

Correlation and Diagnostic Agreement Between Ultrasonography and MRCP in Evaluating Obstructive Jaundice: A Prospective Study

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Keywords: Obstructive Jaundice, Magnetic Resonance Cholangiopancreatography, Ultrasonography, Diagnostic Accuracy, Biliary Obstruction, MRCP Vs. USG, Biliary Imaging, Hepatobiliary Diagnostics

Abstract

Background: Obstructive jaundice is a clinical condition characterized by the yellow discoloration of the skin, sclera, and mucous membranes due to elevated bilirubin levels caused by bile flow obstruction. Accurate diagnosis of the obstruction's cause and site is essential for effective management. Ultrasonography (USG) is commonly used for initial screening, but it has limitations, especially in visualizing the distal common bile duct (CBD). Magnetic resonance cholangiopancreatography (MRCP) has emerged as a superior, non-invasive imaging modality with higher accuracy in evaluating biliary obstructions.

Objective: To evaluate the correlation and agreement between USG and MRCP findings in patients with obstructive jaundice and to determine the diagnostic accuracy of each modality in detecting the level and cause of biliary obstruction.

Methods: This prospective cohort study was conducted over six months at a tertiary care hospital in Rawalpindi. A total of 32 patients with clinical suspicion of obstructive jaundice were included. Each patient underwent both USG and MRCP. USG was performed using a GE Logiq-e machine, followed by MRCP on a Philips Achieva 1.5 Tesla MRI scanner. Data were analyzed using SPSS version 25. Pearson's correlation coefficient and kappa statistics were used to assess the correlation and agreement between the two modalities. The diagnostic accuracy of USG and MRCP was compared based on the detection of the level of obstruction and the identification of benign and malignant etiologies.

Results: The mean age of the patients was 59.53 ± 13.41 years, with 65.6% being male. MRCP showed a diagnostic accuracy of 97.2% compared to 78.1% for USG. MRCP detected distal CBD calculi with 100% accuracy, while USG missed these in 11 cases. A positive correlation was found between USG and MRCP in detecting the site of obstruction ($r = 0.48, p = 0.005$), the porta hepatis as the site of obstruction ($r = 0.47, p = 0.006$), and the ampulla as the site of obstruction ($r = 0.47, p = 0.006$). However, the correlation for benign etiologies was weak ($r = 0.094, p = 0.607$), and for malignant etiologies, it was moderate ($r = 0.31, p = 0.08$).

Conclusion: MRCP demonstrated superior diagnostic accuracy compared to USG in evaluating patients with obstructive jaundice, particularly in detecting distal CBD calculi and malignant lesions. While USG remains useful as an initial screening tool, MRCP should be considered the preferred imaging modality when detailed evaluation is required.

1 Introduction

Obstructive jaundice is a significant clinical condition characterized by yellow discoloration of the skin, sclera, and mucous membranes due to elevated bilirubin levels in the blood. The obstruction of bile flow in the hepatobiliary channels leads to the accumulation of bile in the circulation, causing this yellow discoloration along with other symptoms such as itching and upper abdominal pain. The common causes of biliary obstruction are benign and malignant etiologies, with benign obstructions primarily due to gallstones, iatrogenic strictures, or inflammatory strictures, and malignant obstructions often caused by cholangiocarcinoma, pancreatic head cancer, gallbladder carcinoma, and other related malignancies (1,2). The identification and management of obstructive jaundice are crucial, as the condition can result in severe morbidity and mortality if not promptly diagnosed and treated.

Ultrasonography (USG) is often the first imaging modality used to evaluate patients with suspected obstructive jaundice due to its widespread availability, cost-effectiveness, and non-invasive nature. However, USG has limitations, particularly in visualizing the distal common bile duct (CBD) and pancreas, where bowel gas shadows often obscure the anatomy. Magnetic resonance

cholangiopancreatography (MRCP), a non-invasive imaging technique, has emerged as a superior alternative, providing detailed images of the biliary and pancreatic ductal systems without the need for contrast material or exposure to ionizing radiation (3). MRCP's ability to provide accurate visualization of the biliary tree, including the distal CBD, makes it a valuable tool in the diagnosis and management of biliary tract diseases (4).

In clinical practice, the accurate diagnosis of the site, cause, and extent of biliary obstruction is essential for determining the appropriate therapeutic approach. Studies have shown that MRCP has a higher diagnostic accuracy compared to USG, particularly in identifying distal CBD calculi and biliary strictures (5). Despite its advantages, MRCP is not universally available, and its higher cost compared to USG may limit its use in certain settings. Therefore, understanding the correlation between USG and MRCP findings is important for determining whether these modalities can be used interchangeably or in a complementary manner in the evaluation of obstructive jaundice.

