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Original Research Article

A Prospective Comparative Study of MRCP-First Versus EUS-First Strategy in the Management of Patients with Intermediate Probability of Common Bile Duct (CBD) Stones

Soumya Adhya[1], Tusar Kumar Das[2], Sumit Chakraborty[3], Debashis Misra[4]

[1]Senior Resident, MBBS, MD, DNB, Department of Radio Diagnosis, IPGMER and SSKM Hospital, Kolkata, West Bengal 700020

[2]Senior Resident, MBBS, MD, Department of Radio Diagnosis, IPGMER and SSKM Hospital, Kolkata, West Bengal 700020

[3]Associate Professor, MBBS, MD, DNB, Department of Radio Diagnosis, IPGMER and SSKM Hospital, Kolkata, West Bengal 700020

[4]Assistant Professor, MBBS, MD,DM, Department of Gasteroenterology, Department of Radio Diagnosis, IPGMER and SSKM Hospital, Kolkata, West Bengal 700020

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Corresponding Author: Dr. Soumya Adhya

Conflict of interest: Nil

Abstract

Background: The management of patients with an intermediate probability of common bile duct (CBD) calculus remains a clinical challenge. Both Magnetic Resonance Cholangiopancreatography (MRCP) and Endoscopic Ultrasonography (EUS) are commonly used diagnostic tools in assessing CBD stones. However, there is limited data comparing the efficacy, cost-effectiveness, and clinical outcomes of utilizing MRCP versus EUS as the initial diagnostic modality.

Objective: This study aims to compare the clinical outcomes of a strategy where MRCP is performed first versus one where EUS is performed first in patients with intermediate probability of CBD calculus. The focus is on diagnostic accuracy, procedural complications, treatment outcomes, and overall patient management**.**

Methods: This institution-based, prospective comparative study was conducted in the Department of Radio-diagnosis and Department of Gastroenterology at IPGME&R and SSKM Hospital, Kolkata. The study period spanned from January 2019 to August 2020. A total of 281 patients attending the Surgery and Gastroenterology outpatient departments (OPD) were enrolled. All patients underwent relevant clinical evaluation and diagnostic procedures as per the study protocol.

Result: In this prospective study involving 281 patients, the most common age group was 60 years (26%), followed by 50 years (23%), 40 years (17%), and 30 years (16%), with a slight female predominance (53%). Abdominal pain was the most frequent presenting symptom (76%), followed by jaundice (48%) and fever (23%), while 14% of patients were asymptomatic. Two symptoms were reported by 60% of patients, and a history of pancreatitis was noted in 8%. Liver enzyme elevation was observed in a majority of patients: SGOT in 103, SGPT in 88, and ALP in 125, with 38% showing one enzyme elevated, 15% with two, 15% with all three, and 32% with normal values. Both EUS and MRCP were performed in nearly equal numbers (140 and 141, respectively). Calculus was the predominant finding (92%), with multiple small calculi in 5% and sludge in 3%. Combined EUS and MRCP findings detected choledocholithiasis in 194 patients (69%), with EUS showing a detection rate of 69% and MRCP 70%. EUS correctly identified stones in 95% of positive cases, while MRCP detected stones in 94%. Among those diagnosed, 85% underwent ERCP and 15% had choledocholithotomy, followed by cholecystectomy in 84% of these cases. On follow-up, 13% of patients who were calculus-negative on imaging developed biliary symptoms or stone recurrence, while 87% remained asymptomatic, with similar recurrence rates in EUS-negative (14%) and MRCP-negative (12%) groups.

Conclusion: Both EUS-first and MRCP-first strategies are effective for evaluating patients with intermediate risk of CBD stones. EUS offers the added advantage of real-time detection with the potential for immediate therapeutic planning, while MRCP provides a non-invasive alternative with high diagnostic yield. The choice of initial modality may be guided by local expertise, availability, and patient-specific factors, as both strategies demonstrated comparable outcomes in terms of diagnostic accuracy and clinical resolution**.**

Keywords: MRCP, EUS, common bile duct calculus, diagnostic strategy, prospective study, treatment outcomes.

