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A STUDY TO EVALUATE THE ROLE OF CLINICAL, LABORATORY, AND RADIOLOGICAL PARAMETERS IN PREDICTING THE SEVERITY OF ACUTE PANCREATITIS

General Surgery

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ABSTRACT

Introduction: Acute pancreatitis (AP) is a serious inflammatory disorder of the pancreas that can lead to significant morbidity and mortality. Over the years, numerous studies have delved into understanding the pathophysiology and risk factors associated with AP, yet predicting the severity of the disease remains an intricate puzzle. This study aimed to evaluate the role of clinical, laboratory, and radiological parameters in predicting the severity of acute pancreatitis. **Methods:** This prospective observational study, conducted over 2 years at a Northern Indian teaching hospital, focused on acute pancreatitis. In compliance with ethical standards, it enrolled participants aged over 18 years with confirmed acute pancreatitis diagnosis. Data collection involved demographic, clinical, and radiological parameters. Analysis, including logistic regression, identified independent predictors of severity. Ethical considerations included informed consent and strict confidentiality of data. **Results:** Out of a total 146 patients, the majority were male (64.4%). As per the Atlanta classification, about 67.8% of the patients were diagnosed with mild pancreatitis, and 32.2% from severe pancreatitis. The univariate analysis of CT Balthazar grades and laboratory parameters reveals significant associations. APACHE-II Score, CRP, Ranson score, Glasgow score, and leucocytosis exhibited strong correlations ($p < 0.001$). Severe pancreatitis predictors include Ranson score (OR 1.72, 95% CI 1.12-2.24), age (per year increase, OR 1.12, 95% CI 1.04-1.98), and acute fluid collections (1 AFC, OR 2.78, 95% CI 2.22-3.98). **Conclusion:** The identified predictors of severity and complications offer valuable insights for risk stratification, guiding therapeutic decisions, and optimizing patient outcomes for acute pancreatitis.

KEYWORDS

Acute Pancreatitis, Severity Prediction, Clinical Parameters, Laboratory Markers, Radiological Imaging

INTRODUCTION

Acute pancreatitis (AP) is a serious inflammatory disorder of the pancreas that can lead to significant morbidity and mortality. It is characterized by the sudden onset of severe abdominal pain, nausea, vomiting, and fever.[1] The severity of acute pancreatitis can vary widely, ranging from mild self-limiting disease to severe necrotizing pancreatitis with multi-organ failure.[2] Early identification of patients at risk of developing severe disease is crucial for appropriate management and improved outcomes.

Over the years, numerous studies have delved into understanding the pathophysiology and risk factors associated with AP, yet predicting the severity of the disease remains an intricate puzzle. The quest for reliable prognostic indicators has led to the identification of various clinical, laboratory, and radiological parameters that may contribute to the stratification of AP severity. Clinical parameters encompass a range of signs and symptoms that provide valuable insights into the progression and severity of AP.[3] Pain characteristics, vital signs, and the presence of systemic complications are among the key clinical parameters that clinicians routinely assess. Pain, typically radiating to the back, is a hallmark symptom of AP, and its intensity has been associated with disease severity.[4] Understanding the nuances of pain patterns and their correlation with severity may offer valuable prognostic information. Vital signs, including heart rate, blood pressure, respiratory rate, and temperature, serve as fundamental indicators of physiological stress.

Laboratory investigations play a pivotal role in diagnosing and monitoring AP. Elevated serum levels of pancreatic enzymes, such as amylase and lipase, are classical markers of pancreatic inflammation.[5] However, the extent of enzyme elevation may vary, and recent studies suggest that certain enzyme patterns or ratios may better reflect disease severity. This study will delve into the nuances of enzyme kinetics and explore novel biomarkers that hold promise in predicting the severity of AP. In addition to pancreatic enzymes, the study will scrutinize other laboratory parameters, including complete blood count, liver function tests, and inflammatory markers. Haematological derangements, hepatic involvement, and systemic inflammation are integral components of the disease process and may serve as valuable indicators of disease severity. By examining a comprehensive panel of laboratory parameters, this study aims to identify robust predictors that can aid clinicians in early risk stratification and targeted intervention.

