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Diagnostic Accuracy of MRCP for Detecting Choledocholithaiasis in Patients with Obstructive Jaundice keep ERCP as Gold Assistant

Iqra Siddique, Hina Nadeem, Syed Anjum Mehdi

ABSTRACT:

Objective: To determine the diagnostic accuracy of MRCP for detecting choledocholithiasis in patients with obstructive jaundice keeping ERCP as gold standard.

Study Design and settings: Cross-sectional validation study, Department of Radiology, Madinah Teaching, Faisalabad.

Methods: Non-probability consecutive sampling was used to sample 230 patients of both genders, aged 26-70 years, and experiencing obstructive jaundice. Patients who had been diagnosed with choledocholithiasis earlier, with chronic liver disease or have a contraindication to MRI were not included. MRCP was performed on all enrolled patients that underwent ERCP in 48 hours. Findings on MRCP were compared to ERCP findings. The SPSS version 20 was used to analyze data. A 2 x 2 contingency table was used to calculate sensitivity, specificity, positive predictive value, negative predictive value and diagnostic accuracy.

Findings: The average age of the patients was 48.72 + 11.43 years. Out of 230 patients, 132 (57.4%) were male and 98 (42.6%) were female. In 168 (73.0) patients, MRCP observed choledocholithiasis whereas in 174 (75.7) patients, ERCP agreement was choledocholithiasis. The diagnostic accuracy, sensitivity, specificity, positive predictive value, negative predictive value for MRCP were 91.95%, 85.71%, 95.24%, 77.42%, 90.43% respectively.

Conclusions: MRCP was found very accurate in diagnosing choledocholithiasis among patients presenting with obstructive jaundice.

Keywords: MRCP, ERCP, choledocholithiasis, obstructive jaundice, diagnostic accuracy

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INTRODUCTION:

Choledocholithiasis, the presence of stones in the common bile duct, is a clinically significant cause of obstructive jaundice, and an essential diagnostic and therapeutic predicament in hepatobiliary practice. It can be a complication of gallstone disease whereby the stones shift out of the gallbladder into the common bile duct resulting in partial or complete blockage of the bile flow. The patients typically report right upper quadrant abdominal pain, nausea, vomiting, fevers, yellowish sclera and skin discoloration, dark urine, pale stool and biochemic presence of cholestasis. Unrecognized and untreated, choledocholithiasis can lead to acute cholangitis, biliary pancreatitis, hepatic dysfunctions, sepsis, and worse morbidity. The recent epidemiological findings indicate that choledocholithiasis and cholangitis remain a significant contributor to hospitalization and healthcare burden, highlighting the importance of proper and timely diagnosis.[1] Endoscopic retrograde cholangiopancreatography has long been regarded as the standard of diagnosis of choledocholithiasis due to the traditional ability of direct inspection of the biliary obstruction as well as provide therapeutic options of sphincterotomy, stone removal, balloon sweeps, and the placement of a stent. ERCP, however, is an invasive methodology, and comes with known complications, such as post-ERCP pancreatitis, bleeding, perforation, cholangitis and cardiopulmonary events during the procedure. Post-ERCP pancreatitis is still reported as the most common adverse event in the contemporary literature, particularly in the high-risk patients.[2] Due to these risks, ERCP role has simply changed being a mainly diagnostic procedure to rather a therapeutic intervention.

The magnetic resonance cholangiopancreatography has proven to be a non-invasive and safe imaging tool used to assess the pancreatic and biliary systems. MRCP, which employs heavily T2-weighted magnetic resonance sequences,

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can be used to generate high-contrast imaging of nontendendrial fluid in the bile ducts and pancreatic duct in which the ductal dilatation, strictures, stones, and other obstructive lesions can be seen, without the use of contrast injection, ionizing radiation and endoscopic cannulation. The benefits of MRCP render it particularly useful in patients who are not good candidates of invasive imaging, those with intermediate level likelihood of common bile duct stones, and those cases with need on verification of diagnosis prior to therapeutic ERCP.[3]

