



## CLINICAL VS RADIOLOGICAL GRADING: A COMPARATIVE STUDY OF MODIFIED ATLANTA CLASSIFICATION AND MODIFIED CTSI IN ACUTE PANCREATITIS

### General Surgery

**Dr. Ramesh T**

Junior Resident, Department of General Surgery, Sri Siddhartha Medical College and Hospital, Sri Siddhartha Academy of Higher Education (SSAHE), Tumkur, Karnataka, India

**Dr. Srinivas Arava**

Professor, Department of General Surgery, Sri Siddhartha Medical College and Hospital, Sri Siddhartha Academy of Higher Education (SSAHE), Tumkur, Karnataka, India

**Dr. Seelam Sai  
Siddardha Reddy\***

Junior Resident, Department of General Surgery, Sri Siddhartha Medical College and Hospital, Sri Siddhartha Academy of Higher Education (SSAHE), Tumkur, Karnataka, India\*Corresponding Author

### ABSTRACT

**Background:** Acute pancreatitis is a common, potentially life-threatening gastrointestinal emergency with a clinical spectrum ranging from mild, self-limiting illness to severe necrotizing disease. Mild acute pancreatitis carries a mortality of approximately 1%, whereas the severe form is associated with mortality rates of 20–30%, particularly when complicated by persistent organ failure or infected pancreatic necrosis. Globally, hospital admissions for acute pancreatitis have been rising, with incidence rates of 5–80 per 100,000 population. Accurate severity stratification is essential for guiding clinical management, determining intensive care requirements, and predicting complications and outcomes. Two widely used tools — the Modified Atlanta Classification (MAC), a clinical scoring system, and the Modified CT Severity Index (MCTSI), a radiological scoring system — each capture distinct dimensions of disease severity. However, their comparative performance across the disease course has not been comprehensively evaluated in Indian tertiary care settings.

**Aim of the Study:**

1. Assess acute pancreatitis severity using the Modified Atlanta Classification at admission and after one week.
2. Assess severity using the Modified CT Severity Index (MCTSI) at the same time points.
3. Compare both classification systems in grading disease severity.
4. Correlate complications and outcomes assessed by MCTSI with severity grading by the Modified Atlanta Classification.

**Methodology:**

A prospective, longitudinal comparative observational study was conducted at the Department of General Surgery, Sri Siddhartha Medical College and Hospital, Tumkur, Karnataka — a tertiary care teaching institution serving both urban and rural populations. The study was conducted over 24 months (February 2024 – July 2025), including 18 months of data collection and 6 months of follow-up and analysis. The research included 50 patients. **Conclusion:** This prospective comparative study demonstrates that the Modified Atlanta Classification and Modified CT Severity Index are complementary tools for severity assessment in acute pancreatitis.

### KEYWORDS

Acute pancreatitis, Modified CT Severity Index, Modified Atlanta Classification.

### INTRODUCTION

Acute pancreatitis is a common and potentially life-threatening gastrointestinal emergency that continues to pose significant diagnostic and prognostic challenges despite advances in imaging and critical care. It is characterized by acute inflammation of the pancreas resulting from premature activation of pancreatic enzymes, leading to autodigestion of pancreatic tissue and triggering local and systemic inflammatory responses. The clinical presentation of acute pancreatitis ranges widely from a mild, self-limiting illness to a severe necrotizing form associated with multiorgan failure and high mortality. Mild acute pancreatitis carries a mortality rate of approximately 1%, whereas severe acute pancreatitis is associated with mortality rates ranging between 20% and 30%, particularly in patients who develop persistent organ failure or infected pancreatic necrosis<sup>1</sup>.

Globally, acute pancreatitis is among the most common gastrointestinal disorders requiring hospitalization, with an incidence varying from 5 to 80 cases per 100,000 population per year depending on geographic and demographic factors. Over recent decades, hospital admissions for acute pancreatitis have increased substantially, reflecting changing etiological patterns, lifestyle factors, and improved diagnostic recognition<sup>2</sup>. Although the disease may occur at any age, it shows a higher incidence among young adult males and elderly females, largely influenced by etiologies such as alcohol consumption and gallstone disease<sup>3</sup>. The unpredictable disease course necessitates early identification of patients at risk for severe disease to facilitate timely intervention and optimize outcomes.

