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Timing and Diagnostic Yield of Preoperative MRCP in Acute Gallstone Pancreatitis: Differentiating Spontaneous Stone Passage from Retained Choledocholithiasis.

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Abstract

Background: In acute gallstone pancreatitis (AGP), transient ampullary obstruction by migrating biliary calculi initiates the disease cascade. A substantial proportion of these small choledocholiths pass spontaneously into the duodenum within 24 to 48 hours of onset. Performing routine Magnetic Resonance Cholangiopancreatography (MRCP) immediately upon admission (< 24 hours) frequently captures transient stones in transit, leading to unnecessary preoperative Endoscopic Retrograde Cholangiopancreatography (ERCP), increased procedural morbidity, and surgical delays. ***Objective:*** To evaluate whether a delayed, targeted MRCP protocol (48–72 hours post-admission following liver function test [LFT] trend analysis) improves diagnostic yield for persistent choledocholithiasis, reduces non-therapeutic ERCPs, and optimizes hospital length of stay (LOS) and time-to-cholecystectomy compared to early routine MRCP (< 24 hours). ***Methods:*** A multi-center, comparative cohort study was conducted between June 2023 and May 2025 across three tertiary medical centers in Karnataka, India (GIMS-SSH, Kalaburagi; KIMS, Hubballi; MRMC, Kalaburagi). A total of 112 consecutive adult patients with mild-to-moderate AGP were evaluated. Cohort 1 (n = 54) underwent early routine MRCP (< 24 hours of admission). Cohort 2 (n = 58) received delayed targeted MRCP (48–72 hours post-admission), performed only if serial LFTs demonstrated persistent or worsening cholestasis. Primary endpoints included MRCP diagnostic accuracy, positive predictive value (PPV) for retained stones requiring therapeutic ERCP, rate of non-therapeutic ERCPs, time-to-cholecystectomy, and overall hospital LOS. ***Results:*** Baseline demographics, ASA status, and initial admission LFTs were comparable across cohorts. The delayed targeted MRCP strategy yielded a significantly higher PPV for persistent choledocholithiasis requiring therapeutic intervention (91.3% vs. 64.3%, p = 0.008). In Cohort 2, 35 patients (60.3%) showed rapidly improving/normalizing LFT trends over 48–72 hours, bypassed MRCP, and proceeded directly to index laparoscopic cholecystectomy without biliary complications. Non-therapeutic ERCP rates were significantly lower in the delayed targeted group (3.4% vs. 18.5%, p = 0.012). Furthermore, delayed targeted imaging led to shorter median overall hospital stay (4.5 vs. 6.2 days, p < 0.001) and reduced time-to-cholecystectomy (3.8 vs. 5.1 days, p < 0.001). ***Conclusion:*** Delaying preoperative MRCP to 48–72 hours post-admission combined with serial LFT trend analysis effectively filters out patients with spontaneous stone passage. This targeted strategy substantially increases MRCP diagnostic yield, minimizes non-therapeutic invasive ERCPs, and streamlines index surgical management without compromise to patient safety.

Keywords: Acute gallstone pancreatitis; MRCP; Choledocholithiasis; ERCP; Biliary obstruction; Spontaneous stone passage; Delayed MRCP.

INTRODUCTION

Acute gallstone pancreatitis (AGP) remains one of the primary drivers of emergency gastrointestinal admissions globally.[1,2] The underlying pathophysiology typically involves transient impaction of a migrating biliary calculus at the ampulla of Vater, creating pancreatic ductal hypertension and triggering acinar cell injury.[3] In approximately 20% to 75% of patients,

small gallstones pass spontaneously through the sphincter of Oddi into the duodenum within the first 24 to 48 hours following clinical presentation.[4,5]

Distinguishing between self-limiting ductal transit and persistent choledocholithiasis poses a diagnostic challenge in acute surgical care. Persistent ductal obstruction increases the risk of recurrent pancreatitis, progressive jaundice, and ascending cholangitis.[6] However, subjecting patients with self-cleared biliary trees to invasive interventions like Endoscopic Retrograde Cholangiopancreatography (ERCP) exposes them to procedural complications, including post-ERCP pancreatitis (3%–10%), hemorrhage, duodenal perforation, and sepsis.[7,8]

Magnetic Resonance Cholangiopancreatography (MRCP) has emerged as the non-invasive gold standard for ductal visualization, offering sensitivity and specificity exceeding 90% for choledocholithiasis.[9,10] However, the timing of MRCP execution remains variable:

- Early MRCP (< 24 hours): Captures stones mid-transit, frequently resulting in false-positive indications for therapeutic ERCP or leading to non-therapeutic procedures when stones pass in the interval between MRCP and endoscopy.[5,11]
- Delayed Targeted MRCP (48–72 hours): Leverages the physiological window of spontaneous clearance, reserving advanced cross-sectional imaging for patients whose liver function tests (LFTs) remain elevated or worsen.[4,12]

This prospective comparative multi-center study evaluates the diagnostic yield, clinical utility, and operational impact of an early routine versus a delayed targeted preoperative MRCP pathway in patients presenting with acute gallstone pancreatitis.