Introduction

Scores of research work and literature is being actively compiled regarding imaging modalities for detecting pancreatico-biliary pathologies with keen interest paid towards cost-effectiveness, diagnostic accuracy, safety and reliability.[1] Transabdominal ultrasonography is universally employed as the first diagnostic technique for detecting gastrointestinal pathologies but, unfortunately, has low sensitivity for detecting small common bile duct (CBD) stones and sludge[2] and could achieve definitive diagnosis in only one third of the cases. [3] Similarly, magnetic retrograde cholangio-pancreatogram (MRCP) has a high sensitivity and specificity for detecting choledocholithiasis and strictures but the sensitivity decreases when stone diameter reaches ≤5mm. [4]

Endoscopic retrograde cholangio-pancreatography (ERCP) is the gold standard tool for detecting CBD pathologies with the added benefit of intervention if required.[5]

Due to its invasive nature, ERCP is rarely preferred as the first choice of investigation and is usually preceded by MRCP or endoscopic ultrasound (EUS).[6] Endoscopic ultrasound (EUS) is an emerging minimally invasive technique with no risk of radiations or contrast related adverse effects but has limitations such as high cost, non-availability of the facility and trained personnel [7] and subsequently lack of local database.

This study was conducted to evaluate the diagnostic accuracy of different imaging modalities in patients with partial biliary obstruction, presenting either as asymptomatically raised liver enzymes, cholangitis or biliary dilatation with no obvious aetiology on initial imaging. The study helped to establish a better diagnostic tool in patients that pose as diagnostic dilemma with low and intermediate risk for choledocholithiasis.

The objective of this research is to evaluate the role of Magnetic Resonance Cholangiopancreatography (MRCP) and Endoscopic Ultrasonography (EUS) as first-line diagnostic methods for common bile duct (CBD) calculi in patients with symptomatic gallstone disease. Specifically, it aims to describe the findings of CBD calculi in the intermediate probability group using MRCP and EUS, and to compare the diagnostic accuracy, sensitivity, and specificity of these two modalities in detecting CBD calculi in this patient population. Additionally, the study will further evaluate the outcomes using Endoscopic Retrograde Cholangiopancreatography (ERCP) or Choledocholithotomy as confirmatory procedures.

Materials and Methods

Study Design: Institution based prospective, comparative study

Study setting: Dept. of Radio diagnosis, IPGME & R-SSKM Hospital, Kolkata and Dept. of Gastroenterology, IPGME & R-SSKM Hospital, Kolkata.

Place of study: Dept. of Radio diagnosis, IPGME & R-SSKM Hospital, Kolkata.

Period of Study: January 2019 to August 2020.

Study Population: Patients attending at Surgery and Gastroenterology OPD of IPGME & R and SSKM Hospital, Kolkata.

Sample Size: 281patients.

Study Variables

- Socioeconomic status
- Age
- Sex

Inclusion Criteria

Any patients having clinical feature of Common Bile Duct calculi of intermediate probability group in patients with symptomatic gall stone disease with following findings..

Exclusion Criteria

- CBD stone on Trans abdominal US
- Clinical ascending cholangitis
- Bilirubin > 4 mg/dl

Statistical Analysis: Data from the study were analyzed using SPSS software, with continuous variables (e.g., age, liver enzyme levels) expressed as mean ± SD and compared using t-tests or Mann–Whitney U tests.

Categorical variables (e.g., gender, CBD stones, and complications) were presented as frequencies and percentages, and compared using Chi-square or Fisher's exact tests.

Diagnostic accuracy (sensitivity, specificity, PPV, NPV, and accuracy) was calculated for MRCP-first and EUS-first strategies, using ERCP/intraoperative findings as the reference. Kaplan-Meier analysis may be used for time-to-intervention comparisons. A p-value < 0.05 was considered significant.

Result

Table 1: Distribution of Age (yrs), sex

Age (years)		Frequency	Percent
Age(years)	20	7	2%
	30	45	16%
	40	48	17%
	50	65	23%
	60	72	26%
	70	44	16%
Sex	Male	133	47%
	Female	148	53%

Table 2: Distribution of Symptoms, no of symptom, h/o pancreatitis, enzyme raised, no of enzyme raised

Enzyme Elevation		Frequency	Percent
Symptoms	Pain	214	76%
	Fever	64	22%
	Jaundice	134	47%
No of symptom	One symptom	73	26%
	Two symptoms	169	60%
	No symptom	39	14%
	Total	281	100%
H/o pancreatitis	Yes	22	8%
	No	259	92%
	Total	281	100%
Enzyme raised	SGOT	103	36%
	SGPT	88	31%
	ALP	125	44%
No of enzyme raised	One enzyme	106	38%
	Two enzyme	41	15%
	Three enzyme	43	15%
	Not raised	91	32%
	Total	281	100%

Table 3: Distribution of investigation, content, calculus found in EUS and MRCP, calculus found in EUS, calculus found in MRCP

