Research Article

Clinical and Microbiological Profile of Patients With Acute Cholangitis in A Tertiary Care Centre: A Prospective Observational Study

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Abstract

Background: Acute cholangitis is a potentially life-threatening biliary tract infection, usually associated with biliary obstruction. Microbiological characteristics and antimicrobial susceptibility patterns may vary by underlying aetiology and local epidemiology. This study evaluated the clinical and microbiological profile, severity, management, and outcomes of patients with acute cholangitis. **Methods:** A prospective observational study was conducted at King George Hospital, Visakhapatnam, from March 2023 to February 2024. Adults diagnosed with acute cholangitis according to clinical, biochemical, and imaging criteria were included. Data regarding demographics, aetiology, clinical features, severity according to Tokyo Guidelines 2018, laboratory parameters, microbiological findings, antimicrobial susceptibility, interventions, and outcomes were recorded. Blood and bile samples were subjected to aerobic and anaerobic culture and antimicrobial susceptibility testing. Statistical analysis was performed using SPSS. **Results:** A total of 78 patients were included, with a mean age of 42.73 ± 15.25 years; 47 (60.3%) were male. Grade II cholangitis was predominant (80.8%), followed by Grade III (15.4%) and Grade I (3.8%). Jaundice (92.3%), fever (91.0%), and abdominal pain (89.8%) were the predominant clinical features. Gallstone disease was the most common etiology (30.8%), followed by chronic pancreatitis (15.4%) and malignant biliary obstruction. Blood cultures were positive in 17.9% of patients, with Escherichia coli being the most frequent isolate (9.0%). Bile cultures were positive in 70.5%; E. coli (38.5%) and Klebsiella spp. (20.5%) were the predominant isolates, while Bacteroides spp. were identified in 7.6% of bile cultures. ERCP was performed in 91.0% of patients and PTBD in 9.0%. Overall mortality was 3.8%, with deaths occurring among patients with malignant obstruction and Grade III cholangitis. Malignant obstruction was associated with greater ICU utilization and poorer outcomes. **Conclusion:** Acute cholangitis in this tertiary-care cohort was predominantly associated with benign biliary obstruction, particularly gallstone disease, although malignant obstruction was associated with greater severity and adverse outcomes. E. coli and Klebsiella were the predominant biliary pathogens, with substantial culture negativity. The observed antimicrobial susceptibility pattern, particularly the activity of meropenem and amikacin against several isolates, supports the importance of local microbiological surveillance and culture-guided antimicrobial therapy. Early biliary decompression, predominantly through ERCP, remains central to management.

Keywords: Acute cholangitis; biliary obstruction; bile culture; blood culture, antimicrobial susceptibility; ERCP.

INTRODUCTION

Acute cholangitis is an infectious condition of the biliary tract that generally develops in the setting of biliary obstruction. The resulting biliary stasis and increased intraductal pressure facilitate bacterial translocation and may lead to systemic inflammatory response and sepsis. Historically, the diagnosis was based on Charcot's triad of fever, jaundice, and right upper quadrant pain; however, its limited sensitivity has led to the adoption of more comprehensive diagnostic criteria incorporating clinical, laboratory, and imaging findings.[1-3]

The clinical severity of acute cholangitis ranges from mild disease to severe infection with organ dysfunction and septic shock. The revised Tokyo Guidelines introduced standardized diagnostic and severity criteria, subsequently updated in the Tokyo Guidelines 2018 (TG18), enabling systematic classification into Grade I (mild), Grade II (moderate), and Grade III (severe) disease.[4]

Biliary obstruction due to choledocholithiasis remains a major cause of acute cholangitis, while benign strictures, postoperative changes, biliary instrumentation, and malignant obstruction represent other important etiologies.[5] The microbiological profile predominantly includes Gram-negative organisms, particularly Escherichia coli, Klebsiella spp., and Pseudomonas spp., although Gram-positive and anaerobic organisms may also occur. Local variations in antimicrobial susceptibility make knowledge of the institutional microbiological profile important for appropriate empirical and culture-directed antimicrobial therapy. [6]

Although prompt antimicrobial therapy and biliary decompression are fundamental components of treatment, contemporary prospective data describing the clinical characteristics, severity, microbiological spectrum, antimicrobial susceptibility, and outcomes of acute cholangitis remain limited in many Indian tertiary-care

settings. The present study was therefore undertaken to evaluate the clinical and etiological profile of acute cholangitis, assess disease severity according to TG18, characterize the bacterial profile and antimicrobial susceptibility, and examine the interventions and outcomes among patients presenting to a tertiary-care hospital.

AIM AND OBJECTIVES

Aim

To prospectively evaluate the clinical, etiological, microbiological, therapeutic, and outcome profile of patients with acute cholangitis presenting to a tertiary-care hospital.

Objectives

1. To study the etiological profile, clinical features, interventions, and comorbidities and correlate them with the severity of acute cholangitis.
2. To study the aerobic and anaerobic bacteriological profile and antibiotic susceptibility pattern in patients with acute cholangitis.

MATERIALS AND METHODS

Study Design and Setting

This was a prospective observational study conducted in the Department of Medical Gastroenterology, King George Hospital, Visakhapatnam, from March 2023 to February 2024.

Study Population

A total of 78 adult patients diagnosed with acute cholangitis were prospectively enrolled and evaluated for demographic characteristics, aetiology of biliary obstruction, clinical features, biochemical parameters, microbiological profile, interventions, and clinical outcomes.

Diagnosis and Severity Assessment

Acute cholangitis was diagnosed on the basis of clinical evidence of infection, including fever, leukocytosis, and abdominal pain, in the presence of biliary obstruction. Biliary obstruction was assessed using liver function abnormalities and imaging evidence of common bile duct and/or intrahepatic biliary dilatation. Disease severity was classified according to the Tokyo Guidelines 2018 (TG18). Patients with hypotension, altered consciousness, or organ dysfunction were considered to have severe disease.

Inclusion Criteria

- Patients aged >18 years.
- Patients fulfilling the clinical and imaging criteria for acute cholangitis, including fever, jaundice, abdominal pain, abnormal liver function tests, and imaging evidence of biliary dilatation.
- Patients willing to provide informed written consent.

Exclusion Criteria

- Patients in whom ERCP/PTBD was not feasible.
- Patients unwilling to provide informed consent.

Clinical and Laboratory Evaluation

Baseline evaluation included demographic characteristics, clinical presentation, comorbidities, etiology of biliary obstruction, and biochemical investigations. Blood investigations included hemoglobin, platelet count, total and differential leukocyte counts, liver function tests, serum creatinine, prothrombin time, and partial thromboplastin time.

