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# CLINICAL PROFILE AND OUTCOMES OF ACUTE NECROTIZING PANCREATITIS: A HOSPITAL-BASED PROSPECTIVE COHORT STUDY FROM SOUTH INDIA

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**ABSTRACT:**
**Background:** Acute necrotizing pancreatitis (ANP) is a severe complication of acute pancreatitis characterized by pancreatic and peripancreatic tissue necrosis, with high morbidity and mortality. This study aimed to evaluate the clinical presentation, etiology, imaging severity, management strategies, and outcomes among patients with ANP in a tertiary care setting in South India.
**Methods:** This was a prospective cohort study conducted between October 2021 and September 2023 at GSL Medical College and Hospital, and Saveetha Medical College, India . Fifty inpatients diagnosed with ANP based on clinical, biochemical, and imaging criteria were enrolled. Data on demographics, etiology, CT Severity Index (CTSI), extent of necrosis, microbiological findings, initial and subsequent management, and outcomes were collected and analyzed using descriptive and inferential statistics.
**Results:** The mean age of patients was 37.9 ± 9.9 years, with a male predominance (84%). The most common presenting symptom was abdominal pain (96%). Alcohol (50%) and gallstones (22%) were the leading etiologies. CTSI score of 10 was seen in 54% of patients, and 30% had >50% necrosis. Infection was documented in 36% of patients, with Staphylococcus aureus being the most frequent isolate. Initial management was conservative in 66%, followed by laparoscopic necrosectomy (22%) and pigtail drainage (12%). The overall mortality rate was 8%, and complications included pseudocysts (10%), recurrent pancreatitis (14%), and walled-off necrosis (8%).
**Conclusions:** ANP commonly affects young adult males, with alcohol being the predominant cause. A CTSI score ≥10 and >50% necrosis were significantly associated with infected necrosis and adverse outcomes. Timely conservative management followed by minimally invasive interventions where needed can result in favorable outcomes.

**KEYWORDS**: Acute necrotizing pancreatitis, CT Severity Index, Infected pancreatic necrosis, Minimally invasive necrosectomy, Prospective cohort study, Pancreatic complications.

## INTRODUCTION

Acute necrotizing pancreatitis (ANP) is a critical and life-threatening variant of acute pancreatitis, characterized by necrosis of the pancreatic parenchyma with or without involvement of peripancreatic tissues. It constitutes approximately 15–30% of all acute pancreatitis cases and is associated with substantial morbidity and mortality, particularly when infection complicates the necrotic process. Mortality rates remain low in sterile necrosis (2%) but escalate dramatically to 30–39% in the presence of infection (1–3).

Epidemiologically, ANP complicates 5–10% of acute pancreatitis presentations (1,4). Among these, nearly one-third develop infected necrosis, which significantly contributes to late-phase mortality due to systemic inflammatory response syndrome (SIRS), septic shock and multi-organ dysfunction syndrome (1,5). In addition to systemic complications, local sequelae such as pseudocyst formation, pancreatic abscess, and walled-off necrosis are frequently observed, especially in the setting of infected necrosis (5). While sterile necrosis may resolve with supportive measures alone, infected necrosis often mandates active intervention including drainage or surgical debridement (1,2).

Historically, open surgical necrosectomy was the cornerstone of ANP management but was associated with high complication and mortality rates ranging from 20–40% (1,6) . Over the past decades, however, there has been a paradigm shift toward less invasive approaches. Techniques such as endoscopic transgastric necrosectomy and the "step-up approach"—initiating with percutaneous or endoscopic drainage—have been shown to reduce morbidity, including pancreatic fistula formation, and shorten hospital stays, while achieving comparable or improved mortality outcomes (1–3,7). For instance, comparative mortality in sterile versus infected necrosis has been reported at 4.7% and 13.8%, respectively, with lower morbidity observed in those managed with less invasive modalities (1,5). Etiological patterns of ANP continue to vary across regions. While alcohol and gallstones remain dominant causes, metabolic

derangements such as hypertriglyceridemia and elements of metabolic syndrome are increasingly recognized, especially in urban populations (8). Additionally, the choice of therapeutic modality is influenced by regional resource availability, with advanced endoscopic interventions more commonly practiced in high-income healthcare settings (3). Despite advancements in diagnosis and therapy, ANP remains a formidable clinical challenge. Mortality and morbidity remain high, underscoring the need for timely diagnosis, risk stratification, and multidisciplinary, individualized care pathways tailored to the severity and infective status of pancreatic necrosis.

## OBJECTIVES

The primary objective of this study was to assess the clinical characteristics, etiopathological factors, imaging severity, and treatment outcomes of patients with acute necrotizing pancreatitis admitted to a tertiary care center in South India.
Specific objectives were:
1.To describe the clinical profile and presenting symptoms of patients diagnosed with acute necrotizing pancreatitis.
2.To identify common etiological factors associated with ANP in the study population.
3.To evaluate the effectiveness of various management strategies—conservative, percutaneous, and surgical—and their impact on patient outcomes.

## MATERIALS AND METHODS

### Study Design and Setting

This was a hospital-based prospective cohort study conducted in the Department of General Surgery, GSL Medical College and General Hospital , and Saveetha medical college, India The study period spanned from October 1, 2021, to September 30, 2023, including patient recruitment and data collection from October 2021 to September 2022, and a follow-up period until September 2020.

### Participants

All inpatients diagnosed with acute necrotizing pancreatitis (ANP) based on clinical presentation, biochemical markers, and radiological imaging (contrast-enhanced computed tomography, CECT) were considered for inclusion. Inclusion criteria were:
●Patients aged ≥18 years admitted with clinical/biochemical/imaging evidence of ANP.