Calculus Detection on EUS and MRCP		Frequency	Percent
Investigation	EUS	140	50%
	MRCP	141	50%
	Total	281	100%
Content	Calculus	259	92%
	Multiple small calculi	15	5%
	Sludge only	7	3%
	Total	281	100%
Calculus found in EUS and MRCP	Calculus found	194	69%
	Not found	87	31%
	Total	281	100%
Calculus found in EUS	Calculus found	96	69%
	Calculus not found	44	31%
	Total	140	100%
Calculus found in MRCP	Calculus found	98	70%
	Calculus not found	43	30%
	Total	141	100%

Table 4: Distribution of choledocholithiasis on EUS OR MRCP, Choledocholithiasis in EUS, choledocholithiasis on MRCP, choledocholithiasis on EUS and MRCP

Choledocholithiasis on Both EUS and MRCP		Frequency	Percent
Choledocholithiasis on EUS or MRCP	ERCP	165	85%
	Choledocholithotomy	29	15%
	Total	194	100%
Choledocholithiasis in EUS	Calculus found	91	95%
	Not found	5	5%
	Total	96	100%
Choledocholithiasis on MRCP	Calculus found	92	94%
	Not found	6	6%
	Total	98	100%
Choledocholithiasis on EUS AND MRCP	Calculus found	183	94%
	Not found	11	6%
	Total	194	100%

Table 5: Distribution of Follow-up cholecystectomy, Follow-up of Biliary Symptoms, CBD Calculus, and Post-ERCP/Imaging-Negative Patients

Follow-up Biliary Symptoms with CBD Calculus		Frequency	Percent
Follow-up of Cholecystectomy in Prior ERCP Patients	Done	139	84%
	Not done	26	16%
	Total	165	100%
Biliary Symptoms & CBD Follow-up in Previously EUS & MRCP-Negative Patients	Present	11	13%
	Absent	76	87%
	Total	87	100%
Biliary Symptoms & CBD Calculus Follow-up in Previously EUS-Negative Cases	Present	6	14%
	Absent	38	86%
	Total	44	100%
Biliary Symptoms & CBD Follow-up in Previously MRCP-Negative Cases	Present	5	12%
	Absent	38	88%
	Total	43	100%

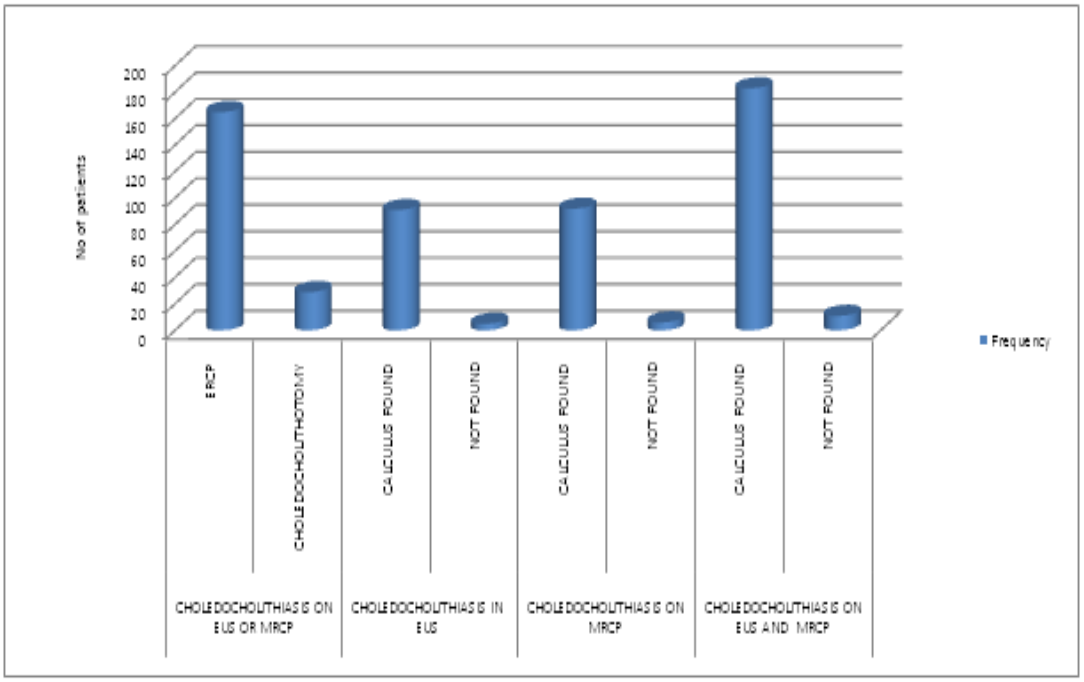

Figure 1: Distribution of choledocholithiasis on EUS OR MRCP, choledocholithiasis in EUS, choledocholithiasis on MRCP, choledocholithiasis on EUS and MRCP

