DIAGNOSTIC ACCURACY OF ULTRASOUND SONOGRAPHY TEST AND COMPUTED TOMOGRAPHY COMPARED WITH MAGNETIC RESONANCE CHOLANGIO PANCREATOGRAPHY IN PATIENTS WITH OBSTRUCTIVE JAUNDICE CONSIDERING ENDOSCOPIC RETROGRADE CHOLANGIO PANCREATOGRAPHY AS GOLD STANDARD

Muhammad Sehran Khalid[1], Sadaf Arooj[1,2], Awais Ahmed[1], Ali Mansoor[1-3], Mahjabeen Masood[1]

[1] Department of Radiology, Mayo Hospital Lahore, Pakistan
[2] Department of Radiology, Jinnah Hospital Lahore, Pakistan
[3] Department of Radiology, Lahore General Hospital - Pakistan

Address for correspondence:
Muhammad Sehran Khalid
Department of Radiology, Mayo Hospital Lahore, Pakistan

E-mail:
sehrankhalid@gmail.com

Date Received:
28th February, 2023
Date Revised:
9th July, 2023
Date Accepted:
16th July, 2023

This article may be cited as
Khalid MS, Arooj S, Ahmed A, Mansoor A, Masood M. Diagnostic accuracy of ultrasound sonography test and computed tomography compared with magnetic resonance cholangio pancreatography in patients with obstructive jaundice considering endoscopic retrograde cholangio pancreatography as gold standard. J Postgrad Med Inst 2023;37(3): 201-07. http://doi.org/10.54079/jpmi.37.3.3226

ABSTRACT

Objective: To determine the diagnostic accuracy of USG and CT compared with MRCP in the patients with obstructive jaundice considering ERCP as the gold standard

Methodology: This cross-sectional study at Mayo Hospital, Lahore, spanned 6 months and included 71 cases meeting predefined criteria. A senior radiologist prepared all reports. The study used preliminary ultrasound, CECT abdomen, and MRCP for patients with cholestatic jaundice, comparing results with ERCP. MRCP showed higher diagnostic accuracy.

Results: MRCP proved to be the most accurate in diagnostic accuracy. Its sensitivity and specificity for benign conditions were 94.87% and 93.75% while for CT it was 87.18% and 81.25% and for USG it was 84.62% and 90.63% respectively. For malignant conditions sensitivity and specificity for MRCP was 93.75% and 97.44% for CT it was 87.5% and 92.31% and for USG it was 81.25% and 89.74% respectively.

Conclusion: The results of this study demonstrate that MRCP is a superior modality, exhibiting higher sensitivity, specificity, and diagnostic accuracy for evaluating both malignant and benign conditions in patients with obstructive jaundice compared to USG and contrast-enhanced CT. MRCP's specificity for various etiologies matches that of ERCP, which is considered the gold standard. While MRCP's cost and availability may be a concern, its non-invasiveness, contrast-free nature, and high diagnostic accuracy make it an ideal choice for evaluating patients with obstructive jaundice.

Keywords: Diagnostic accuracy; Ultrasonography; Computerized tomography, Obstructive Jaundice

INTRODUCTION

Obstructive jaundice is a fairly prevalent condition resulting from a range of etiological factors, leading to yellowish discoloration of the skin and mucous membranes due to hyperbilirubinemia (bilirubin greater than 2.5 mg/dl).[1] One study determined that 17.1% of jaundice cases are obstructive, commonly due to pancreaticobiliary pathologies.[2] Obstructive jaundice can be of intrahepatic or extrahepatic types. The extrahepatic type is further divided into intraductal causes, such as stones, strictures, neoplasms, or sclerosing cholangitis, and extraductal causes, including compression due to periampullary carcinoma, carcinoma of the head of the pancreas, cystic duct stone (Mirizzi syndrome), or pancreatitis.[3]

With the evolution in therapeutic modalities for various etiologies of obstructive jaundice, diagnostic methods have also advanced over time. Now, it is essential not only to diagnose obstructive pathology but also to identify the level of obstruction, involved segment, structural abnormalities, and staging in case of infiltrative disease. This approach helps in selecting the most appropriate management option for the patient. According to one study, the relative prevalence of different etiologies such as choledocholithiasis, tumors of the papilla of Vater, pancreatic head tumors, common bile duct strictures, and cholangiocarcinoma are 54%, 17%, 13%, 5%, 2%, respectively, with 2% of unidentifiable causes.[4] Benign etiologies account for 64%, while malignant etiologies account for 36% of the cases of obstructive jaundice.[5]

