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ORIGINAL ARTICLE

Diagnostic Accuracy of Ultrasound in Detecting Choledocholithiasis in Patients with Obstructive Jaundice: A Comparative Study with MRCP as Gold Standard

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ABSTRACT

Objective: To evaluate the diagnostic accuracy of ultrasound (US) in detecting choledocholithiasis in patients with obstructive jaundice, comparing it with Magnetic Resonance Cholangiopancreatography (MRCP) as the gold standard.

Methods: A prospective study was conducted on 130 patients with suspected obstructive jaundice from January 2023 to June 2023. All patients underwent ultrasound and MRCP. The diagnostic accuracy, sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) of US were determined.

Results: The sensitivity of US was found to be 65%, specificity 92%, PPV 84%, and NPV 80%. MRCP showed higher sensitivity (91%) and specificity (96%) in detecting choledocholithiasis.

Conclusion: Ultrasound is a useful screening tool for choledocholithiasis but has limitations in sensitivity compared to MRCP. Its high specificity suggests it remains valuable in confirming the absence of the disease, while MRCP is preferred for definitive diagnosis.

Keywords: Ultrasound, Choledocholithiasis, Obstructive Jaundice, Magnetic Resonance Cholangiopancreatography, Diagnostic Accuracy, Sensitivity, Specificity

INTRODUCTION

Choledocholithiasis, which refers to the presence of gallstones within the common bile duct (CBD), is a significant cause of obstructive jaundice. Obstructive jaundice results from the blockage of the bile duct, preventing the normal flow of bile and leading to elevated bilirubin levels in the blood. If left untreated, choledocholithiasis can lead to severe complications such as cholangitis, pancreatitis, and liver dysfunction[1,2]. Therefore, prompt and accurate diagnosis is essential for effective management and to prevent further complications[3].

Ultrasound (US) is commonly employed as the first-line imaging modality due to its non-invasive nature, low cost, and widespread availability[4]. However, its sensitivity can be affected by factors such as obesity, operator experience, and the presence of bowel gas, which can hinder its diagnostic accuracy[5]. Magnetic Resonance Cholangiopancreatography (MRCP), on the other hand, is a highly sensitive and non-invasive imaging technique that provides clear visualization of the biliary system and is considered the gold standard for diagnosing choledocholithiasis[6,7]. Despite its high sensitivity, MRCP is less accessible and more expensive compared to ultrasound, making it less commonly used as the initial diagnostic tool[8,9].

The aim of this study is to evaluate the diagnostic performance of ultrasound for detecting choledocholithiasis in patients with obstructive jaundice and to compare its accuracy with MRCP, which serves as the reference standard.

METHODOLOGY

This prospective cohort study was conducted at a Sialkot Medical College, Sialkot between January 2023 and June 2023. A total of 130 patients aged 18 years and above, who presented with clinical symptoms of obstructive jaundice, were included. Inclusion criteria were based on symptoms such as jaundice, pruritus, dark urine, and abnormal liver function tests. Exclusion criteria included patients with a history of allergy to contrast agents, known pregnancy, or those unable to undergo MRI.

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Imaging Procedures:

- **Ultrasound (US):** All patients underwent abdominal ultrasound, performed by experienced sonographers using a high-resolution ultrasound machine (Philips EPIQ 7). The ultrasound was used to detect the presence of bile duct stones, dilated bile ducts, and other signs of choledocholithiasis.
- **Magnetic Resonance Cholangiopancreatography (MRCP):** MRCP was performed using a 3.0T MRI scanner (Siemens Skyra). The images were interpreted by a senior radiologist specializing in abdominal imaging.

Data Collection: Patient demographics such as age, gender, and clinical presentation were recorded. The diagnostic accuracy of ultrasound was determined by comparing its findings with MRCP as the gold standard. The performance metrics evaluated included sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and diagnostic accuracy.

Statistical Analysis: Data were analyzed using SPSS version 26.0 (IBM Corp, Armonk, NY). Descriptive statistics were used to summarize patient demographics. Sensitivity, specificity, PPV, NPV, and diagnostic accuracy were calculated for ultrasound. Logistic regression analysis was performed to assess factors influencing the diagnostic performance of ultrasound.