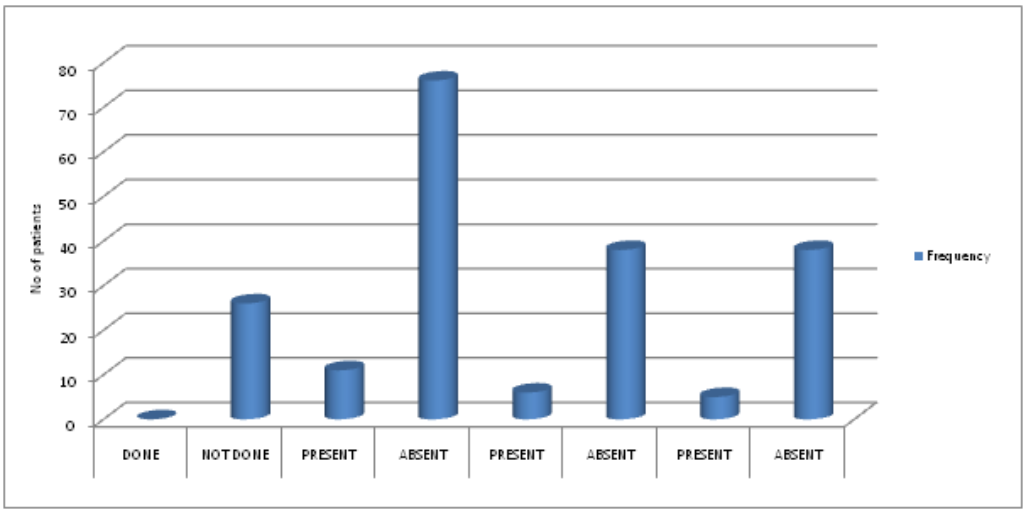

Figure 2: Distribution of Follow-up cholecystectomy, Follow-up of Biliary Symptoms, CBD Calculus, and Post-ERCP/ImagingNegative Patient

In our study involving 281 patients, the most common age group was 60 years, comprising 72 patients (26%), followed by 50 years with 65 patients (23%), 40 years with 48 patients (17%), 30 years with 45 patients (16%), and 70 years with 44 patients (16%). The least number of patients were from the 20-year age group, accounting for only 7 patients (2%). Regarding sex distribution, 133 patients (47%) were male, while 148 patients (53%) were female.

In our study comprising 281 patients, the most common presenting symptom was abdominal pain, reported by 214 patients, followed by jaundice in 134 patients, and fever in 64 patients. Regarding the number of symptoms at presentation, 169 patients (60%) had two symptoms, while 73 patients (26%) had only one symptom, and 39 patients (14%) were asymptomatic at the time of presentation. A history of pancreatitis was documented in 22 patients (8%), while 259 patients (92%) had no such history. Assessment of liver enzymes revealed SGOT elevation in 103 patients, SGPT in 88 patients, and ALP in 125 patients. When classified by the number of enzymes elevated, 106 patients (38%) had one enzyme raised, 41 patients (15%) had two enzymes elevated, and 43 patients (15%) had all three enzymes elevated, whereas 91 patients (32%) had no enzyme elevation.

In our study among the 281 patients in our study, endoscopic ultrasound (EUS) was performed in 140 patients (50%), and magnetic resonance cholangiopancreatography(MRCP) in 141 patients (50%).Regarding the biliary content, calculus was the predominant finding, present in 259 patients (92%). Additionally, multiple small calculi were observed in 15 patients (5%), while sludge alone was noted in 7 patients (3%).When combining findings from both EUS and MRCP, calculus was detected in 194 patients (69%), while 87 patients (31%) showed no evidence of calculus. On individual modality analysis, EUS detected calculus in 96 out of 140 patients (69%), while 44 patients (31%) had no calculus on EUS. Similarly, MRCP revealed calculus in 98 out of 141 patients (70%), and 43 patients (30%) had no detectable calculus on MRCP.