Advanced imaging modalities, such as computed tomography (CT) scans, play a pivotal role in diagnosing and assessing the extent of pancreatic inflammation in AP.[6] The presence of pancreatic necrosis, peripancreatic fluid collections, and other radiological findings can offer crucial insights into disease severity.[7] This study will critically evaluate various radiological parameters, exploring their individual and collective contributions to predicting the severity of AP.

The results of this study will have important implications for the management of patients with acute pancreatitis. If certain parameters are found to be strongly associated with severe disease, they could be used to identify patients at high risk of developing complications and guide early intervention. This could potentially improve outcomes and reduce the morbidity and mortality associated with acute pancreatitis. This study aimed to evaluate the role of clinical, laboratory, and radiological parameters in predicting the severity of acute pancreatitis.

METHODS

Study Design:

This study adopted a prospective observational design. The study was conducted at a tertiary care teaching hospital in Northern India involving the Surgery department for a total duration of 2 years. The study followed the guidelines specified in the Declaration of Helsinki. Ethical approval was obtained from the Institutional Review Board (IRB) of the participating institutions. Informed consent was obtained

from all study participants, ensuring compliance with ethical standards. All the patients were enrolled as per the inclusion criteria only.

Inclusion Criteria:
- Patients aged more than 18 years
- Confirmed diagnosis of acute pancreatitis based on established clinical and laboratory criteria

Exclusion Criteria:
- Patients not willing to participate in the study
- Patients with previous history of chronic pancreatitis
- Pregnant patients
- Patients with known allergies to contrast agents (for CT scan assessment)

Data Collection:
All the eligible study participants attending the study site were approached, and briefed about the objective of the study. Detailed data on demographic characteristics, clinical Parameters such as pain characteristics, including location, intensity, and radiation, vital signs such as heart rate, blood pressure, respiratory rate, and temperature, and presence of systemic complications were collected. Data on laboratory parameters such as serum levels of pancreatic enzymes (amylase and lipase), and complete blood count, liver function tests, and inflammatory markers were collected. Radiological parameters such as computed tomography (CT) scans to assess pancreatic necrosis, peripancreatic fluid collections, and other relevant findings were also observed.

Data Analysis:
Descriptive statistics was used to summarize demographic and clinical characteristics. Univariate analysis to explore the association between individual parameters and the severity of AP was done. Multivariate analysis, including logistic regression, to identify independent predictors of AP severity was done. Statistical significance was set at $p < 0.05$.

Ethical Considerations:
Informed consent was obtained from all participants. Patient confidentiality and data protection was strictly maintained throughout the study.

RESULTS

A total of 146 patients meeting the inclusion criteria were enrolled in the study. The demographic characteristics of the study participants are summarized in Table 1.

Table 1: Demographic Characteristics of The Study Participants

Demographic variable	Values
Total participants (n)	146
Age (Years) (Mean ± SD)	49.56 ± 8.12
Gender	
Male – n (%)	94 (64.4%)
Female – n (%)	52 (35.6%)
Duration of hospital stay (Days) (Mean)	15.18 ± 4.06

The mean age of study participants was 49.56 ± 8.12 years. The majority were male (64.4%), and the average duration of hospital stay was 15.18 ± 4.06 days (Table 1). Alcohol, biliary pancreatitis, trauma, and hypertriglyceridemia were some common causes for acute pancreatitis.

The clinical parameters assessed in the study are presented in Table 2. These include pain characteristics, vital signs, and the presence of systemic complications.