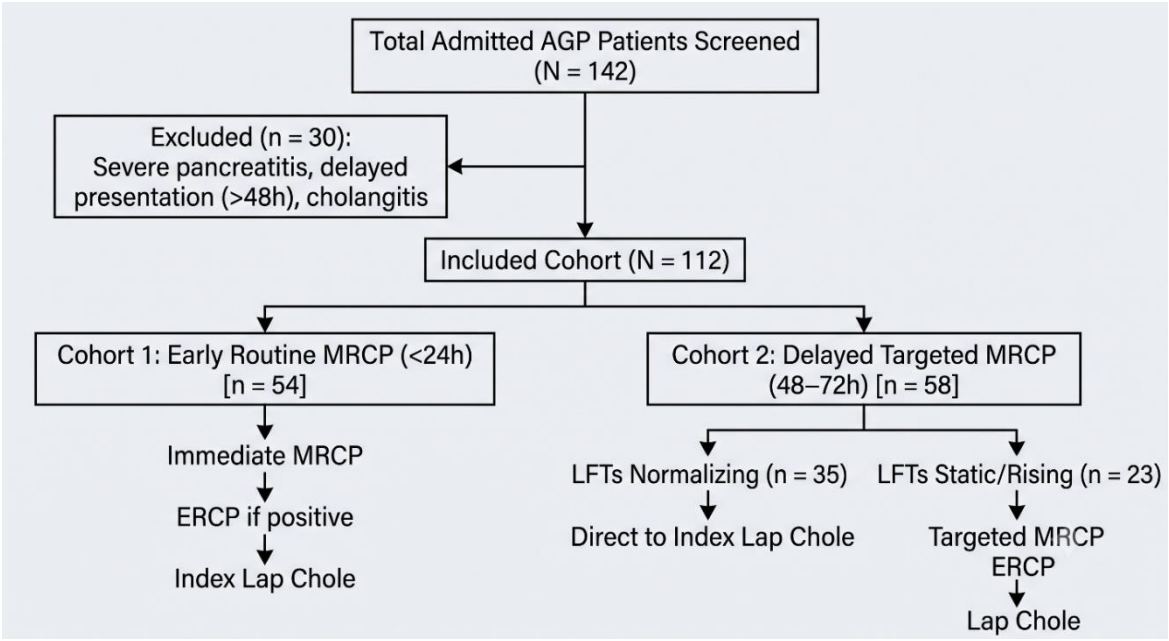
MATERIALS AND METHODS

Study Design and Clinical Settings

This multi-center, comparative cohort study was conducted between June 2023 and May 2025 (24-month study period). Patient enrollment and data extraction were coordinated across three tertiary care and safety-net teaching institutions in Karnataka, India:

1. Department of Surgical Gastroenterology, Gulbarga Institute of Medical Sciences – Super Speciality Hospital (GIMS-SSH), Kalaburagi.
2. Department of Surgical Gastroenterology, Karnataka Institute of Medical Sciences (KIMS), Hubballi.
3. Department of Radiology, Mahadevappa Rampure Medical College (MRMC) and Basaveshwar Teaching Hospital, Kalaburagi.

The protocol was approved by the respective Institutional Ethics Committees (IEC), and written informed consent was secured from all participants prior to enrollment.



Participant Eligibility

Inclusion Criteria:

- Adult patients aged 18 to 70 years.

- Confirmed diagnosis of acute gallstone pancreatitis defined by Atlanta Classification criteria (2 of 3 features: upper abdominal pain, serum amylase/lipase >3 times upper limit of normal, and abdominal ultrasound demonstrating cholecystolithiasis/biliary sludge).[1]
- Mild to moderate severity (revised Atlanta classification).[1]
- Presentation within 24 hours of abdominal pain onset.

