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CORRELATION OF EXTRA-PANCREATIC NECROSIS VOLUME WITH THE PROGNOSIS IN CASES OF ACUTE PANCREATITIS

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ABSTRACT **Introduction:** Acute pancreatitis (AP) is an inflammatory condition resulting in pancreatic tissue damage. Its severity ranges from mild cases to severe necrotizing forms associated with systemic complications, leading to high morbidity and mortality. In recent years, extra-pancreatic necrosis volume (EPNV) has gained attention as a potential prognostic indicator in AP, providing insights into disease progression and outcomes. **Objective:** This study aimed to analyse the correlation between EPNV and clinical outcomes in patients with acute necrotizing pancreatitis, assessing its role in predicting prognosis, including organ failure, mortality, and hospitalization duration. Additionally, we evaluated the predictive utility of combining EPNV with the Modified Computed Tomography Severity Index (M-CTSI) for better prognostic accuracy. **Methods:** A cross-sectional study was conducted on 48 patients diagnosed with AP who underwent contrast-enhanced computed tomography (CECT) within 3–6 days of symptom onset. Patients were selected based on findings of combined pancreatic and extra-pancreatic necrosis. Data on demographics, etiological factors, EPNV, M-CTSI scores, and outcomes were collected and analysed. **Results:** The study showed a predominance of male patients (91.7%) with a mean age of 40.5 years. Alcoholism was identified as the leading etiological factor (70.8%). EPNV showed a strong positive correlation with prolonged hospital stays ($r=0.868$, $p<0.01$) and moderate correlation with M-CTSI scores ($r=0.506$, $p<0.01$). EPNV demonstrated superior predictive accuracy for organ failure compared to M-CTSI. **Conclusion:** EPNV serves as a valuable prognostic marker in AP, showing strong associations with adverse clinical outcomes. Its predictive utility surpasses that of M-CTSI, advocating for its integration into routine prognostic evaluations in AP management. Further research with larger cohorts is recommended to validate these findings and enhance prognostic models.

KEYWORDS : Acute pancreatitis; Extra-pancreatic necrosis; Prognosis; Computed tomography; Severity index; Organ failure;

INTRODUCTION

Acute pancreatitis (AP) is a complex inflammatory condition involving pancreatic inflammation due to the pancreas's own enzymes breaking down its tissues, leading to damage. The primary causes of AP are excessive alcohol consumption and gallstones, though other factors—such as genetic predispositions, high lipid or calcium levels, certain medications, and trauma—can also play a role. Given the broad spectrum of potential causes, accurately identifying risk factors in each patient is crucial for guiding effective treatment [1].

Globally, AP has an estimated annual incidence between 13 and 45 cases per 100,000 people, highlighting its significant impact across populations. The clinical presentation of AP can range from mild, self-limiting cases to severe, life-threatening forms with considerable health risks [2]. Over recent years, AP cases have risen worldwide, attributed to lifestyle changes, a growing prevalence of obesity and gallstone disease, and improvements in diagnostic technology. This allows for the detection of cases that might have previously gone unrecognized. In India, recent epidemiological data indicate a notable increase in AP cases, reflecting global trends and emphasizing the need for preventive measures and increased awareness [3].

As understanding of AP has evolved, outcomes for affected patients have improved, but the disease remains unpredictable and complex. Its severity can range from mild cases, often resolving with supportive care, to severe cases that may result in complications such as systemic inflammatory response syndrome (SIRS), pancreatic necrosis, multiorgan failure, and infections, including infected pancreatic necrosis or abscess formation [4]. These complications are significant contributors to AP's high morbidity and mortality rates. The updated Atlanta classification system is crucial for categorizing AP cases as mild, moderately severe, or severe, aiding in the prognosis and informing treatment choices. Although numerous criteria exist for assessing AP severity, the complexity of the disease can make predicting its course challenging [5].

Beyond alcohol and gallstones as primary causes, AP can also result from other less common factors, including genetic predispositions, drug reactions, hypertriglyceridemia, and pancreatic anatomical abnormalities. The diversity in causes underscores the importance of thorough diagnostic evaluation to understand the underlying etiology in each case [6]. Clinical symptoms like abdominal pain, nausea, vomiting, and fever often indicate AP, and elevated serum lipase and amylase levels serve as diagnostic markers. However, these markers alone may not always provide definitive diagnostic clarity. Imaging techniques, such as computed tomography (CT) and abdominal ultrasound, are essential in confirming AP diagnosis, assessing severity, and identifying complications like necrosis or fluid collections [7].

