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Accuracy of Magnetic Resonance Cholangiopancreatography (MRCP) in Comparison with Endoscopic Retrograde Cholangiopancreatography (ERCP) for Diagnostic Choledocholithiasis

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ABSTRACT

Objective: To determine the diagnostic accuracy of MRCP for the diagnosis of choledocholithiasis keeping ERCP as gold standard.

Methodology: The Cross sectional study was planned in department of radiology, PIMS, Islamabad from August 2021 to July 2022. All patients suspected of choledocholithiasis will be diagnosed on the basis of symptoms, laboratory findings, and radiological results. Hematologic and biochemical tests will be performed on all patients shortly after admission. Inclusion of 100 suspected patients of choledocholithiasis through non-probability consecutive sampling. MRCP will be performed and followed by the ERCP. Patient demographic data, symptoms associated with choledocholithiasis, comorbidity history, laboratory profiles, and final diagnoses based on MRCP and ERCP results were recorded using a self-designed form.

Results: The average age of the patient was 54.63±11.8 years. The male to female ratio in the study was 1.27:1. Derange liver function test was observed in 48% patients. Colicky was found in 39% cases, abdominal pain was observed in 86% and intermittent jaundice was observed in 33% patients. The diagnostic analysis of MRCP showed that the MRCP had a sensitivity of 98.4%, specificity 89.7%, positive predictive value 94.9% and negative predictive value 87.8%.

Conclusion: MRCP had a high sensitivity and specificity for detection of choledocholithiasis.

Keywords: Cholangiopancreatography, Magnetic Resonance, Cholangiopancreatography, Endoscopic Retrograde, Choledocholithiasis

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Introduction

Biliary stone disease stands as one of the prevalent causes of hospitalization. Nevertheless, assessing the prevalence of gallstones in the general population poses challenges due to the asymptomatic nature of biliary stone disease. Merely one-third of gallstones manifest symptoms or give rise to complications, such as choledocholithiasis.[1]

Choledocholithiasis is a medical condition where a stone or stones are developed inside the common bile duct of a patient. This problem is reported in 3-22 percent of the individuals.[2] In most of the cases, this problem is symptomatic. Pain in the upper right quadrant due to the distention of extrahepatic bile duct, nausea and vomiting are some common symptoms of this disease.[3]

The main reasons for this disease are when stones form in the bile duct or when gallstones from the gallbladder move into the bile duct. A few things can make this happen faster, like chemical imbalances, pH imbalances, bile not flowing properly, bacteria in the bile, more bilirubin coming out, and sludge being produced. Sometimes, stones also form in the tubes in the liver. This

is called primary hepatolithiasis and might cause choledocholithiasis later on.[4]

Research studies indicate that choledocholithiasis affects approximately 4.6 to 18.8 percent of patients who undergo cholecystectomy. Age plays a significant role, with a higher likelihood of incidence as individuals grow older, particularly in those with a history of cholelithiasis diagnosis. This condition is notably more prevalent among females and pregnant women compared to men. Additionally, older individuals and those with elevated serum lipid levels face an increased risk of developing cholelithiasis.[5]

Patients who have obesity, engage in minimal physical activity, or undergo significant intentional weight loss face an elevated risk of developing cholesterol stones. Similarly, individuals with cirrhosis, undergoing total parenteral nutrition, or experiencing an ileal resection are more prone to developing black pigment stones. Nucleating factors, such as bacteria, act as the primary source of brown pigment stones in the common bile duct.[6]

Although diagnostic endoscopic retrograde cholangiopancreatography (ERCP) is more efficient and sensitive compared to this technique, but it is no longer applied in common examinations because of its potential to cause post-procedure complications. According to some researchers, this technique results in a 10 percent risk for post-procedure pancreatitis.[7]

ERCP is normally utilized as the reference standard for evaluating choledocholithiasis. The rate of complication of ERCP technique is reported to be as high as 8 to 12 percent by several research studies in the past.[8p] This method is commonly suggested for patients having higher risks of choledocholithiasis, because of its invasiveness as well as the ability to be treated, if choledocholithiasis is discovered.[9]

MRCP, a widely utilized noninvasive imaging technique, serves as an effective tool in evaluating choledocholithiasis often linked with CBD dilatation, offering diagnostic outcomes comparable to ERCP. However, its use is reserved for patients with clear indications due to inherent limitations. The causes of CBD dilatation are diverse. Consequently, when MRCP indicates only mild CBD dilation, physicians confront the decision of proceeding to further investigation via ERCP or ceasing all inquiries, presuming the dilatation represents a normal variation. Despite advancements in MRCP techniques for imaging biliary abnormalities, its utility remains constrained by the necessity for contrast agents and the inability to provide a histological diagnosis. The aim of this study was to determine the diagnostic accuracy of Magnetic Resonance Cholangiopancreatography (MRCP) keeping Endoscopic Retrograde Cholangiopancreatography (ERCP) for diagnosis of Choledocholithiasis.