The pathophysiology of acute pancreatitis involves a complex interplay of pancreatic acinar cell injury, inflammatory mediator release, microcirculatory disturbances, and systemic inflammatory response syndrome. These mechanisms contribute to a spectrum of disease severity, from interstitial edematous pancreatitis to necrotizing pancreatitis, the latter being associated with extensive pancreatic and

peripancreatic tissue necrosis, secondary infection, and systemic complications<sup>4</sup>. Accurate stratification of disease severity is therefore crucial for guiding clinical management, determining the need for intensive care, predicting complications, and improving prognosis.

Over the years, several clinical, biochemical, radiological, and scoring systems have been developed to assess the severity of acute pancreatitis. Early classification systems lacked uniformity and often failed to correlate adequately with clinical outcomes. To address these limitations, the Atlanta Classification was first introduced in 1992 and later revised in 2012 to provide a standardized framework for defining disease severity, local complications, and systemic involvement<sup>5</sup>. The revised Atlanta Classification categorizes acute pancreatitis into mild, moderately severe, and severe forms based on the presence and duration of organ failure and local or systemic complications. Mild acute pancreatitis is defined by the absence of organ failure and complications, moderately severe disease by transient organ failure or local complications, and severe acute pancreatitis by persistent organ failure lasting more than 48 hours<sup>6</sup>.

The Modified Atlanta Classification emphasizes early clinical assessment and is particularly valuable within the first 48 hours of presentation, allowing clinicians to identify high-risk patients at an early stage. However, while this classification provides a robust clinical framework, it does not incorporate detailed radiological parameters, which are essential for evaluating morphological changes, extent of necrosis, and extrapancreatic complications that evolve during the disease course.

Imaging plays a pivotal role in the diagnosis and severity assessment of acute pancreatitis. Ultrasonography is often used as an initial imaging modality but is limited by bowel gas and operator dependency. Contrast-enhanced computed tomography (CECT) remains the imaging modality of choice for evaluating pancreatic morphology,

detecting necrosis, and identifying local and systemic complications. Based on CECT findings, the Computed Tomography Severity Index (CTSI) was developed to quantify disease severity by combining pancreatic inflammation and necrosis scores. Although CTSI demonstrated prognostic value, it did not adequately account for extrapancreatic complications, which significantly influence patient outcomes.

To overcome these limitations, the Modified CT Severity Index (MCTSI) was introduced, incorporating pancreatic inflammation, extent of necrosis, and extrapancreatic complications such as pleural effusion, ascites, vascular involvement, and gastrointestinal complications. The Modified CTSI has shown improved correlation with clinical outcomes, need for intervention, duration of hospital stay, and intensive care unit admission when compared to the original CTSI<sup>7</sup>. As a result, MCTSI has gained acceptance as a reliable radiological tool for prognostic assessment, particularly when imaging is performed after 48–72 hours of symptom onset.

Despite the availability of multiple scoring systems, there remains ongoing debate regarding the optimal method for early severity stratification in acute pancreatitis. Clinical scoring systems such as APACHE II and SOFA provide valuable information on systemic illness and organ dysfunction but are complex, require repeated calculations, and may overestimate severity in some patients<sup>8</sup>. Conversely, radiological indices provide objective morphological assessment but may underestimate severity if performed too early, before necrosis and complications become evident.

Recent studies have emphasized the complementary roles of clinical and radiological scoring systems. Evidence suggests that the Modified Atlanta Classification effectively identifies severe cases within the first 48 hours, while Modified CTSI offers superior prognostic accuracy in predicting complications, interventions, and outcomes during the later phase of the disease<sup>9</sup>. Studies conducted in Indian tertiary care settings have demonstrated strong concordance between Modified Atlanta Classification and Modified CTSI, although discrepancies have been noted in intermediate severity categories, highlighting the need for comparative evaluation<sup>10</sup>.

Given the dynamic nature of acute pancreatitis, a single scoring system may not be sufficient to capture the evolving disease severity. Early clinical assessment using the Modified Atlanta Classification may guide initial triage and management, while subsequent radiological assessment using Modified CTSI may refine prognosis and guide therapeutic decisions. Comparative analysis of these two systems at different time points may therefore provide valuable insights into their relative accuracy, predictive value, and clinical utility.