Timely identification and proper risk stratification of AP severity are crucial for appropriate management. Mild cases generally benefit from supportive care, including pain management, fluid resuscitation, and nutritional support. In contrast, severe cases require more intensive care, often in an intensive care unit, and may need invasive interventions like endoscopic or surgical drainage of necrotic collections [8]. Severe AP remains a challenging condition despite advancements in diagnosis and treatment, with substantial mortality and morbidity. Ongoing research aims to uncover the underlying mechanisms of AP progression and develop new treatment strategies. Addressing AP often requires collaboration across disciplines, involving clinicians, researchers, and healthcare professionals [9].

In recent years, research has increasingly focused on extra pancreatic necrosis (EPN), a complication marked by necrotic changes in the tissues surrounding the pancreas. EPN is gaining attention for its potential impact on patient outcomes, with the volume of necrotic tissue adjacent to the pancreas emerging as a key factor in assessing AP severity and providing insights into disease progression. Integrating EPN volume into AP severity assessments allows for a more comprehensive understanding of the condition, enhancing risk stratification and supporting timely interventions that could improve patient outcomes [10].

The Atlanta Classification, originally introduced in 1992, provided a framework for categorizing AP based on its severity. Revised in 2012, it included a moderately severe category to better reflect the full spectrum of AP presentations and guide treatment more effectively. Combining the revised classification with EPN volume assessment allows clinicians to take a more nuanced approach to evaluating AP. By considering both pancreatic and extra pancreatic necrosis, clinicians can form a clearer understanding of the disease's severity, facilitating more accurate risk assessment [11].

This research underscores the potential value of incorporating EPN volume in AP severity assessments. Measuring the extent of necrotic tissue surrounding the pancreas can deepen the understanding of AP's pathophysiology and its progression. Moreover, examining the correlation between EPN volume and key clinical outcomes—such as organ failure, mortality, and the need for invasive procedures—could provide clinicians with valuable information for risk stratification and assist in clinical decision-making [12].

A secondary aspect of this research explores the potential of combining EPN volume with the modified CT severity score. This integrated approach may improve predictive accuracy for clinical outcomes in patients with AP. Insights from this study could inform future research and clinical practice, highlighting the prognostic utility of EPN volume in AP. The findings may contribute to shaping AP management strategies, offering a pathway to more tailored treatment options [13].

This approach has significant implications for clinical practice, as it emphasizes the need for individualized AP management. By highlighting the value of EPN volume as a prognostic indicator, the research may encourage more tailored treatment approaches for patients with AP[14]. Furthermore, understanding the mechanisms behind EPN development could identify therapeutic targets, helping reduce AP-related morbidity and mortality. This study aims to contribute to a deeper knowledge of AP's pathophysiology and prognosis, aiding clinicians in improving patient outcomes and enhancing the quality of care for those affected by this challenging condition [15].

The aim of this study is to analyse and compare the relationship between extra-pancreatic necrosis (EPN) volume and the prognosis of patients with acute necrotizing pancreatitis. The primary objectives are to estimate the EPN volume in patients with acute pancreatitis and to compare this volume with key outcome variables, including organ failure, mortality, and the need for intervention. Additionally, the study includes a secondary objective to examine the predictive power of EPN volume when combined with the modified CT severity index, aiming to enhance the accuracy of prognostic assessments in these patients.

MATERIALS AND METHODS

This cross-sectional study explored the relationship between extra-pancreatic necrosis (EPN) volume and outcomes in acute pancreatitis at Yenepoya Medical College (Nov 28, 2022–May 27, 2024). A sample size of 48 was calculated based on a prior study's 0.392 correlation between EPN volume and organ failure, ensuring 99% power and 1% significance using G*power. Patients with acute pancreatitis symptoms underwent evaluation, ultrasound, and CECT (3–6 days post-symptom onset). Inclusion required combined pancreatic and EPN on CECT, while exclusions applied to pregnant individuals, those with contrast contraindications, or isolated peripancreatic necrosis.

RESULTS

The study participants' ages range from 20 to 80 years, with a mean age of 40.5 years and a standard deviation of 14.2 years, indicating a varied age distribution. The gender distribution shows a predominance of male participants (91.7%) compared to females (8.3%), highlighting a significant gender imbalance.

This information is essential for understanding both the age and gender demographics within the study, which may influence the interpretation of findings and their applicability across different groups.

Table-1: Distribution Of Aetiology Among Study Participants

Aetiology	Frequency (N=48)	Proportion
Alcoholism	34	70.8 %
DM	5	10.4 %
Gall stone	7	14.6 %
Trauma	2	4.2 %

The study identifies alcoholism as the leading cause of the medical condition in participants, comprising 70.8% of cases. Additional causes include diabetes mellitus (10.4%), gallstones (14.6%), and trauma (4.2%), highlighting the primary contributing factors and providing insights into the condition's underlying etiology among participants.