The role of ultrasound in determining biliary tract pathologies is profound, providing a noninvasive, cheap, and readily available screening modality with significant diagnostic sensitivity. Moreover, it serves as a basic diagnostic tool to screen patients with obstructive jaundice. The sensitivity and specificity of USG are around 84.57% and 79.10%, respectively.[6] CECT has a fairly good sensitivity of 91.6%, according to one study, but it carries potential hazards of ionizing radiations and contrast infusion.[7]

The role of CT is more pronounced in cases of infiltrative disease and accurately determining the level of involvement in the diseased segment. However, it struggles with the detection of radiolucent bilious stones. On the other hand, MRCP, being a contrast-free and non-invasive modality, excels in diagnosing most etiologies due to its superior contrast resolution. It provides detailed information about infiltrative processes, radiolucent bilious stones, level of obstruction, involved segments, and structural anomalies, among others. MRCP uses HASTE, RARE, and fast spin echo sequences to produce heavily weighted T2 images, effectively imaging the hepatobiliary system.[8]

According to one study, MRCP has a sensitivity and specificity of 97% and 98%, respectively.[9] ERCP, involving endoscopic-guided catheterization and visualization of the pancreaticobiliary system, has several drawbacks, notably morbidity (7%), mortality (1%), unsuccessful cannulation of bile ducts (3-7%), limited or no opacification of bile ducts distal to the obstruction, operator dependence, and post-ERCP pancreatitis.[10] Due to these shortcomings and its matching sensitivity and specificity with MRCP, MRCP can be used as the primary imaging modality in patients with obstructive jaundice. It provides the most accurate results when compared to the gold standard of ERCP, making it the most useful noninvasive diagnostic modality.

Our study compares the diagnostic accuracy of ultrasound, CT, and MRCP with ERCP in diagnosing and differentiating various etiologies of obstructive jaundice, providing insights into their differences in diagnostic accuracy. This comparison helps the referring physician in understanding which etiology should be best imaged and evaluated with a specific diagnostic modality. Furthermore, the detailed comparison provides the referring physician with appropriate grounds to decide on different therapeutic options for different etiologies of obstructive jaundice.

METHODOLOGY

This was a cross-sectional analytical study carried out at the Department of Radiology, Mayo Hospital, Lahore. The study was conducted over a 6-month period, and it included patients of either gender, male and female, aged greater than 12 years, presenting with signs and symptoms of obstructive jaundice. These symptoms included biliary colic, scleral icterus, yellowing of the skin and mucous membranes, epigastric pain, and weight loss. Patients referred from the Department of General Surgery were diagnosed with obstructive jaundice (having Bilirubin greater than 2.5 gm/dl) and underwent initial screening with USG. Suspicious lesions in the biliary system detected on ultrasonography were further evaluated using contrast-enhanced CT and MRCP.

The study excluded patients with known allergic reactions to low osmolar contrast agents for enhanced CT, impaired renal function (GFR $<$ 30 ml/min or creatinine $>$ 1.2 mg/dl), prehepatic or hepatic jaundice, patients with pacemakers, prosthetic valves, aneurysm clips, plates, or any other ferromagnetic material, patients with claustrophobia, and patients with disseminated metastatic pancreaticobiliary disease meant for palliative care rather than diagnosis.

For this study, a sample size of 71 was calculated with a prevalence of obstructive jaundice of 17%, sensitivity of 97%, specificity of 98%, confidence interval (Z) of 95%, and margin of error (d) of 10%. The non-probability purposive sampling technique was used for sample selection. Cultural ethics were observed to respect patient privacy and ensure proper confidentiality of patient data. Informed consent was obtained from all patients before enrolling them in the study, and their biodata and clinical history were recorded through a performa. All reporting was done by a senior radiologist with 5-10 years of experience.

Preliminary ultrasound of the hepatobiliary system and pancreas was performed under the guidance of a consultant radiologist using Esaote my lab 8 ultrasound machines. USG served as a basic diagnostic screening tool to differentiate patients with non-obstructive and obstructive jaundice, along with the assessment of direct and indirect bilirubin values. Patients who underwent screening were then subjected to enhanced CT abdomen using Prime Aquilian, Toshiba, 160 slice CT machines. 150 ml of contrast was injected with a microinjector at a rate of 5cc per sec. Subsequently, MRCP was performed using GE Healthcare, sigma voyager, and 1.5 Tesla MRI machines.