**Exclusion criteria were:**
1.Drug-induced pancreatitis,
2.Pancreatitis complicating pregnancy,
3.History of previous abdominal surgery,
4.Refusal to provide informed consent.
Participants were followed prospectively throughout hospitalization and post-discharge at 1 and 6 months.

### Variables and Definitions

●Primary outcome: Clinical outcome at discharge (survival or death), need for intervention, and complication profile.
●Exposures and predictors: Etiological factors (e.g., alcohol, gallstones), extent of necrosis, CT Severity Index (CTSI), and infection status.
●CT Severity Index (CTSI) was calculated based on pancreatic inflammation (score 0–4) and necrosis extent (score 0–6), totaling up to 10.
●Infected necrosis was confirmed by culture from image-guided aspiration or presence of gas in collections on imaging.
●Sterile necrosis was defined by the absence of microbiological growth or imaging signs of infection.
Diagnostic confirmation was performed using CECT abdomen within 24–48 hours of admission. Serum amylase, lipase, and other laboratory tests were performed as per institutional protocol.

### Data Collection and Measurement

Clinical data (symptoms, vitals, past history), laboratory values (e.g., TLC, amylase, lipase), and radiological findings (CTSI, extent of necrosis, presence of infection) were prospectively recorded using a structured data collection form. Bacteriological analysis was done using Gram stain and culture from aspirated necrotic fluid. All assessments were standardized and interpreted by designated radiologists and microbiologists blinded to patient outcomes.

### Sample Size

The study included 50 consecutive eligible patients admitted over a one-year period. This sample was determined by total case availability during the defined recruitment window, as no formal sample size calculation was conducted due to the observational design.

### Bias and Quality Control

To minimize selection bias, consecutive sampling was used. Radiological and microbiological evaluations were performed by experienced personnel to reduce measurement bias. Observer bias was mitigated by maintaining blinding of investigators analyzing microbiological and imaging results to treatment outcomes.

### Statistical Analysis

Data were analyzed using SPSS version 23.0. Continuous variables were summarized using mean ± standard deviation or median (IQR) for skewed distributions. Categorical variables were expressed as frequencies and percentages. For group comparisons:
●Student’s t-test was used for normally distributed continuous variables,
●Mann-Whitney U test for non-normally distributed variables,
●Chi-square test or Fisher’s exact test for categorical data.

A p-value < 0.05 was considered statistically significant. Subgroup analyses were performed based on infectivity status and extent of necrosis. No imputation was required for missing data, as complete datasets were available for all participants. No matched groups or sensitivity analyses were performed.

## RESULTS

### Participant Flow and Follow-Up

A total of 50 patients who met the inclusion criteria were prospectively enrolled between October 1, 2021, and September 30, 2022, at GSL Medical College and General Hospital, and Saveetha medical college, India. All participants completed hospitalization and follow-up assessments at 1 and 6 months, with no loss to follow-up.

### Baseline Characteristics

The mean age of patients was 37.92 ± 9.9 years, with the majority (46%) in the 31–40 year age group (Table 1, Figure 1). Males predominated significantly, accounting for 84% of the study population (Table 2, Figure 2).

**Table 1: Distribution of study subjects according to age group**

| Age | Frequency | Percentage |
|---|---|---|
| 21-30 | 10 | 20.0 |
| 31-40 | 23 | 46.0 |
| 41-50 | 12 | 24.0 |
| 51-60 | 5 | 10.0 |
| TOTAL | 50 | 100 |

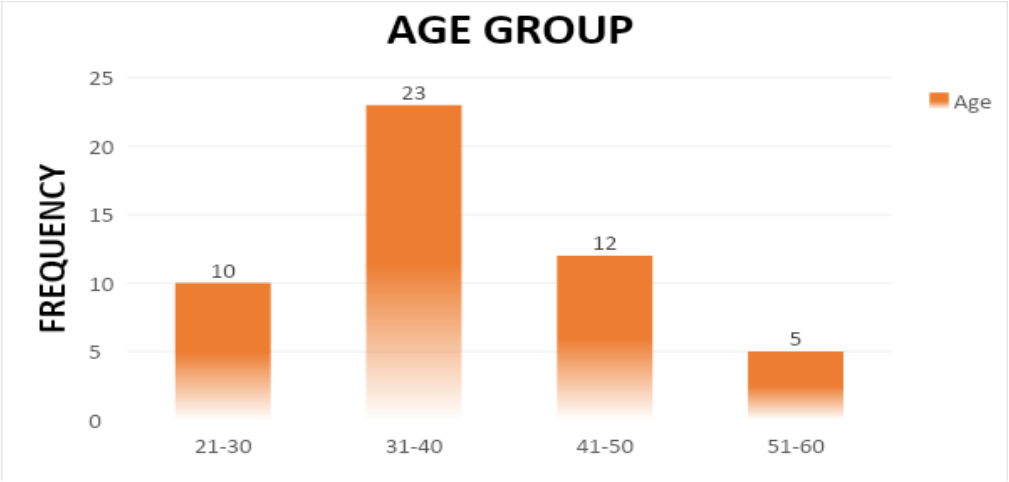


**Figure 1: Age-wise distribution of patients**

**Table 2: Distribution of study subjects according to gender**

| GENDER | Frequency | Percentage |
|---|---|---|
| FEMALE | 8 | 16.0 |
| MALE | 42 | 84.0 |
| TOTAL | 50 | 100 |