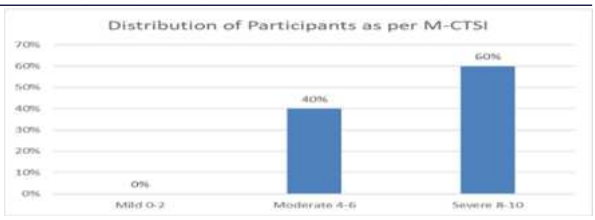

Chart 1: Distribution of Participants as per Modified CTSI

In the study, the Modified CTSI score reveals that most participants fall into the "Severe 8-10" category, representing 60% of cases, while 39.6% are in the "Moderate 4-6" category. Notably, no participants fall into the "Mild 0-2" category, illustrating the severity distribution among the study population.

The study provides mean values and standard deviations for haematological parameters, including Total WBC Count, Platelet Count, Serum Amylase, CRP Level, and Serum Creatinine, offering insights into baseline characteristics. For example, the Total WBC Count shows a mean of 30.7 with a high standard deviation of 131.2, indicating substantial variability within the study group.

Table-2: Correlation between M-CTSI and Haematological Parameters:

Correlations							
		Modified CTSI	Total WBC	Platelet	Amylase	CRP	creatinine
Modified CTSI	Pearson Correlation	1	.201	.531**	.512**	.506*	.307*
	Sig. (2-tailed)		.172	.000	.000	.000	.034
	N	48	48	48	48	48	48
Total WBC	Pearson Correlation	.201	1	.512**	.493**	.301*	.319*
	Sig. (2-tailed)	.172		.000	.000	.038	.027
	N	48	48	48	48	48	48
Platelet	Pearson Correlation	.531**	.512**	1	.976**	.926*	.693**
	Sig. (2-tailed)	.000	.000		.000	.000	.000
	N	48	48	48	48	48	48
Amylase	Pearson Correlation	.512**	.493**	.976**	1	.967*	.728**
	Sig. (2-tailed)	.000	.000	.000		.000	.000
	N	48	48	48	48	48	48
CRP	Pearson Correlation	.506**	.301*	.926**	.967**	1	.715**
	Sig. (2-tailed)	.000	.038	.000	.000		.000
	N	48	48	48	48	48	48
creatinine	Pearson Correlation	.307*	.319*	.693**	.728**	.715*	1
	Sig. (2-tailed)	.034	.027	.000	.000	.000	
	N	48	48	48	48	48	48

The study explores correlations between the Modified Computed Tomography Severity Index (M-CTSI) and haematological parameters, presenting correlation coefficients for Total WBC, Platelet, Amylase, CRP, and creatinine levels. Significant correlations are marked at ** (0.01 level) and * (0.05 level), with p-values confirming the statistical significance of these relationships.

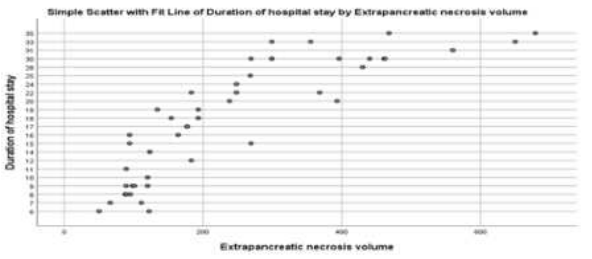

Chart 2: Scatter Diagram-Correlation between the Duration of hospital stay and EPNV

The study reveals that the mean hospital stay for participants is 11 days, with a standard deviation of 7 days. This data provides insight into the

typical length of hospitalization, essential for evaluating the impact of the medical condition and estimating healthcare resources needed for patient care.

The study finds a strong positive Pearson correlation of 0.868 ($p < 0.01$) between hospital stay duration and extra-pancreatic necrosis volume (EPNV). This significant relationship indicates that as EPNV increases, hospital stay length also rises, underscoring a robust positive linear association between these two variables.

Table-3 Correlation between EPNV and M-CTSI

		Modified CTSI	Extra-pancreatic necrosis volume
Modified CTSI	Pearson Correlation	1	.506**
	Sig. (2-tailed)		.000
	N	48	48
Extra-pancreatic necrosis volume	Pearson Correlation	.506**	1
	Sig. (2-tailed)	.000	
	N	48	48
**. Correlation is significant at the 0.01 level (2-tailed).			

The study shows a moderately strong positive Pearson correlation of 0.506 ($p < 0.01$) between extra-pancreatic necrosis volume (EPNV) and the Modified Computed Tomography Severity Index (M-CTSI). This significant correlation indicates that as EPNV severity rises, the M-CTSI score also tends to increase, reflecting a moderate positive relationship between these variables.