The final step of ERCP was performed by an experienced consultant gastroenterologist. This step involved direct visualization of the lesion, biopsy, or any other appropriate intervention. The results of USG, CT, and MRCP were then compared to the results of ERCP.

Data was entered and analyzed using SPSS 23. Mean and standard deviation were calculated for quantitative variables, while frequency and percentage were calculated for qualitative variables. A 2x2 contingency table was generated to calculate sensitivity, specificity, negative predictive value, positive

predictive value, and accuracy. The comparison of ultrasound enhanced abdominal CT, and MRCP was done using ERCP as the gold standard. Bias was avoided by using a uniform source of information and an efficient questionnaire, and the USG, CT, and MRI machines were standardized and checked for artifacts.

RESULTS

In this study, a total of 71 patients presenting with signs and symptoms of obstructive jaundice were included. The mean age of the patients was 33.73±8.25 years, with an age range between 20-50 years. Among these patients, 32 (45.1%) were male, and 39 (54.9%) were female. Benign pathologies were diagnosed in 39 (54.9%) patients, while malignant pathologies were diagnosed in 32 (45.1%) patients. Table-1 describes the benign and malignant pathologies diagnosed among the patients.

MRCP exhibited the highest diagnostic accuracy and showed the highest sensitivity and specificity in diagnosing both benign and malignant conditions, with sensitivity of 94.8% and 93.7%, respectively. CECT showed sensitivity of 87.1% and 87.5%, while USG showed sensitivity of 84.6% and 81.2% in benign and malignant conditions, respectively. Table-2 and Table-3 compare the sensitivity, specificity, and diagnostic accuracy of MRCP, CT, and ultrasound in benign and malignant conditions, respectively.

DISCUSSION

The evolution of diagnostic imaging has significantly improved the diagnosis of biliary tract diseases. Diagnostic procedures range from invasive methods like endoscopic retrograde cholangiopancreatography (ERCP), percutaneous transhepatic cholangiography (PTC), and endoscopic ultrasound (EUS) to noninvasive techniques such as ultrasound, multidetector CT (MDCT), and magnetic res-

Table 1: Diagnosed pathologies among patients

	Diagnosis		Total
	Benign	Malignant	
Benign stricture	12(30.8%)	-	12
CA head of pancreas	-	4(12.5%)	4
Cholangiocarcinoma	-	16(50%)	16
Cholangitis	4(10.3%)	-	4
Choledocholithiasis	23(59%)	-	23
Periampullary carcinoma	-	12(37.5%)	12
Total	39	32	71

Table 2: Diagnostic Accuracy of MRCP, CT and USG for Benign Conditions

Benign Conditions								
MRCP	ERCP		CT	ERCP		USG	ERCP	
	+	-		+	-		+	-
	37	2		34	6		33	3
	2	30		5	26		6	29
Sensitivity	94.87%		87.18%			84.62%		
Specificity	93.75%		81.25%			90.63%		
PPV	94.87%		85.00%			91.67%		
NPV	93.75%		83.87%			82.86%		
DA	94.37%		84.51%			87.32%		

Table 3: Diagnostic Accuracy of MRCP, CT and USG for Malignant Conditions

Malignant Conditions								
MRCP	ERCP		CT	ERCP		USG	ERCP	
	+	-		+	-		+	-
	30	1		28	3		26	4
	2	38		4	36		6	35
Sensitivity	93.75%		87.5%			81.25%		
Specificity	97.44%		92.31%			89.74%		
PPV	96.77%		90.32%			86.67%		
NPV	95.00%		90.00%			85.37%		
DA	95.77%		90.14%			85.92%		

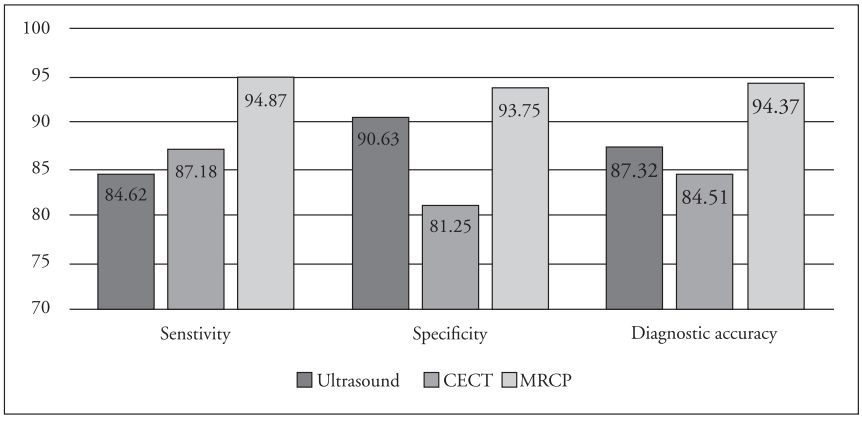

Figure 1: Comparison of sensitivity, specificity and diagnostic accuracy of US, CECT & MRCP in benign conditions.