Microbiological Evaluation

Blood samples of approximately 5–10 mL were collected for aerobic and anaerobic cultures. Bile samples were obtained during ERCP after guide-wire cannulation. The initial 2 mL of bile was discarded, followed by collection of approximately 2–5 mL in a sterile container under aseptic precautions and transport to the microbiology laboratory.

Blood and bile specimens were processed using automated blood-culture systems (BACTEC/BacT/ALERT).

Positive cultures underwent Gram staining and subculture on blood agar and MacConkey agar, followed by incubation at 37°C for 18–24 hours. Antimicrobial susceptibility testing was performed using the Kirby–Bauer disc diffusion method, with automated identification and susceptibility testing using the VITEK 2 system where required.

Treatment and Biliary Decompression

Empirical antimicrobial therapy was initiated according to the institutional antibiotic policy. Biliary decompression was performed in all patients. ERCP was performed using a side-viewing endoscope, with bile sampling obtained during the procedure. PTBD was performed when ERCP was not feasible.

Data Collection

Data pertaining to demographic characteristics, aetiology, clinical features, biochemical parameters, microbiological findings, antimicrobial susceptibility, interventions, ICU requirement, hospital course, and outcomes were recorded prospectively.

Ethical Considerations

The study was conducted after obtaining approval from the Institutional Ethics Committee, Andhra Medical College, Visakhapatnam (IEC Registration No. EC/NEWINST/2019/397; Approval Serial No. 90/IEC AMC/APR 2023). Written informed consent was obtained from all participants, with separate consent obtained before ERCP or PTBD. Participants were informed of their right to withdraw from the study, and confidentiality of patient information was maintained. No external funding was received, and there was no additional cost to participants for study-related investigations.

Statistical Analysis

Data were analysed using SPSS (Statistical Package for the Social Sciences), version 21.0. Normally distributed continuous variables were expressed as mean ± standard deviation, while non-normally distributed continuous variables were presented as median with range. Categorical variables were expressed as frequency and percentage. Student's t-test was used for normally distributed continuous variables, the Mann–Whitney U test for non-normally distributed continuous variables, and the chi-square test for categorical variables. A p-value < 0.05 was considered statistically significant.

RESULTS

Table 1. Baseline Demographic and Clinical Characteristics of Patients with Acute Cholangitis (N = 78)

Characteristic	n (%) / Mean ± SD
Age, years	42.73 ± 15.25
Male sex	47 (60.3)
Fever	71 (91.0)
Abdominal pain	70 (89.8)
Jaundice	72 (92.3)
Anorexia	19 (24.4)
Weight loss	25 (31.9)
Gastrointestinal bleeding	7 (9.0)
Previous biliary colic	78 (100.0)
Previous ERCP	28 (35.9)
Previous history of jaundice	77 (98.7)
Diabetes mellitus	21 (26.9)
Hypertension	9 (11.5)
Alcohol consumption	28 (35.9)
Smoking	28 (35.9)

Data are presented as n (%) unless otherwise indicated. Continuous data are expressed as mean ± standard deviation (SD). ERCP, endoscopic retrograde cholangiopancreatography.

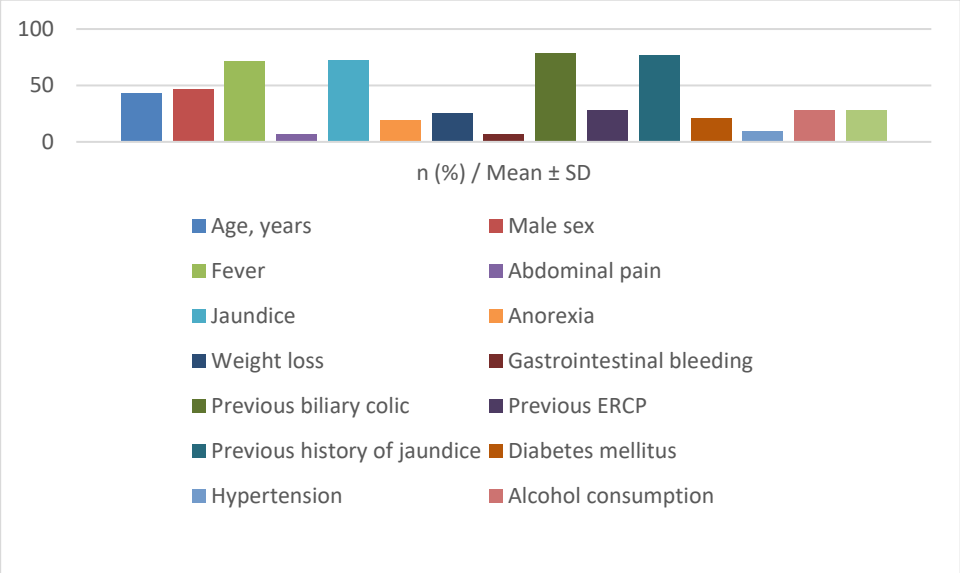


Table 2. Etiological Profile of Acute Cholangitis (N = 78)

Etiology	n (%)
Gallstone disease	24 (30.8)
Chronic pancreatitis	12 (15.4)
Sickle cell anaemia with gallstone disease	11 (14.1)
Carcinoma of the head of the pancreas	6 (7.7)
EHPVO with portal biliopathy	5 (6.4)
Hilar cholangiocarcinoma	4 (5.1)
Post-cholecystectomy CBD stricture	4 (5.1)
Carcinoma gallbladder	3 (3.8)
Distal CBD stricture	3 (3.8)
Carcinoma stomach, stage IV	2 (2.6)
Distal cholangiocarcinoma	1 (1.3)
Choledochal cyst	1 (1.3)
Migrated biliary stent	1 (1.3)
Recurrent acute cholangitis with carcinoma	1 (1.3)

CBD, common bile duct; EHPVO, extrahepatic portal vein obstruction. Percentages are based on the total study population (N = 78).

