



A Comparison of Apache Iii and Modified Ct Severity Index in Predicting the Severity of Acute Pancreatitis

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ABSTRACT:

Introduction: Acute pancreatitis is a common, yet potentially devastating, condition with a wide range of aetiologies and clinical presentations. Its incidence varies geographically, largely influenced by the prevalence of gallstones and alcohol consumption. Despite advancements, the mortality rate for diagnosed cases has remained high at 10-25% over the last two decades. Most research on the condition has focused on Western populations, where it is generally perceived to have a more severe course than in Asian countries. Recent years have seen a rise in cases, coinciding with an increase in gallstone disease and alcohol abuse. The ability to accurately predict the severity of the disease is vital for improving patient survival, requiring simple, accurate, and non-invasive criteria. The 2012 Revised Atlanta Classification for Acute Pancreatitis sought to standardise diagnostic definitions using clinical and radiological investigations.

Objectives: This study sought to compare two widely used systems, the APACHE III and the Modified CT Severity Index (MCTSI), in their ability to predict the severity of acute pancreatitis in a South Indian tertiary care centre. A further objective was to identify individual parameters within the APACHE III score that are particularly useful in predicting the severity of the condition.

Methods: This was a prospective study conducted between June 2017 and November 2019. The study cohort comprised 50 patients over the age of 18 who were clinically diagnosed with acute pancreatitis based on their amylase and lipase values. Patients with chronic, recurrent, or acute-on-chronic pancreatitis were excluded. On admission and again after 48 hours, arterial blood gas (ABG) values were taken to calculate the APACHE III score. A Contrast Enhanced CT scan with pancreatic protocol was also performed to calculate the MCTSI score. An increase of five points in the APACHE III score was considered indicative of worsening acute pancreatitis. The collected data were analysed using SPSS 17 statistical software, employing descriptive frequency analysis, Chi-square tests, and post hoc tests such as Tukey HSD and Bonferroni.

Results: The Revised Atlanta score showed that 74% of the patients had mild pancreatitis, 22% had moderately severe, and 4% had severe acute pancreatitis. The MCTSI score classified the majority of patients (54%) as having moderately severe pancreatitis, 26% as mild, and 20% as severe.

The comparison between the APACHE III score and the Revised Atlanta Classification demonstrated a highly statistically significant correlation, with a p-value of <0.001. Of the patients who showed a worsening APACHE III score, 83.3% had moderately severe and 16.7% had severe acute pancreatitis. In contrast, the comparison between MCTSI and the Revised Atlanta Classification was found to be statistically insignificant, with a p-value of 0.071. However, when considered individually, necrosis was found to be a significant predictor of severity with a p-value of 0.003.



The study found a statistically significant correlation between the severity of pancreatitis and the presence of interstitial pancreatitis ($p=0.001$). There was no significant relationship between the degree of pancreatitis and either gender or alcohol consumption.

Analysing individual parameters from the APACHE III score, several were found to be significant predictors of severity. On admission, serum creatinine ($p<0.007$), urine output ($p<0.001$), and BUN ($p<0.001$) were significant. Over 48 hours, an increasing pulse rate ($p<0.0001$), worsening tachypnoea ($p=0.01$), increasing WBC counts ($p<0.001$), rising serum creatinine ($p<0.0001$), increasing BUN ($p<0.0001$), and worsening hyponatraemia ($p<0.0001$) were found to be significant predictors of an adverse prognosis.

Conclusions: This study concludes that APACHE III is a better tool for predicting the severity of acute pancreatitis than the Modified CTSI. It also highlights that several individual physiological and biochemical parameters, particularly their trends over the initial 48 hours of hospitalisation, are valuable independent predictors of a patient's prognosis. The authors acknowledge that a larger study population, especially within the severe acute group, is required to substantiate these findings and better inform patient management.

Introduction

Acute pancreatitis is a common yet potentially devastating disorder, characterised by a wide range of aetiologies and a highly variable clinical course¹. The incidence of the disease is known to vary geographically, largely influenced by the differing prevalence of gallstone disease and alcohol abuse worldwide. Despite advancements, the mortality rate for diagnosed cases has remained high at 10–25% over the past two decades, with nearly a quarter of all attacks resulting in severe complications.