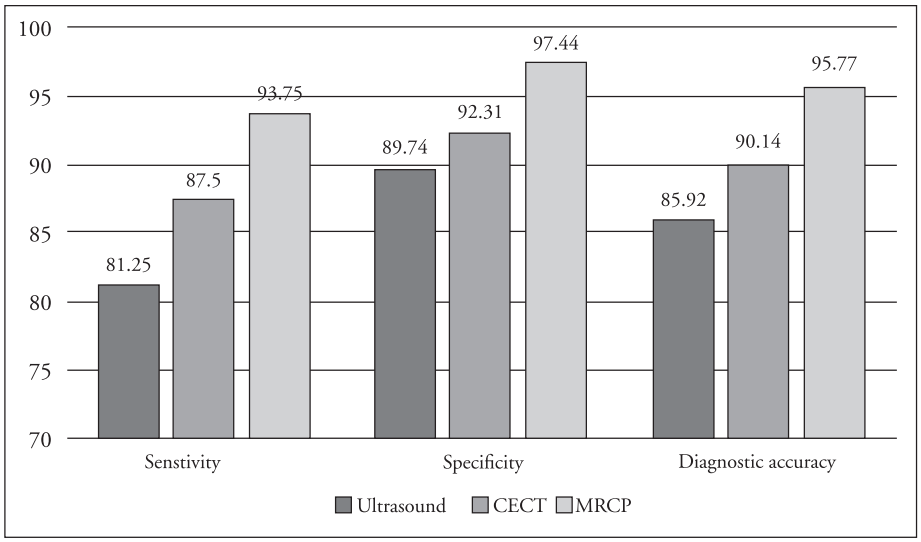

Figure 2: Comparison of sensitivity, specificity and diagnostic accuracy of US, CECT & MRCP in malignant conditions