In resource-limited healthcare settings, accurate and timely severity assessment is particularly important to optimize utilization of intensive care resources and reduce morbidity and mortality. Establishing the comparative effectiveness of Modified Atlanta Classification and Modified CT Severity Index in predicting disease severity, complications, and outcomes may help standardize severity assessment protocols and improve patient care. Therefore, this study aims to compare these two widely used classification systems at admission and after the first week in patients with acute pancreatitis, with the objective of identifying the most reliable approach for early and evolving severity assessment.

### Aim & Objectives of Study

The aim of this study is to compare the severity of acute pancreatitis as determined by the **Modified Atlanta Classification** with the **Modified Computed Tomography Severity Index (CTSI)** at the time of admission and after the first week.

### OBJECTIVES

- To assess the severity of acute pancreatitis using the **Modified Atlanta Classification** at admission and after the first week.
- To assess the severity of acute pancreatitis using the **Modified Computed Tomography Severity Index (MCTSI)** at admission and after the first week.
- To compare the **Modified Atlanta Classification** and **Modified Computed Tomography Severity Index (MCTSI)** in grading the severity of acute pancreatitis. To compare the **complications and outcomes** of acute pancreatitis as assessed by Modified CTSI in the second week with the severity grading by the Modified Atlanta Classification.

### Materials and Methods

#### Study Design

The study was designed as a **longitudinal comparative observational study**. It compared the severity of acute pancreatitis using the **Modified Atlanta Classification (MAC)** and the **Modified Computed Tomography Severity Index (MCTSI)** at two time intervals—on admission and after the first week of hospitalization. The study aimed to determine the correlation between these two established scoring systems in evaluating disease severity, predicting complications, and assessing patient outcomes. The longitudinal nature allowed the monitoring of clinical progress and radiological changes over time, ensuring an accurate comparison between early clinical scoring and imaging-based severity indices. The study was hospital-based, prospective, and analytical in nature.

#### Study Setting

The study was conducted in the **Department of General Surgery, Sree Siddhartha Medical College and Hospital, Agalakote, Tumkur, Karnataka**. The hospital served as a tertiary care teaching institution catering to both urban and rural populations. Data were collected from patients admitted to the **Inpatient Department (IPD), Emergency Department, and Intensive Care Unit (ICU)** of the hospital who were diagnosed with **acute pancreatitis**. Diagnostic and imaging facilities, including biochemical laboratories and CT imaging units, were utilized within the same institution. The study environment ensured access to multidisciplinary care, including radiology and gastroenterology, facilitating comprehensive evaluation and management of patients.

#### Participants – Inclusion and Exclusion Criteria :

All adult patients who were admitted with a clinical and biochemical diagnosis of **acute pancreatitis** were screened for eligibility.

#### Inclusion criteria were:

- Patients aged **18 to 70 years**, of either sex.
- Patients diagnosed with **acute pancreatitis** based on at least two of the following:

- Abdominal pain consistent with acute pancreatitis (sudden onset of severe epigastric pain radiating to the back).
- Serum amylase and/or lipase levels at least **three times greater than the upper limit of normal**.
- Characteristic findings of acute pancreatitis on **ultrasound or CT scan**.

- Patients willing to provide **written informed consent** for participation.

#### Exclusion criteria included:

- Patients allergic to **iodinated contrast agents** (such as Iohexol).
- Pregnant women**.
- Patients with **chronic pancreatitis, pancreatic malignancy**, or significant **comorbid conditions** such as renal failure or cardiac disease.
- Patients who were **unwilling or unable** to undergo CT imaging or follow-up scans.

A total of **50 patients** diagnosed with acute pancreatitis were included in the study.

#### Study Groups

The participants were categorized into three groups based on **disease severity** as defined by the **Modified Atlanta Classification** and the **Modified CT Severity Index**.

**Group I:** Mild acute pancreatitis

**Group II:** Moderately severe acute pancreatitis

**Group III:** Severe acute pancreatitis

Each patient was evaluated at **two time points**—within 48 hours of admission and after 7 days (or earlier in case of deterioration). The comparative performance of MAC and MCTSI was analyzed based on how accurately each method predicted disease progression, complications, and outcomes.

#### Study Parameters

The following **parameters** were evaluated and recorded for each patient:

**1. Demographic parameters:** Age, sex, and relevant history (alcohol intake, gallstones, previous episodes).

**2. Clinical parameters:** Presenting symptoms (abdominal pain, vomiting, fever), duration of symptoms, vital signs, systemic examination findings.

