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Original Research Article

COMPARISON OF DIAGNOSTIC ACCURACY OF ULTRASONOGRAPHY AND MAGNETIC RESONANCE CHOLANGIOPANCREATOGRAPHY IN BILIARY AND PANCREATIC PATHOLOGIES

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ABSTRACT

Background: Biliary and pancreatic pathologies are common causes of morbidity and include gallstones, strictures, and neoplasms. Early and accurate imaging is crucial for effective management. Ultrasonography (USG) is the first-line investigation, while magnetic resonance cholangiopancreatography (MRCP) has emerged as a superior, non-invasive diagnostic tool. **Objective:** To compare the diagnostic accuracy of USG and MRCP in evaluating biliary and pancreatic pathologies.
Materials and Methods: This cross-sectional study was conducted over 18 months at tertiary care hospital, Mohali, including 90 patients suspected of biliary or pancreatic disease. All underwent both USG and MRCP. Transabdominal USG was performed on all patients with suspected pancreaticobiliary pathologies using a curvilinear probe (2-5 Hz) on GE VOLUSON E8 and GE LOGIQ F6 USG machines, focusing on the details of the Liver, GB, pancreas, and the biliary system. The findings were recorded in a proforma for comparison. MRCP was performed on a 1.5 Tesla GE BRIO 360 MRI system, using a phased array body coil. All the listed protocols obtained heavily T2-weighted sequences. Sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) of USG were calculated in comparison with MRCP.
Results: The mean age was 57.98 ± 15.65 years (range 21–87), with 52 females (57.8%) and 38 males (42.2%). On USG, gallbladder calculi were detected in 63.3% and CBD calculi in 1.1%, while MRCP detected gallbladder calculi in 65.6% and CBD calculi in 16.7%. MRCP identified more pancreatic masses (7.8%) compared to USG (2.2%). Overall, USG demonstrated sensitivity of 66.7%, specificity of 100%, PPV of 100%, and NPV of 93.8% compared with MRCP.
Conclusion: USG is a highly specific and valuable first-line imaging tool for detecting common biliary conditions such as cholelithiasis and gallbladder mass lesions.
Keywords: Ultrasonography, MRCP, Biliary obstruction, Pancreatic pathology, Diagnostic accuracy.

INTRODUCTION

Pancreatic and biliary pathologies are frequent clinical problems worldwide and include gallstones, cholecystitis, choledocholithiasis, strictures, and malignancies.[1] These conditions can present with nonspecific symptoms such as jaundice, abdominal pain, fever, and weight loss, making imaging a cornerstone of diagnosis.[2] The role of radiology is to identify the etiology, location, and extent of disease, thereby guiding appropriate therapy.[3]

Ultrasonography (USG) is typically the first-line imaging modality in suspected biliary and pancreatic diseases, with good sensitivity for gallstones and intrahepatic duct dilatation.[4] However, limitations include poor visualization of the distal common bile duct (CBD) due to overlying bowel gas or obesity.[5,6] MRCP, a non-invasive MRI technique uses heavily T2-weighted sequences to visualize fluid-filled structures such as the biliary tree and pancreatic ducts.7 It avoids ionizing radiation and contrast risks associated with CT or ERCP.[8] MRCP can detect stones as small as 2 mm and provides detailed information about strictures, cysts, and masses. Its sensitivity for CBD stones is superior to USG and CT, and comparable with ERCP.[9]

Multiple studies comparing USG and MRCP have demonstrated higher sensitivity and specificity of MRCP, especially for choledocholithiasis and strictures.[10] Nonetheless, USG remains invaluable as a rapid, low-cost first-line investigation.[11] The present study compares the diagnostic performance of USG and MRCP in biliary and pancreatic pathologies, using surgical, ERCP, histopathological, or clinical endpoints as reference standards.

Objectives

1. To compare the diagnostic accuracy of USG and MRCP in biliary and pancreatic pathologies.
2. To study the radiological findings in biliary and pancreatic pathologies using USG and MRCP.

MATERIALS AND METHODS

This cross-sectional analytical study was carried out in the Department of Radiodiagnosis, in a tertiary care centre, Mohali, Punjab (India) over a period of 18 months. Patients clinically suspected to have biliary or pancreatic disease and had undergone both USG and MRCP were included in the study and those who underwent only one imaging modality, had contraindications to MRI such as pacemakers, metallic implants, or claustrophobia, or if they declined to provide informed consent were excluded from the study. Institutional ethical committee approval was obtained before the start of the study. Informed written consent was obtained from all study participants, confidentiality was maintained throughout the study and in accordance to the Declaration of Helsinki.

