **abscess formation** at around 8%, compared to the 11.7% in the current study. This difference may be due to the focus on stone-related complications in Pavone's study, whereas the present study encompasses a broader range of biliary complications.

The study found that MRCP had superior sensitivity (81.82%), specificity (100%), and diagnostic accuracy (95.56%) compared to USG (45.45%, 72.06%, and 65.56%, respectively). MRCP also had

lower false positive and false negative rates. **Romagnuolo et al.[18] (2003)** reported that MRCP had a sensitivity of 85% and specificity of 98%, while USG had a sensitivity of 50% and specificity of 70%, closely matching the present study's findings. **Ferrucci et al.[4] (1979)** also noted that MRCP had superior diagnostic accuracy (92%) compared to USG (68%), which supports the findings of the present study. **Prusty et al.[2] (2019)** found that MRCP had an overall diagnostic accuracy of 96%, compared to 64% for USG, reinforcing the superior diagnostic performance of MRCP observed in the present study.

CONCLUSION

This study highlights the diagnostic superiority of MRCP over USG in detecting obstructive jaundice and post-surgical biliary complications. While USG, with a 65% detection rate for obstructive pathologies, is a non-invasive, cost-effective initial screening tool, MRCP offers much higher sensitivity (81.82%), specificity (100%), and diagnostic accuracy (95.56%). MRCP is more effective in identifying bile duct injuries and bile leaks, which were the most frequent complications. It is also valuable for confirming USG findings, assessing the level of biliary obstruction, pre-surgical mapping to avoid bile duct injuries, and diagnosing post-surgical complications. The demographic analysis revealed that most participants were female (68.89%) and aged 51-60, with yellowish discoloration of the skin as the most common symptom (76.67%). MRCP is recommended for detailed characterization of post-surgical biliary injuries and guiding management.

Limitations

One limitation of this study is the relatively small sample size of 90 participants, which may limit the generalizability of the findings. Additionally, the study did not account for variations in operator expertise during USG, which could affect diagnostic accuracy. Another limitation is that the cost and availability of MRCP may restrict its routine use in some healthcare settings, making it less accessible compared to USG. Lastly, the study did not explore the long-term outcomes of patients following diagnosis and treatment.

Conflict Of Interest:
All authors declare no conflict of interest.
Source of funding:
None.
Consent:
As per international standards or university standards written participant consent has been collected and preserved by the authors.

Ethical approval:
As per international standards or university standards written ethical permission has been collected and preserved by the author(s).

REFERENCES

1. Magnuson TH, Bender JS, Duncan MD, Ahrendt SA, Harmon JW, Regan F. Utility of magnetic resonance cholangiography in the evaluation of biliary obstruction. J Am Coll Surg. 1999;189:63–72.
2. Prusty SK, Bhagat S, Panda BB. Ultrasonography vs MRCP in evaluation of obstructive jaundice. J Med Sci Clin Res. 2019;7:1120–8.
3. Soto JA, Yucel EK, Barish MA, Chuttani R, Ferrucci JT. MR cholangiopancreatography after unsuccessful or incomplete ERCP. Radiology. 1996;199:91–8.
4. Ferrucci JT Jr. Body ultrasonography (second of two parts). N Engl J Med. 1979;300:590–602.
5. Prasad AS, Sandeep J. Ultrasound and magnetic resonance cholangio-pancreatography correlation in biliary disorders. MRIMS J Health Sci. 2015;3:142–6.
6. Taylor KJ, Carpenter DA, McCready VR. Ultrasound and scintigraphy in the differential diagnosis of obstructive jaundice. J Clin Ultrasound. 1974;2:105–16.
7. Pavone P, Laghi A, Lomanto D, et al. MR cholangiography (MRC) in the evaluation of CBD stones before laparoscopic cholecystectomy. Surg Endosc. 1997;11:982–5.
8. Guibaud L, Bret PM, Reinhold C, Atri M, Barkun AN. Diagnosis of choledocholithiasis: value of MR cholangiography. AJR Am J Roentgenol. 1994;163:847–50.
9. Vaishali MD, Agarwal AK, Upadhyaya DN, Chauhan VS, Sharma OP, Shukla VK. Magnetic resonance cholangiopancreatography in obstructive jaundice. J Clin Gastroenterol. 2004;38:887–90.
10. Verma SR, Sahai SB, Gupta PK, Munshi A, Verma SC, Goyal P. Obstructive jaundice-aetiological spectrum, clinical, biochemical and radiological evaluation at a tertiary care teaching hospital. Int J Trop Med. 2011;7.
11. Singh A, Mann HS, Thukral CL, Singh NR. Diagnostic accuracy of MRCP as compared to ultrasound/CT in patients with obstructive jaundice. J Clin Diagn Res. 2014;8:103–7.
12. Guibaud L, Bret PM, Reinhold C, Atri M, Barkun AN. Diagnosis of choledocholithiasis: value of MR cholangiography. AJR Am J Roentgenol. 1994;163:847–50.
13. Kaur A, Malaviya A, Deepika KN. Comprehensive evaluation of MRCP versus ultrasonography in biliary obstruction. Int J Med Res Rev. 2018;6:143–52.
14. Upadhyaya V, Upadhyaya DN, Ansari MA, Shukla VK. Comparative assessment of imaging modalities in biliary obstruction. Ind J Radiol Imag. 2006;16.
15. Romagnuolo J, Bardou M, Rahme E, Joseph L, Reinhold C, Barkun AN. Magnetic resonance cholangiopancreatography: a meta-analysis of test performance in suspected biliary disease. Ann Intern Med. 2003;139:547–57.