Section: General Surgery

Original Research Article

CLINICAL AND ULTRASOUND EXAMINATION AND ITS CORRELATION WITH MAGNETIC RESONANCE CHOLANGIO PANCREATOGRAPHY IN GALLSTONE DISEASE

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Abstract

Background: Cholelithiasis is a common condition that can lead to significant complications if not diagnosed accurately. Traditional diagnostic methods include clinical examination and ultrasound (USG), but with advancements in imaging, Magnetic Resonance Cholangiopancreatography (MRCP) has become an important tool. This study aimed to evaluate and compare the diagnostic accuracy of USG in detecting cholelithiasis and to assess their correlation with MRCP findings. **Materials and Methods:** A total of 51 patients with suspected cholelithiasis were included in this study. Clinical symptoms were recorded, and each patient underwent USG, MRCP, and measurement of bilirubin levels. The diagnostic accuracy of USG was assessed by comparing their results with MRCP, which served as the reference standard. Diagnostic metrics including sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and overall accuracy were calculated. Receiver Operating Characteristic (ROC) analysis was conducted to determine the Area Under the Curve (AUC) for both USG and bilirubin levels. **Result:** Abdominal pain was the most common symptom, reported by 76.47% of patients, while jaundice and vomiting were reported by 25.50% and 15.70% of patients, respectively. USG demonstrated high diagnostic performance with a sensitivity of 85%, specificity of 96.77%, PPV of 94.44%, NPV of 90.91%, and a diagnostic accuracy of 92.16%. The AUC for USG was 0.909 (95% CI: 0.809-1.000), indicating excellent diagnostic capability. **Conclusion:** USG was found to be a more accurate and reliable diagnostic tool for cholelithiasis. The diagnostic accuracy of USG suggests that it should be the preferred method for detecting cholelithiasis, however integrating MRCP can enhance diagnostic accuracy by providing a more comprehensive evaluation of the biliary system.

INTRODUCTION

Gallstones are crystalline deposits of bile, bilirubin, and cholesterol that form in the gallbladder or biliary tree. Gallstones can cause right upper abdomen pain, nausea, vomiting, blockage, cholangitis, and pancreatitis, especially after eating greasy or spicy foods, even though they are frequently asymptomatic and only discovered by accident.[1] A meta-analysis projected that the pooled global prevalence of gallstones was 6.1% which was reported higher among females (7.6%) than males (5.4%).[2] Gallstone disease affects roughly 6% of the population in India.[3]

Numerous clinical algorithms that evaluate the value of preoperative evaluation of gallstones have been adequately codified. These algorithms are based on clinical, biochemical, and radiological indices.[4] Gallbladder polyps, sludge, and stones as tiny as 2 mm can all be seen with ultrasound, which has a 90% specificity for stone detection. Gallbladder wall thickness more than 3 mm, pericholecystic fluid, and a painful reaction to the ultrasound probe's pressure (known as the Murphy sign) are ultrasound findings

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indicative of acute cholecystitis. While MRIs and CT scans are also frequently used to detect gallstones, they are less accurate in identifying acute cholecystitis. The calcium concentration of gallstones makes about 10% of them visible on x-rays.[5] Common duct stones can be identified with excellent sensitivity and specificity using endoscopic retrograde cholangiopancreatography (ERCP) and magnetic retrograde cholangiopancreatography (MRCP). If a common duct stone is found on MRCP, the most common treatment technique is ERCP, although MRCP is noninvasive but has limitations in terms of cost and availability.[6]

Because of its many benefits, including its affordability, ease of use, and lack of ionising radiation and contrast material required, ultrasonography is utilised as the first screening procedure.[7] However, the level of expertise of the operators and the gastrointestinal gas of the patients can easily affect the results of ultrasonography. It can also be challenging to identify structural variations in the bile duct and easy to overlook combined common bile duct stones (CBDS).[8] Traditionally, clinical examination and ultrasound have been the cornerstones of initial evaluation for gallstone disease due to their non-invasive nature and widespread availability. However, with advancements in imaging technology, Magnetic Resonance Cholangiopancreatography (MRCP) has emerged as a powerful tool offering high-resolution imaging of the biliary and pancreatic ducts, providing detailed anatomical information that can enhance diagnostic accuracy. This study aims to explore the efficacy and accuracy of clinical examination and ultrasound in the diagnosis of gallstone disease and to assess their correlation with MRCP findings.

Objective

To detect the presence of CBD stone by MRCP in cases of gallstone disease diagnosed by clinical and ultrasound examination.