USG was performed using GE VOLUSON E8 and LOGIQ F6 machines with 2–5 MHz curvilinear probes. The liver, gallbladder, pancreas, and biliary ducts were evaluated after a fasting period of 6–8 hours to ensure gallbladder distension and to minimize bowel gas. MRCP was performed on a 1.5 Tesla GE BRIO 360 MRI system using a phased-array body coil. The imaging protocol included Ax SSFSE BH ARC, 3D MRCP RTr ASSET, axial and coronal FIESTA, axial T1 FSPGR BH, and axial diffusion-weighted imaging (DWI). Heavily T2-weighted sequences were acquired for optimal visualization of the biliary and pancreatic ducts.

The imaging parameters evaluated included gallbladder lesions such as stones, polyps, and masses; the status of the common bile duct (CBD) with regard to calibre, calculi, strictures, or masses; dilatation of intrahepatic biliary radicals (IHBR); and lesions in the liver and pancreas. The sample size was calculated based on a reported specificity of USG of 80% in a study by Kumari et al,[19] and allowable error of 10%. The minimum sample size required was 75, which was adjusted to 90 to account for potential non-response. Hence, 90 consecutive patients who were clinically suspected of having biliary or pancreatic pathology and were referred for imaging were included in the study.

Data were analyzed using SPSS version 26. Quantitative variables were expressed as mean ± standard deviation (SD), while categorical variables were presented as frequencies and percentages. Diagnostic accuracy parameters of USG were calculated using MRCP as the reference standard. A p-value of ≤ 0.05 was considered statistically significant. Ethical clearance was obtained from the institutional ethics committee, and written informed consent was obtained from all participants.

RESULTS

The mean age of the study population was 57.98 ± 15.65 years, ranging from 21 to 87 years. There was a female predominance, with 52 patients (57.8%) female and 38 (42.2%) male. Regarding mass lesions, ultrasonography detected gallbladder masses in 5 patients (5.6%), liver masses in 4 patients (4.4%), and pancreatic masses in 2 patients (2.2%). MRCP demonstrated similar detection of gallbladder masses in 5 patients (5.6%) but identified liver masses in 5 patients (5.6%) and pancreatic masses in 7 patients (7.8%), indicating greater sensitivity for pancreatic pathology.

Evaluation of ductal dilatation revealed that USG detected intrahepatic biliary radical (IHBR) dilatation in 21 patients (23.3%), common hepatic duct (CHD) dilatation in 20 patients (22.2%), common bile duct (CBD) dilatation in 24 patients (26.7%), and pancreatic duct (PD) dilatation in 3 patients (3.3%). In contrast, MRCP demonstrated higher detection rates, identifying IHBR dilatation in 28 patients (31.1%), CHD dilatation in 32 patients (35.6%), CBD dilatation in 27 patients (30%), and PD dilatation in 7 patients (7.8%). USG identified gallbladder calculi in 57 patients (63.3%) and CBD calculi in only 1 patient (1.1%). MRCP, however, detected gallbladder calculi in 59 patients (65.6%) and CBD calculi in 15 patients (16.7%), highlighting its superior sensitivity for choledocholithiasis. [Table 1]

On USG, the most frequent diagnosis was cholelithiasis, observed in 56 patients (62.2%). One patient (1.1%) had combined cholelithiasis with choledocholithiasis, while gallbladder polyps were detected in 7 patients (7.8%). Gallbladder masses were identified in 5 patients (5.6%), liver masses in 4 patients (4.4%), and pancreatic masses in 2 patients (2.2%). MRCP revealed a slightly different distribution of pathologies. Cholelithiasis was identified in 43 patients (47.8%), while combined cholelithiasis with choledocholithiasis was detected in 14 patients (15.6%). In addition, MRCP detected CBD strictures in 5 patients (5.6%) and a choledochal cyst in 1 patient (1.1%). Gallbladder polyps were seen in 7 patients (7.8%) and gallbladder masses in 5 patients (5.6%). Liver masses were identified in 5 patients (5.6%), and pancreatic masses were noted in 7 patients (7.8%), again demonstrating MRCP's greater sensitivity for pancreatic pathology compared to USG. [Table 2]