Most studies on acute pancreatitis have focused on Western populations. It is generally thought that the condition follows a more benign course in Asian countries and that its aetiology may differ from that seen in the West². Recently, the incidence of acute pancreatitis has been on the rise, correlating with an increase in gallstone disease and alcohol consumption. For this reason, it is critical to have a simple, accurate, quantitative, and non-invasive system for predicting disease severity, as this is key to improving survival³.

As a clinical entity, acute pancreatitis has historically lacked a standardised definition, contributing to its unpredictable course. The 2012 Revised Atlanta Classification for Acute Pancreatitis sought to address this by providing a consistent set of definitions for

diagnosis, based on clinical and radiological investigations⁴.

This study, conducted at a tertiary care centre in South India, assesses the APACHE III scoring system to better understand patient outcomes and mortality risk for critically ill, hospitalised adults with acute pancreatitis. The APACHE III system offers two options: one for initial risk stratification of moribund patients and another to predict hospital mortality for those in intensive care. A five-point increase in the total APACHE III score is considered a significant indicator of an increased risk of hospital death or disease progression⁵. Accordingly, this study aims to compare two commonly used systems in assessing the severity of acute pancreatitis in a South Indian population.

Aims and objective

- To compare APACHE 3 and Modified CT Severity Index score in predicting the severity in acute pancreatitis.
- To identify the individual parameters in APACHE 3 which will help in predicting the severity in acute pancreatitis.



Materials and methods

This is a prospective study done from June 2017 to November 2019. Initial diagnosis of Pancreatitis to be made based on Amylase, Lipase values APACHE III score calculated at admission and at the end of 48 hours. Contrast enhanced CT scan with pancreatic protocol was done and Modified CTSI score calculated. Results will be tabulated.

INCLUSION CRITERIA:

- All patients clinically diagnosed with Acute Pancreatitis based on amylase and lipase values
- All patients who have taken CECT and ABG values on admission and after 48 hours.
- All patients above the age of 18 years.

EXCLUSION CRITERIA:

- Patients diagnosed with chronic pancreatitis.
- Patients with recurrent pancreatitis.
- All patients with Acute on chronic pancreatitis.

After obtaining institutional ethics committee approval, 50 patients were included in the study after obtaining informed consent. On admission ABG values were taken and APACHE 3 score was calculated. The patient was reassessed after 48 hours and repeat ABG was taken and APACHE 3 score was calculated. An increase in the APACHE 3 score by 5 implied worsening of acute pancreatitis.

STATISTICAL ANALYSIS

The collected data were analysed with the SPSS 17 statistics software. Descriptive frequency analysis was used. Tukey HSD and Bonferroni, single step multiple comparison procedure and statistical tests were used as post hoc tests. Chi square test to check for p value.

Results

Table 1: Revised Atlanta score

REVISED ATLANTA SCORE	No. of Patients

Mild	37
Moderately severe	11
Acute severe	2

The Revised Atlanta score was calculated for the study population Shows that majority i.e. 74% of the patients are in the mild group, 22% in the moderately severe group and 4% in acute severe group.

Table 2: MCTSI score

MCTSI SCORE	No. of Patients
Mild (0-2)	13
Moderately severe (4-6)	27
Severe (8-10)	10

The MCTSI score calculated for the study population shows that the majority i.e., 54% of the patients are in the moderate group, 26% in the mild group and 20 % in the severe group.

Table 3: APACHE 3 score

APACHE III	No. of Patients
Worsening	12
Improvement	10
Not significant	28

Based on the APACHE III scoring system, the study population was analyzed and found that 24% of the population had worsening, 20 % had an improvement and 56 % of the population did not show any significant improvement or worsening.