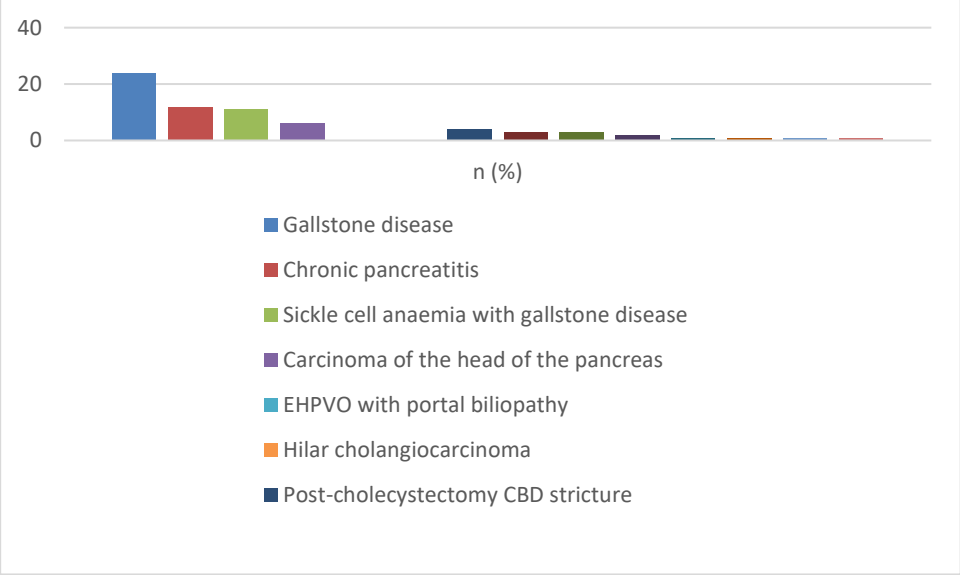
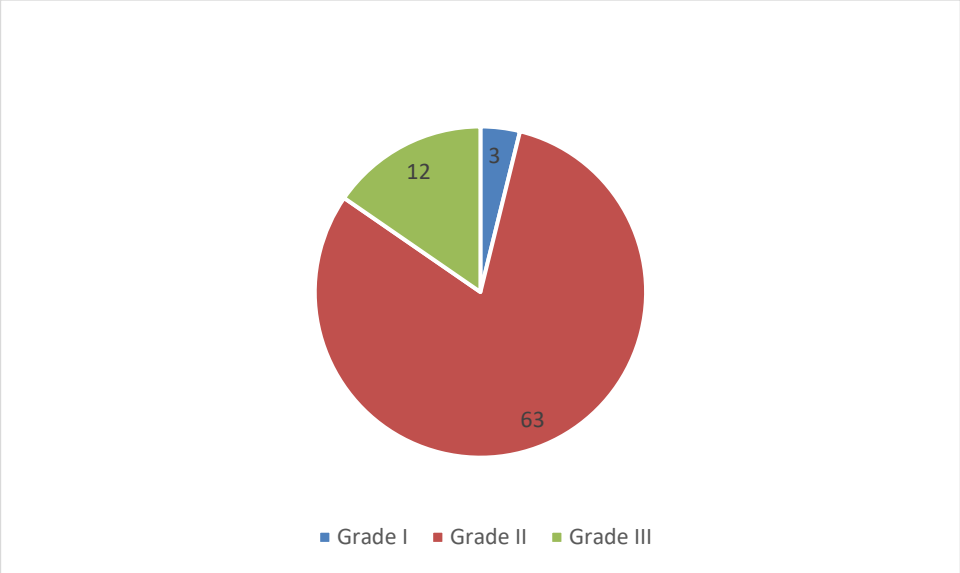
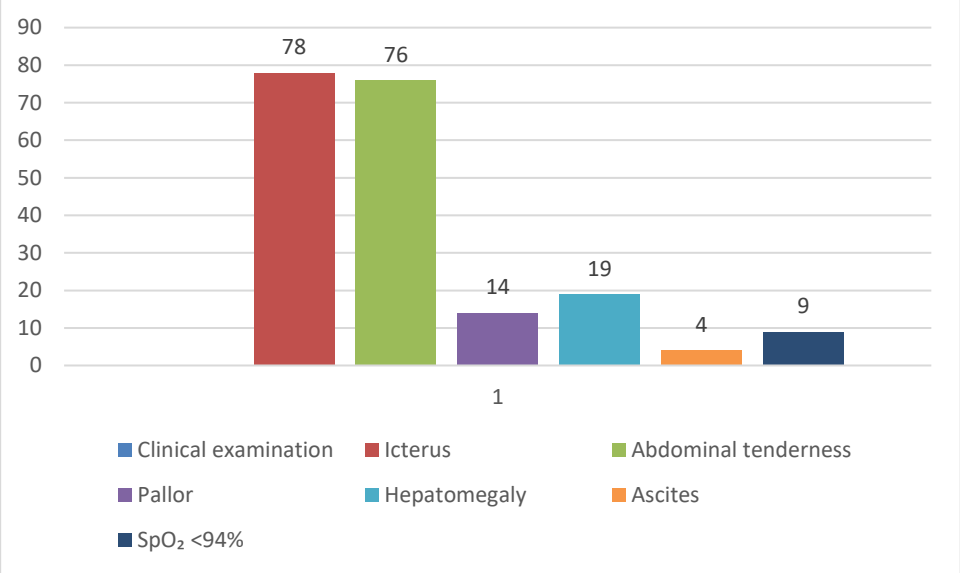


Table 3. Disease Severity, Clinical Examination, Laboratory and Imaging Findings

Parameter	Value
TG18 severity grade	
Grade I	3 (3.8)
Grade II	63 (80.8)
Grade III	12 (15.4)
Clinical examination	
Icterus	78 (100.0)
Abdominal tenderness	76 (97.4)
Pallor	14 (17.9)
Hepatomegaly	19 (24.4)
Ascites	4 (5.1)
SpO_2 <94%	9 (11.5)
Laboratory parameters	
Haemoglobin, g/dL	9.97 ± 2.33
Total leukocyte count, cells/µL	18,369 ± 5,126
Albumin, g/dL	4.01 ± 0.43
SGOT, U/L	57.58 ± 27.33
SGPT, U/L	28 (25.5–48.0)
Total bilirubin, mg/dL	8.2 (6.0–16.5)
Alkaline phosphatase, U/L	411.60 ± 196.83
INR	1.40 ± 0.29
Creatinine, mg/dL	1.22 ± 0.63
Imaging findings	
Stones detected on USG	44 (56.0)
Stones detected on CECT	20 (25.6)
Stones detected on MRCP	24 (30.8)
Stones detected on EUS	16 (20.5)
Stones detected on ERCP	38 (48.7)

Data are presented as n (%), mean ± SD, or median (range), as appropriate. TG18, Tokyo Guidelines 2018; SGOT, serum glutamic-oxaloacetic transaminase; SGPT, serum glutamic-pyruvic transaminase; INR, international normalised ratio; USG, ultrasonography; CECT, contrast-enhanced computed tomography; MRCP, magnetic resonance cholangiopancreatography; EUS, endoscopic ultrasonography; ERCP, endoscopic retrograde cholangiopancreatography. Imaging percentages represent the proportion of the total cohort in whom the respective finding was detected.