Exclusion Criteria:
- Severe acute pancreatitis (persistent organ failure >48 hours).
- Clinical or radiological signs of acute ascending cholangitis requiring emergency ERCP within 12 hours.[6]
- Prior history of ERCP, sphincterotomy, or upper gastrointestinal tract reconstruction.
- Contraindications to MRI/MRCP (e.g., pacemakers, metallic implants, severe claustrophobia).
- Chronic pancreatitis or suspicion of pancreatico-biliary malignancy.

Intervention & Imaging Pathways

Patients were assigned to one of two diagnostic pathways based on admitting unit protocol:
- Early Routine MRCP Cohort (n = 54): Patients underwent high-resolution 1.5T/3.0T MRCP within 24 hours of hospital admission regardless of clinical progression or initial LFT trajectory. If MRCP demonstrated choledocholithiasis, ERCP with sphincterotomy and stone extraction was scheduled prior to index laparoscopic cholecystectomy.
- Delayed Targeted MRCP Cohort (n = 58): Patients received initial conservative management (fluid resuscitation, analgesia, and enteral feeding). Serial LFTs (total bilirubin, direct bilirubin, alkaline phosphatase [ALP], alanine aminotransferase [ALT], and \gamma-glutamyl transferase [GGT]) were drawn at admission, 24 hours, and 48 hours.
  - Subgroup A (Normalizing LFTs): Patients exhibiting >30% drop in total bilirubin and transaminases over 48 hours bypass preoperative MRCP and proceed directly to index laparoscopic cholecystectomy with intraoperative cholangiography (IOC) or post-operative monitoring.
  - Subgroup B (Persistent/Worsening LFTs): Patients with plateauing or rising cholestatic markers underwent targeted MRCP at 48–72 hours post-admission. Therapeutic ERCP was performed only if MRCP confirmed persistent common bile duct (CBD) stones.

Outcome Parameters

1. Diagnostic Yield & Accuracy: Sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) of MRCP for true retained choledocholithiasis confirmed during therapeutic ERCP or surgery.
2. Procedural Performance: Rate of non-therapeutic ERCPs (procedures resulting in normal cholangiograms without stone extraction).
3. Surgical & Efficiency Metrics: Time-to-index cholecystectomy, total hospital length of stay (LOS), and 30-day readmission/biliary complication rates.

RESULTS

Baseline Clinical Characteristics

A total of 112 patients completed the protocol (54 in Early Routine MRCP; 58 in Delayed Targeted MRCP). Demographics, baseline laboratory parameters at admission, and disease severity scores showed no statistically significant differences between the two study groups (Table 1).

Table 1: Baseline Demographic and Clinical Parameters at Presentation

Parameter	Early MRCP (n=54)	Delayed Targeted MRCP (n=58)	t / $\chi 2$ value	p-value
Age (years), Mean ± SD	45.2 ± 12.1	46.8 ± 11.4	t = -0.72	0.47
Sex (Male / Female), n (%)	28 (51.9%) / 26 (48.1%)	31 (53.4%) / 27 (46.6%)	$\chi 2$ = 0.03	0.86
BMI, Mean ± SD	24.1 ± 3.2	24.5 ± 2.8	t = -0.70	0.48
Admission Serum Amylase (U/L)	1240 ± 410	1190 ± 385	t = 0.66	0.51
Admission Total Bilirubin (mg/dL)	3.4 ± 1.2	3.6 ± 1.1	t = -0.92	0.36
Admission ALP (U/L)	280 ± 75	295 ± 82	t = -1.01	0.31
BISAP Score (≤0.5), n (%)	42 (77.8%) / 12 (22.2%)	46 (79.3%) / 12 (20.7%)	$\chi 2$ = 0.04	0.84

Diagnostic Accuracy & ERCP Yield

In the Early Routine MRCP Cohort (n = 54), MRCP identified CBD stones or defect fills in 28 patients (51.9%). All 28 underwent preoperative ERCP; however, ductal stones were retrieved in only 18 cases, while 10 patients (35.7% of ERCPs; 18.5% of total cohort) had normal therapeutic cholangiograms, confirming spontaneous stone passage prior to endoscopy. In the Delayed Targeted MRCP Cohort (n = 58), 35 patients (60.3%) demonstrated significant biochemical improvement by 48–72 hours and bypassed MRCP. The remaining 23 patients (39.7%) with static/rising LFTs underwent delayed MRCP, which identified choledocholithiasis in 21 patients. Subsequent ERCP confirmed and successfully extracted stones in 21 of 23 patients (PPV: 91.3%). Only 2 patients underwent non-therapeutic ERCP (3.4% of overall cohort).