MATERIALS AND METHODS

The study was a cross-sectional investigation aimed at evaluating the correlation between clinical and ultrasound examination findings with Magnetic Resonance Cholangiopancreatography (MRCP) in patients with gallstone disease. The study population consisted of patients diagnosed with gallstones who were admitted to the Department of General Surgery at Trichy SRM Medical College and Hospital. The study was conducted in the Department of General Surgery at Trichy SRM Medical College and Hospital over six months. A total of 51 patients were included in the study using universal sampling, whereby all eligible patients who met the inclusion criteria were considered for the study.

The inclusion criteria comprised patients aged between 18 and 70 years with a probable gallstone disease diagnosis as determined by clinical examination Both symptomatic and asymptomatic patients were eligible for the study. Patients were excluded if they were unwilling to undergo MRCP, unwilling to proceed with surgical intervention, or had conditions such as empyema of the gall bladder, mucocele of the gall bladder, or acute cholecystitis. Data collection involved several steps. Clinical examination was performed by a trained physician to document symptoms, physical findings, and patient history related to gallstone disease. All patients underwent abdominal ultrasound examination to identify the presence, size, and number of gallstones, as well as to assess any associated complications such as gallbladder wall thickening or bile duct dilation. MRCP was then performed on all patients to obtain detailed imaging of the bile ducts, gallbladder, and pancreatic duct. The MRCP results were used to identify and assess the gallstones and any anatomical or pathological abnormalities.

The data collection process involved several steps. First, a clinical examination was conducted by a trained physician to document symptoms, physical findings, and patient history related to gallstone disease. An ultrasound examination was performed to confirm the presence of cholelithiasis (gallstones). If cholelithiasis was present, MRCP evaluation was conducted to assess common bile duct calculi and further characterize the gallstones.

If MRCP identified choledocholithiasis (gallstones in the common bile duct), Endoscopic Retrograde Cholangiopancreatography (ERCP) was performed to address this condition. For patients with cholelithiasis but without choledocholithiasis, open or laparoscopic cholecystectomy was carried out as the surgical intervention.

The statistical analysis was conducted using the Statistical Package for the Social Sciences (SPSS) IBM Version 21.0. Baseline clinical profiles of patients were described using frequency and percentage values, while continuous variables were presented with descriptive statistics such as mean, standard deviation, and range values. To assess the agreement between different diagnostic methods, MRCP was used as the gold standard. Sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and diagnostic accuracy were calculated for ultrasound and clinical diagnoses in comparison to MRCP.

A two-sided probability of $p < 0.05$ was considered statistically significant for all statistical tests. The study aimed to evaluate the accuracy of ultrasound and clinical diagnoses compared to MRCP and provide insights into the effectiveness of these diagnostic methods in managing gallstone disease.

Ethical considerations were carefully addressed by obtaining informed consent from all participants before their inclusion in the study. The study adhered to ethical standards and guidelines, ensuring patient confidentiality and the right to withdraw from the study at any time. Data collected was recorded in a secure database with restricted access to ensure confidentiality, and data analysis was performed using SPSS statistical software. The study received

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Institutional Ethics Committee (IEC) approval from K.A.P.V. Medical College to ensure compliance with ethical standards. Informed consent was obtained from all participants before their inclusion in the study, and confidentiality was maintained throughout.

RESULTS

This study was conducted among 51 patients presenting with probable gallstone disease. The age of the participants ranged from 34 to 61 years, with a mean age of 43.98 years (± 7.146 years). The median age was 45 years. The descriptive data of the participants, as summarized in Table 1, reveals key demographic and health-related characteristics of the study cohort. Out of the 51 participants, 32 individuals (62.7%) were 40 years of age or younger, while 19 individuals (37.3%) were older than 40 years. This indicates a predominance of younger patients in the study. Regarding gender distribution, there were 22 males (43.1%) and 29 females (56.9%), reflecting a slightly higher proportion of females in the cohort. In terms of comorbid conditions, the majority of participants did not have significant comorbidities, with 34 individuals (66.66%) classified as having no notable comorbid conditions. Diabetes mellitus (DM) was present in 11 participants (21.56%), and hypertension (HT) was observed in 6 participants (11.76%). These figures illustrate the overall health profile of the participants, with a significant proportion being relatively free of chronic conditions, while diabetes and hypertension were less common.

[Figure 1] illustrates the prevalence of clinical symptoms reported by patients in the study. The most common symptom was abdominal pain, experienced by 39 patients, which corresponds to 76.47% of the cohort. This was followed by jaundice, reported by 13 patients (25.50%). Vomiting was less common, occurring in 8 patients (15.70%). Notably, 10 patients (19.60%) reported no symptoms. These findings highlight that abdominal pain was the predominant symptom among patients, with other symptoms such as jaundice and vomiting being less frequent.