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Clinical examination
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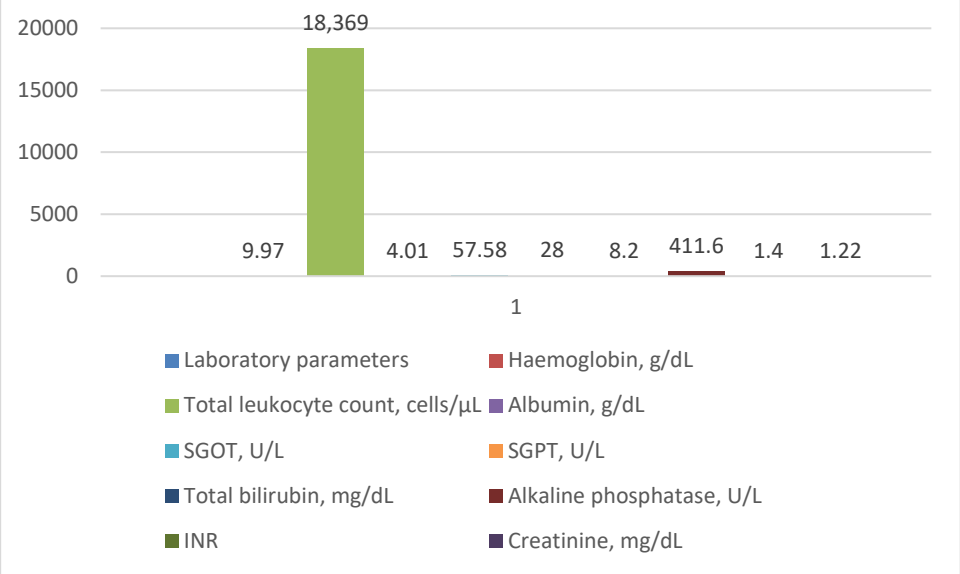
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Laboratory parameters
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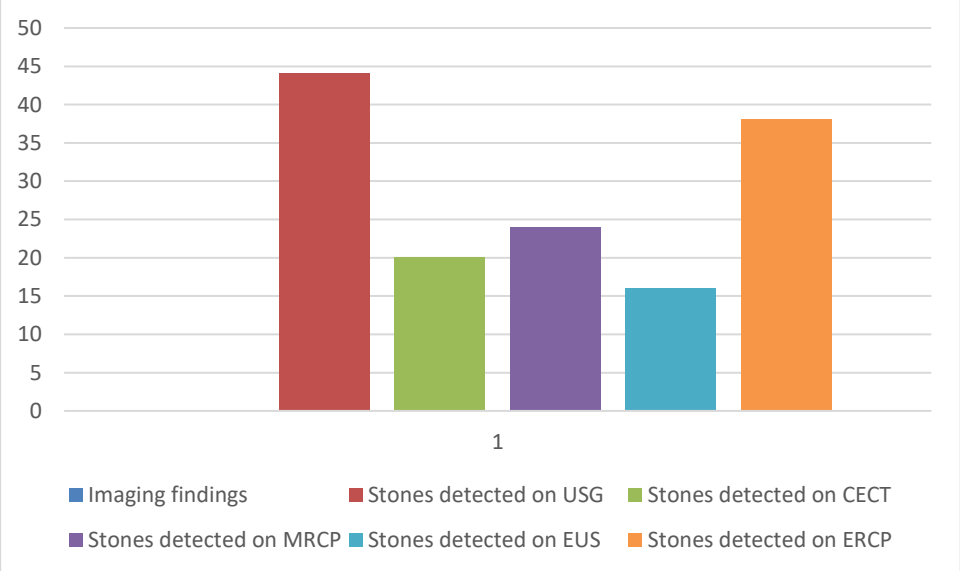
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Imaging findings
Stones detected on USG
Stones detected on CECT
Stones detected on MRCP
Stones detected on EUS
Stones detected on ERCP

Table 4. Microbiological Profile of Blood and Bile Cultures

Organism / Culture status	Blood culture, n (%)	Bile culture, n (%)
E. coli	7 (9.0)	30 (38.5)
Klebsiella spp.	3 (3.8)	16 (20.5)
Acinetobacter spp.	3 (3.8)	5 (6.4)
Pseudomonas spp.	1 (1.3)	3 (3.8)
Staphylococcus spp.	—	1 (1.3)
Bacteroides spp.	0	6 (7.6)†
Sterile/no growth	64 (82.1)	23 (29.5)
Total	**78 (100.0)**	**78 (100.0)**

†Bacteroides was reported in polymicrobial bile cultures and is therefore not included in the mutually exclusive aerobic culture categories. No anaerobic growth was reported in blood cultures.

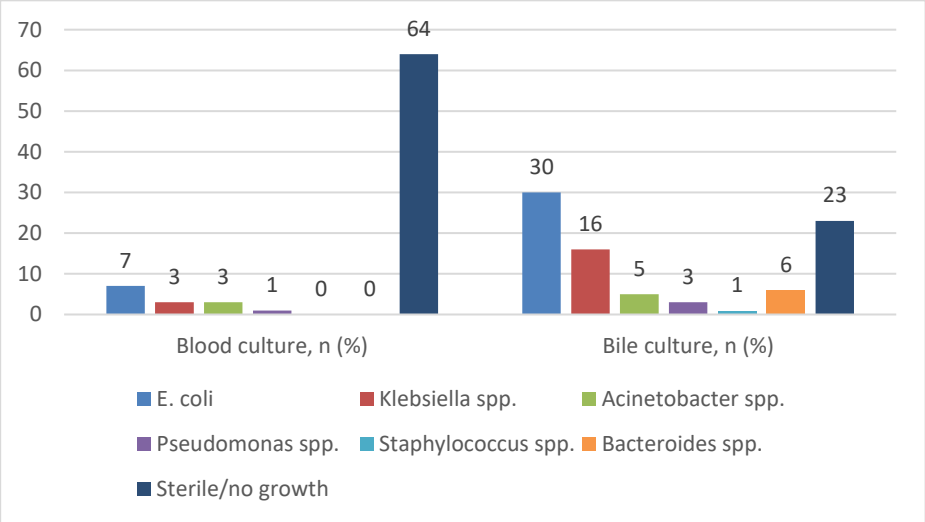


Table 5. Antimicrobial Susceptibility of Bacterial Isolates from Bile Cultures

Antibiotic	Acinetobacter (%)	E. coli (%)	Klebsiella spp. (%)	Pseudomonas spp. (%)	Staphylococcus spp. (%)
Meropenem	40.0	30.0	56.3	100.0	NR
Ertapenem	20.0	56.7	25.0	0	0
Piperacillin	20.0	60.0	37.5	33.0	NR
Amikacin	20.0	63.3	50.0	33.0	NR
Gentamicin	80.0	36.7	43.8	66.7	NR
Ciprofloxacin	60.0	16.7	25.0	0	0
Ampicillin	40.0	13.3	25.0	0	100.0

Values represent percentage susceptibility among isolates tested. NR, not reported in the source document. The source reported varying susceptibility across isolates; therefore, these values should not be interpreted as comparative efficacy estimates.