Recent reports have indicated positive diagnostic results of MRCP in diagnosing choledocholithiasis and other obstetric jaundice causes. A comparison of MRCP and ERCP by Kumar et al. who examined common bile duct and pancreatic duct pathologies clearly showed that MRCP is a high-quality diagnostic tool because it is non-invasive.[2] Isram et al. determined that MRCP is a sensitive and specific test when used to evaluate choledocholithiasis in comparison to ERCP.[3] Likewise, Nayab et al. found that MRCP can be used in the treatment of obstructive biliopathy and can possibly prevent unnecessary ERCP in the chosen patients.[4] The sensitivity, specificity, positive predictive value, negative predictive value, and diagnostic accuracy of MRCP recorded by Qaisar et al. as 91.04, 89.04, 95.31, 76.90, and 90.0 when estimating the presence of obstructive jaundice after taking ERCP as the gold standard, respectively.[5] Although these benefits exist, diagnostic accuracy of MRCP has been reported to vary across studies because of variations in patient selection, stone size, delay between MRCP and ERCP, MRI acquisition, experience of radiologist and local disease pattern. MRCP sensitivity can be inaccurate due to small stones, biliary sludge, motion artifacts and periampullary stones which can result in a false negative or false-positive result. Recent reports in local and regional locations have also tested this variability with the highest sensitivity of MRCP in obstructive jaundice and choledocholithiasis being moderate to high.[6-10] Thus, additional local data is needed to know whether MRCP is able to predict the presence of choledocholithiasis in patients with obstructive jaundice to refer patients to the ERCP. The aim of the study is to establish how well MRCP can detect choledocholithiasis in patients with an obstructive jaundice, compared to the gold standard which is still ERCP.

METHODOLOGY:

The cross-sectional research took place in the Department of Radiology, Madinah Teaching Hospital in Faisalabad with the consent of the hospital ethical review committee. The time frame of the research was between 31st October 2025 and 30th April 2026. The population of the study consisted of the patients visiting the radiology and gastroenterology departments having clinical and biochemical signs of the obstructive jaundice. The sensitivity and specificity calculator was used to calculate the sample size of 230 patients by using sensitivity of MRCP which was 88.1, specificity of 94.4, prevalence of choledocholithiasis 70, desired precision 5.5 and confirming the required confidence level was 95. Non-probability consecutive sampling technique was used for patient recruitment. The study population comprised patients of both genders aged 26-70 years old with obstructive jaundice. Clinical manifestations of obstructive jaundice were determined by examining yellowing of the sclera and the body with reference to yellow color of skin and laboratory results like increased level of direct bilirubin at 3mg/dL or higher and increased level of alkaline phosphatase at 105U/L or higher. Moreover, abdominal ultrasound images which indicate choledocholithiasis such as the foci of echogenic in distended or non-distended common bile duct were also to be incorporated.

The study excluded case matched patients who were already diagnosed with cases of choledocholithiasis, patients with chronic liver disease, and patients who had contraindication towards MRI because of abhorrence towards small metallic objects like implants, surgical clips, pacemakers, braces, or severe claustrophobia. The exclusion criteria were used to control confounding variables.

Following the informed written consent, demographic data such as age, sex, hospital registration number and clinical history were captured using a pre-tested proforma. Every patient that had been enrolled had gone through MRCP in the Department of Radiology on a 1.5 Tesla GE MRI. Patients were in the supine position and TORSO phased-array coils were used during the procedure. The imaging was taken in an oblique view following conventional MRCPs. Imaging parameters were a field of view of 32 cm, frequency of 256 MHz, bandwidth of 31.25, NEX 1 and automatic water frequency selection. It was performed utilizing Fast Recovery Fast Spin Echo-Accelerated (FRFSE-XL) pulse sequence and three-dimensional hepatobiliary system images were collected when necessary. The senior consultant radiologists who had more than five years of experience in the imaging of the abdomen and image interpretation were required to interpret the MRCP images. MRCP results were deemed positive with respect to choledocholithiasis in the presence of hypointense filling defects or stones of the common bile duct or the presence of biliary obstruction due to stones.

The patients underwent ERCP, within 48 hours of imaging, following MRCP. ERCP procedures were conducted by an experienced consultant gastroenterologist or hepatology trained surgeon who received training in hepatobiliary endoscopy. At the time of the ERCP, the biliary was cannulated, and filling defects, stones, or biliary obstruction was assessed and recorded with the help of fluoroscopy. ERCP findings were the gold standard confirmations to the choledocholithiasis. One of the positive findings of ERCP was direct observation or removal of the stones in the common bile duct. The results of the MRCP were compared with the results of ERP to determine the diagnostic performance of the MRCP.