This study aims to assess the correlation between USG and MRCP findings in patients with obstructive jaundice, focusing on the detection of the level and cause of obstruction. By evaluating the diagnostic accuracy of both modalities, this research seeks to determine the extent to which USG and MRCP can provide consistent results and whether MRCP can reliably complement or replace USG in the diagnostic process. The findings of this study will contribute to the existing body of knowledge on the role of imaging in obstructive jaundice and may help guide clinical decision-making in the management of this condition (6,7).

2 Material and Methods

This prospective cohort study was conducted at a tertiary care hospital in Rawalpindi over six months, from January 15th to July 15th, 2023, to evaluate the correlation and agreement between ultrasound (USG) and magnetic resonance cholangiopancreatography (MRCP) findings in patients with obstructive jaundice. The study included 32 patients who presented with strong clinical signs and symptoms suggestive of obstructive jaundice, such as biliary colic, scleral icterus, yellowing of the skin and mucous membranes, epigastric pain, and weight loss. Patients were referred to the radiology department for further evaluation using both USG and MRCP. The sample size was determined using the WHO sample size calculator, with a confidence interval of 95%, a margin of error of 5%, and a prevalence rate of obstructive jaundice in Pakistan estimated at 2% (8).

The study adhered to ethical principles as outlined in the Declaration of Helsinki, and ethical approval was obtained from the Institutional Review Board before the commencement of the study. Informed written consent was obtained from all participants after explaining the study's purpose, procedures, and potential risks. Patients aged 18 years and above, of either gender, with a strong clinical suspicion of obstructive jaundice confirmed by clinical and laboratory findings, were included in the study. Exclusion criteria included patients with contraindications for MRI, those with peripheral or hepatic jaundice, and patients who had undergone surgical procedures for CBD stone removal.

The data collection process involved a comprehensive clinical evaluation followed by imaging studies. Initially, all patients underwent transabdominal ultrasonography using a curvilinear probe on a GE Logiq-e machine. The ultrasound findings were recorded, focusing on the detection of cholelithiasis, CBD dilation, gallbladder (GB) masses, and other relevant abnormalities. Following the ultrasound examination, MRCP was performed using a Philips Achieva 1.5 Tesla MRI scanner. Patients were instructed to fast for 8-12 hours before the MRCP to ensure optimal gallbladder distension and to minimize fluid secretions in the stomach and duodenum, which could affect image quality. Heavily T2-weighted images were acquired to suppress background signals, allowing for the clear visualization of bile within the biliary tract.

The assessment of imaging results was carried out independently by experienced radiologists who were blinded to the clinical information and the results of the other modality. The findings from both USG and MRCP were documented, and the correlation between the two modalities was analyzed. The degree of agreement between USG and MRCP in detecting the level and cause of obstruction was calculated using Pearson's correlation coefficient and kappa statistics. A p-value of less than 0.05 was considered statistically significant.

Data analysis was performed using SPSS version 25. Descriptive statistics, including mean, frequency, percentage, and standard deviation, were used to summarize the demographic and clinical characteristics of the patients. Inferential statistics were employed to assess the correlation and agreement between USG and MRCP findings. The study focused on the diagnostic accuracy of USG and MRCP in identifying the level of obstruction, distinguishing between benign and malignant etiologies, and diagnosing specific causes of obstructive jaundice. The results of this analysis were intended to provide insight into the potential interchangeability or complementary use of these imaging modalities in clinical practice (9).

3 Results

The study included 32 patients with a mean age of 59.53 ± 13.41 years, with the majority being male (21, 65.6%) and 11 (34.4%) being female. The clinical evaluation revealed that icterus was the most common presenting symptom, observed in 25% of cases. Abdominal pain was reported in 12.5% of cases, while icterus combined with abdominal pain was noted in 21.9% of cases. The distribution of clinical symptoms among the patients is detailed in Table 1.