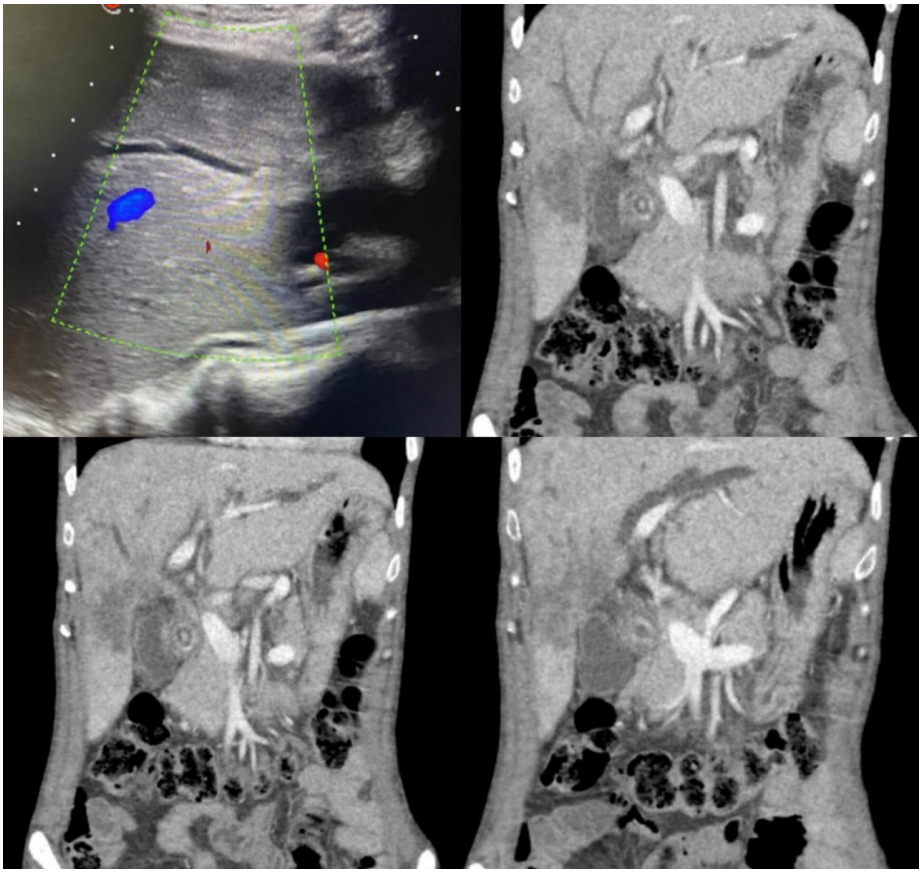

Figure 3: Top left image is an axial ultrasound image showing abrupt cut off in intrahepatic biliary channel in segment VIII of liver with retrograde distension of the biliary duct. Post contrast CT coronal images shows an ill-defined hypo enhancing infiltrating lesion in the right lobe of liver with no confluence of the right and left hepatic duct seen and abrupt cut off in biliary channels seen with their retrograde distention. Patient was diagnosed as perihilar cholangiocarcinoma infiltrating in the adjacent liver. Note was also made of the gall bladder neck calculus, however no extrinsic compression depicted.

onance cholangiopancreatography (MRCP). In cases of suspected obstructive jaundice, MRCP is considered the superior noninvasive modality for assessing the pancreaticobiliary tract.

To diagnose the etiological factors of obstructive jaundice, referring clinicians should understand the role and inherent limitations and advantages of each imaging modality. In this study, we compared MRCP with CT and Ultrasonography in patients with obstructive jaundice, considering ERCP as the gold standard. The results showed that the sensitivity and specificity of MRCP for benign conditions were 94.87% and 93.75% respectively, for CT it was 87.18% and 81.25%, and for USG it was 84.62% and 90.63%. For malignant conditions, the sensitivity and specificity of MRCP were 93.75% and 97.44%, for CT it was 87.5% and 92.31%, and for USG it was 81.25% and 89.74% respectively.

Patel et al. conducted a study of 50 patients and found that the sensitivity of MRCP in detecting bile duct stones, CBD strictures, and cholangiocarcinoma was 100%, 93%, and 100% respectively, while for ERCP, the sensitivities were 87.5%, 100%, and 100% respectively. They showed that MRCP is even superior to ERCP in detecting choledocholithiasis.[11]

Satyanarayana Goud reported sensitivity and specificity for MRCP as 100% and 96.5% respectively.[12] A local study from Dow University Karachi reported the sensitivity and specificity of MRCP as 92.95% and 86.02%, consistent with our study.[13] Purnima Irom's study of 36 patients showed a diagnostic accuracy of 94.4%, aligning with our study.[14]

Farhana Salam's study on 50 patients determined the diagnostic accuracy and sensitivity of MRCP in diagnosing cases with malignant causes of obstructive jaundice as 98% and 95.8% respectively, while ERCP

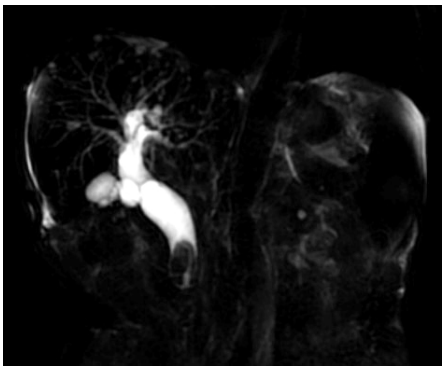

Figure 4: Above T2 FRFSE MRCP image shows signal void representing choledocholithiasis in the intrapancreatic part of the CBD, with minimal distention of biliary tree.

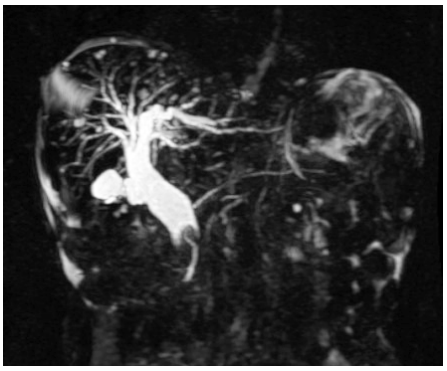

Figure 5: The image shows distal CBD cutoff, soft tissue structure inside, retrograde biliary distension, and micro abscesses—a case of cholangiocarcinoma in ERCP biopsy.