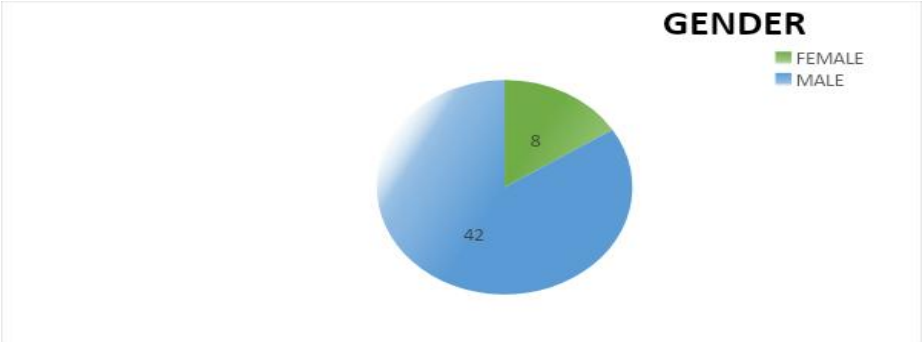


**Figure 2: Gender-wise distribution**

**Clinical Presentations**

The most common presenting symptom was abdominal pain (96%), followed by vomiting (52%) and fever (34%) (Tables 3-5; Figures 3-5).

**Table 3: Incidence of abdominal pain**

| PAIN ABDOMEN | Frequency | Percentage |
|---|---|---|
| YES | 48 | 96.0 |
| NO | 2 | 4.0 |
| TOTAL | 50 | 100 |

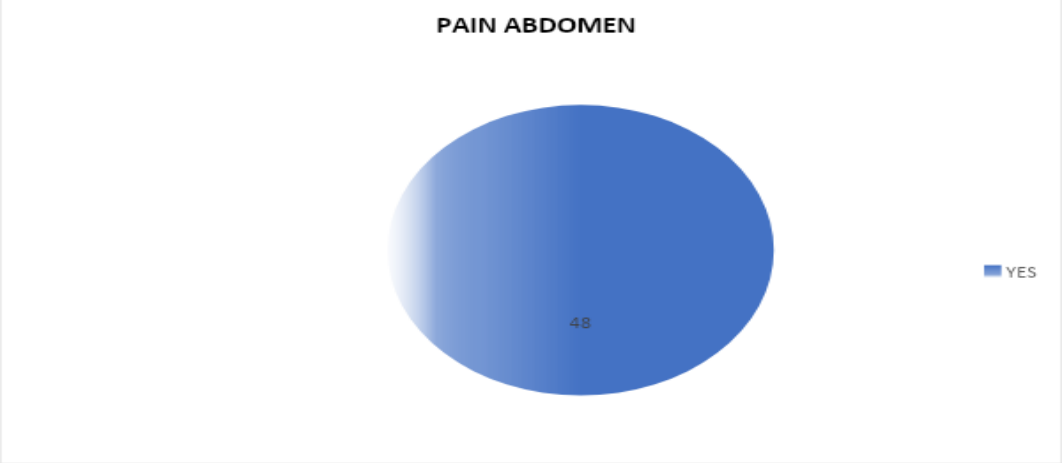


**Figure 3: Abdominal pain distribution**

**Table 4: Incidence of vomiting**

| VOMITING | Frequency | Percentage |
|---|---|---|
| NO | 24 | 48.0 |
| YES | 26 | 52.0 |
| TOTAL | 50 | 100 |

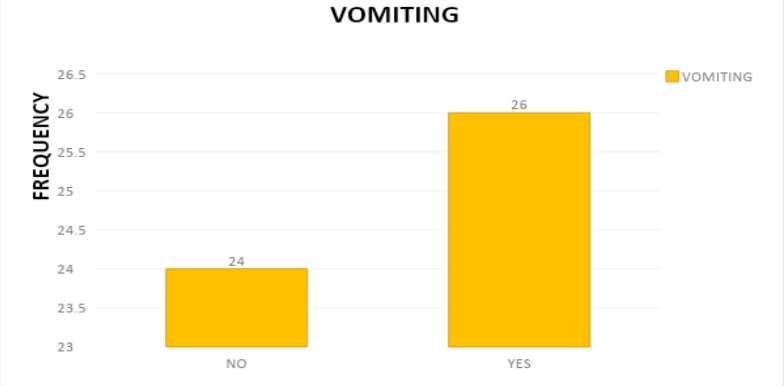


**Figure 4: Vomiting incidence**

**Table 5: Incidence of fever**

| FEVER | Frequency | Percentage |
|---|---|---|
| NO | 33 | 66.0 |
| YES | 17 | 34.0 |
| TOTAL | 50 | 100 |

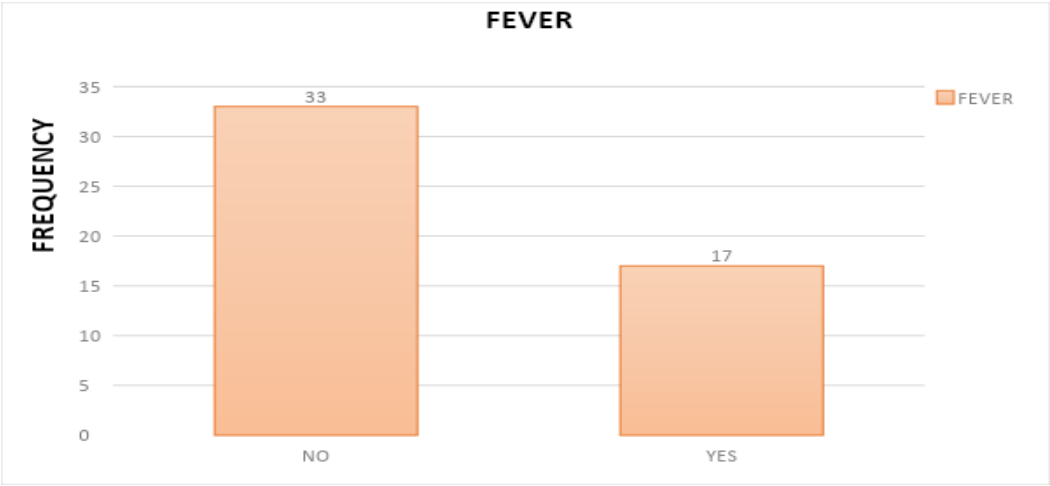


**Figure 5: Fever incidence**

**Etiology**

Alcohol was the predominant etiological factor (50%), followed by gallstones (22%) and idiopathic causes (20%). Other less common causes included hypercalcemia, hyperlipidemia, and trauma (Table 6, Figure 6).