Methodology

This cross-sectional comparative study took place at the Department of Radiology, Pakistan Institute of Medical Sciences (PIMS) Hospital in Islamabad, spanning from August 2021 to June 2022. Ethical approval for the research was obtained from the hospital's review board. The sample size was determined using a sensitivity and specificity sample size calculator, considering an incidence population proportion of choledocholithiasis at 0.22[2], sensitivity at 0.92, specificity at 0.97[10], with a 95% confidence interval and 10% precision. For the study objective, a minimum sample size of 90 was required, leading to the inclusion of 100 suspected patients of choledocholithiasis through non-probability consecutive sampling.

Inclusion criteria comprised patients aged between 18 to 80 years, of all genders, exhibiting a clear indication for ERCP. Exclusion criteria encompassed patients diagnosed with tumors, those who had undergone MRCP outside the hospital, pregnant females, individuals with claustrophobia, and patients suspected of having sludge on the CBD.

Written informed consent was obtained, and only those patients who consented to participate were included. MRCP examinations were conducted using a torso phased-array coil, while ERCP procedures utilized a duodeno-videoscope and general electric fluoroscopy. The MRCP images were assessed by a blinded radiologist, whereas the interpretation of ERCP results was conducted by an experienced consultant gastroenterologist, also blinded to the MRCP findings.

Patient demographic data, symptoms associated with choledocholithiasis, comorbidity history, laboratory profiles, and final diagnoses based on MRCP and ERCP results were recorded using a self-designed form. SPSS version 25 was employed for data analysis. Descriptive analysis of quantitative variables utilized mean and standard deviation, while frequency and percentage were used for qualitative variables. The diagnostic accuracy of

MRCP was computed using ERCP findings as the gold standard.

Results

Out of 100 suspected patients of choledocholithiasis, 56 (56%) were male and 44 (44%) were female. The average age of the patients was 54.63±11.8 years. Among male patients, the average was 54.48±10.33 years whereas the average of female patients was 54.82±12.3 years. The average of the patient was not significantly different between male and female patients with p value 0.885. The frequency chart of comorbidities of the patient is showed in Figure 1.

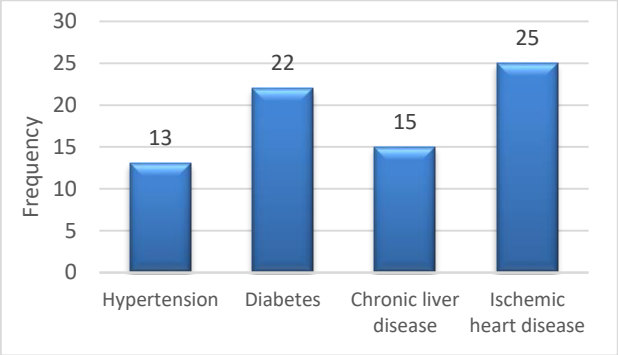

Figure 1. Frequency of comorbidities in suspected choledocholithiasis cases.

The mean total bilirubin was 3.88±1.51 mg/dL, the mean aspartate aminotransferase (AST) was 154.24±63.28 IU/L and the mean alkaline phosphatase (ALP) was 497.48±230.39 IU/L. Derange liver function test was observed in 48 (48%) patients. Colicky, abdominal pain and intermittent jaundice was noted as symptoms of suspicious cases of choledocholithiasis. The result showed that colicky was present in 39 patients, intermittent jaundice was observed in 33 patients and abdominal pain was observed in 86 cases. The cross tabulation of symptoms of choledocholithiasis with respect of presence of stone was mentioned in table I.

The ERCP and MRCP images were not taken at the same day and we give a minimum 24 hrs gap between two diagnostic exercises. In 5 cases ERCP diagnosed choledocholithiasis but the MRCP fails to diagnose. Out of 100 cases, choledocholithiasis diagnosed in 65 patients having stones, single in 41 out of 65 (63.1%) cases, 2 stones in 17 out of 65 (26.2%) cases and 3 stones in 7 out of 65 (10.8%) cases. The size of the stone was between 3mm to 10mm with an average stone size of 5.85±2.27mm. The sensitivity specificity analysis, keeping ERCP result as gold standard, showed that the accuracy of MRCP was very high to diagnosed choledocholithiasis. The sensitivity was 98.4%, specificity 89.7%, positive predictive value 94.9% and negative predictive value was 87.8%.

Table I: Cross tabulation of other symptoms of choledocholithiasis with presence of stone.