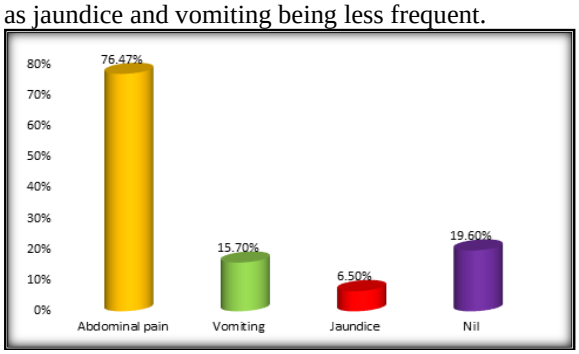

Figure 1: Clinical symptoms of patients

[Table 2] compares the diagnostic outcomes of cholelithiasis as determined by ultrasound (USG) with those obtained through Magnetic Resonance Cholangiopancreatography (MRCP). Among the 51 patients, 17 patients with a positive USG result were also confirmed as positive by MRCP, representing 94.4% agreement. Conversely, 1 patient with a positive USG result was found negative by MRCP, which constitutes 5.6% of this group. For those with a negative USG result, 3 patients (9.1%) were confirmed positive by MRCP, while 30 patients (90.9%) were negative according to MRCP.

The comparison yielded a p-value of 0.001, indicating a statistically significant correlation between USG and MRCP findings in diagnosing cholelithiasis.

[Table 3] presents the diagnostic accuracy metrics for cholelithiasis diagnosis using ultrasound (USG). USG demonstrated an 85% sensitivity, indicating its strong ability to correctly identify patients with cholelithiasis. USG had a high specificity of 96.77%, meaning it effectively identified patients without cholelithiasis. USG had a PPV of 94.44%, suggesting a high likelihood that a positive test result accurately reflects the presence of cholelithiasis. USG had an NPV of 90.91%, showing that a negative result is a reliable indicator of the absence of cholelithiasis.

The AUC of 0.909 (95%CI: 0.809 – 1) indicates that USG has an excellent ability to discriminate between patients with and without cholelithiasis. Figure 2 shows the ROC curves of USG levels.

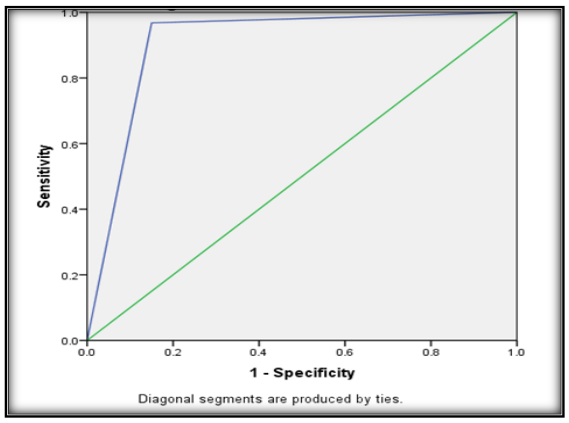

Figure 2: ROC Curve of USG

Table 1: Descriptive data of participants.

S No	Variables		Frequency	Proportion
1	Age	> 40 years	19	37.3%
		≤ 40 years	32	62.7%

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2	Gender	Male	22	43.1%
		Female	29	56.9%
3	Comorbid	DM	11	21.56%
		HT	6	11.76%
		Normal	34	66.66%

Table 2: Diagnosis of cholelithiasis by USG compared with MRCP (n = 51)

S No	USG	MRCP cholelithiasis	MRCP	p-value
1	Positive	17 (94.4%)	1 (5.6%)	0.001
2	Negative	3 (9.1%)	30 (90.9%)	

Table 3: Diagnostic accuracy of USG

S No	Parameters	USG
1	Sensitivity	85%
2	Specificity	96.77%
3	Positive predictive value	94.44%
4	Negative predictive value	90.91%
5	Diagnostic accuracy	92.16%

DISCUSSION

Clinical profile and Biochemical parameters: The symptomatology observed in our study revealed that abdominal pain was the most common complaint, reported by 76.47% of patients. This is consistent with the known presentation of cholelithiasis, where abdominal pain is frequently associated with gallstone disease. Jaundice and vomiting were reported less frequently, at 6.5% and 15.70%, respectively. The 19.60% of patients who reported no symptoms underscore the variability in clinical presentation and the potential for asymptomatic cases, which can complicate diagnosis based solely on clinical symptoms.