**Table 6: Etiology of acute necrotizing pancreatitis**

| ETIOLOGY | Frequency | Percentage |
|---|---|---|
| ETHANOL | 25 | 50.0 |
| GALLSTONES | 11 | 22.0 |
| HYPERCALCEMIA | 2 | 4.0 |
| HYPERLIPIDEMIA | 1 | 2.0 |
| IDIOPATHIC | 10 | 20.0 |
| TRAUMA | 1 | 2.0 |
| TOTAL | 50 | 100 |

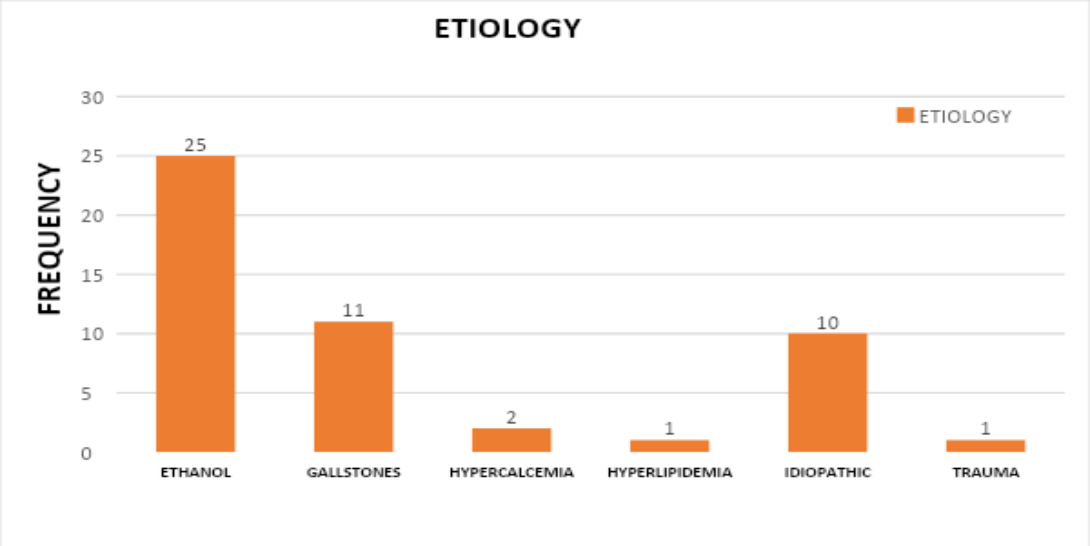


**Figure 6: Etiology-wise distribution**

**Radiological Severity**

CT Severity Index (CTSI) scores were highest in 54% of patients (score 10), indicating severe disease. Scores of 8 and 7 were observed in 22% and 8% of patients, respectively (Table 7, Figure 7).

**Table 7: Distribution of CTSI scores**

| CT SEVERITY INDEX (CTSI.) | Frequency | Percentage |
|---|---|---|
| 4 | 1 | 2.0 |
| 5 | 1 | 2.0 |
| 6 | 3 | 6.0 |

| | | |
|---|---|---|
| 7 | 4 | 8.0 |
| 8 | 11 | 22.0 |
| 9 | 3 | 6.0 |
| 10 | 27 | 54.0 |
| TOTAL | 50 | 100 |

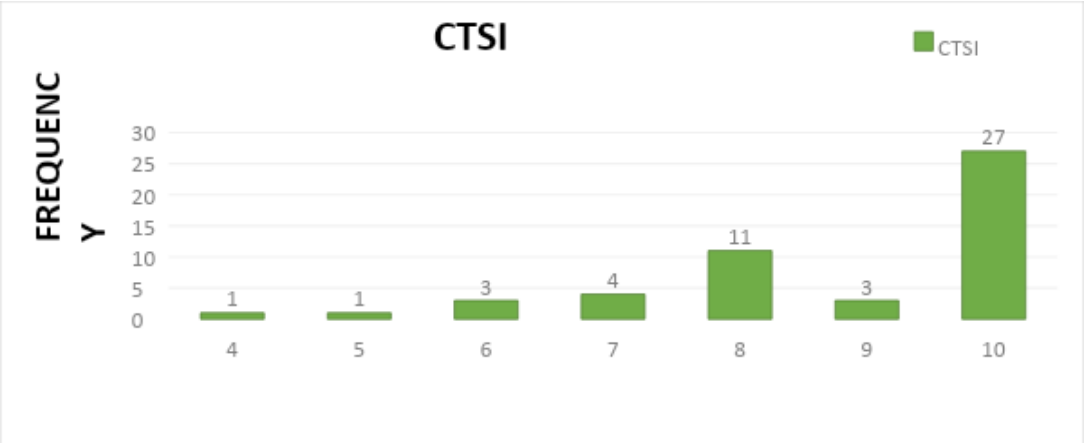


**Figure 7: CTSI severity distribution**

The extent of necrosis was <30% in 46% of patients, 30–50% in 24%, and >50% in 30% (Table 8, Figure 8).