Table 2: Clinical Parameters of Study Participants (n=146)

Clinical Parameter	Mean ± SD / n (%)
Heart rate (Bpm)	112.24 ± 08.12
Blood pressure (mmHg)	98.16 ± 06.26 / 68.22 ± 03.56
Respiratory rate (breaths/min)	19.78 ± 03.46
Temperature (°C)	38.22 ± 01.88
Local & Systemic complications	
Acute peripancreatic fluid collection	18 (12.3%)
Pleural effusion	17 (11.6%)
Pancreatic pseudocyst	6 (4.1%)
Multi-organ failure	3 (2%)
Cholangitis	1 (0.7%)
Pain Location	
Upper abdominal pain	132 (90.4%)
Epigastric pain	104 (71.2%)
Pain radiation to back	49 (33.6%)
Pain relief by leaning forward	40 (27.4%)

Mean heart rate was 112.24 ± 08.12 bpm, blood pressure was 98.16 ± 06.26 / 68.22 ± 03.56 mmHg, respiratory rate was 19.78 ± 03.46 breaths/min, and temperature was 38.22 ± 01.88 °C. Local and systemic complications included acute peripancreatic fluid collection (12.3%), pleural effusion (11.6%), pancreatic pseudocyst (4.1%), multi-organ failure (2%), and cholangitis (0.7%). The majority experienced upper abdominal pain (90.4%), epigastric pain (71.2%), pain radiation to the back (33.6%), and pain relief by leaning forward (27.4%) (Table 2).

Laboratory parameters assessed in the study are summarized in Table 3. This includes serum levels of pancreatic enzymes, enzyme kinetics, novel biomarkers, complete blood count, liver function tests, and inflammatory markers.

Table 3: Laboratory Parameters of Study Participants

Laboratory findings	Mean values	Range
Serum Amylase (IU/L)	858.18 ± 137.12	788 - 1259
Serum Lipase (U/L)	972.32 ± 104.12	542 - 1672
Aspartate aminotransferase (AST) (IU/L)	298.12 ± 13.33	268 - 334
Lactate dehydrogenase (LDH) (IU/L)	402.44 ± 22.11	387 - 512
Glucose (mg/dl)	133.22 ± 12.77	102 - 154
Total Bilirubin (mg/dl)	2.96 ± 0.11	2.02 – 4.12
Direct Bilirubin (mg/dl)	0.99 ± 0.13	0.76 – 1.12
Indirect Bilirubin (mg/dl)	1.54 ± 0. 34	1.12 – 2.34
Serum Calcium (mg/ml)	8.4 ± 1.18	6.16 – 12.77
Serum Albumin (g/l)	3.42 ± 0.88	2.78 – 5.12
CRP (mg/dl)	133.12 ± 12.6	22.12 – 248.98
PCT (ng/ml)	0.74 ± 0.06	0.62 – 1.98
Haemoglobin (g/dl)	13.98 ± 2.12	12.5 – 14.9
WBC Count (cells/microliter)	8400 ± 1200	7800 – 12300
Neutrophil (%)	78.4 ± 12.12	66.63 – 98.12
Lymphocyte (%)	10.5 ± 2.3	9.12 – 11.26

The study participants exhibited varied laboratory parameters. Mean values for key parameters include: Serum Amylase 858.18 ± 137.12 IU/L, Serum Lipase 972.32 ± 104.12 U/L, Glucose 133.22 ± 12.77 mg/dl, Total Bilirubin 2.96 ± 0.11 mg/dl, Direct Bilirubin 0.99 ± 0.13 mg/dl, Indirect Bilirubin 1.54 ± 0.34 mg/dl, Serum Calcium 8.4 ± 1.18 mg/ml, Serum Albumin 3.42 ± 0.88 g/l, CRP 133.12 ± 12.6 mg/dl, PCT 0.74 ± 0.06 ng/ml, Haemoglobin 13.98 ± 2.12 g/dl, WBC Count 8400 ± 1200 cells/microliter, Neutrophil 78.4 ± 12.12%, Lymphocyte 10.5 ± 2.3%. The ranges for these values are also provided (Table 3).