Table 4: APACHE III vs Revised Atlanta

			Revised Atlanta Classification			Total
			Mild	Moderately Severe	Severe Acute	
APACHE WORSENING	Count		0	10	2	12
	% within APACHE		.0%	83.3%	16.7%	100.0%
IMPROVEMENT	Count		10	0	0	10
	% within APACHE		100.0%	.0%	.0%	100.0%
NOT SIGNIFICANT	Count		27	1	0	28
	% within APACHE		96.4%	3.6%	.0%	100.0%
Total	Count		37	11	2	50
	% within APACHE		74.0%	22.0%	4.0%	100.0%

Chi-square tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	45.071 ^a	4	.000
Likelihood Ratio	49.026	4	.000
Linear-by-Linear Association	30.697	1	.000
N of Valid Cases	50		

On comparing APACHE III with Revised Atlanta Scoring system, it is observed that 12 patients are worsening and 10 patients are improving according to APACHE III. Similarly, 11 patients have a

moderately severe score, 2 patients have Severe Acute score and 37 patients have a mild score in Revised Atlanta, The p-value for this is 0.000 which is highly statistically significant.

Table 5 :CTSI with Revised Atlanta

			Revised Atlanta Classification			Total
			Mild	Moderately Severe	Severe Acute	
CTSI	Mild	Count	12	0	1	13



		% within CTSI	92.30%	0.00%	7.70%	100.00%
	Moderate	Count	20	6	1	27
		% within CTSI	74.10%	22.20%	3.70%	100.00%
	Severe	Count	5	5	0	10
		% within CTSI	50.00%	50.00%	0.00%	100.00%
Total		Count	37	11	2	50
		% within CTSI	74.00%	22.00%	4.00%	100.00%

Chi-square tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	8.640 ^a	4	.071
Likelihood Ratio	10.909	4	.028
Linear-by-Linear Association	2.252	1	.133
N of Valid Cases	50		

On comparing Revised Atlanta scoring system with CTSI scores it is found that 11 patients have a moderately severe score, 2 patients have Severe Acute score and 37 patients have a mild score in Revised Atlanta. In CTSI Scoring, 10 patients have a severe

score, 13 patients have a mild score and 27 patients have a moderate score. On statistical analysis it is found that the p-value is 0.071 which is statistically insignificant.

Parameters in APACHE 3 at 0 and 48 hours

APACHE III	AT	0	HOURS	AT	48	HOURS	
PARAMETERS	Mild	Moderately severe	Severe acute	Mild	Moderately severe	Severe acute	P-VALUE
Mean pulse	98.97	86.55	95	92.05	90	106	0.000
Mean BP	92.89	91.45	90	93.59	93.18	85	0.278



Mean Temperature (c°)	36.89	36.96	36.94	36.88	36.85	37.75	0.259
Mean Respiratory rate	24.73	21.09	26.00	24.11	24.27	26.00	0.010
Mean Pa o2	91.68	91.27	87.00	91.7	91.09	87.00	0.371
Mean AAO2	8.85	9.048	17.105	11.045	11.191	17.100	0.000
Mean HCT	40.88	36.92	36.00	37.97	35.66	37.70	0.226
Mean WBC	12693	11736	15850	12078	12834	20550	0.000
Mean Creatinine	1.01	0.80	3.75	0.86	0.92	4.20	0.000
Mean urine output /day	1424	1690	950	1524	1554	800	0.001
Mean BUN	15.16	15.64	47	13.11	16.91	60.50	0.000
Mean Serum sodium	132.8	136	131	135.2	136	125.5	0.000
Mean serum albumin	3.34	3.54	3.05	3.30	3.36	3.05	0.059
Mean serum bilirubin	1.28	0.94	5.76	1.23	1.15	8.73	0.000
Mean RBS	129	130	155	129	128	156	0.539
Mean PCO2	38.46	38.09	36.50	39.32	39.50	36.50	0.007
Mean pH	7.39	7.41	7.29	7.39	7.42	7.26	0.000

The table shows a change in pulse, tachypnoea, WBC counts, creatinine, BUN, Serum Sodium and Bilirubin are significant in predicting the severity of acute pancreatitis.