**Table 8: Extent of necrosis distribution**

| EXTENT OF NECROSIS | Frequency | Percentage |
|---|---|---|
| <30% | 23 | 46.0 |
| 30%-50% | 12 | 24.0 |
| >50% | 15 | 30.0 |
| TOTAL | 50 | 100 |

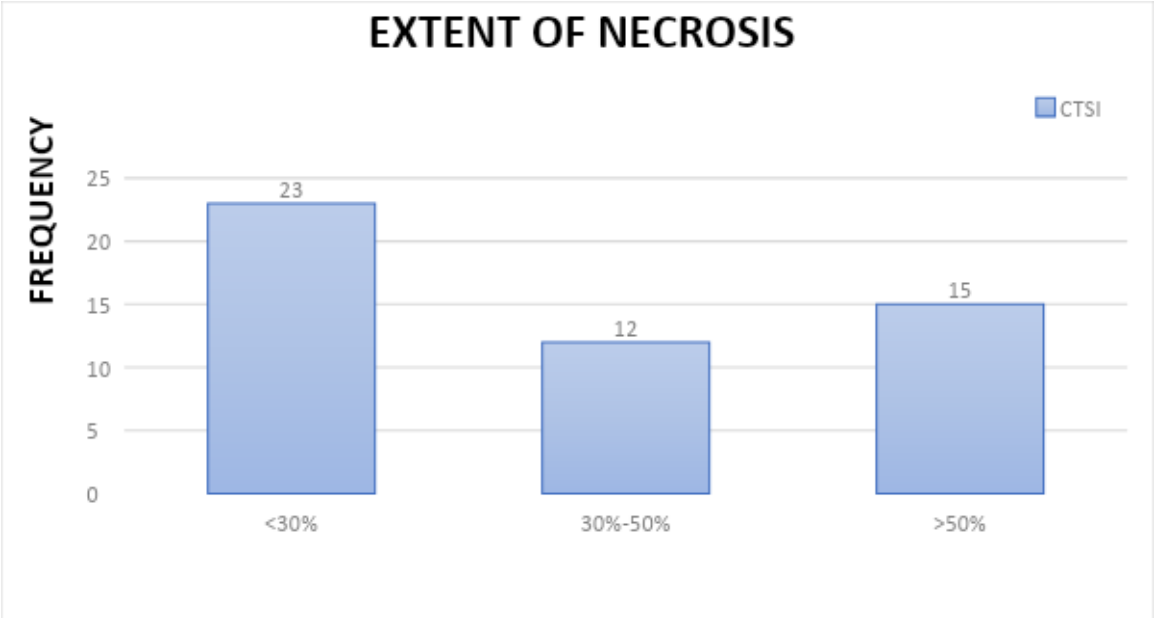


**Figure 8: Graphical representation of extent of necrosis**

**Microbiological Findings**

Among 50 patients, 18 (36%) had infected necrosis, while 32 (64%) were sterile. Staphylococcus aureus was the most frequently isolated organism (18%), followed by Candida albicans (8%) and Enterococcus (4%) (Table 9, Figure 9).

**Table 9: Bacteriological findings in study subjects**

| INFECTIVE | Frequency | Percentage |
|---|---|---|
| C.ALBICANS | 4 | 8.0 |
| E. COLI. | 1 | 2.0 |
| ENTEROCOCCUS | 2 | 4.0 |

| | | |
|---|---|---|
| KLEBSIELLA | 1 | 2.0 |
| S. AUREUS | 9 | 18.0 |
| STREPTOCOCCUS | 1 | 2.0 |
| STERILE | 32 | 64.0 |
| TOTAL | 50 | 100 |

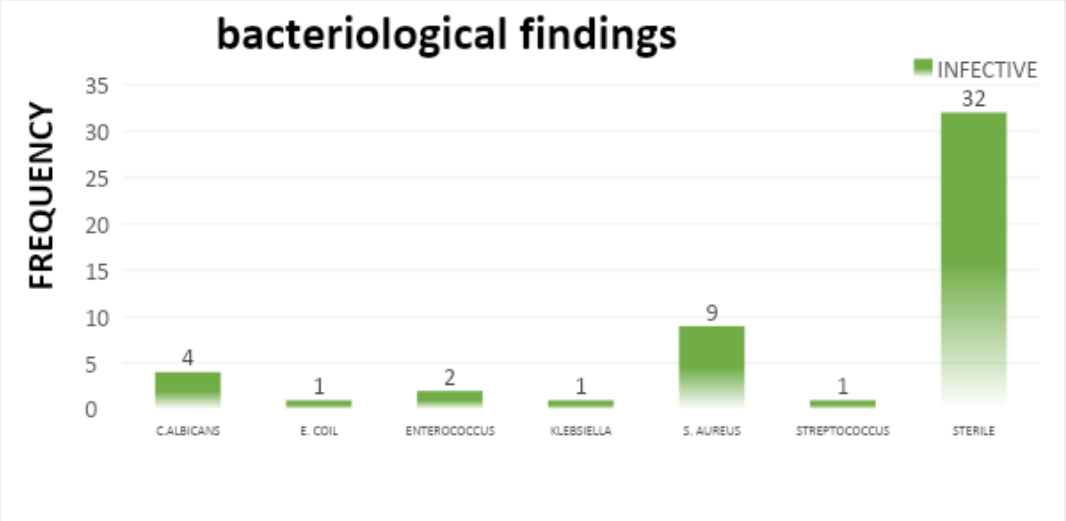


**Figure 9: Infection status distribution**

**Management and Treatment Outcomes**

Initial management was conservative in 66% of patients, while 22% underwent laparoscopic necrosectomy and 12% received percutaneous pigtail drainage (Table 10, Figure 10).