Table 6. Comparison of Microbiological Profile Between Benign and Malignant Biliary Obstruction

Culture result	Benign obstruction, n (%)	Malignant obstruction, n (%)	Total, n (%)
Blood culture			
Acinetobacter spp.	0 (0.0)	3 (18.8)	3 (3.8)
E. coli	6 (9.7)	1 (6.3)	7 (9.0)
Klebsiella spp.	1 (1.6)	2 (12.5)	3 (3.8)
Pseudomonas spp.	0 (0.0)	1 (6.3)	1 (1.3)
Sterile	55 (88.7)	9 (56.3)	64 (82.1)
Bile culture			
Acinetobacter spp.	3 (4.8)	2 (12.5)	5 (6.4)
E. coli	28 (45.1)	2 (12.5)	30 (38.5)
Klebsiella spp.	10 (16.1)	6 (37.5)	16 (20.5)
Pseudomonas spp.	0 (0.0)	3 (18.8)	3 (3.8)

Staphylococcus spp.	0 (0.0)	1 (6.3)	1 (1.3)
Sterile	21 (33.9)	2 (12.5)	23 (29.5)

Benign obstruction, n = 62; malignant obstruction, n = 16. Percentages within each obstruction category are based on the corresponding subgroup.

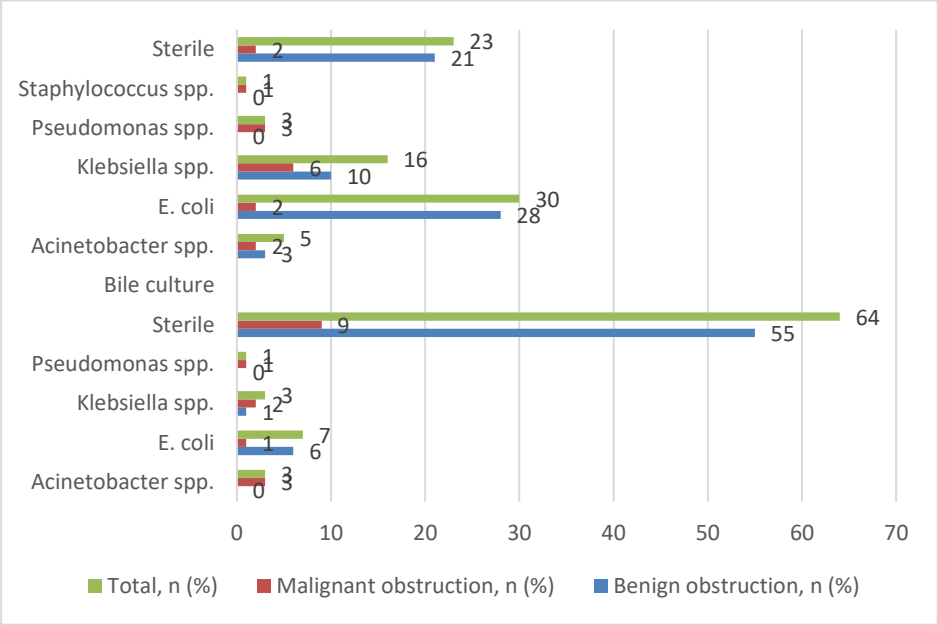


Table 7. Biliary Intervention and Clinical Outcomes

Outcome / Intervention	n (%)
Biliary drainage procedure	
ERCP	71 (91.0)
PTBD	7 (9.0)
ICU requirement	
ICU care required	37 (47.4)
No ICU care	41 (52.6)
Discharge status	
Healthy	54 (69.2)
Sick	21 (26.9)
Death	3 (3.8)

ERCP, endoscopic retrograde cholangiopancreatography; PTBD, percutaneous transhepatic biliary drainage; ICU, intensive care unit.

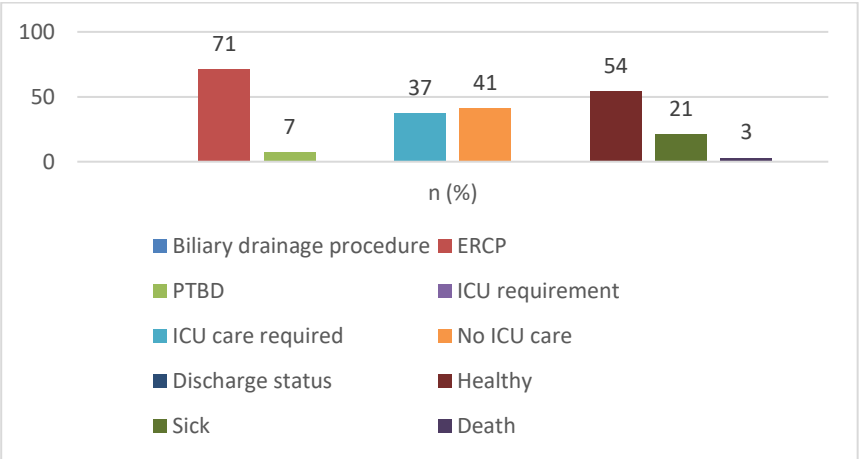
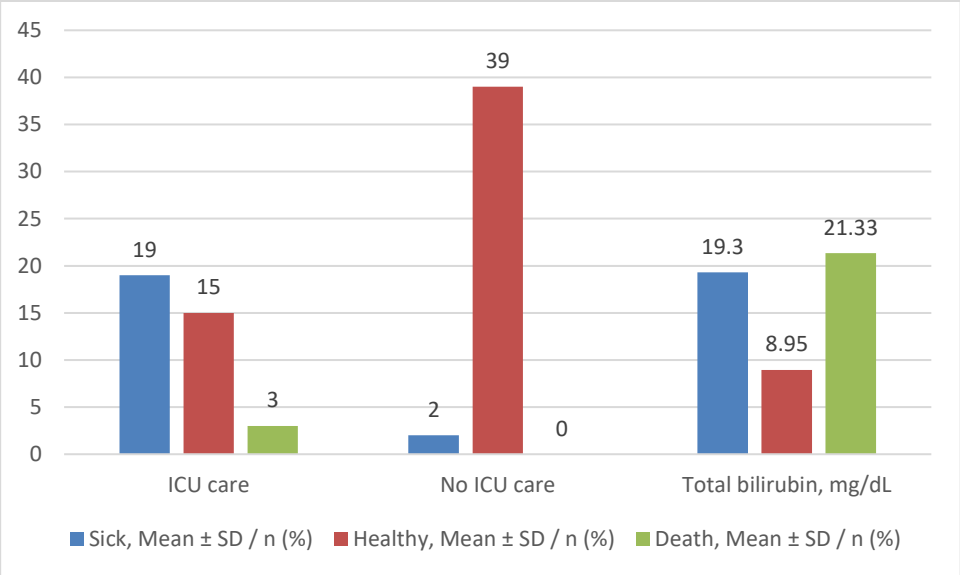