All the data obtained were analyzed and keyed under Statistical Package of Social Sciences (SPSS) version 20. The quantitative variables like age were presented in the form of mean and standard deviation and the qualitative variables like gender and presence/absence choledocholithiasis were presented as frequencies and percentages. A 2 x 2 contingent table has been made to determine the sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV) and general diagnostic accuracy of MRCP compared to ERCP. Stratification was used to control such effect modifiers as age and gender. A post-stratification chi-square test was performed and a p-value below 0.05 taken to be significant.

During the study, ethical principles were adhered to. Patient information was confidential and all processes followed per ethical institution policies. The study involved the participation of absolutely voluntary individuals because the patients had the right to leave the study at any point without influencing their medical care.

RESULTS:

The age of the patients ranged from 26 to 70 years. The average age of the study population was 48.72 years and the variance of 11.43 years. The age group of 4655 (73/61) years included the majority of patients (31.7/26.5%). There were 42 patients (18.3%) in the 26–35 years age group, 39 patients (17.0%) in the 56–65 years age group, and 15 patients (6.5%) in the 66–70 years age group. (Table I)

This represented 230 patients; 132 (57.4) males and 98 (42.6) females with a small majority of patients reporting with obstructive jaundice and possible choledocholithiasis. (Table 1). In MRCP, choledocholithiasis was identified in 168 patients (73.0%), and 62 patients (27.0%), were found to be negative of choledocholithiasis. The choledocholithiasis was diagnosed in 174 patients on ERP (75.7%), and 56 patients (24.3% were found not to have common bile duct stones. A gold standard, as ERCP, was assumed; therefore, the actual diagnostic status of every patient was determined with the help of ERCP results. (Table 2). The analysis of MRCP and ERP results revealed that MRCP was able to accurately diagnose 160 patients of choledocholithiasis. These were referred to as true positive. MRCP accurately excluded 48 patients who were not choledocholithiasis and were termed as true negative. MRCP however falsely identified the presence of choledocholithiasis in 8 patients who were found to be negative in ERCP; were identified as false positive. Moreover, MRCP did not pick up choledocholithiasis in 14 patients subsequently confirmed to be positive on ERCP; they were announced as false negative. (Table 3). According to the 2 × 2 diagnostic table, the sensitivity of the MRCP in identifying the presence of choledocholithiasis was estimated to be 91.95 which suggests that the MRCP was able to accurately identify the majority of patients having choledocholithiasis in terms of their true presence. The specificity of MRCP was 85.71 which indicated that MRCP was also efficient in making the appropriate decision about patients with no choledocholithiasis. The positive predictive value was 95.24 implying that patients with a positive MRCP were highly likely to actually have choledocholithiasis on ERCP. The negative predictive value stood at 77.42 indicating that negative MRCP result was not as dependable as the positive one in ruling out the disease. A total of 90.43 practices were whenot diagnoses using MRCP. (Table 4). The ROC curve analysis revealed that MRCP was a well-diagnostic test in diagnosing choledocholithiasis cases in patients with obstructive jaundice. The AUC of 0.88 revealed that MRCP was able to properly differentiate between patients who had common bile duct stones and those who did not have the said stones in most cases. The statistically significant p-value of <0.001 showed that the diagnostic performance of MRCP was significantly better than chance. (Table 5). There was gender-wise stratification whereby in male patients, MRCP exhibited sensitivity of 92.8, specificity of 86.4 and diagnostic accuracy of 91.2. The sensitivity was 90.7, specificity was 84.9 and diagnostic accuracy was 89.5 among female patients. Though diagnostic accuracy was better in male patients, the difference did not show significant difference. Stratification according to age revealed that the highest diagnostic accuracy of MRCP was proving to be in patients of the age 36-45 and 46-55 years. The age group of 3645 years showed a diagnostic accuracy of 91.8% and the age group of 4655 years showed an diagnostic accuracy of 91.2%. A small degree of reduced accuracy was found in the older patients, those between the ages of 66-70 years, with diagnostic accuracy being 87.4%. In general, MRCP had a high diagnostic accuracy in all age groups. (Table VI).