**Table 12: Initial treatment modalities**

| INITIAL TREATMENT | Frequency | Percentage |
|---|---|---|
| CONSERVATIVE MANAGMENT | 33 | 66.0 |
| LAPAROSCOPIC NECROSECTOMY | 11 | 22.0 |
| PERCUTANEOUS PIGTAIL DRAINAGE | 6 | 12.0 |
| TOTAL | 50 | 100 |

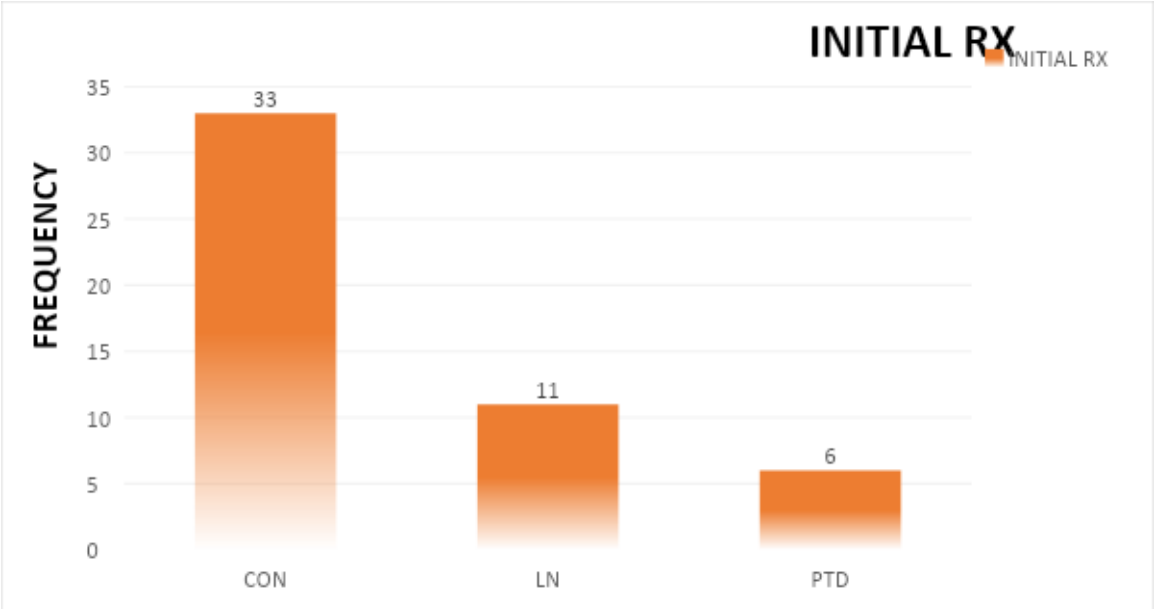


**Figure 10: Initial treatment distribution**

In subsequent management, 48% continued conservative care, 18% underwent secondary laparoscopic necrosectomy, 2% had open necrosectomy, and 8% succumbed to complications (Table 11, Figure 11). One patient required open necrosectomy with distal pancreatectomy and splenectomy due to recurrence.

**Table 11: Subsequent management and outcomes**

| SUBSEQUENT MANAGEMENT | Frequency | Percentage |
|---|---|---|
| LAPAROSCOPIC NECROSECTOMY (INITIAL) | 10 | 20.0 |
| CONSERVATIVE MANAGEMENT | 24 | 48.0 |
| DEATH | 4 | 8.0 |
| LAPAROSCOPIC NECROSECTOMY | 9 | 18.0 |
| OPEN NECROSECTOMY | 1 | 2.0 |
| OPEN NECROSECTOMY + DISTAL PANCREATECTOMY + SPLENECTOMY (ON+DP+S) | 1 | 2.0 |
| PERCUTANEOUS PIGTAIL DRAINAGE | 1 | 2.0 |
| TOTAL | 50 | 100 |

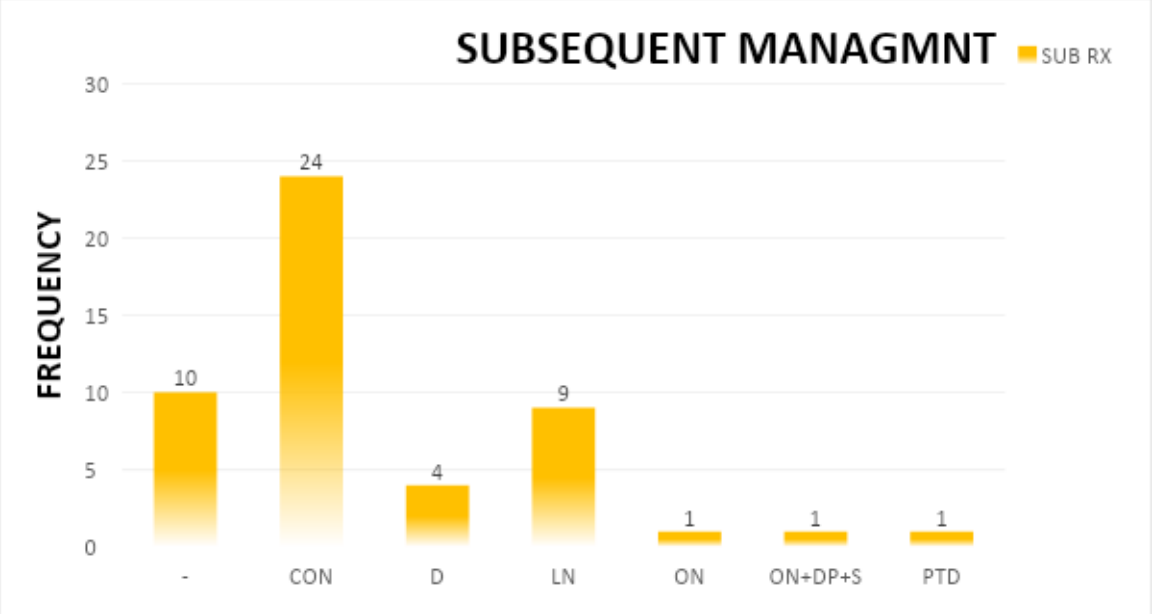


**Figure 11: Subsequent treatment distribution**

**Follow-Up Outcomes**

At 6 months, 52% of patients had fully recovered. Complications included recurrent pancreatitis (14%), pseudocyst formation (10%), walled-off necrosis (8%), pancreatic abscess (4%), pseudoaneurysm (2%), and splenic vein thrombosis (2%) (Table 12, Figure 12). The total mortality rate was 8%.