Table 8. Factors Associated with Adverse Clinical Outcome

Variable	Sick, Mean ± SD / n (%)	Healthy, Mean ± SD / n (%)	Death, Mean ± SD / n (%)	P value
ICU care	19 (90.5)	15 (27.8)	3 (100.0)	<0.001

No ICU care	2 (9.5)	39 (72.2)	0	
Total bilirubin, mg/dL	19.30 ± 9.02	8.95 ± 6.30	21.33 ± 4.72	<0.001*

Footnote: ICU, intensive care unit. *The reported comparison was significant for sick versus healthy patients (mean difference, 10.35 mg/dL; P < 0.001) and healthy versus death (mean difference, 12.40 mg/dL; P = 0.013).



DISCUSSION

The present prospective observational study evaluated the clinical, etiological, microbiological, therapeutic, and outcome profile of 78 patients with acute cholangitis treated at a tertiary-care centre. The study population had a mean age of 42.73 ± 15.25 years, with a male predominance (60.3%). The most frequent clinical manifestations were jaundice (92.3%), fever (91.0%), and abdominal pain (89.8%). Gallstone disease was the most frequent individual etiology (30.8%), while malignant obstruction accounted for 20.5%. According to TG18 severity grading, 80.8% had Grade II disease, 15.4% had Grade III disease, and only 3.8% had Grade I disease. Bile culture yielded E. coli in 38.5%, followed by Klebsiella spp. in 20.5%. ERCP was performed in 91.0%, ICU care was required in 47.4%, and overall mortality was 3.8%. These findings provide an opportunity to compare the clinical and microbiological profile of the present cohort with previously published Indian and international studies.

Etiological profile

In the present study, gallstone disease was the most common etiology, accounting for 30.8% of cases, followed by chronic pancreatitis (15.4%) and sickle cell anemia with gallstone disease (14.1%). Malignant causes collectively constituted approximately one-fifth of the cohort, including carcinoma head of pancreas, hilar cholangiocarcinoma, carcinoma gallbladder, distal cholangiocarcinoma, and other malignant biliary obstruction.

This predominance of stone-related disease is consistent with the large multicentre study by Gomi et al., in which bile duct stones remained the most frequent underlying etiology of acute cholangitis. Their study included 6,433 patients fulfilling TG13 diagnostic criteria and demonstrated that biliary stones remained the principal cause despite the increasing contribution of malignant and healthcare-associated disease. [7] (Wiley Online Library) Thus, the present finding of gallstone disease as the leading individual cause is in line with the established epidemiological pattern.

A similar pattern was observed by Sahu et al., who studied 185 patients and reported choledocholithiasis in 62.7% and malignancy in 29.2% as the major predisposing factors. [8] (PubMed) Compared with their cohort, the present study had a lower proportion of stone-related disease (30.8% vs 62.7%) and a lower proportion of malignant disease (20.5% vs 29.2%). Therefore, the etiological hierarchy was in line, although the magnitude of the individual categories was different.

The relatively substantial proportion of malignant obstruction in the present study is clinically relevant because malignant obstruction was associated with markedly greater disease burden. ICU care was required in 93.8% of

malignant cases compared with 35.5% of benign cases, and all three deaths occurred among patients with malignant obstruction. This pattern is consistent with the observations of Schneider et al., who found that malignant underlying disease was associated with a significantly higher mortality risk, with an odds ratio of 3.0 compared with benign/idiopathic causes. [16] (PubMed Central (PMC)

The difference in the proportion of malignant disease between studies may reflect differences in referral patterns. The present study was undertaken in a tertiary gastroenterology centre where patients with complex strictures, recurrent cholangitis, pancreatic malignancy, cholangiocarcinoma, and post-procedural biliary obstruction are more likely to be referred.

Demographic characteristics and clinical presentation

The present cohort demonstrated a male predominance of 60.3%, with a mean age of 42.73 ± 15.25 years. The relatively young mean age compared with several international cohorts may be related to the etiological composition of the present population, particularly the contribution of gallstone disease, chronic pancreatitis, and sickle-cell-associated biliary disease.

The clinical presentation was dominated by jaundice (92.3%), fever (91.0%), and abdominal pain (89.8%). On examination, icterus was reported in all patients and abdominal tenderness in 97.4%. This demonstrates that clinical manifestations of biliary obstruction and systemic infection were prominent in the present cohort.

The findings are compatible with the clinical framework underlying the Tokyo Guidelines, which emphasize systemic inflammation, cholestasis, and imaging evidence of biliary obstruction in diagnosing acute cholangitis. The importance of not relying solely on the classical Charcot triad is particularly relevant because individual clinical manifestations may occur with variable frequency.

Raghhupatruni et al., in a tertiary-care study from South India, evaluated patients with acute cholangitis undergoing endoscopic biliary drainage and demonstrated substantial variation in clinical presentation and severity. [8] (ResearchGate) The present study, with jaundice, fever, and abdominal pain occurring in approximately 90% of patients, therefore appears in line with the clinical presentation described in tertiary-care populations.

Severity according to Tokyo Guidelines

One of the most important findings of the present study was the predominance of Grade II acute cholangitis, which accounted for 80.8% of the cohort. Grade III disease occurred in 15.4%, whereas Grade I disease accounted for only 3.8%.

This distribution differs considerably from that reported by Gomi et al., who evaluated 6,433 patients and found Grade I, Grade II, and Grade III disease in 37.5%, 36.2%, and 26.2%, respectively. [7] (Wiley Online Library) Therefore, the present study is out of line with Gomi et al. with respect to the relative distribution of severity grades, particularly because Grade II disease was considerably more frequent in our population.