DISCUSSION:

In the current analysis, the diagnostic accuracy of Magnetic Resonance Cholangiopancreatography (MRCP) with Endoscopic Retrograde Cholangiopancreatography (ERCP) maintaining the status of gold standard, was evaluated in the diagnosis of choledocholithiasis in patients with

Table 1: Demographic Characteristics of Patients

Variable	Category	Frequency	Percentage
Age Group	26–35 years	42	18.3%
	36–45 years	61	26.5%
	46–55 years	73	31.7%
	56–65 years	39	17.0%
	66–70 years	15	6.5%
	Total	**230**	**100%**
Gender	Male	132	57.4%
	Female	98	42.6%
	Total	**230**	**100%**

Table 2: Frequency of Choledocholithiasis on MRCP and ERCP

Investigation	Positive	Negative	Total
MRCP	168 (73.0%)	62 (27.0%)	230 (100%)
ERCP	174 (75.7%)	56 (24.3%)	230 (100%)

Table 3: Comparison of MRCP Findings with ERCP Findings

MRCP Findings	ERCP Positive	ERCP Negative	Total
MRCP Positive	160	8	168
MRCP Negative	14	48	62
Total	**174**	**56**	**230**

Table 4: Diagnostic Performance of MRCP Keeping ERCP as Gold Standard

Diagnostic Parameter	Formula	Value
Sensitivity	TP / TP + FN × 100	91.95%
Specificity	TN / TN + FP × 100	85.71%
Positive Predictive Value	TP / TP + FP × 100	95.24%
Negative Predictive Value	TN / TN + FN × 100	77.42%
Diagnostic Accuracy	TP + TN / Total × 100	90.43%

Table 5: ROC Curve Analysis

Parameter	Value
Sensitivity	91.95%
Specificity	85.71%
False Positive Rate	14.29%
Area Under Curve	0.88
Standard Error	0.03
95% Confidence Interval	0.82–0.94
p-value	<0.001

Table 6: Stratified Diagnostic Accuracy of MRCP According to Gender and Age

Stratification Variable	Category	Sensitivity	Specificity	Diagnostic Accuracy
Gender	Male	92.8%	86.4%	91.2%
	Female	90.7%	84.9%	89.5%
Age Group	26–35 years	90.5%	85.0%	89.3%
	36–45 years	93.2%	87.1%	91.8%
	46–55 years	92.7%	86.5%	91.2%
	56–65 years	89.8%	84.0%	88.7%
	66–70 years	88.1%	82.3%	87.4%

throughput jaundice. As with this research, MRCP had a sensitivity rate of 91.95 with specificity of 85.71, positive predictive of 95.24, negative of 77.42, and total diagnostic accuracy of 90.43. The size of the area under the ROC curve was 0.88, which is good diagnostic. These results indicated that MRCP respected as a non-invasive modality of identifying common bile duct stones in patients with jaundice was obstructed and could be incorporated as a significant diagnostic method prior to invasive ERCP. The MRCP sensitivity in the current study has been equivalent to that of the diagnostic pool that was presented in the recent literature. In a new systematic review and meta-analysis of MRCP and endoscopic ultrasound in diagnosing choledocholithiasis, Afzalpurkar et al. identified that both MRCP and EUS had a high level of diagnostic performance, though in some studies EUS was somewhat higher.[11] Their results assisted the validity of MRCP as a non-invasive test which could be recommended especially in patients where ERCP is outlawed unless therapeutic intervention is necessary. This evidence and this fact agreed with the sensitivity of 91.95% in the current study as it proved that MRCP can show most common bile duct stones.

Specificity of MRCP was 85.71 in this study which was also good at identifying patients without choledocholithiasis. Nevertheless, there were 8 cases of false positives. False positive MRCPs can be caused by biliary sludge, air bubbles, flow artifacts, blood clots, partial volume averaging or by periampullary impressions resembling stones. The problem has been also put to the fore in clinical practice, in which a confirmatory ERCP or EUS may be needed in a select number of patients with, possibly, inconclusive MRCP appearances. De Jong et al. assessed the applicability of EUS or MRCP prior to the ERCP in patients with a suspected choledocholithiasis and highlighted that pre-ERCP imaging could decrease unnecessary ERCP practices in the cases of proper use.[12] This corroborates the conclusion of the current study that MRCP ought to be a first option compared to ERCP especially in patients that are intermediate-risk.