Table 2: Diagnostic Performance and Interventional Yield

Metric	Early MRCP (n=54)	Delayed Targeted MRCP (n=58)	Odds Ratio / Difference	p-value
Total MRCP Scans Performed, n (%)	54 (100.0%)	23 (39.7%)	Risk Diff: -60.3%	< 0.001
Total ERCP Procedures, n (%)	28 (51.9%)	23 (39.7%)	OR: 0.61 (0.28-1.32)	0.20
Therapeutic ERCP (Stones Extracted), n	18	21	—	—
Non-Therapeutic ERCP Rate, n (%)	10 (18.5%)	2 (3.4%)	OR: 0.16 (0.03-0.78)	0.012
Positive Predictive Value (PPV) for ERCP	64.3%	91.3%	Diff: +27.0%	0.008
MRCP False Positive Rate for Retained Stone	35.7%	8.7%	Diff: -27.0%	0.008

Hospital Workflow and Clinical Outcomes

Patients managed via the delayed targeted workflow experienced significantly shorter operative waiting times and total hospital stay. Patients in Cohort 2 who bypassed MRCP underwent laparoscopic cholecystectomy earlier during index admission (median 3.2 days). Overall median time-to-cholecystectomy was 3.8 days in Cohort 2 compared to 5.1 days in Cohort 1 ($p < 0.001$). Total length of stay was 4.5 days vs. 6.2 days ($p < 0.001$). 30-day post-cholecystectomy biliary complications and readmission rates were low and showed no statistical difference between groups.

Table 3: Operational Metrics and Postoperative Outcomes

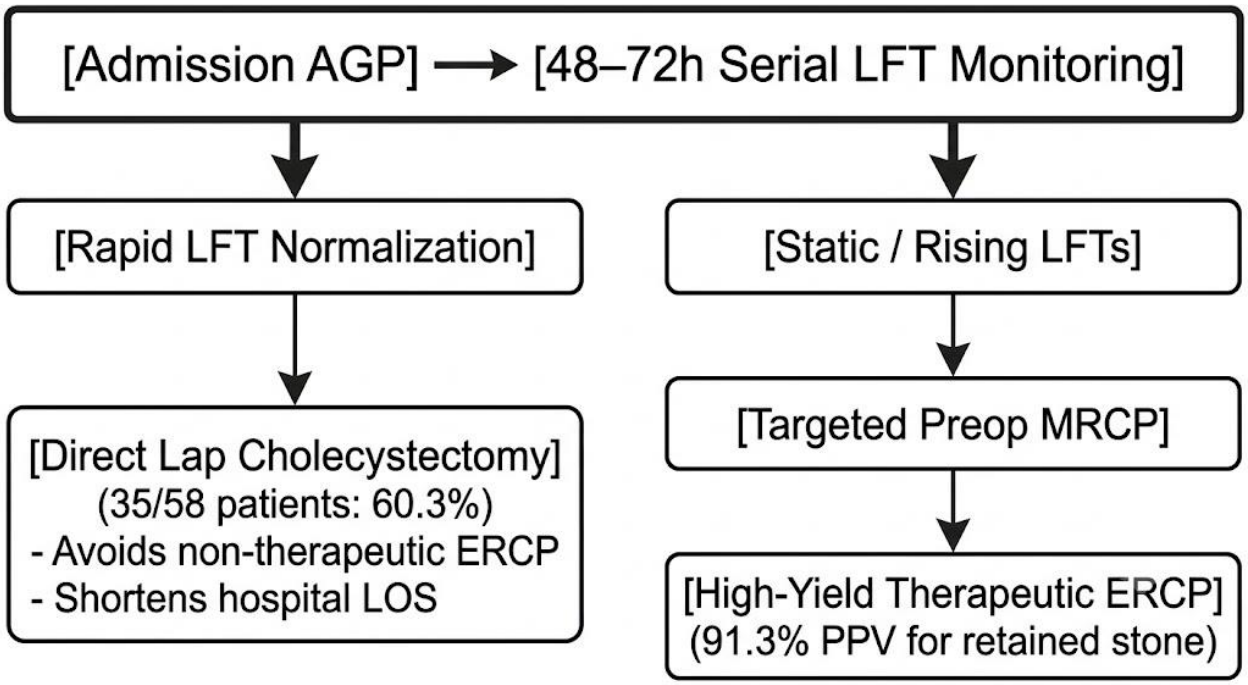
Outcome Parameter	Early MRCP (n=54)	Delayed Targeted MRCP (n=58)	Difference / Statistic	p-value
Time to Cholecystectomy (days), Median (IQR)	5.1 (4.0-6.5)	3.8 (3.0-4.8)	Diff: -1.3 days	< 0.001
Length of Hospital Stay (days), Median (IQR)	6.2 (5.0-7.8)	4.5 (3.5-5.5)	Diff: -1.7 days	< 0.001
Post-ERCP Complications (Pancreatitis/Bleeding), n (%)	4 (7.4%)	1 (1.7%)	OR: 0.21 (0.02-1.97)	0.16
30-Day Biliary Readmissions, n (%)	1 (1.9%)	1 (1.7%)	OR: 0.93 (0.06-15.2)	1.00