Table 6: Gender vs Revised Atlanta Classification

			Revised Atlanta Classification			Total
			Mild	Moderately Severe	Severe Acute	
SEX	Male	Count	33	11	2	46
		% within SEX	71.7%	23.9%	4.3%	100.0%
	Female	Count	4	0	0	4
		% within SEX	100.0%	.0%	.0%	100.0%
Total		Count	37	11	2	50
		% within SEX	74.0%	22.0%	4.0%	100.0%

There is no significant relationship to degree of pancreatitis and gender. The p-value for this correlation is 0.466 which is not statistically significant.

Table 7: Alcohol vs Revised Atlanta Classification

			Revised Atlanta Classification			Total
			Mild	Moderately Severe	Severe Acute	
Alcoholic	Yes	Count	25	11	1	37
		% within Alcoholic	67.6%	29.7%	2.7%	100.0%
	No	Count	12	0	1	13
		% within Alcoholic	92.3%	.0%	7.7%	100.0%
Total		Count	37	11	2	50
		% within Alcoholic	74.0%	22.0%	4.0%	100.0%

There is a significant relationship to the severity of pancreatitis and alcohol consumption. The p-value is 0.072 which is statistically insignificant.



Table 8 :Necrosis vs Revised Atlanta Classification

			Revised Atlanta Classification			Total
			Mild	Moderately Severe	Severe Acute	
Necrosis	Yes	Count	7	8	1	16
		% within Necrosis	43.8%	50.0%	6.3%	100.0%
	No	Count	30	3	1	34
		% within Necrosis	88.2%	8.8%	2.9%	100.0%
Total		Count	37	11	2	50
		% within Necrosis	74.0%	22.0%	4.0%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	11.592 ^a	2	.003
Likelihood Ratio	11.130	2	.004
Linear-by-Linear Association	8.399	1	.004
N of Valid Cases	50		

There is a relationship between the degree of necrosis and the severity of acute pancreatitis. The p-value is 0.003 which is statistically significant

Table 9: Interstitial pancreatitis vs Revised Atlanta Classification

			Revised Atlanta Classification			Total
			Mild	Moderately Severe	Severe Acute	
Interstitial Pancreatitis	Yes	Count	29	3	0	32



	% within Interstitial Pancreatitis	90.60%	9.40%	0.00%	100.00%
	Count	8	8	2	18
No	% within Interstitial Pancreatitis	44.40%	44.40%	11.10%	100.00%
	Count	37	11	2	50
Total	% within Interstitial Pancreatitis	74.00%	22.00%	4.00%	100.00%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	13.316 ^a	2	.001
Likelihood Ratio	13.817	2	.001
Linear-by-Linear Association	12.778	1	.000
N of Valid Cases	50		

There is a significant correlation between the degree of Pancreatitis and the presence of interstitial pancreatitis. The p-value is 0.001 which is statistically significant.

Discussion

Based on our study, the APACHE III scoring system is a superior prognostic tool for assessing the course of acute pancreatitis compared to the Modified CT Severity Index (MCTSI).

APACHE III's Predictive Accuracy: The APACHE III score was found to accurately predict disease severity. All 12 patients in the study with a worsening APACHE III score developed either moderately severe or severe pancreatitis. In contrast, only one of the 38 patients whose APACHE score showed either

an improvement or no significant change progressed to a moderately severe or severe state. The correlation between the APACHE III scores and the Revised Atlanta Classification was highly statistically significant, with a p-value of <0.001.

MCTSI's Limitations: The MCTSI score performed poorly in predicting the overall severity of pancreatitis, with a statistically insignificant p-value of 0.071. However, it is notable that necrosis as a single parameter was found to be a more effective predictor of severity, with a p-value of 0.003.

Analysis of Individual Parameters

The study's findings also highlight the significance of several individual physiological and biochemical parameters in predicting disease progression, which



may be more practical for routine clinical use than the complex APACHE III score.