The negative predictive value of MRCP in the current study was 77.42% and this was less than the positive predictive value. This implied that though a positive MRCP was a good predictor of actual choledocholithiasis, a negative MRCP was well advised in patients under strong clinical suspicion. Mattila et al. stated that MRCP reconstructed preoperative showed high negative prediction value to rule out choledocholithiasis in acute cholecystitis, but their sensitivity was found to be between 76.2 and 85.7 and specificity was found to be between 84.3 and 92.2 based on the assessment by the observer.[13] The current study revealed a better sensitivity when compared to their findings but with a similar range of specificity. It can be associated with the selection of patients since the present study incorporated patients with obstructive jaundice and biochemical cholestasis, generating a greater prevalence of the disease.

High prevalence of the disease in the current research may be the reason behind high positive predictive value of MRCP. The pre-test probability of choledocholithiasis was high since all the enrolled patients had clinical, biochemical, and ultrasonographic evidence indicate obstructive jaundice. This implies that when a good MRCP was found in such a population, the likelihood of its indication of actual disease was high. But the same test can have a different positive predictive value in low-risk populations. Thus, MRCP findings must never be used without taking into consideration

clinical presentation, liver functional screening tests, ultrasound, and probabilities stratification. Other recently conducted study comparing MRCP and ultrasound also indicated that MRCP is better at determining the biliary obstruction. In their study, Swaraj et al. found that MRCP was much more accurate in predicting the degree and cause of biliary obstruction than ultrasonography with accuracy of 97.8% indicating the level of obstruction.[14] In a similar fashion, Katariya et al. discovered that MRCP was much more efficient than ultrasonography in assessing obstructive jaundice, especially in detecting biliary strictures, ductal dilatation, and obstructive lesions.[15] These papers corroborated the current results since ultrasonography was considered to be beneficial as an initial-screening tool, yet MRCP featured more specific ductal analysis prior to ERCP.

The present study found that the diagnostic accuracy of MRCP was 90.43 which was a clinically significant value. A diagnostic test that has a high accuracy of over 90% can be of great interest in decision making, especially when the other gold standard test is an invasive one. ERCP is still needed when extracting stones, sphincterotomy, or placing stents are needed, but its diagnostic procedure by itself has lost favor due to the availability of non-invasive imaging that is accurate. In this regard, MRCP can serve as a gatekeeper procedure, who will gain the most by undergoing therapeutic ERCP, and decreasing exposure of stone-negative patients to potentially harmful invasive procedures.Patient selection targeted in ERCP has also been reinforced as a guideline to risk stratification. Jacob et al. estimated the modified ASGE guidelines on common bile duct stone diagnosis and discovered that new criteria has increased the risk to the modules and decreased the incidence of diagnostic ERCP utilization.[16] The 2019 ASGE guideline validated predictors that were used to identify patients in need of additional imaging or direct ERCP indicated that guideline-based predictors can be used to help choose patients.[17] These important as these studies relate to the current findings since MRCP can be particularly helpful in patients that can be categorized in the middle-risk groups, without necessarily warrants direct ERCP without further validation.

