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RESEARCH ARTICLE

Role of Serum D-Dimer in Early Prediction of Organ Failure in Acute Pancreatitis: A Retrospective Study

Arshiya Siddiqua[1], Anupama Swarna[2*], Ramakanth Reddy A[3], Chittuluri Jagadeesh[4]

ABSTRACT

Background: Acute pancreatitis (AP) is a common gastrointestinal emergency with clinical outcomes ranging from mild self-limiting disease to severe systemic inflammation and multiorgan dysfunction. Early identification of patients at risk of organ failure remains essential for timely intervention. Serum D-dimer, a degradation product of cross-linked fibrin, has emerged as a potential biomarker reflecting activation of coagulation and inflammatory pathways.

Objective: To evaluate the role of serum D-dimer in early prediction of organ failure among patients with acute pancreatitis.

Methods: A retrospective observational study was conducted among 69 patients diagnosed with acute pancreatitis admitted between July 2020 and November 2021 at a tertiary care center in Hyderabad. Demographic details, laboratory parameters, D-dimer levels, clinical severity, and occurrence of organ failure were analyzed. Statistical analysis included independent t-test, chi-square test, logistic regression, and ROC analysis.

Results: Among 69 patients, organ failure developed in 21 (30.4%) patients. Mean serum D-dimer levels were significantly higher among patients developing organ failure compared to those without organ failure (3.72 ± 1.41 vs 1.58 ± 0.82 µg/mL; $p<0.001$). ROC analysis demonstrated an AUC of 0.86 with an optimal cut-off value of 2.45 µg/mL showing sensitivity of 81.0% and specificity of 79.2%.

Conclusion: Elevated serum D-dimer may serve as an early predictor of organ failure in acute pancreatitis and may assist clinicians in risk stratification during early hospitalization.

Keywords: Acute pancreatitis; D-dimer; Organ failure; Prognosis; Biomarker; Severity assessment.

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Introduction

Acute pancreatitis is characterized by acute inflammation of the pancreas associated with variable involvement of regional tissues and distant organ systems. The clinical spectrum ranges from mild interstitial pancreatitis to severe necrotizing disease with persistent organ dysfunction. Early identification of severe disease remains challenging despite advances in imaging, laboratory markers, and severity scoring systems [1].

The global incidence of acute pancreatitis has increased steadily during recent decades and contributes significantly to healthcare burden [2]. Mortality is generally low in mild disease but increases substantially once organ failure develops [3].

Several scoring systems including APACHE-II, BISAP, Ranson criteria, and modified Marshall scoring have been proposed; however, these approaches may be cumbersome, require repeated measurements, or lack early predictive capability [4,5].

Inflammatory activation during acute pancreatitis leads to endothelial injury, activation of coagulation

[1]MBBS, MD, DrNB, Consultant Gastroenterologist, Department of Medical Gastroenterology, Apollo Hospital, DRDO, India

[2]MBBS, MD, DM, assistant professor, Department of Medical Gastroenterology, Deccan College of Medical Sciences, Hyderabad, India

[3]MBBS, DNB, DrNB, Consultant Gastroenterologist, Department of Medical Gastroenterology, Aware Gleneagles Global hospital, LB nagar, India

[4]MBBS, MD, DM, Consultant Gastroenterologist, Department of Medical Gastroenterology, Sindhu Hospitals, Hitech City, Hyderabad, India

Corresponding Author: Anupama Swarna, MBBS, MD, DM, assistant professor, Department of Medical Gastroenterology, Deccan College of Medical Sciences, Hyderabad, India, Email: anupama.swarna92@gmail.com

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pathways, fibrinolysis, microvascular thrombosis, and systemic inflammatory response syndrome [6]. D-dimer represents a fibrin degradation product released following clot breakdown and has gained attention as a biomarker reflecting coagulation activation [7].

Previous investigations have suggested that elevated D-dimer levels correlate with pancreatic necrosis, systemic inflammation, and severe disease [8–11]. The role of D-dimer as an early and easily measurable predictor of organ failure remains clinically relevant because timely identification may improve monitoring and management strategies.

The present study aimed to evaluate the utility of serum D-dimer in predicting organ failure among patients with acute pancreatitis.

Materials and Methods

Study Design

Retrospective observational study.