DISCUSSION

The primary clinical objective in acute gallstone pancreatitis management is balancing prompt surgical resolution of the underlying gallstone source with safe clearance of main bile duct obstruction.[1,2] Early identification of persistent choledocholithiasis is vital; however, over-investigating transient ductal migration leads to unnecessary procedural risks and health system bottlenecks.[3–5]

Our multi-center findings demonstrate that executing MRCP routinely within 24 hours of presentation captures a significant proportion of stones during active ductal transit. In Cohort 1, more than one-third of positive or suspicious early MRCPs resulted in non-therapeutic ERCPs, as small stones (<5 mm) cleared into the duodenum during the operational interval

between imaging and endoscopic intervention. This observation aligns with previous studies reporting spontaneous ductal clearance rates between 20% and 70% during the initial 48 hours of AGP management.[4,5,11]



By delaying MRCP to 48–72 hours post-admission and filtering utilization through serial LFT trends, the diagnostic yield for true persistent choledocholithiasis rose to 91.3%. Biochemical clearance served as an accurate surrogate marker for spontaneous ductal passage, allowing 60.3% of patients in the targeted group to bypass magnetic resonance imaging altogether without incurring biliary adverse events.

Impact on Invasive Procedural Burden

Minimizing non-therapeutic ERCPs carries significant clinical benefits. ERCP in the setting of acute pancreatitis involves heightened technical difficulty and carries elevated risks of exacerbating pancreatic parenchymal inflammation, post-ERCP pancreatitis, and duodenal wall edema.[7,8] Reducing the non-therapeutic ERCP rate from 18.5% to 3.4% ($p = 0.012$) directly mitigates procedural morbidity and optimizes high-demand endoscopy suites in safety-net hospital systems.

Operational Efficiency and Index Cholecystectomy Timing

Current international guidelines (ACG, IAP/APA, WSES) recommend index laparoscopic cholecystectomy during the same hospital admission for mild AGP to prevent recurrent biliary events.[1,2,6] Unnecessary imaging workups create diagnostic delays, pushing surgical intervention further into the admission. By adopting a 48–72 hour diagnostic window, low-risk patients with normalizing LFTs proceed to surgery without delay, significantly reducing median time-to-cholecystectomy (3.8 vs. 5.1 days) and total length of stay (4.5 vs. 6.2 days).

LIMITATIONS

Several study limitations should be considered:

1. Non-Randomized Allocation: Allocation to imaging cohorts was dictated by participating hospital unit protocols, introducing potential selection bias, although baseline characteristics were comparable.
2. Sample Size: While adequate for identifying primary differences in diagnostic yield, non-therapeutic ERCP, and length of stay, the sample size (N = 112) was underpowered to detect rare major complications such as post-ERCP mortality or perforation.
3. Institutional Imaging Access: Variations in MRI scanner availability (1.5T vs. 3.0T) and ERCP scheduling windows across tertiary centers reflect real-world clinical practice but may introduce minor institutional variability.

CONCLUSION

1. Avoid Routine Early MRCP: Performing MRCP within <24 hours of admission for acute gallstone pancreatitis over-diagnoses transient ductal migration and leads to high rates of non-therapeutic ERCP.

2. Utilize 48–72 Hour Biochemical Triaging: Serial LFT trend analysis over 48–72 hours accurately differentiates self-clearing biliary transit from persistent obstruction.
3. Target High-Risk Cohorts: Preoperative MRCP should be reserved for patients with static or rising cholestatic LFTs at 48–72 hours, achieving high diagnostic yield and therapeutic accuracy.
4. Optimize Clinical Care: Implementing a delayed targeted pathway safely reduces non-therapeutic endoscopic procedures, shortens surgical waiting times, and minimizes overall hospital length of stay.

Ethical Approval:
Approved by the Institutional Ethics Committees of GIMS-SSH Kalaburagi, KIMS Hubballi, and MRMC Kalaburagi. Conducted in accordance with the 1964 Declaration of Helsinki and its later amendments.

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Conflicts of Interest:
The authors declare no financial or personal conflicts of interest related to this manuscript.

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