Several factors may explain this difference. First, the present study was conducted in a single tertiary gastroenterology centre and therefore may have preferentially captured patients requiring hospitalization and biliary intervention. Second, the relatively small sample size of 78 patients can result in substantial variation in the distribution of severity categories. Third, differences in referral patterns, diagnostic thresholds, and the underlying etiological spectrum may influence TG severity distribution.

Importantly, despite the difference in severity distribution, the relationship between greater severity and poorer outcome was consistent with previous studies. Gomi et al. demonstrated increasing 30-day all-cause mortality from 2.4% in Grade I to 4.7% in Grade II and 8.4% in Grade III disease. [7] (Wiley Online Library)

Similarly, Tsuyuguchi et al. evaluated 215 consecutive cases managed according to the Tokyo Guidelines and reported mortality of 0%, 2.3%, and 20.0% in mild, moderate, and severe cholangitis, respectively. [15] (Wiley Online Library) In the present study, all three deaths occurred among patients with severe disease, supporting the same direction of association. Thus, the relationship between disease severity and outcome was in line, although the absolute mortality percentages differed.

Microbiological profile

The microbiological findings constitute an important component of the present study. Bile cultures were positive in approximately 70.5% of patients, whereas blood cultures were positive in only 17.9%. E. coli was the most frequently isolated organism from bile (38.5%), followed by Klebsiella spp. (20.5%), Acinetobacter (6.4%), and Pseudomonas (3.8%).

The predominance of Gram-negative organisms is consistent with the established microbiology of acute cholangitis. Shivaprakasha et al. examined 209 bile samples and identified E. coli in 30.0%, Klebsiella spp. in 23.98%, and Enterococcus spp. in 12.21% of isolates. [10] (PubMed)

Numerically, the present study demonstrated a higher proportion of E. coli (38.5% vs 30.0%) but a very similar proportion of Klebsiella (20.5% vs 23.98%). Therefore, the overall microbiological pattern was in line with Shivaprakasha et al., particularly regarding the dominance of E. coli and Klebsiella.

The findings are also consistent with the large multicentre study of Gomi et al., in which E. coli and K. pneumoniae were among the most frequently isolated organisms from blood and bile across severity grades. [7] (Wiley Online Library) This reinforces the importance of Gram-negative coverage in empirical treatment of acute cholangitis.

Blood culture versus bile culture

An important observation in the present study was the substantial difference between blood and bile culture positivity. Blood cultures were sterile in 82.1%, whereas bile cultures were sterile in 29.5%. This indicates that bile obtained directly from the infected biliary system provides a considerably greater microbiological yield than blood culture alone.

This finding is supported by Sahu et al., who reported positive bile cultures in 88 of 95 patients, whereas blood cultures were positive in only 47 of 178 patients (26.4%). They also reported that bile cultures were predominantly polymicrobial, whereas blood cultures were much less frequently polymicrobial. [8] (PubMed)

Although the exact culture positivity rates differed, the relative diagnostic yield of bile versus blood culture was in line with their findings.

Similarly, Gomi et al. reported positive bile cultures in 83.4% of patients in whom bile culture was performed. [7] (Wiley Online Library) The present bile-culture positivity of approximately 70.5% was therefore somewhat lower but remained substantial.

The higher rate of sterile blood cultures may also be explained by several factors, including localized biliary infection without sustained bacteremia, previous antimicrobial exposure, intermittent bacteremia, and differences in the timing of blood collection. Therefore, a negative blood culture should not be interpreted as evidence against biliary infection when the clinical and imaging findings are consistent with acute cholangitis.

Anaerobic organisms

Anaerobic organisms were identified in 7.6% of bile cultures in the present study, with Bacteroides being the principal anaerobic organism. No anaerobic growth was identified in blood cultures.

The absence of anaerobic bacteremia despite identification of anaerobes in bile suggests that anaerobic organisms may contribute predominantly to the local biliary microbial environment rather than producing detectable systemic infection in every patient.

The findings should nevertheless be interpreted cautiously because anaerobic recovery is influenced by specimen collection, transport, culture methodology, and prior antimicrobial exposure. The present finding therefore provides support for considering anaerobic coverage in selected clinical circumstances, particularly in patients with recurrent infection or altered biliary-enteric anatomy, but does not establish that all patients require routine anaerobic therapy.

Antimicrobial susceptibility pattern

The present study demonstrated considerable variation in antimicrobial susceptibility between organisms.

Meropenem showed susceptibility of 40.0% in Acinetobacter, 30.0% in E. coli, 56.3% in Klebsiella, and 100% in Pseudomonas. Amikacin susceptibility was 20.0%, 63.3%, 50.0%, and 33.0%, respectively. Ciprofloxacin susceptibility was relatively low among E. coli (16.7%) and Klebsiella (25.0%).

These results demonstrate that antimicrobial susceptibility in acute cholangitis is highly dependent on the organism and local ecology.

The findings differ from those reported by Shivaprakasha et al., who found meropenem susceptibility of 90.64% and amikacin susceptibility of 76.61% among Gram-negative isolates. They also reported high resistance to ampicillin, cephalexin, ciprofloxacin, and piperacillin. [10] (PubMed) Thus, while the general observation of substantial resistance was in line, the susceptibility to meropenem and amikacin in the present study was considerably lower.

Sahu et al. also reported high resistance of E. coli to third-generation cephalosporins and ciprofloxacin. [8] (PubMed) In our cohort, E. coli susceptibility to ciprofloxacin was only 16.7%, which is consistent with the presence of substantial fluoroquinolone resistance.

The study by Noor et al. from Central India similarly demonstrated substantial variation in local antimicrobial susceptibility, with E. coli and Pseudomonas aeruginosa each accounting for 40.9% of positive cultures. Polymyxins had the highest sensitivity, followed by aminoglycosides and imipenem. [13] (ResearchGate) Compared with the present study, E. coli frequency was almost identical (38.5% vs 40.9%), whereas Pseudomonas was markedly less frequent (3.8% vs 40.9%). Therefore, the E. coli finding was in line, whereas the Pseudomonas distribution was out of line.

These differences emphasize that antimicrobial policies should be based on institution-specific susceptibility data rather than extrapolation from another hospital or geographical region.

Benign versus malignant biliary obstruction

A particularly important finding was the marked microbiological and clinical difference between benign and malignant obstruction.

Among the 62 patients with benign obstruction, blood cultures were sterile in 88.7%, compared with only 56.3% among the 16 patients with malignant obstruction. Acinetobacter, Klebsiella, and Pseudomonas were more frequent in malignant obstruction. In bile cultures, E. coli predominated in benign disease (45.1%), whereas Klebsiella was the most frequent organism in malignant obstruction (37.5%). Pseudomonas was detected in 18.8% of malignant cases but none of the benign cases.