Table 1: Comparison of abnormalities detected in USG and MRCP

Abnormalities detected	USG Freq (%)	MRCP Freq (%)
Gallbladder mass	5 (5.6)	5 (5.6)
Liver mass	4 (4.4)	5 (5.6)
Pancreatic mass	2 (2.2)	7 (7.8)
IHBR dilatation	21 (23.3)	28 (31.1)
CHD dilatation	20 (22.2)	32 (35.6)
CBD dilatation	24 (26.7)	27 (30.0)
PD dilatation	3 (3.3)	7 (7.8)
Gallbladder calculi	57 (63.3)	59 (65.6)
CBD calculi	1 (1.1)	15 (16.7)

Table 2: Spectrum of diagnoses by USG and MRCP

Diagnoses	USG Freq (%)	MRCP Freq (%)
Cholelithiasis	56 (62.2)	43 (47.8)
Cholelithiasis + choledocholithiasis	1 (1.1)	14 (15.6)
CBD stricture	–	5 (5.6)
Choledochal cyst	–	1 (1.1)
Gallbladder polyp	7 (7.8)	7 (7.8)
Gallbladder mass	5 (5.6)	5 (5.6)
Liver mass	4 (4.4)	5 (5.6)
Pancreatic mass	2 (2.2)	7 (7.8)
No abnormality detected	15 (16.7)	3 (3.3)
Total	90 (100)	90 (100)

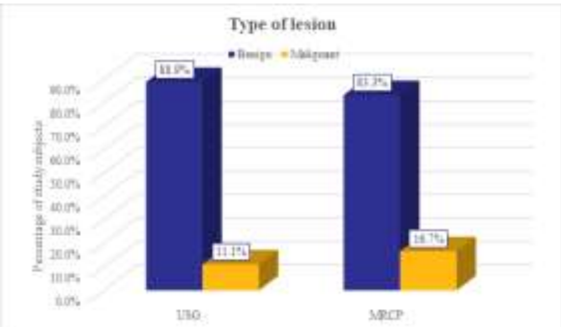

Figure 1: Comparison of Detection of type of lesion by USG and MRCP (p-value: 0.281)

Ultrasonography classified 80 patients (88.9%) as having benign disease and 10 patients (11.1%) as malignant. Among the malignant cases detected by USG, 5 were gallbladder cancers, 3 were liver malignancies, and 2 were pancreatic cancers. MRCP, on the other hand, identified 75 patients (83.3%) with benign disease and 15 patients (16.7%) with malignancy. The malignant cases detected on MRCP comprised 5 gallbladder cancers, 4 liver malignancies, and 6 pancreatic cancers, however the difference was statistically not significant with a p-value of 0.281. [Figure 1]

The sensitivity of USG was 66.7%, indicating that approximately one-third of cases were missed, however specificity was 100%, meaning that whenever USG detected a lesion, it was invariably correct. The positive predictive value was also 100%, and negative predictive value was 93.8%.

Table 3: Diagnostic accuracy of USG in comparison to MRCP

Diagnostic Statistic	Value	95 Confidence Interval
Sensitivity	66.7	38.4 to 88.2
Specificity	100.0	95.2 to 100.0
Positive Predictive Value	100.0	69.2 to 100.0
Negative Predictive Value	93.8	88.0 to 96.8

DISCUSSION

Biliary and pancreatic diseases represent a significant proportion of gastrointestinal pathology worldwide, often presenting with overlapping and nonspecific clinical features that necessitate accurate imaging for timely diagnosis and management. The present study directly compares the diagnostic performance of USG and MRCP. By evaluating their relative strengths and limitations across a spectrum of benign and malignant hepatobiliary and pancreatic conditions, this study provides practical insights that can inform imaging algorithms, optimize resource utilization, and ultimately improve patient care.