**Table 12: Follow-up observations at 6 months**

| FOLLOW-UP OBSERVATIONS | Frequency | Percentage |
|---|---|---|
| DEATH | 4 | 8.0 |
| PANCREATIC ABSCESS | 2 | 4.0 |
| PSEUDOANEURYSM | 1 | 2.0 |
| PSEUDOCYST | 5 | 10.0 |
| RECOVERED | 26 | 52.0 |
| RECURRENT PANCREATITIS | 7 | 14.0 |
| SPLENIC VEIN THROMBOSIS | 1 | 2.0 |
| WALLED OFF NECROSIS | 4 | 8.0 |
| TOTAL | 50 | 100 |

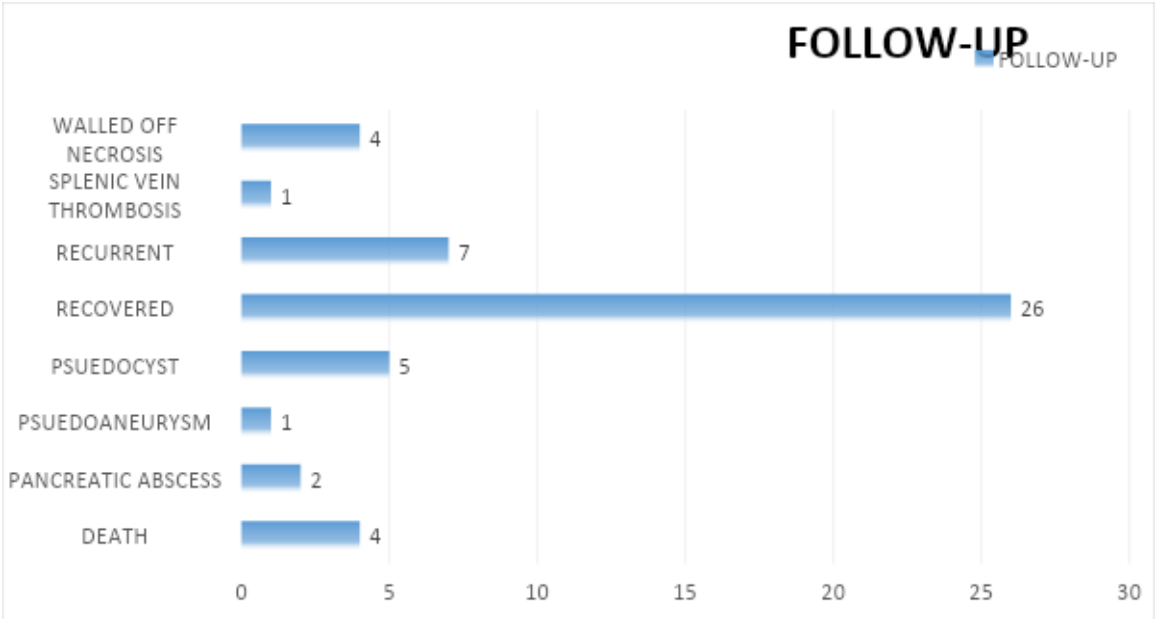


**Figure 12: Outcome distribution during follow-up**

**Association Analyses**

**CTSI and Laboratory Parameters**

A statistically significant association was observed between higher CTSI scores and elevated serum amylase (P = 0.025) and lipase levels (P = 0.014). No significant correlation was found between CTSI and total leukocyte count (P = 0.122) (Table 13).

**Table 13: Association between CTSI and laboratory parameters**

| CTSI | N | Mean± Std. Dev | | |
|---|---|---|---|---|
| | | TLC. | S. AMYLASE | S. LIPASE |
| 4.0 | N= 1 | 4000.00 | 589.00 | 65.0 |
| 5.0 | N= 2 | 11450.0±9828.78 | 436.0±97.58 | 67.0±31.11 |
| 6.0 | N= 4 | 16575.0±16134.51 | 415.0±387.87 | 75.75±12.14 |
| 7.0 | N= 4 | 6400.0±938.08 | 894.75±162.67 | 91.0±2.70 |
| 8.0 | N= 14 | 8907.14±4520.97 | 558.57±280.86 | 107.35±60.93 |
| 9.0 | N= 3 | 8400.0±2771.28 | 813.66±459.25 | 235.66±49.16 |
| 10.0 | N= 22 | 15113.63±8368.03 | 978.22±454.68 | 274.22±202.84 |
| P value(t-test) | | P=0.122 | P=0.025 | P=0.014 |

**CTSI and Duration of Hospitalization**

Although mean hospitalization duration increased with CTSI severity (ranging from 6 to 14.5 days), the association was not statistically significant (P = 0.301) (Table 14).