DISCUSSION

This cross-sectional study was conducted on 48 patients with clinically suspected pancreatitis who underwent contrast-enhanced computed tomography (CECT) between 3 to 6 days after onset. Participants were selected based on CECT findings of combined pancreatic and extra-pancreatic necrosis. Extra-pancreatic necrosis includes peripancreatic and retroperitoneal fat necrosis, defined by fluid collections, fat infiltration, or solid components with attenuation over 20 Hounsfield units (HU). Necrotizing pancreatitis is a severe form of pancreatic inflammation, characterized by pancreatic cell death and extending necrosis. Common causes include alcohol abuse, gallstones, trauma, and systemic diseases. The condition's pathophysiology involves an inflammatory cascade, with cytokines like IL-6 and TNF-alpha leading to microvascular thrombosis, ischemia, and pancreatic autodigestion through activated enzymes such as lipases and proteases. Clinically, it presents with severe abdominal pain, fever, leukocytosis, and systemic inflammation. Diagnosis relies on imaging, while management requires a multidisciplinary approach involving fluid resuscitation, nutritional support, pain control, and occasionally invasive interventions to address complications [16].

Our study, including authors Banks et al. (2013), examined the relationship between extra-pancreatic necrosis volume (EPNV) and the prognosis of acute necrotizing pancreatitis in 48 participants, primarily male (91.7%) with a mean age of 40.5 years. We evaluated EPNV's impact on organ failure, mortality, and interventions, comparing its predictive accuracy with the Modified Computed Tomography Severity Index (M-CTSI). The findings reflect a young to middle-aged cohort, with male predominance linked to higher alcoholism rates [17].

Our study identified alcoholism as the primary cause of pancreatitis (70.8%), followed by gallstones (14.6%), diabetes mellitus (10.4%), and trauma (4.2%), underscoring lifestyle factors, particularly alcohol use, as key contributors. Similar findings by Yadav and Lowenfels (2013) highlighted alcohol's role in pancreatitis. Most participants had severe disease (58.3%) per M-CTSI scores, consistent with Balthazar et al. (1994) and others who link higher scores to greater morbidity and mortality in pancreatitis [18,19].

This study revealed significant variability in haematological parameters, especially in Total WBC Count (mean 30.7, SD 131.2), indicating diverse inflammatory responses. Median values, such as WBC at 11.5 and CRP at 94.6, underscore the inflammatory nature of severe pancreatitis, consistent with Mounzer et al. (2012). Factors like disease progression, individual immune responses, complications (e.g., infection or organ failure), treatment interventions, and timing of blood samples contribute to this variability. Correlations were found between M-CTSI scores and parameters like Platelet count ($r=0.531$, $p<0.01$), Serum Amylase ($r=0.512$, $p<0.01$), and CRP ($r=0.506$, $p<0.01$), linking higher severity with elevated inflammatory markers and organ dysfunction. Similar findings by Wu et al. (2008) and Nepolean et al. (2010) show that higher M-CTSI scores reflect widespread inflammation and tissue damage, crucial in severe pancreatitis, leading to increased WBC and CRP levels due to a heightened systemic inflammatory response [20,21,22].

This study found that higher M-CTSI scores correlated with severe outcomes, including organ failure, necrosis, and infections, which worsen clinical outcomes by intensifying inflammation, disrupting systemic homeostasis, and impairing pancreatic function. Patients with higher M-CTSI scores face longer hospital stays, increased critical care needs, and higher mortality risks, often developing SIRS and MODS, as noted by Mortele et al. (2004) and Bollen et al. (2011). Strong correlations were observed between EPNV and hematological parameters, notably Platelet count ($r=0.977$) and Serum Amylase ($r=0.991$), indicating its role in inflammation, systemic response, and complications, consistent with Singh et al. (2011) and Petrov et al. (2010). EPNV's specificity (100%) and moderate AUC (0.627) suggest better predictive accuracy for organ failure compared to M-CTSI (AUC=0.515) [23,24,25].

This study highlights EPNV as a valuable prognostic marker in acute necrotizing pancreatitis, showing strong correlations with outcomes like organ failure, hypotension, and hospital stay duration. These findings align with Beger et al. (2013), emphasizing necrosis extent's importance in predicting outcomes. EPNV's superior predictive accuracy over M-CTSI suggests incorporating EPNV assessment into routine evaluations to improve patient management [22].

CONCLUSION

This study underscores the significance of Extra-pancreatic Necrosis Volume (EPNV) as a key prognostic indicator in acute necrotizing pancreatitis, showing strong correlations with adverse outcomes, including prolonged hospital stays, organ failure, and mortality. EPNV demonstrated greater predictive accuracy for organ failure than the Modified Computed Tomography Severity Index (M-CTSI), advocating its integration into routine assessments. Incorporating EPNV evaluation could enhance patient risk stratification, enabling more personalized, timely interventions. While our findings support EPNV's value as a reliable prognostic tool, further research with larger, diverse populations is essential to validate these results and improve predictive models, optimizing patient care.

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