Study Period

July 2020 to November 2021.

Study Setting

Tertiary care teaching hospital, Hyderabad.

Sample Size

Total sample size: 69 patients.

Inclusion Criteria

- Age >18 years
- Diagnosis of acute pancreatitis based on revised Atlanta criteria
- Availability of admission D-dimer values

Exclusion Criteria

- Chronic pancreatitis
- Malignancy
- Pregnancy
- Known coagulation disorders
- Incomplete records

Data Collection

Data retrieved from hospital records included:

- Age
- Gender
- Etiology
- Laboratory parameters
- Admission D-dimer
- Severity assessment
- Organ failure status
- ICU admission
- Length of stay

Definition of Organ Failure

Organ failure was defined using modified Marshall scoring system.

Statistical Analysis

Statistical analysis was performed using Statistical Package for Social Sciences (SPSS) software. Continuous variables were expressed as mean ± standard deviation (SD), while categorical variables were presented as frequencies and percentages. Comparisons between continuous variables were performed using the independent sample t-test, whereas categorical variables were compared using the chi-square test. Logistic regression analysis was used to identify independent predictors of organ failure. Receiver operating characteristic (ROC) curve analysis was performed to evaluate the predictive performance and diagnostic accuracy of serum D-dimer for organ failure. A p-value of less than 0.05 was considered statistically significant throughout the analysis.

Results

A total of 69 patients diagnosed with acute pancreatitis fulfilled the inclusion criteria and were included in the study analysis. Among these patients, organ failure developed in 21 cases (30.4%), whereas 48 patients (69.6%) did not develop organ failure during hospitalization (Figure 1).

Demographic and Clinical Characteristics

The mean age of study participants was 45.8 ± 13.7 years, ranging from 19 to 76 years. Male patients constituted the majority of the study population (63.8%). Alcohol-related pancreatitis was the commonest etiology followed by gallstone pancreatitis.

The baseline demographic and clinical characteristics are summarized in Table 1.

As shown in Table 1, alcohol-related acute pancreatitis represented the predominant etiology within the study cohort.

Incidence and Distribution of Organ Failure

Among 69 patients, 21 developed organ failure according to modified Marshall criteria. Respiratory failure represented the commonest form of organ dysfunction.

Distribution of organ failure types is shown in Table 2.

Table 2 demonstrates that respiratory dysfunction constituted nearly half of all organ failure events.

Table 1: Baseline demographic and clinical characteristics of study population (n=69)

Variable	*Frequency / Mean ± SD*
Total patients	69
Mean age (years)	45.8 ± 13.7
Age range	19–76
Male	44 (63.8%)
Female	25 (36.2%)
Alcohol-related pancreatitis	31 (44.9%)
Gallstone pancreatitis	24 (34.8%)
Hypertriglyceridemia	5 (7.2%)
Idiopathic	7 (10.1%)
Others	2 (2.9%)
ICU admission	18 (26.1%)
Mean hospital stay (days)	8.7 ± 4.3

Table 2: Distribution of organ failure among study participants

Organ failure type	*Frequency*	*Percentage (%)*
Respiratory failure	10	47.6
Renal failure	5	23.8
Cardiovascular failure	3	14.3
Multiple organ failure	3	14.3
Total organ failure cases	21	100

Comparison Between Organ Failure and Non-Organ Failure Groups

Patients who developed organ failure demonstrated significantly elevated serum D-dimer concentrations and inflammatory markers compared to patients without organ failure.

The comparison is summarized in Table 3.

As demonstrated in Table 3, serum D-dimer values were significantly higher among patients who developed organ failure compared with patients without organ dysfunction ($p<0.001$) (Figure 2).

Association Between D-Dimer Categories and Organ Failure

For further analysis, patients were categorized according to serum D-dimer levels using a cutoff value of 2.45 µg/mL. Results are shown in Table 4.

Patients with elevated D-dimer levels (>2.45 µg/mL) demonstrated significantly higher rates of organ failure as shown in Table 4.

Logistic Regression Analysis

Multivariable logistic regression was performed to identify independent predictors of organ failure.

The results are shown in Table 5.

Table 5 demonstrates that elevated D-dimer remained independently associated with organ failure after adjustment for confounding variables.