Figure 6: Above constructed 3D MRCP image shows abrupt cut off in the ampullary region with retrograde distension of pancreaticobiliary tree in a biopsy proven case of periampullary CA through ERCP.

Figure 7: Above axial contrast and non-contrast CT images showing radio dense choledocholithiasis in distal CBD.

showed 89.5% and 89% respectively. This demonstrates that MRCP is an even better diagnostic tool than ERCP.[15] Pramod Chhetri reported an overall diagnostic accuracy of MRCP in benign and malignant causes as 93.98% and 97.6% respectively, which also aligns with our study.[3]

A CECT is usually more accurate for determining the type and level of obstruction than an ultrasound scan, however it is less accurate in diagnosing radiolucent calculi.[16] Both USG and CT scans are considered safe and non-invasive procedures for assessing biliary tract health. In this study diagnostic accuracy, sensitivity and specificity of CT for benign and malignant conditions was 84.51%, 87.18%, 81.25% and 90.14%, 87.5% and 92.31%. Salma et al in his study reported the diagnostic accuracy of CT for malignant obstructive jaundice as 91.43% and sensitivity as 91.67% respectively which is slightly higher than our study.[15] Mahendra Shrestha has reported diagnostic accuracy and sensitivity of CT scan for benign causes of obstructive jaundice as 90%, 84% and for malignant causes, diagnostic accuracy and sensitivity of CT was 82% and 70%.[17] They determined sensitivity of CT to be slightly less than that of our study. Jena et al reported diagnostic accuracy of CT for benign and malignant causes of obstructive jaundice as 88% and 85% while sensitivity was 93% for benign and 74% for malignant causes.[18] This study shows slightly less sensitivity for malignant cases as compared to our study.

Moreover, it is a known fact that CT scans cannot reveal radiolucent biliary stones, despite being readily available and effective in diagnosing obstructive jaundice. As an initial modality, USG confirms or excludes duct obstruction with a 90% accuracy rate.[19]Studies have reported similar sensitivity, specificity and diagnostic accuracy for ultrasonography for diagnosis of benign and malignant condition in obstructive jaundice patients.[2,20] Consistent with previous literature in this study sensitivity (84.62% & 81.25%), specificity (90.63% & 89.74%) and diagnostic accuracy (87.32% & 85.92%) was seen for USG for benign and malignant conditions. Pramod Chhetri reported overall diagnostic accuracy of USG in benign and malignant causes as 76.62% and 84.52% respectively, which is in line with that of our study.[3] Contrary to this Hiba Mohammed Abdul wahid in their study reported lower sensitivity (75%), specificity (66.7%) and diagnostic accuracy (41.6%) for malignant detection.[21] Purnima Irom also reported lower diagnostic accuracy (30.56%), sensitivity (18.75%) and specificity (40%) for USG.[14] Sunny Sawraj in his study of 120 patients revealed significantly less diagnostic accuracy of 49% in determining nature of obstruction while diagnostic accuracy of 64.3% was depicted when site of obstruction was evaluated.[22] This low sensitivity and diagnostic accuracy is attributable to the difficulty of visualizing the distal part of the common bile duct on ultrasound. Furthermore, ultrasound cannot clearly visualize the intrapancreatic and ampullary regions. A

patient's body habitus could also contribute to this. As a result, it is difficult to visualize the common bile duct distally and problem is further augmented by bowel gas shadows.[23]

Hence inferred from the above stated material, ultrasound does not indicate the possible cause of obstructive jaundice, despite being an excellent first-line diagnostic tool. CT struggles with radiolucent calculi. MRCP defines the entire ductal system, while ultrasound may not see the most distal parts of CBD because of overlying gas. In addition, as US is operator-dependent, while it is not the case with MRCP. Ultrasound is therefore regarded as the initial examination, which provides a guide for choosing patients for contrast enhanced CTs and MRCPs[24], while further workup to be followed with CTs and MRCPs. If the only one investigation needs to be caried out it should be nothing else but MRCP.