Table 1: Demographics and Clinical Profile of Patients with Obstructive Jaundice

Variable	Frequency	Percentage
Mean Age (years)	59.53 ± 13.41	
Gender		
Male	21	65.6%
Female	11	34.4%
Clinical Symptoms		
Icterus	8	25.0%
Abdominal Pain	4	12.5%
Icterus & Pruritus	5	15.8%
Icterus, Pruritus & Weight Loss	3	9.4%
Icterus & Abdominal Pain	7	21.9%
Icterus, Abdominal Pain & Weight Loss	4	12.5%
Icterus & Weight Loss	1	3.1%

In the ultrasound examination, cholelithiasis was the most common finding, detected in 28.1% of cases. Dilated intra and extrahepatic biliary channels were observed in 15.6% of cases, while 21.9% of cases had a normal ultrasound study. The findings from the MRCP confirmed that periampullary growth, causing intra and extrahepatic biliary dilation, was present in 12.5% of cases. A detailed comparison of the ultrasound and MRCP findings is presented in Table 2.

Table 2: Comparison of Ultrasound and MRCP Findings in Patients with Obstructive Jaundice

Findings	Ultrasound (USG)	MRCP
Cholelithiasis	9 (28.1%)	1 (3.1%)
CBD Dilated	4 (12.5%)	-
Gallbladder Mass	1 (3.1%)	-
Dilated Intra and Extrahepatic Biliary Channels	5 (15.6%)	-
Gallbladder Sludge	2 (6.3%)	-
Prominent Intrahepatic Biliary Channels	1 (3.1%)	-
Cholelithiasis with Intrahepatic Biliary Dilation	1 (3.1%)	-
Normal Study	7 (21.9%)	2 (6.3%)
Other Findings	2 (6.3%)	-
Choledocholithiasis	-	2 (6.3%)
CBD Stricture with Biliary Dilation	-	1 (3.1%)
Mass at Porta Hepatis	-	2 (6.3%)
Periampullary Growth with Biliary Dilation	-	4 (12.5%)
Choledocholithiasis with Biliary Dilation	-	5 (15.6%)
Neoplastic CBD Stricture with Biliary Dilation	-	1 (3.1%)
Cholelithiasis with Intrahepatic Dilation	-	1 (3.1%)
Mirizzi Syndrome	-	1 (3.1%)
Post-Cholecystectomy Biliary Dilation	-	1 (3.1%)
Cholelithiasis & Pancreatic Mass with Biliary Dilation	-	1 (3.1%)
Distal CBD Stricture with Upstream Dilation	-	1 (3.1%)
Post-Cholecystectomy Normal Study	-	1 (3.1%)

The analysis revealed that all benign etiologies were correctly diagnosed by MRCP, while ultrasound identified benign etiologies in 25 out of 32 cases. MRCP demonstrated a higher diagnostic accuracy for detecting distal CBD calculi, with 100% accuracy, whereas ultrasound failed to detect distal CBD calculi in 11 cases. Similarly, all malignant lesions were correctly identified by MRCP, whereas ultrasound identified only 3 out of 7 malignant cases, missing cases of pancreatic and periampullary carcinomas.

The correlation between ultrasound and MRCP findings was evaluated using Pearson's correlation coefficient, as shown in Table 3. A positive correlation was noted between the two modalities in detecting the site of obstruction ($r = 0.48, p < 0.05$), the porta hepatis as the site of obstruction ($r = 0.47, p < 0.05$), and the ampulla as the site of obstruction ($r = 0.47, p < 0.05$). However, the correlation

between the detection of benign etiologies on USG and MRCP was weak ($r = 0.094$, $p = 0.607$), and the correlation for malignant etiologies was moderate ($r = 0.31$, $p = 0.08$).

Table 3: Correlation Between Ultrasound and MRCP Findings

Parameter	Correlation Value (r)	p-value
Obstruction on USG x Obstruction on MRCP	0.48	0.005*
Obstruction at Porta Hepatis on USG x MRCP	0.47	0.006*
Obstruction at CBD Level on USG x MRCP	0.281	0.11
Obstruction at Ampulla on USG x MRCP	0.47	0.006*
Benign Etiologies on USG x Benign Etiologies on MRCP	0.094	0.607
Malignant Etiologies on USG x Malignant Etiologies on MRCP	0.31	0.08

*p-value < 0.05 was considered significant.

The study results indicate that MRCP is superior to ultrasound in diagnosing the level and cause of obstruction in patients with obstructive jaundice. While there is a positive correlation between the two modalities for certain parameters, MRCP consistently demonstrated higher diagnostic accuracy, particularly for distal CBD calculi and malignant lesions. These findings suggest that MRCP may be a more reliable imaging modality for the evaluation of obstructive jaundice, especially in complex cases where accurate diagnosis is critical for guiding therapeutic decisions.