Significant Predictors:

- **Pulse Rate:** An increasing pulse rate over 48 hours was found to be a useful predictor (p-value <0.0001).
- **Respiratory Rate:** Worsening tachypnoea was a significant risk factor for severe pancreatitis (p=0.01).
- **White Blood Cell (WBC) Counts:** Increasing WBC counts over 48 hours were associated with patient deterioration (p<0.001).
- **Serum Creatinine:** Both serum creatinine on admission (p<0.007) and a rising trend over 48 hours (p < 0.0001) were significant in predicting severe pancreatitis.
- **Urine Output:** A declining urine output trend over the first 24 hours (p<0.001) and over 48 hours (p<0.001) indicated a worsening condition.
- **Blood Urea Nitrogen (BUN):** An initial raised BUN (p<0.001) and an increasing trend over 48 hours (p<0.0001) were significant indicators of severe acute pancreatitis.
- **Hyponatraemia:** Worsening hyponatraemia over 48 hours (p-value <0.0001) was linked to a worsening prognosis.
- **Serum Bilirubin:** A high serum bilirubin level on admission and a rising trend over 48 hours (both p-values <0.001) were identified as independent predictors of severe acute pancreatitis.

Non-Significant Predictors:

- **Haematocrit:** Unlike some other studies, haematocrit on admission (p=0.15) and its increase over 48 hours (p=0.55) were not found to be significant factors in predicting severity.
- **Hyperglycaemia:** Hyperglycaemia was not a significant predictor during the course of hospitalisation.

- **Blood Pressure:** Blood pressure, as a single variable, did not predict the severity or progression of the disease.
- **Serum Albumin:** Neither serum albumin on admission (p=0.404) nor its decreasing trend over 48 hours (p=0.059) was found to be significant.

This study corroborates that APACHE III is a more reliable prognostic tool for acute pancreatitis than the MCTSI. It also underscores the importance of monitoring individual physiological parameters for changes over time. However, the authors note that the primary limitation of the study is its small sample size, especially within the severe acute pancreatitis group. They suggest that larger population studies are needed to substantiate these findings and to have a more significant impact on patient management.

Conclusion

APACHE 3 is better than modified CTSI in predicting the severity of acute pancreatitis. In APACHE 3 we found that on admission serum creatinine, urine output, BUN and blood sugars were independent factors in predicting the severity of pancreatitis. Increasing tachycardia, worsening tachypnea, increasing WBC counts, rising BUN, decreasing urine output and worsening hyponatremia over 48 hours were found to adversely affect the prognosis of acute pancreatitis. However large population studies are required to substantiate these findings

Abbreviations

CTSI	-	COMPUTERISED TOMOGRAPHY SEVERITY INDEX
MCTSI	-	MODIFIED COMPUTERISED TOMOGRAPHY SEVERITY INDEX
CECT	-	CONTRAST ENHANCED COMPUTERISED TOMOGRAPHY
ARDS	-	ACUTE RESPIRATORY DISTRESS SYNDROME
LDH	-	LACTATE DEHYDROGENASE
BUN	-	BLOOD UREA NITROGEN
CRP	-	C- REACTIVE PROTEIN



PLA2 - PHOSPHOLIPASE A2
TAP - TRYPSINOGEN ACTIVATION PEPTIDE
GCS - GLASGOW COMA SCALE
AST - ASPARTATE AMINOTRANSFERASE
ALT - ALANINE AMINOTRANSFERASE
APACHE - ACUTE PHYSIOLOGY AND CHRONIC HEALTH EVALUATION
SIRS - SYSTEMIC INFLAMMATORY RESPONSE SYNDROME
MOSS - MULTIPLE ORGAN SYSTEM SCORE
PP - PANCREATIC POLYPEPTIDE
GIP - GASTRIC INHIBITORY PEPTIDE
GLP 1 - GLUCAGON LIKE PEPTIDE 1
VIP - VASOACTIVE INTESTINAL POLYPEPTIDE
CCK - CHOLECYSTOKININ
Camp - CYCLIC ADENOSINE MONOPHOSPHATE
CFTR - CYSTIC MEMBRANE TRANSMEMBRANE RECEPTOR
Pdx1 - PANCREATIC AND DUODENAL HOMEBOX
PTF1a - PANCREATIC SPECIFIC TRANSCRIPTION FACTOR 1 a
SHH - SONIC HEDGEHOG
FGF - FIBROBLAST GROWTH FACTOR
IEP - INTERSTITIAL EDEMATOUS PANCREATITIS
GCS - GLASGOW COMA SCALE

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