Table 4: Correlation between the severity of acute pancreatitis and clinical, imaging, and laboratory parameters

Characteristics	Grade of severity of Acute pancreatitis		
	Mild (n=99)	Severe (n=47)	p-value
APACHE* II score			
≥9	10 (10.1%)	42 (89.4%)	0.04
<9	89 (89.9%)	5 (10.6%)	
Ranson score			
≥3	11 (11.2%)	41 (87.2%)	0.02
<3	88 (88.8%)	6 (12.8%)	
Glasgow score			
≥3	12 (12.1%)	40 (85.1%)	0.001
<3	87 (87.9)	7 (14.9%)	
CTSI*			
≥7	21 (21.2%)	39 (83%)	0.03
<7	78 (78.8%)	8 (17%)	
Number of AFC*			
≥2	16 (16.1%)	36 (76.6%)	0.002
<2	83 (83.9%)	11 (23.4%)	

*APACHE – Acute physiology and chronic health evaluation, CTSI – CT severity index, AFC – Acute fluid collections

Patients were classified as per the Atlanta classification, where about 67.8% of the patients were from mild acute pancreatitis, and 32.2% from severe acute pancreatitis. In patients with acute pancreatitis, a significant correlation was observed between the severity of the condition and various parameters. Higher APACHE II, Ranson, Glasgow scores, CTSI, and number of AFC were associated with severe cases. For instance, 89.4% of severe cases had APACHE II scores ≥9, compared to 10.1% in mild cases (p=0.04). Similar trends were noted for other parameters (Table 4). All patients of mild acute pancreatitis (n=99) demonstrated full recovery through conservative treatment. Significantly prolonged hospital stays were observed in the severe disease group compared to the mild disease group.

Table 5: Analysis of CT Balthazar grade and laboratory parameters through univariate evaluation

Parameter	Balthazar grade					p-value
	A	B	C	D	E	
AST (IU/L)	255	258	261	313	298	0.36
LDH (IU/L)	378	392	399	414	408	0.06
Serum amylase (IU/L)	822	856	888	928	898	0.18
APACHE-II Score	5	6	8	10	18	0.0002
CRP (mg/dl)	24	37	88	134	348	0.0002
Ranson score	2	3	3	4	5	0.0003
Glassgow score	1	2	3	3	4	0.0003
Leucocytosis	8	9	11	12	20	0.0002

Using Balthazar's criteria, we categorized 84 patients (57.5%) with mild acute pancreatitis and 62 (42.5%) with severe AP. The univariate analysis of CT Balthazar grades and laboratory parameters reveals significant associations. While AST, LDH, and serum amylase show no significant trends, APACHE-II Score, CRP, Ranson score, Glasgow score, and leucocytosis exhibit strong correlations ($p < 0.001$). These findings suggest potential clinical implications for the latter parameters in the evaluated conditions (Table 5).

Table 6: Complication predictions based on acute fluid collections

Predictors	Increase	Adjusted OR	95% CI
Ranson score	Severe	1.72	1.12-2.24
Age	1 year	1.12	1.04-1.98
Acute fluid collections	1 AFC	2.78	2.22-3.98

A notable correlation was identified between the acute fluid collections (AFC) and the occurrence of complications. The prognostic factor for complications was identified as a cut-off point of >1 acute fluid collection (AFC). Severe pancreatitis predictors include Ranson score (OR 1.72, 95% CI 1.12-2.24), age (per year increase, OR 1.12, 95% CI 1.04-1.98), and acute fluid collections (1 AFC, OR 2.78, 95% CI 2.22-3.98) (Table 6).

Figure 1 depicts CT scan imaging of acute pancreatitis and shows pancreatic necrosis, and peripancreatic fluid collections.