This difference is clinically meaningful. Malignant obstruction may be associated with persistent biliary obstruction, repeated instrumentation, biliary stenting, prolonged hospitalization, and impaired drainage. These factors can alter biliary flora and increase the likelihood of resistant or healthcare-associated organisms.

The observation is consistent with Schneider et al., who found malignant underlying disease to be associated with increased mortality, with an OR of 3.0 compared with benign or idiopathic causes. [16] (PubMed Central (PMC)) In the present study, the clinical difference was even more apparent in ICU utilization: 93.8% of malignant patients required ICU care compared with 35.5% of benign patients.

The finding therefore suggests that malignant obstruction should be regarded as an important marker of increased clinical complexity, although the present sample size is insufficient to establish malignancy as an independent predictor of mortality.

Biliary drainage

ERCP was the principal therapeutic intervention, being performed in 71 of 78 patients (91.0%), whereas PTBD was performed in 7 patients (9.0%). This reflects the central role of endoscopic biliary decompression in the management of acute cholangitis.

The predominance of ERCP is consistent with the management strategy described in the literature, where biliary drainage is a key component of source control. The large multicentre study by Gomi et al. emphasized

endoscopic or percutaneous biliary drainage together with antimicrobial therapy as the main therapeutic approach. [7] (Wiley Online Library)

The use of PTBD predominantly in malignant obstruction in the present study is also clinically understandable because malignant hilar or distal obstruction, altered anatomy, or technically unsuccessful ERCP may necessitate a percutaneous approach.

However, the present study should not be interpreted as demonstrating superiority of ERCP over PTBD because there was no randomized comparison of the two procedures and the treatment choice was determined by clinical and anatomical considerations.

ICU requirement and clinical outcome

Nearly half of the study population (47.4%) required ICU care. The difference between benign and malignant disease was striking, with ICU admission in 35.5% of benign cases versus 93.8% of malignant cases.

Furthermore, ICU requirement was strongly associated with adverse outcome. Among patients requiring ICU care, 19 were sick, 15 were healthy at discharge, and 3 died, whereas among patients not requiring ICU care, only 2 were sick and 39 were healthy, with no deaths. The association was statistically significant ($p < 0.001$).

This finding is consistent with the broader literature showing that organ dysfunction and severe systemic disease are major determinants of outcome. Tsuyuguchi et al. demonstrated a marked increase in mortality with increasing severity, with mortality reaching 20.0% in severe cholangitis compared with 0% in mild disease. [15] (Wiley Online Library)

Similarly, Gomi et al. reported increasing mortality across TG13 grades, with 30-day mortality of 2.4%, 4.7%, and 8.4% in Grades I, II, and III, respectively. [7] (Wiley Online Library)

Thus, the association between ICU requirement and adverse outcome in the present study is in line with previous evidence. Nevertheless, ICU admission is itself a marker of severity and should not be interpreted as an independent causal determinant of mortality.

Hyperbilirubinemia and mortality

Total bilirubin emerged as an important marker associated with adverse outcome in the present study. Mean bilirubin was 19.30 ± 9.02 mg/dL in sick patients, 8.95 ± 6.30 mg/dL in healthy survivors, and 21.33 ± 4.72 mg/dL among patients who died. The difference between sick and healthy patients was statistically significant.

These findings are strongly supported by Schneider et al., who evaluated 981 episodes of acute cholangitis and identified serum bilirubin ≥5 mg/dL as a significant predictor of mortality, with an OR of 4.5 (95% CI 2.2–9.9). They also identified bacteremia, insufficient drainage, leukocytosis, AST elevation, and malignant etiology as significant predictors. [16] (PubMed Central (PMC)

Therefore, the present study is in line with Schneider et al. with regard to the prognostic importance of hyperbilirubinemia. The biological interpretation is also plausible: marked biliary obstruction results in greater cholestatic burden, while severe obstruction may coexist with systemic infection and organ dysfunction.

However, because the present study had only three deaths, bilirubin should be regarded as an associated prognostic marker rather than an independently validated mortality predictor.

Mortality

The overall mortality in the present study was 3.8% (3/78). All deaths occurred in patients with malignant obstruction and severe disease.

The mortality rate is numerically comparable with several published series. Tsuyuguchi et al. reported an overall mortality of 4.2% among 215 patients. [15] (Wiley Online Library) However, their mortality in severe disease was substantially higher at 20.0%, whereas the present study had only three deaths, limiting meaningful grade-specific comparison.

The much larger Gomi et al. study reported overall 30-day all-cause mortality of approximately 4.2%, with mortality increasing from 2.4% in Grade I to 8.4% in Grade III. [7] (Wiley Online Library) Thus, the overall mortality in the present cohort was in line with the broad range reported in contemporary literature.

Schneider et al. reported an overall mortality of 4.5% in 981 acute cholangitis episodes, again closely approximating the present finding of 3.8%. [16] (PubMed Central (PMC)

The similarity in overall mortality despite differences in patient characteristics suggests that early recognition, prompt antimicrobial treatment, and timely biliary decompression may have contributed to favorable short-term outcomes in the present cohort.

Clinical implications

The findings of this study have several practical implications. First, the predominance of E. coli and Klebsiella supports the need for effective initial Gram-negative coverage. Second, the substantial variation in susceptibility, particularly the relatively low susceptibility to ciprofloxacin and variable carbapenem susceptibility, highlights the importance of local antibiograms and culture-directed antimicrobial de-escalation.

Third, the high proportion of positive bile cultures compared with blood cultures supports obtaining bile for microbiological examination whenever biliary drainage is performed, because bile culture can provide organism-specific information even when blood culture is sterile.

Finally, the strong association between malignant obstruction, ICU requirement, hyperbilirubinemia, and adverse outcome indicates that these features should prompt closer monitoring and early escalation of care.

The principal findings that were out of line or substantially different were the unusually high proportion of Grade II disease (80.8%) compared with the distribution reported by Gomi et al., and the local antimicrobial susceptibility profile, particularly the relatively low susceptibility to several commonly used agents. These differences are likely to reflect differences in patient selection, referral patterns, healthcare-associated exposure, local antimicrobial practices, and bacterial ecology rather than a fundamental contradiction with the established pathophysiology of acute cholangitis.

Importantly, the present study adds prospective, institution-specific microbiological and susceptibility data from an Indian tertiary-care centre, while simultaneously demonstrating clinically important differences between benign and malignant obstruction. The findings therefore support a management approach combining TG18-based severity assessment, early biliary decompression, appropriate empirical antimicrobial therapy, and subsequent culture-directed modification of treatment.

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