In accordance with recent American College of Radiology guidelines, MRI/MRCP is considered an appropriate imaging tool after initial ultrasound screening in patients with obstructive jaundice accompanied by pain (variant 1) or when mechanical obstruction is suspected (variant 2) to detect any mass lesions using contrast enhanced MRI/MRCP, as well as when mechanical obstruction is less likely to occur (variant3) to detect infiltrating liver disease.[25]

With the establishment of the fact on the basis of above discussed material that MRCP is the most accurate noninvasive diagnostic tool, it also opens up the horizon for further diagnostic work on MRCP to make it even more reliable like the use of liver based contrast media with MRCP to better delineate the structural anomalies and iatrogenic injuries.[26] In some patients, excessive bowel gas in the duodenum can hinder visualization of the distal CBD and pancreatic head during MRCP. Moreover, some patients may have difficulty holding their breath adequately, affecting the quality of MRCP images. Clinicians should be aware of these challenges and consider alternative imaging options when necessary.

CONCLUSION

The results of this study demonstrate that MRCP is a superior modality with higher sensitivity, specificity, and diagnostic accuracy for evaluating malignant and benign conditions in patients presenting with obstructive jaundice compared to USG and CECT. However, initially, USG can serve as a screening modality to confirm or exclude biliary dilatation and help in selecting patients for further CT and MRCP examinations. The only issue with MRCP is its cost and availability; however, its non-invasiveness, contrast-free nature, and high accuracy make it an ideal modality for the workup of obstructive jaundice patients.

REFERENCES

1. Le Huong NT, An NT. Jaundice in adult in-patients at a tertiary general hospital. J Biosci Med. 2015;3(02):1-11. DOI: 10.4236/jbm.2015.32001
2. Hanif H, Khan SA, Muneer S, Adil SO. Diagnostic accuracy of ultrasound in evaluation of obstructive jaundice with MRCP as gold standard: Accuracy of ultrasound in obstructive jaundice. Pak J Med Sci. 2020;36(4):652–6. DOI: 10.12669/pjms.36.4.1665
3. Chhettri P, Rana H. Ultrasonography and magnetic resonance cholangiopancreatography in patients with obstructive jaundice. J Coll Med Sci-Nepal. 2020;16(1):6–11. DOI: 10.3126/jcmsn.v16i1.26641
4. Makmun D, Fauzi A, Shatri H. Sensitivity and specificity of magnetic resonance cholangiopancreatography versus endoscopic ultrasonography against endoscopic retrograde cholangiopancreatography in diagnosing choledocholithiasis: The Indonesian experience. Clin Endosc . 2017;50(5):486–90. DOI: 10.5946/ce.2016.159
5. Khopde PA, Kelkar A, Joshi P, Bandgar A, Mahajan M. Pancreatico-biliary pathologies: correlation of USG and MRCP. Int Surg J . 2019;6(7):2373. DOI: 10.18203/2349-2902.isj20192969
6. Farrukh SZ, Siddiqui AR, Haqqi SA, Muhammad AJ, Dheddi AS, Niaz SK. Comparison of ultrasound evaluation of patients of obstructive jaundice with Endoscopic Retrograde Cholangio-Pancreatography findings. J Ayub Med Coll Abbottabad. 2016;28(4):650-2.
7. 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(3):103-7. DOI: 10.7860/JCDR/2014/8149.4120
8. Dillman JR, Patel RM, Lin TK, Towbin AJ, Trout AT. Diagnostic performance of magnetic resonance cholangiopancreatography (MRCP) versus endoscopic retrograde cholangiopancreatography (ERCP) in the pediatric population: a clinical effectiveness study. Abdom Radiol (NY). 2019;44(7):2377-83. DOI: 10.1007/s00261-019-01975-8
9. Gondal M, Hussain AI, Awan T, Gondal S, Ch K. Accuracy of MRCP in Comparison with ERCP for Diagnosing Hepato-Pancreatico-Biliary Pathologies. Rawalpindi Med Coll. 2018;22(2):88-91
10. Baiu I, Visser B. Endoscopic retrograde cholangiopancreatography. JAMA. 2018;320(19):2050. DOI: 10.1001/jama.2018.14481
11. Patel VB, Musa RK, Patel N, Patel SD. Role of MRCP to determine the etiological spectrum, level and degree of biliary obstruction in obstructive jaundice. J Family Med Prim Care . 2022;11(7):3436-41. DOI: 10.4103/jfmpc.jfmpc_2362_21
12. Devi B, Goud S, Kale PG, Lakshmi AY,