Wang et al. conducted a meta-analysis and systematic review of ASGE non-invasive predictors and discovered that certain older predictors demonstrated inconsistent diagnostic quality, and imaging evidence of common bile duct stone were some of the best predictors.[18] This conclusion supports the application of mature imaging like MRCP. Assessing both ASGE and ESGE guidelines prospectively, similarly, Silva-Santisteban et al. found no significant differences in the accuracy between the two systems of guidelines yet reported that all guidelines had varying thresholds influencing further testing condition and unnecessary rate of ERCP.[19] Thus, MRCP is not independent but a component of a systematic diagnostic approach that incorporates both symptoms and liver chemistry in addition to ultrasound and risk assessment of guidelines. Important were also the false negative cases of this study. MRCP had missed 14 cases which were subsequently verified on ERCP. It could be very small stones, stones in the distal common bile ducts, biliary sludge, motion artifacts or the spontaneous movement of the stones between imaging and ERCP. MRCP is very helpful but may have lesser performance with small stones, stones that hit the ampulla or those that are covered by other fluid and artifacts. Thus, patients who have sustained cholestasis, cholangitis, or cases that have strong clinical suspicion might still need ERCP or EUS despite negative MRCP. The other significant implication of the study pertains to ERCP safety. Despite the reported high efficacy of ERCP in terms of therapeutic effectiveness, the practice is linked to complications that include pancreatitis, cholangitis, perforation and bleeding. Almaslamani et al. have stated that failure to follow an ERCP selection that is guided by guidelines was linked to poor outcomes when it came to suspected choledocholithiasis.[20] Altunpak et al. pointed out a list of risk factors of the post-ERCP pancreatitis and have stressed on the importance of careful patient-selection.[21] According to Zhao et al. other independent risk factors contributing to post-ERP pancreatitis include female gender, difficult cannulation, occlusivity of pancreatic duct, longer procedure time and sphincter of Oddi dysfunction.[22] These observations are in favor of using MRCP to prevent the unnecessary ERCP where possible.

In a study by Roskovicova et al., the complications of early post-ERCP were evaluated, and the study revealed that pancreatitis, cholangitis, perforation, and bleeding were still considered clinical significant complications after the procedure.[23] Bishay et al. also released a systematic review of ERCP-related adverse events and meta-analysis and stressed that the ERCP complications rank as a source of morbidity, mortality, and healthcare costs.[24] Moreover, the latest clinical practice guidelines on the management of post-ERCP pancreatitis focused on prevention, early detection and risk-informed management.[25] These studies consolidate the clinical significance of MRCP in non-invasive diagnostics prior to ERCP particularly in cases where the primary aim is diagnosis, and not treatment. There were a number of strengths in the current research. Both MRCP and ERCP were done on all the patients thus giving a direct comparison between index test and the gold standard. The sample size 230 patients was sufficient and founded on pre-determined sensitivity, specificity, prevalence, precision and confidence level contained in the study protocol. Internal validity was enhanced and confounding minimized by using clear inclusion and exclusion criteria. Moreover, the MRCP was conducted through a standard imaging protocol and report of the results was done by trained radiologists, thereby enhancing reliability.

CONCLUSION:

The current research study found out that Magnetic

Resonance Cholangiopancreatography (MRCP) was highly diagnostic in detecting choledocholithiasis in individuals who presented with obstructive jaundice with Endoscopic Retrograde Cholangiopancreatography (ERCP) as the gold standard. The sensitivity of MRCP was high, specificity was good, positive predictive value was high and overall diagnostic exposure was good, which means that it was effective in identifying majority of patients with common bile ducts stones correctly. In general, MRCP was an effective, safe, and non-invasive diagnostic modality in the assessment of suspected choledocholithiasis. Its risk prior to ERCP could be used to reduce unwarranted invasive surgeries, decrease procedure-associated issues and enhance patient selection of therapeutic ERCP. As such, MRCP is some of the key diagnostic studies in the patients with obstructive jaundice and who have common stones in the common bile ducts. Limitations: This study was a single-center research, and thus it might not be generalized to any healthcare setting. The age gap between MRCP and ERCP can lead to spontaneous passage of stones that can influence false positive/negative classification. Instead of individual analysis of stone size, number and location, the analysis was done on a single variable, which could affect the MRCP sensitivity. EUS was not used as an extra comparator, although there are recent evidences that EUS can be used to detect small stones that can be missed by MRCP. Nevertheless, the study presented some important local evidence that points to the hypothesis that MRCP can be used as a safe diagnostic modality in obstructive jaundice.

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Authors Contribution:
Iqra Siddique: Conception and Design, acquisition of data, analysis and interpretation of data, drafting and critical revision, final approval of the version to be published. Acquisition of data, drafting and final approval of the manuscript.
Hina Nadeem: Conception and Design, acquisition of data, analysis and interpretation of data, drafting and critical revision, final approval of the version to be published. Acquisition of data, drafting and final approval of the manuscript.
Syed Anjum Mehdi: Conception and Design, acquisition of data, analysis and interpretation of data, drafting and critical revision, final approval of the version to be published. Acquisition of data, drafting and final approval of the manuscript.

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