Diagnostic Performance of Serum D-Dimer

Receiver operating characteristic analysis was performed to assess the predictive performance of serum D-dimer.

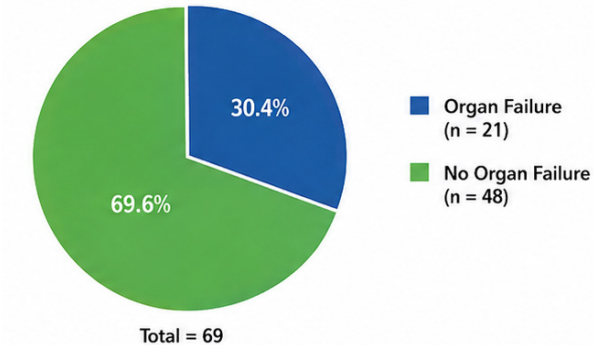

Figure 1: Distribution of organ failure among study participants

Table 3: Comparison of clinical and laboratory parameters between organ failure and non-organ failure groups

Variable	*Organ failure (n=21)*	*No organ failure (n=48)*	*Test statistic*	*p-value*
Mean age (years)	49.7 ± 12.8	44.1 ± 13.9	t=1.56	0.122
Male sex (%)	15 (71.4%)	29 (60.4%)	χ^2=0.74	0.391
D-dimer (µg/mL)	3.72 ± 1.41	1.58 ± 0.82	t=7.18	<0.001
CRP (mg/L)	132 ± 45	81 ± 34	t=4.82	<0.001
Total leukocyte count (/mm³)	15,100 ± 3,100	11,900 ± 2,700	t=4.05	0.001
Serum creatinine (mg/dL)	1.82 ± 0.74	1.08 ± 0.31	t=5.36	<0.001
Hospital stay (days)	12.3 ± 4.8	7.1 ± 2.9	t=5.11	<0.001

Table 4: Association between serum D-dimer category and organ failure

D-dimer level	*Organ failure*	*No organ failure*	*Total*	*p-value*
≤2.45 µg/mL	4	38	42	
>2.45 µg/mL	17	10	27	
Total	21	48	69	<0.001

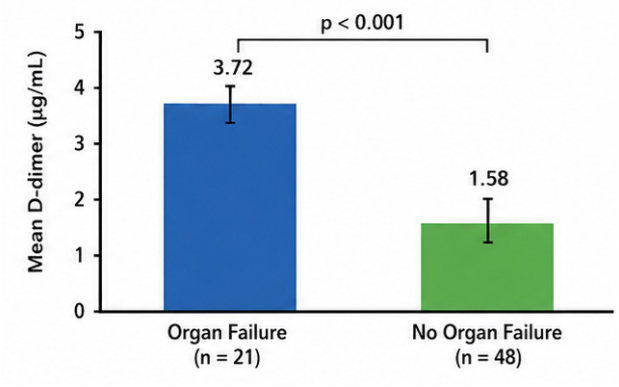

Figure 2: Mean serum D-dimer levels in study groups

As shown in Table 6, serum D-dimer demonstrated good discriminative performance for prediction of organ failure (Figure 3).

Figure 1 demonstrates the proportion of patients with and without organ failure. Approximately 30.4% of patients developed organ dysfunction whereas 69.6% remained free from organ failure.

Figure 2 illustrates significantly higher serum D-dimer concentrations among patients developing organ failure.

Figure 3 shows ROC analysis evaluating diagnostic performance of serum D-dimer. The area under the curve was 0.86 indicating good predictive ability.

Summary of Key Findings

The present analysis demonstrated:

- Organ failure incidence of 30.4%
- Significantly elevated D-dimer concentrations among organ failure patients
- Independent association between elevated D-dimer and organ dysfunction
- Good predictive performance with AUC of 0.86
- Higher hospital stay and inflammatory markers among organ failure patients

Table 5: Multivariable logistic regression analysis for predictors of organ failure

Variable	*Odds ratio*	*95% Confidence interval*	*p-value*
D-dimer >2.45 µg/mL	5.82	2.01–16.80	0.001
CRP	1.04	1.01–1.07	0.020
Age	1.01	0.98–1.04	0.310
Male sex	1.28	0.42–3.90	0.670