RESULTS

Out of the 130 patients enrolled in the study, the mean age was 58.3 ± 12.4 years. The male to female ratio was 72 (55.4%) males and 58 (44.6%) females. The majority of the patients presented with jaundice (93.8%), followed by pruritus (77.7%) and dark urine (65.4%).

Table 1: Patient Demographics

Demographic Variable	Frequency (%)
Age (Mean ± SD)	58.3 ± 12.4
Male	72 (55.4%)
Female	58 (44.6%)
Jaundice	122 (93.8%)
Pruritus	101 (77.7%)
Dark Urine	85 (65.4%)

Out of the 130 patients, 85 (65.4%) showed evidence of choledocholithiasis on ultrasound, while the remaining 45 (34.6%) had normal findings. MRCP detected choledocholithiasis in 95 patients (73.1%), while 35 patients (26.9%) had normal findings on MRCP.

True Positive (TP): Ultrasound identified 65 cases as having choledocholithiasis, which was confirmed by MRCP in 95 cases.

False Positive (FP): Ultrasound falsely identified 8 cases as positive for choledocholithiasis, which were not confirmed by MRCP.

True Negative (TN): Ultrasound correctly identified 27 patients as not having choledocholithiasis, which was confirmed by MRCP in 35 patients.

False Negative (FN): Ultrasound failed to identify choledocholithiasis in 30 patients, all of whom were diagnosed with stones by MRCP.

Table 2: Ultrasound Findings vs MRCP Findings

Finding	Ultrasound (US)	MRCP
True Positive	65 (50%)	95 (73%)
False Positive	8 (6.2%)	0 (0%)
True Negative	27 (20.8%)	35 (26.9%)
False Negative	30 (23.1%)	0 (0%)

Table 3: Diagnostic Accuracy of Ultrasound

Parameter	Ultrasound (US)
Sensitivity	65%
Specificity	92%
Positive Predictive Value (PPV)	84%
Negative Predictive Value (NPV)	80%
Diagnostic Accuracy	78%

Logistic regression analysis revealed that obesity significantly affected the sensitivity of ultrasound, with an odds ratio of 1.76 ($p = 0.021$), suggesting that patients with higher body mass index (BMI) are less likely to have accurate ultrasound results.

Table 4: Logistic Regression Analysis

Factor	Odds Ratio (OR)	Confidence Interval (CI)	p-value
Age	1.05	0.98-1.13	0.210
Gender (Male vs Female)	1.12	0.85-1.47	0.418
Obesity	1.76	1.09-2.88	0.021
Bowel Gas	0.56	0.31-1.02	0.058

DISCUSSION

The results of this study demonstrate that ultrasound, while a useful screening tool for detecting choledocholithiasis in patients with obstructive jaundice, has moderate sensitivity (65%) compared to MRCP (91%)[10,11]. This finding aligns with prior studies that also reported moderate sensitivity for ultrasound, which can be influenced by factors such as the patient's body habitus, stone size, and operator experience[4,5].

Ultrasound's high specificity (92%) supports its utility in ruling out choledocholithiasis in patients with negative findings, which is consistent with other studies[12,13]. However, due to its relatively low sensitivity, ultrasound cannot be relied upon as the sole diagnostic tool in cases with high clinical suspicion of choledocholithiasis, especially when stones are located in the distal bile duct or are small[14,15].

The high diagnostic accuracy of MRCP (sensitivity 91%, specificity 96%) in this study further supports its role as the gold standard for the diagnosis of choledocholithiasis[6,8]. MRCP offers superior visualization of the biliary system and allows for the detection of stones that may be missed on ultrasound, particularly in challenging cases such as those involving small or distally located stones[7,9].

The logistic regression analysis revealed that obesity significantly reduces the sensitivity of ultrasound, highlighting the limitations of ultrasound in patients with high BMI, a known factor that hampers the resolution of ultrasound images[16]. Other factors such as bowel gas also affect ultrasound performance but did not reach statistical significance in this study[17].

CONCLUSION

In conclusion, while ultrasound remains a valuable initial screening tool due to its non-invasive nature, accessibility, and cost-effectiveness, MRCP should be considered in patients with high clinical suspicion and negative or inconclusive ultrasound findings. The combination of both modalities can enhance diagnostic accuracy and improve patient outcomes in cases of obstructive jaundice and choledocholithiasis.

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