The present study enrolled 90 participants with a mean age of 57.98 years, with a broad age range from 21 to 87 years. This age distribution is consistent with other studies examining pancreaticobiliary pathologies, where older age groups are commonly affected. In a study conducted by Singh et al. (2014), the mean age of the patients was 58 years, which aligns closely with the present study's findings.[14] Similar findings were observed in Kaur et al. (2018), where the mean age of participants was also around 57 years.[15] Kumari et al. (2022) reported a broader age range, similar to the present study, with the mean age of patients being around 60 years.[13]

In the present study, USG detected gallbladder masses in 5.6% of patients, liver masses in 4.4%, and pancreatic masses in 2.2%. These results are comparable with Kaur et al. (2018), who reported gallbladder masses in 14% of their cohort, and with Prusty et al. (2019), who observed a prevalence of 8%.[15,16] Liver masses in 4.4% of patients in this study were consistent with Singh et al. (2014), who noted liver masses in 5%.[14] Pancreatic masses were observed in 2.2% of patients, aligning with Hanif et al. (2020), who reported pancreatic lesions in 3 cases.[17]

On MRCP, gallbladder and liver masses were detected in 5.6% each, while pancreatic masses were identified in 7.8%, demonstrating higher sensitivity for pancreatic pathology. Singh et al. (2014) also found gallbladder masses in 12% of their patients, while Prusty et al. (2019) reported a prevalence of 9%.[14,16] The liver mass prevalence (5.6%) aligned with Kaur et al. (2018), who found liver masses in 5%.14 Notably, pancreatic masses were more frequent on MRCP (7.8%), similar to Hanif et al. (2020), who detected them in 6 patients.[17] These findings emphasize MRCP's superiority in detecting pancreatic malignancies, which are often missed on USG.

On USG, ductal dilatation was identified in 23.3% of patients for IHBR, 22.2% for CHD, 26.7% for CBD, and 3.3% for PD. These results are consistent with Singh et al. (2014), who reported similar rates of CBD and IHBR dilatation.[14] Prusty et al. (2019) also reported CBD dilatation in 25% and IHBR in 21% of cases, closely matching the present study.[16] MRCP demonstrated higher detection rates, with dilatation observed in 31.1% for IHBR, 35.6% for CHD, 30.0% for CBD, and 7.8% for PD. These findings were comparable to Singh et al. (2014), who reported CBD dilatation in 28% and CHD dilatation in 32%.[14] Kaur et al. (2018) observed CHD dilatation in 24% of patients, while Hanif et al. (2020) reported PD dilatation in 5%.[14,17] The higher detection rate in the present study highlights MRCP's enhanced ability to evaluate obstructive processes, particularly strictures and pancreatic duct involvement.

USG detected gallbladder calculi in 63.3% and CBD calculi in only 1.1%. These results are consistent with Singh et al. (2014), who reported gallbladder stones in 60%, and Kaur et al. (2018), who noted a similarly low incidence of CBD calculi on USG.[14,15] MRCP detected gallbladder calculi in 65.6% and CBD calculi in 16.7%. Hanif et al. (2020) reported a comparable CBD stone detection rate of 17% using MRCP.17 Prusty et al. (2019) also found gallbladder calculi in 64% of cases, consistent with this study's 65.6%.16 These findings confirm MRCP's superior sensitivity in detecting choledocholithiasis.

USG classified 88.9% of lesions as benign and 11.1% as malignant. Similar findings were noted by Singh et al. (2014), where 85% of cases were benign and Prusty et al. (2019), who reported 87% benign lesions.[14,16] MRCP detected 83.3% benign and 16.7% malignant lesions, demonstrating a higher malignancy detection rate compared to USG. Kaur et al. (2018) also reported that MRCP was more sensitive (94%) for detecting malignancy, while Hanif et al. (2020) identified malignant lesions in 18%.[15,17]

In the present study, USG showed a sensitivity of 66.7% (95% CI: 38.4–88.2), consistent with Kaur et al. (2018), who reported sensitivity of 60–70%.15 Specificity was 100% (95% CI: 95.2–100), highlighting USG's ability to avoid false positives, a finding similar to Prusty et al. (2019).[14,16] The positive predictive value was 100%, indicating that all lesions detected by USG were true positives, consistent with Hanif et al. (2020).[17] However, the negative predictive value was 93.8%, suggesting that a small proportion of negative USG findings could still harbor disease.

Limitations & Recommendations

Being a single-center study, the findings may not be fully generalizable to wider populations with differing demographic or disease profiles. Future research should focus on larger multicenter studies to validate these findings across diverse patient populations.

CONCLUSION

USG remains a highly specific and valuable first-line imaging tool for detecting common biliary conditions such as cholelithiasis and gallbladder mass lesions. The high specificity and positive predictive value of USG suggest its reliability in ruling out significant pathology when the results are negative. The present study's findings confirm the complementary roles of USG and MRCP, with USG being effective for initial screening and MRCP serving as an advanced imaging modality for more detailed evaluation, especially in cases where USG findings are inconclusive.

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