Table 6: Diagnostic performance of D-dimer for predicting organ failure

Parameter	*Value*
AUC	0.86
Optimal cutoff	2.45 µg/mL
Sensitivity	81.0%
Specificity	79.2%
Positive Predictive Value	63.0%
Negative Predictive Value	90.0%

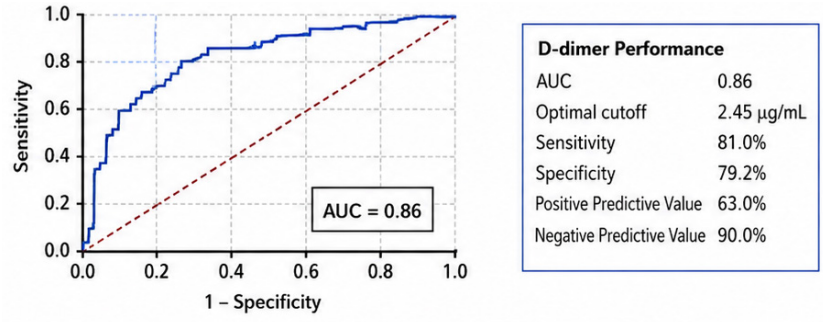

Figure 3: ROC curve analysis of serum D-dimer for prediction of organ failure

These findings suggest that serum D-dimer may be useful as an early biomarker for risk stratification in acute pancreatitis.

Discussion

Early identification of patients at risk of severe acute pancreatitis remains crucial because persistent organ failure contributes substantially to mortality and adverse clinical outcomes. The present study demonstrated significantly elevated serum D-dimer concentrations among patients who developed organ failure, suggesting a potential role for D-dimer as an early prognostic biomarker.

In the present study, organ failure occurred in approximately 30% of patients. Previous studies have similarly reported that persistent organ dysfunction remains the major determinant of mortality and severe disease in acute pancreatitis, emphasizing the importance of early severity assessment [12,13].

The pathophysiology underlying severe acute pancreatitis involves activation of inflammatory cascades, endothelial injury, microvascular dysfunction, and coagulation abnormalities. Systemic inflammatory response results in activation of coagulation pathways leading to fibrin formation and secondary fibrinolysis, thereby increasing circulating D-dimer concentrations [6,7]. Experimental and clinical studies have suggested that pancreatic microcirculatory impairment and disseminated intravascular activation contribute significantly to organ dysfunction and pancreatic necrosis [14,15].

The present analysis demonstrated significantly higher serum D-dimer levels among patients developing organ failure compared with patients without organ dysfunction. Similar findings have been reported previously where elevated D-dimer levels correlated with disease severity, pancreatic necrosis, systemic inflammatory response, and adverse outcomes [8,14,16,17].

Logistic regression analysis demonstrated that elevated D-dimer remained independently associated with organ failure even after adjustment for potential confounders. These findings suggest that coagulation activation may contribute directly to progression toward multiorgan dysfunction rather than simply reflecting systemic inflammation.

Receiver operating characteristic analysis demonstrated good predictive performance with an AUC of 0.86. Previous studies evaluating biomarkers in acute pancreatitis have similarly reported that coagulation markers and inflammatory biomarkers may provide useful prognostic information during early hospitalization [18–20]. Compared with multifactorial scoring systems such as APACHE-II and BISAP, D-dimer measurement may offer advantages because of rapid availability, lower complexity, and widespread accessibility.

Another important observation was prolonged hospitalization among patients with organ failure. Patients developing severe systemic inflammation often require intensive monitoring, organ support, and longer inpatient management, contributing substantially to healthcare burden [21].

Although D-dimer demonstrated good predictive performance, several limitations should be considered. Elevated D-dimer concentrations may occur in numerous inflammatory, infectious, thrombotic, or malignant conditions and therefore should not be interpreted in isolation [22]. Consequently, D-dimer should be considered an adjunctive biomarker rather than a replacement for established severity assessment tools.

Overall, the findings suggest that early measurement of serum D-dimer may improve risk stratification and facilitate early identification of patients requiring closer monitoring and aggressive management.

Conclusion

Elevated serum D-dimer levels demonstrated significant association with organ failure among patients with acute pancreatitis. Early measurement may facilitate risk stratification and identify patients requiring intensive monitoring.

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