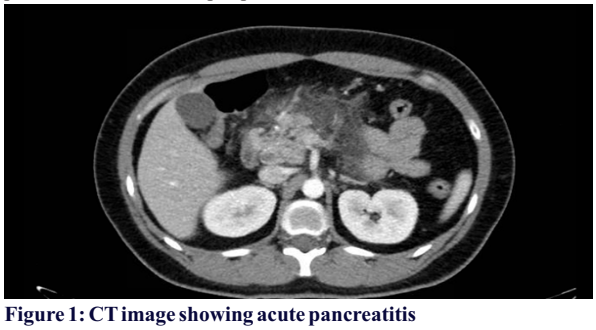

Figure 1: CT image showing acute pancreatitis

DISCUSSION

The mean duration of hospital stay was 15.18 ± 4.06 days, reflecting the significant impact of acute pancreatitis on patients' well-being. The diverse etiologies, including alcohol, biliary pancreatitis, trauma, and hypertriglyceridemia, highlighted the multifactorial nature of this condition.[8]

The assessment of clinical parameters uncovered key aspects of symptomatology and complications associated with acute pancreatitis. Mean heart rate, blood pressure, respiratory rate, and temperature revealed physiological abnormalities, emphasizing the systemic impact of the disease. The prevalence of upper abdominal pain (90.4%) and other characteristic pain patterns provided valuable insights into the clinical presentation.[9] Notably, the study explored both local and systemic complications, with acute peripancreatic fluid collection being the most common (12.3%). Pleural effusion, pancreatic pseudocyst, multi-organ failure, and cholangitis were also observed. These findings underscored the diverse and potentially severe consequences of acute pancreatitis, necessitating a comprehensive approach to patient management.[10]

The laboratory parameters exhibited considerable variations among study participants, shedding light on the pathophysiological changes associated with acute pancreatitis. Elevated levels of pancreatic enzymes (amylase and lipase), liver function markers, inflammatory markers, and alterations in complete blood count indicated systemic involvement.

The correlation analysis between the severity of acute pancreatitis and clinical, imaging, and laboratory parameters revealed compelling associations. Higher scores in APACHE II, Ranson, Glasgow scores, CT severity index (CTSI), and the number of acute fluid collections (AFC) were significantly linked to severe cases. This emphasized the potential utility of these parameters in predicting disease severity and guiding clinical decision-making.[11]

The use of Balthazar's criteria for radiological assessment provided further insights into the severity of acute pancreatitis. The univariate evaluation of CT Balthazar grades and laboratory parameters highlighted significant correlations, particularly with APACHE-II Score, CRP, Ranson score, Glasgow score, and leucocytosis. These findings suggested the potential clinical relevance of these parameters in predicting disease severity, guiding therapeutic interventions, and facilitating risk stratification.[12]

A critical aspect of the study involved predicting complications based on acute fluid collections (AFC). The presence of AFC was identified as a significant predictor of complications, with an adjusted odds ratio of 2.78 (95% CI 2.22-3.98). This emphasized the importance of early identification and monitoring of fluid collections in assessing the risk of complications.[13]

The multivariate analysis further identified Ranson score and age as independent predictors of severe pancreatitis. These findings provided a valuable prognostic tool for clinicians, aiding in risk assessment and early intervention strategies.

CONCLUSION

This study comprehensively evaluated the role of clinical, laboratory, and radiological parameters in predicting the severity of acute pancreatitis. The findings highlighted the importance of a multidimensional approach in assessing patients with acute pancreatitis, considering clinical, laboratory, and radiological aspects. The identified predictors of severity and complications offer valuable insights for risk stratification, guiding therapeutic decisions, and optimizing patient outcomes. Further research and validation studies are warranted to refine and enhance the predictive models, ultimately contributing to improved patient care in the management of acute pancreatitis.

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Conflict Of Interest: None declared

Ethical approval: The study was approved by the Institutional Review Board

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