Symptoms	Categories	Presence of stone		P value
		Yes	No	
Colicky	Yes	39	0	0.000
	No	26	35	
Abdominal Pain in upper right quadrant	Yes	57	29	0.511
	No	8	6	
Intermittent Jaundice	Yes	33	0	0.000
	No	32	35	

Discussion

MRCP is a noninvasive exam. Research studies have reported the sensitivity and specificity of this test to be as high as 92 percent and 100 percent. This diagnosis technique uses the T2-weighted images for visualizing the filling defects (biliary stones) or stenosis found in the slowly moving fluid present inside the biliary tree.[11]

Another advantage of applying this technique is the better visualization effects because of the application of a contrast agent and additional information about the level of obstruction. Research studies reported that no significant difference exists between the ability of T1 contrast-enhanced and T2 MRCP diagnostic methods in terms of detection of choledocholithiasis.[12]

In a cross sectional study conducted in Portugal, the researchers analyzed 40 suspicious patients of choledocholithiasis. Out of 40 suspicious cases of choledocholithiasis, 31(77.5%) was a high risk patient. Out of 31 high risk patients, 18 patients were confirmed choledocholithiasis patients out of them 2 patients were had intermittent risk of the disease, while the remaining 7 patients were undiagnosed. They conclude that American Society for Gastrointestinal Endoscopy (ASGE) probability risk score for choledocholithiasis was not a very good diagnostic method before ERCP. They also recommended that other alternative diagnostic technique i.e. MRCP or EUS was used before ERCP.[13]

In a study conducted in Turkey, the researchers calculate the diagnostic accuracy of ultrasounography (US), computed tomography (CT) and magnetic resonance cholangiopancreatography (MRCP) keeping endoscopic retrograde cholangiopancreatography (ERCP) as gold standard. The study included 86 diagnosed cases of

choledocholithiasis based on ERCP. Out of 86 cases, 31.4% had a single stone, 39.5% cases had stone diameter of less or equal to 3mm, 36% had stone of 3-10 mm and 24.5% had over 10mm stone. The result showed that MRCP was highly accurate to predict no. of stone and the size of stone as compared to the other two diagnostic techniques. The sensitivity of US was 40.8%, 76.9% of CT and 86.4% of MRCP.[14]

In a recent local study, the researchers compared the results of transabdominal ultrasound (TAUS) with MRCP result for the diagnosis of choledocholithiasis. Out of 102 suspicious cases of choledocholithiasis, the choledocholithiasis was confirmed in 81 (79.4%) cases with MRCP and 82 (80.3%) diagnosed on the basis of TAUS. The researchers concluded that TAUS can also use for the diagnosis of choledocholithiasis as the alternative of MRCP at first line diagnosis before confirmation with ERCP.[15]

In another local study, the researchers assessed EUS keeping the gold standard of ERCP for the diagnosis of common bile duct stones. They included 123 patients having mean age of 50.3±13.91 years. They concluded that the EUS had the sensitivity 89.5%, specificity 96.5%, positive predictive value 91.9% and negative predictive value of 95.3%.[16]

In a study conducted in Italy, the researchers 104 patients who underwent MRCP prior to cholecystectomy. Out of 104 patients, 93 (89.4%) cases came with the complaint of upper abdominal pain. They conclude that MRCP can be used for detection of common bile duct stones and preoperative MRCP help us to reduce wrong diagnosis of choledocholithiasis.[17]

In another study conducted in Turkey, consisting 37 patients of bile duct obstruction. The patients had both MRCP and ERCP results. The sensitivity and specificity of MRCP was found 93% and 75% that shows a very high level agreement with ERCP for detection of choledocholithiasis.[18] In another local study, the researchers compared the result of MRCP to detect of bile duct pathologies i.e. choledocholithiasis, pancreatico-biliary strictures and dilatation with ERCP result. The result showed that MRCP had sensitivity, specificity, positive predictive value and negative predictive value to detect choledocholithaisis was 87%, 80%, 83.3% and 84.2% respectively.[19]

Similarly, in another study the researcher included 78 patients of suspected cholecystitis with a mean age of 66.06±15.63 years. The selected patients were underwent for CT, MRCP and ERCP. The researchers interpret the MRCP and CT report by two different radiologists and on the basis of both radiologist's readings MRCP was found superior to CT and the difference between accuracy, sensitivity and specificity in both cases were significant at 5% level of significance.[20]

Contrarily to the above, in another study, the researchers concluded that the accuracy, sensitivity, specificity, positive predictive value and negative predictive value of MRCP for detection of choledocholithiasis was observed 71.3%, 58.3%, 90.2%, 86.2% and 67.5% respectively which is not so good and not matched with our study results.[21]

Conclusion

Our study results led us to conclude that MRCP demonstrated a notably high level of agreement with ERCP in detecting choledocholithiasis. We were particularly surprised by the significantly high sensitivity and specificity of MRCP compared to ERCP in this study. This leads us to assert that the expertise of the MRCP image interpreter plays a vital role in obtaining highly accurate results from MRCP.

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