In our study, Out of 194 patients who were diagnosed with choledocholithiasis based on EUS or MRCP, 165 patients (85%) underwent endoscopic retrograde cholangiopancreatography (ERCP), while 29 patients (15%) underwent choledocholithotomy as the definitive intervention. On individual imaging modality analysis, EUS detected choledocholithiasis in 91 out of 96 patients (95%), with 5 patients (5%) showing no evidence of stones. Similarly, MRCP detected choledocholithiasis in 92 out of 98 patients (94%), while 6 patients (6%) had no findings of choledocholithiasis. When findings from both EUS and MRCP were combined, choledocholithiasis was identified in 183 out of 194 patients (94%), while 11 patients (6%) had negative findings despite symptoms and/or biochemical evidence.

In our study among the 165 patients who underwent intervention for choledocholithiasis (either ERCP or choledocholithotomy), follow-up cholecystectomy was performed in 139 patients (84%), while 26 patients (16%) did not undergo the procedure. During follow-up, biliary symptoms and recurrence of common bile duct (CBD) calculi were observed in a subset of patients who initially had no calculus detected on imaging. Among the 87 patients who were calculus-negative on either EUS or MRCP, 11 patients (13%) developed biliary symptoms or CBD stones, while 76 patients (87%) remained asymptomatic. Specifically, among the 44 patients with no calculus found on

EUS, 6 patients (14%) developed symptoms or stones during follow-up, while 38 patients (86%) remained symptom-free. Similarly, of the 43 patients who had no calculus detected on MRCP, 5 patients (12%) developed biliary symptoms or recurrence, while 38 patients (88%) remained asymptomatic.

Discussion

We found that 281 patients, the majority of individuals belonged to the older age group, with the peak incidence of symptomatic biliary disease seen in those aged 60 years and above. This age-related trend correlates with several previous reports, which have identified increasing age as a risk factor for gallstone formation and complications such as choledocholithiasis [8,9]. Female predominance was noted (53%), consistent with the well-established higher prevalence of gallstone disease among women, likely due to hormonal influences, particularly estrogen, as also reported by Shaffer et al. and others [10,11]. We examined that Abdominal pain was the most common presenting symptom in our cohort (76%), followed by jaundice and fever. Similar symptom patterns have been noted in other Indian and global studies, highlighting right upper quadrant pain as the hallmark of biliary tract pathology [12,13]. Most patients (60%) presented with two symptoms simultaneously, indicating a substantial clinical burden at the time of presentation. We found that history of pancreatitis was present in 8% of our patients, which aligns with the known association between choledocholithiasis and gallstone pancreatitis [14]. Enzyme elevation patterns showed ALP as the most commonly raised parameter (125 patients), followed by SGOT and SGPT. These findings are comparable to those in a study by Akyürek et al., where cholestatic enzyme elevation strongly indicated biliary obstruction [15]. We observed that In terms of imaging, EUS and MRCP were equally utilized, and calculus detection rates were comparable—69% for EUS and 70% for MRCP. EUS demonstrated slightly better sensitivity for choledocholithiasis (95%) than MRCP (94%), as supported by prior comparative studies which suggested EUS as the superior modality, especially for small or distally located stones [16,17]. Calculus was identified in 94% of patients when both imaging modalities were combined, reinforcing the diagnostic utility of a multimodal approach [18].

Among those diagnosed with choledocholithiasis, ERCP was the primary therapeutic modality in 85% of patients, whereas choledocholithotomy was needed in 15%. These findings support the trend toward endoscopic over surgical intervention in appropriately selected cases, as observed in recent literature [19].

Cholecystectomy was performed in 84% of patients during follow-up. However, recurrence of CBD stones or biliary symptoms was observed in a small proportion of patients who initially had negative imaging findings. Notably, 13% of patients with no calculus detected on either EUS or MRCP later developed symptoms or stones. This underscores the limitation of even advanced imaging in detecting microlithiasis or sludge, as reported by Lee et al. [20]. Similarly, follow-up data showed recurrence in 14% of EUS-negative and 12% of MRCP-negative patients, which aligns with findings from other prospective analyses on recurrence risk after stone clearance [21, 22].

Conclusion

In our study, the majority of patients presenting with suspected biliary pathology were found to have calculi as the predominant biliary content. Both endoscopic ultrasound (EUS) and magnetic resonance cholangiopancreatography (MRCP) proved effective in detecting choledocholithiasis, with comparable diagnostic yields. A significant number of patients who were diagnosed with choledocholithiasis underwent endoscopic or surgical intervention, followed by cholecystectomy in most cases. While the majority of patients who had no calculus detected on imaging remained asymptomatic during follow-up, a small subset developed biliary symptoms or recurrence of stones, highlighting the importance of close monitoring. Overall, the combination of imaging modalities, followed by appropriate intervention and surveillance, provided favorable outcomes in the management of choledocholithiasis and related biliary disorders.

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