Reddy VR. To study diagnostic efficacy of ultrasound and magnetic resonance cholangiopancreatography in obstructive jaundice. J Dr NTR Univ Health Sci. 2020;9(4):217-21. DOI: 10.4103/jdrntruhs.jdrntruhs_43_20
13. Naz N, Aymen U. Diagnostic Accuracy of Magnetic Resonance Cholangio-Pancreatography in Choledocholithiasis. J Dow Univ Health Sci. 2016;10(3):77-81.
14. Irom DP, Shetty DP, Aggarwal DA. Diagnostic utility of MRCP in obstructive jaundice and comparison with CT & ultrasonography. Int J Radiol Diagn Imaging . 2022;5(3):01-6. DOI: 10.33545/26644436.2022.v5.i3a.268
15. Salam F, Islam NF, Huda N, Parveen F, Afrin T, Ha NH, et al. Comparison among the role of different imaging techniques in diagnosis of malignant lesions causing obstructive jaundice. J Bangladesh Coll Phys Surg. 2021;39(4):233-40. DOI: 10.3329/jbcps.v39i4.55944
16. Zhang ZY, Wang D, Ni JM, Yu XR, Zhang L, Wu WJ, et al. Comparison of three-dimensional negative-contrast CT cholangiopancreatography with three-dimensional MR cholangiopancreatography for the diagnosis of obstructive biliary diseases. Eur J Radiol. 2012;81(5):830-7. DOI: 10.1016/j.ejrad.2011.02.036
17. Shrestha M. The Radiological Study to Determine the MRCP's Accuracy over USG and CT in Diagnosing Obstructive Jaundice. Eur J Mol Clin Med. 2022;9(1).
18. Jena P, Prasad AM, Jena D. To establish the accuracy of MRCP over USG & CT in diagnosing the case of obstructive Jaundice with radiological study. Int J Radiol Diagn Imaging. 2021;4(3):133-6. DOI: 10.33545/26644436.2021.v4.i3b.230
19. Lee DH, Kim B, Lee ES, Kim HJ, Min JH, Lee JM, et al. Radiologic evaluation and structured reporting form for extrahepatic bile duct cancer: 2019 consensus recommendations from the Korean Society of Abdominal Radiology. Korean J Radiol . 2021;22(1):41-62. DOI: 10.3348/kjr.2019.0803
20. Debbarma B, Reang C, Tripura K. Diagnostic efficacy of ultrasonography against magnetic resonance cholangiopancreatography in obstructive biliopathy. European Journal of Molecular & Clinical Medicine. 2022;9(16):1232-43.
21. Abdulwahid HM, Al-Mosawe AM, Jabbar J, Nayyef QT. The Diagnostic Accuracy of MRCP and Transabdominal Ultrasound in Patients with Obstructive Jaundice in Correlation with ERCP. Iraqi Postgrad Med J. 2022;21(1):55-62.
22. Swaraj S, Mohapatra M, Sathpathy G, Yalamanchi R, Sen K, Menon SM, et al. Diagnostic performance of ultrasonography versus magnetic resonance cholangiopancreatography in biliary obstruction. Cureus. 2023;15(1):e33915. DOI: 10.7759/cureus.33915
23. Nurman A. Imaging of common bile duct stones. Universa Medicina. 2009;28(1):59-68. DOI: 10.18051/UnivMed.2009.v28.59-68
24. Klimkowski SP, Fung A, Menias CO, Elsayes KM. Gallbladder imaging interpretation pearls and pitfalls: Ultrasound, computed tomography, and magnetic resonance imaging. Radiol Clin North Am. 2022;60(5):809-24. DOI: 10.1016/j.rcl.2022.05.002
25. Hindman NM, Arif-Tiwari H, Kamel IR, Al-Refaie WB, Bartel TB, Cash BD, et al. ACR Appropriateness Criteria® Jaundice. J Am Coll Radiol. 2019;16(5):S126-40. DOI: 10.1016/j.jacr.2019.02.012
26. Argiro R, Sensi B, Siragusa L, Bellini L, Conte LE, Riccetti C, et al. Liver-specific contrast-enhanced magnetic resonance cholangio-pancreatography (Ce-MRCP) in non-invasive diagnosis of iatrogenic biliary leakage. Diagnostics. 2023;13(10):1681. DOI: 10.3390/diagnostics13101681.

Author's Contribution

MSK conceived the idea and helped in the data collection, data analysis and writing of the manuscript. AA, AM Cntributed in data collection and overall manuscript writing. SA and MM supervised the study. Authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

Conflict of Interest

Authors declared no conflict of interest

Grant Support and Financial Disclosure

None

Data Sharing Statement

The data that support the findings of this study are available from the corresponding author upon reasonable request.