**Table 14: Association between CTSI and hospitalization duration**

| C.T.S.I. | N | Mean± Std. Dev |
|---|---|---|
| | | Duration of Hospitalization (DOH) |
| 4.0 | N= 1 | 6.00 |
| 5.0 | N= 2 | 10.50±3.53 |
| 6.0 | N= 4 | 5.25±2.06 |
| 7.0 | N= 4 | 7.25±1.70 |
| 8.0 | N= 14 | 11.64±5.78 |
| 9.0 | N= 3 | 4.04±2.33 |
| 10.0 | N= 22 | 14.45±10.08 |
| P VALUE | | P=0.301 |

**Extent of Necrosis and Infection**

A significant association was found between extent of necrosis and infectivity (P = 0.01). Infected necrosis was most prevalent in patients with >50% necrosis (72.3%), while sterile necrosis predominated among those with <30% necrosis (68.7%) (Table 15).

**Table 15: Association between infectivity and extent of necrosis**

| | **EXTENT OF NECROSIS** | | | |
|---|---|---|---|---|
| | **<30%** | **30%-50%** | **>50%** | **TOTAL** |
| INFECTIVE | 1(5.5) | 4 (22.2) | 13 (72.3) | 18 |
| NON-INFECTIVE | 22(68.7) | 8(25) | 2(6.3) | 32 |
| TOTAL | 23(46) | 12(24) | 15 (30) | 50 |

## DISCUSSION

This prospective cohort study provides insights into the clinical spectrum, etiopathogenesis, imaging severity, infection rates, and management outcomes of acute necrotizing pancreatitis (ANP) in a tertiary care setting. Alcohol emerged as the most prevalent etiological factor, predominantly affecting males in the 31–40-year age group, consistent with established Indian epidemiological trends (9,10). More than half of the study participants had a CT Severity Index (CTSI) score of 10, and a significant proportion had >50% necrosis. These patients exhibited a higher risk of infected necrosis, underscoring necrosis extent as a surrogate marker for poor prognosis (11–13). Biochemical markers—serum amylase and lipase—correlated significantly with disease severity (14). While conservative management was effective in 66% of patients, minimally invasive approaches such as laparoscopic necrosectomy and pigtail drainage were beneficial in selected cases, supporting the global shift toward step-up strategies (15,16).

The findings align with prior evidence highlighting alcohol as a dominant etiology of ANP in Indian males (9,10). The association between >50% necrosis and infection is in concordance with earlier studies linking necrotic volume to the development of organ failure and mortality (11–13). The favorable outcomes achieved with conservative management in sterile necrosis further validate guideline-recommended delayed interventions in such cases (15,16). The lower mortality in this study (8%) contrasts with higher global figures for infected necrosis (30–39%) (12,13,17), possibly attributable to timely multimodal escalation of care.

The absence of endoscopic drainage in this cohort, in contrast to trials such as PANTER (2,11), highlights a resource-dependent disparity in care access. Moreover, the microbial profile in this study—with Staphylococcus aureus and Candida albicans as dominant pathogens—mirrors findings from other Indian studies (e.g., Kumar et al., 2020; Sharma et al., 2018), but diverges from Western data where E. coli and anaerobes often predominate (16,18). . This suggests the need for localized antimicrobial stewardship strategies (12,19). The emphasis on early risk stratification using CTSI and biochemical parameters provides a clinically relevant framework for treatment escalation, especially in resource-limited environments where real-time imaging and microbiological testing may not be universally accessible.

## LIMITATIONS

Several limitations should be acknowledged. The relatively small sample size (n = 50) restricts the statistical power of subgroup analyses and may limit the detection of subtle outcome differences. This was a double-center experience, which may not capture the variability in practice patterns or microbial flora across diverse settings. The study excluded patients managed as outpatients or those with mild disease, introducing potential selection bias. Furthermore, while short-term follow-up was robust, long-term consequences such as pancreatic insufficiency, recurrence, or chronic pancreatitis evolution were not evaluated. Confounders such as comorbid conditions, timing of intervention, and nutritional status were not controlled in adjusted analyses, and radiological assessments may have been subject to inter-observer variability.

### Generalisability

The results of this study are most applicable to urban Indian tertiary centers with comparable infrastructure and case profiles (16), Generalisation to populations with differing predominant etiologies—such as gallstone-related pancreatitis in Western nations—or to settings with routine access to endoscopic or retroperitoneal necrosectomy may be limited (10,20) Variability in microbiological flora further limits extrapolation of infection management protocols. Nevertheless, the findings contribute important regional data and reinforce the relevance of individualized, step-up therapeutic strategies in managing ANP.

To strengthen external validity and refine management algorithms, future research should focus on multicenter, prospective cohort studies using standardized diagnostic, microbiological, and surgical protocols(21).

## CONCLUSION

This prospective study underscores the clinical burden of acute necrotizing pancreatitis (ANP), particularly among young adult males with alcohol-related etiology. The extent of necrosis, especially when exceeding 50%, was significantly associated with infective complications and guided the choice of management strategy. Serum amylase and lipase levels correlated well with radiological severity, offering useful adjuncts in early risk stratification.Conservative management proved safe and effective in cases of sterile necrosis, while minimally invasive interventions—such as laparoscopic necrosectomy and percutaneous drainage—demonstrated favorable outcomes in patients with infected

collections or clinical deterioration. The absence of endoscopic drainage in this cohort reflects resource-dependent limitations, reinforcing the need for context-specific treatment protocols.

Laparoscopic necrosectomy was a particularly effective component of the step-up approach, offering adequate debridement without significant procedural complications. Nevertheless, the potential for peritoneal contamination in infected cases highlights the need for careful patient selection and optimal timing.

In conclusion, ANP requires a multidisciplinary, individualized, and escalation-based treatment framework. Minimally invasive techniques, especially when employed as part of a structured step-up approach, represent a safe and effective alternative to open surgery and should be integrated wherever feasible, particularly in resource-constrained settings.

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