Ultrasonogram: This study highlights the efficacy of ultrasound (USG) in diagnosing cholelithiasis, demonstrating high-performance metrics including a sensitivity of 85%, specificity of 96.77%, positive predictive value (PPV) of 94.44%, negative predictive value (NPV) of 90.91%, and an overall diagnostic accuracy of 92.16%. USG's ability to detect gallstones is well-supported by its imaging characteristics. Gallstones typically appear as echogenic foci in the gallbladder lumen, exhibiting posterior acoustic shadowing due to their high echogenicity. This shadowing is generally complete and devoid of reverberation artifacts, which enhances the diagnostic clarity and accuracy of USG in detecting gallstones. The sensitivity and specificity reported in this study align with the established understanding that USG is highly effective in identifying gallstones and assessing their impact on the gallbladder.[9] Khalid et al,[10] from Pakistan reported a sensitivity and specificity of 84.62% and 90.63% for USG in diagnosing obstructive jaundice, which corroborates our high specificity.

Samara et al,[11] study observed that USG's accuracy (76.1%) was lower than MRCP's, highlighting that while USG is effective, MRCP provides a more comprehensive view of ductal dilation and stone detection. They noted that USG had 7.8% false positives and 16% false negatives, further underscoring the need for complementary imaging in certain cases. Ahmed et al,[12] found a sensitivity of 85% and specificity of 100% for USG in detecting gallstones, reinforcing the reliability of USG in stone detection. Conversely, Kaur et al,[13] from Punjab reported a lower overall sensitivity of 60% but high specificity (100%) and diagnostic accuracy (97%) for biliary obstruction, suggesting variability in USG performance based on the type of biliary condition.

Swaraj S et al,[14] from India reported a significant drop in USG's ability to accurately identify biliary obstruction, with only 33.3% sensitivity and 64.3% diagnostic accuracy compared to MRCP. This highlights the limitations of USG in diagnosing specific types of biliary obstruction and underscores the importance of using MRCP for a more precise assessment. Singh et al,[15] from India observed detection rates of 89.75% for gallstones and 76.19% for common bile duct stones using USG. These results are consistent with our study, affirming USG's effectiveness in detecting gallstones but also illustrating its limitations in detecting CBD stones compared to MRCP. However, when evaluating choledochal diameter, our findings align with those of Virzi et al,[16] from Italy, who reported that USG had a sensitivity of only 14.3% and a specificity of 95.9% for detecting ductal dilation in patients with gallbladder stones. Virzi et al.'s study also noted a PPV of 20% and an NPV of 94% for USG in this context. In contrast, Magnetic Resonance Cholangiopancreatography (MRCP) showed a higher sensitivity for detecting choledochal calculi, identifying stones in 7 out of 104 patients (6.7%).

These findings suggest that while USG is highly effective for detecting gallstones, it has limitations in assessing ductal structures and dilation. USG is highly effective in detecting cholelithiasis with excellent diagnostic accuracy, it has limitations in assessing choledochal diameter and biliary obstruction.

MRCP offers superior diagnostic capability in this area, highlighting the need for complementary imaging techniques to achieve a comprehensive evaluation of biliary conditions. Complementary use of MRCP can enhance diagnostic accuracy by

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providing a more comprehensive evaluation of the biliary system. This study supports the integration of USG with MRCP for a more robust diagnostic approach to cholelithiasis and related biliary conditions. You et al,[17] found that the MRCP demonstrated better diagnostic performance in choledocholithiasis detection. McMahon C et al,[18] also suggested that for common duct calculi, MRCP ought to be the initial line of inquiry. Guo et al,[8] described that the preoperative MRCP is useful in planning surgical procedures and minimizing surgical problems because it can identify conditions that abdominal ultrasonography cannot diagnose, such as CBDS, cystic duct stones, and morphological variants of the biliary tract. In patients with suspected cholecystitis, MRCP would be a suitable first-line modality for evaluating common bile duct stones because of its absence of radiation and contrast enhancement.

CONCLUSION

In conclusion, this study affirmed that ultrasound (USG) is a highly effective and reliable diagnostic tool for cholelithiasis. USG demonstrated superior sensitivity, specificity, and overall diagnostic accuracy, with an Area Under the Curve (AUC) of 0.909. The findings highlighted that USG's high diagnostic accuracy makes it a preferred choice for identifying cholelithiasis, as it consistently provides a more precise assessment than symptoms alone. USG remains a robust and reliable method for diagnosing cholelithiasis, it is not without its limitations. Complementary use of MRCP is recommended for a comprehensive evaluation, especially in cases involving ductal dilation or complex biliary conditions. Integrating both USG and MRCP into diagnostic protocols can enhance overall diagnostic accuracy and improve patient management in cholelithiasis and related biliary disorders.

Limitations

- The study included a relatively small sample size of 51 patients. A larger sample would enhance the generalizability of the results and provide a more robust assessment of the diagnostic accuracy of both ultrasound (USG) and bilirubin levels.
- The study did not address potential complications or additional findings related to cholelithiasis, such as acute cholecystitis or pancreatitis. Including such data might offer a more comprehensive view of the impact of diagnostic accuracy on patient management and outcomes.

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