4 Discussion

The findings of this study demonstrated that magnetic resonance cholangiopancreatography (MRCP) exhibited superior diagnostic accuracy compared to ultrasonography (USG) in detecting the causes and levels of obstruction in patients with obstructive jaundice. MRCP's higher sensitivity in identifying distal common bile duct (CBD) calculi, biliary strictures, and malignant lesions aligned with previous research that highlighted the advantages of MRCP over other imaging modalities. This study's results supported earlier findings, such as those by Bhatt et al., which reported 100% accuracy in diagnosing benign strictures using MRCP (17). Similarly, studies by Guidbaud et al. and Soto et al. confirmed MRCP's high sensitivity and specificity in detecting CBD calculi (15,16).

USG, while widely available and cost-effective, showed limitations in visualizing the distal CBD and pancreas due to interference from bowel gas shadows. This limitation has been consistently noted in the literature, where USG is recognized as a useful screening tool but less reliable in complex cases requiring detailed visualization of the biliary tree (13,18). In this study, USG failed to detect distal CBD calculi in 11 cases that were subsequently identified by MRCP, underscoring the latter's utility in overcoming USG's limitations.

The positive correlation observed between USG and MRCP in detecting the site of obstruction, particularly at the porta hepatis and ampulla, suggested that USG could still play a role in the initial assessment of patients with obstructive jaundice, particularly in settings where MRCP is not readily available. However, the moderate correlation for malignant etiologies and the weak correlation for benign etiologies indicated that USG might not be as reliable as MRCP in distinguishing between different types of biliary obstructions. This finding was consistent with previous studies, such as those by Kumar et al. and Romognoulu et al., which reported variable accuracy for USG in detecting the site of obstruction, with MRCP offering more precise evaluations (12,14).

One of the strengths of this study was its prospective design, which allowed for a systematic comparison of USG and MRCP in the same cohort of patients. The inclusion of a relatively homogeneous patient population with a confirmed clinical suspicion of obstructive jaundice further strengthened the reliability of the findings. Additionally, the use of Pearson's correlation coefficient and kappa statistics provided a robust analysis of the agreement between the two modalities, offering valuable insights into their relative diagnostic performances.

However, the study had several limitations that should be acknowledged. The sample size was relatively small, which may limit the generalizability of the findings to larger populations. Additionally, the study was conducted at a single tertiary care center, which may not reflect the variability in clinical practice and imaging availability across different settings. The study also did not assess the cost-effectiveness of using MRCP as the primary imaging modality, which could be a consideration in resource-limited environments. Moreover, while MRCP showed higher accuracy, it is important to note that it is not as widely available as USG, and its higher cost may limit its use in certain settings.

In light of these findings, it was recommended that MRCP be considered the imaging modality of choice for evaluating patients with obstructive jaundice, particularly in cases where USG findings are inconclusive or when a detailed assessment of the biliary tree is required. USG could continue to serve as an initial screening tool, especially in resource-limited settings, but clinicians should be aware of its limitations and the potential need for further evaluation with MRCP. Future research should focus on larger, multi-center studies to validate these findings and explore the cost-effectiveness of incorporating MRCP into routine clinical practice for the diagnosis and management of obstructive jaundice.

5 Conclusion

In conclusion, while the study revealed a high level of awareness and certain strengths in waste management practices, significant gaps and areas for improvement were identified. Addressing these issues through targeted training, better resource allocation, and policy development will be crucial for enhancing the effectiveness of hospital waste management and safeguarding public health and the environment.

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Disclaimers

Author Contributions	Muhammad Sohail Nisar (MSN) contributed substantially to study design, data analysis, and manuscript writing. Syed Parvez (SP) contributed to study design, data acquisition, interpretation, and critical review. Muhammad Javed (MJ) was involved in data acquisition, interpretation, and manuscript writing. Faizan Ali Khan (FAK) contributed to data collection, analysis, and critical review. Syed Shafqat (SS) played a significant role in study design, data analysis, and manuscript writing. Saad Muhammad Zeeshan (SMZ) contributed to the study concept, data collection, and critical manuscript review. All authors gave final approval of the version to be published.
Conflict of Interest	The authors declare that there are no conflicts of interest.
Data Availability	Data and supplements available on request to the corresponding author.
Funding	NA
Ethical Approval	Institutional Review Board (IRB) Armed Forces Institute of Radiology and Imaging, Rawalpindi, Pakistan
Trial Registration	NA
Acknowledgments	NA

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~ JHRR, ISSN: 2791-156X ~