**3. Biochemical parameters:** Serum amylase, lipase, blood urea, creatinine, electrolytes, SGOT, LDH, PCV, and arterial blood gases.

- 4. Radiological parameters:**
- Ultrasound findings on admission.
  - Contrast-Enhanced CT (CECT) findings at admission and after one week.

- 5. Scoring systems used:**
- **Modified Atlanta Classification (MAC)** for clinical severity grading.
  - **Modified CT Severity Index (MCTSI)** for radiological severity assessment.

**6. Outcome parameters:**  
Duration of hospital stay, ICU admission, complications (local/systemic), and mortality.

**Statistical Analysis**  
Statistical analysis was performed using **SPSS version 26.0** and **Microsoft Excel 2019**. Quantitative data were expressed as **mean ± standard deviation**, while qualitative data were presented as percentages and proportions.

The **paired t-test** was applied to determine the significance of differences between mean values at admission and after one week. The **Modified CT Severity Index (MCTSI)** was used as the reference (gold standard) for evaluating the diagnostic accuracy of the **Modified Atlanta Classification (MAC)**.

- The following statistical measures were calculated:
- **Sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV)** of MAC compared to MCTSI.
  - **Chi-square test** for categorical data.
  - **Pearson's correlation coefficient (r)** for assessing correlation between MAC and MCTSI scores. A **p-value < 0.05** was considered statistically significant. The results were interpreted to establish the comparative diagnostic and prognostic reliability of the two scoring systems.

**RESULTS**  
**Fig.1 : Demographic and Etiological Profile**

| Parameter            | Finding                                                                |
|----------------------|------------------------------------------------------------------------|
| Sample Size          | 50 patients                                                            |
| Age Range            | 18–70 years (Mean: 46.36 ± 15.77 years)                                |
| Gender Distribution  | 34 Males (68.0%), 16 Females (32.0%)                                   |
| Most Common Etiology | Alcohol (52.0%), Gallstones (32.0%), Idiopathic (12.0%), Others (4.0%) |

**Fig.2 : Clinical Presentation and Laboratory Findings**  
Abdominal pain was universal (100%). Other common symptoms included vomiting (74.0%), anorexia (60.0%), and fever (22.0%). Key laboratory values at admission:

| Parameter             | Mean ± SD                             |
|-----------------------|---------------------------------------|
| Serum Amylase         | 895.98 ± 175.58 U/L                   |
| Serum Lipase          | 1164.86 ± 212.90 U/L                  |
| Total Leukocyte Count | 13,350.20 ± 2,369.18 /mm <sup>3</sup> |
| Serum Creatinine      | 1.67 ± 0.37 mg/dL                     |

**Fig.3 : Severity Classification at Admission and After One Week**  
Both systems identified an increase in severe cases from admission to one week, reflecting disease progression over time.

| Scoring System    | Mild       | Moderate/Mod<br>erately Severe | Severe     |
|-------------------|------------|--------------------------------|------------|
| MAC – Admission   | 22 (44.0%) | 18 (36.0%)                     | 10 (20.0%) |
| MAC – One Week    | 20 (40.0%) | 16 (32.0%)                     | 14 (28.0%) |
| MCTSI – Admission | 24 (48.0%) | 17 (34.0%)                     | 9 (18.0%)  |

|                  |            |            |            |
|------------------|------------|------------|------------|
| MCTSI – One Week | 21 (42.0%) | 14 (28.0%) | 15 (30.0%) |
|------------------|------------|------------|------------|

**Fig.4 : Key Outcome Findings**

| Outcome Parameter                | Finding                                                                         | Statistical Value            |
|----------------------------------|---------------------------------------------------------------------------------|------------------------------|
| ICU Admission                    | 18 patients (36.0%)                                                             | —                            |
| Systemic Complications           | 70.0% of patients; Pleural effusion (36.0%), Renal failure (26.0%), ARDS (8.0%) | —                            |
| Organ Failure                    | 58.0% overall: Single (28.0%), Multiple (30.0%)                                 | —                            |
| MCTSI (1 week) vs Complications  | 100% of moderate/severe MCTSI had complications; 0% in mild MCTSI               | $\chi^2 = 50.000, p < 0.001$ |
| Hospital Stay (MCTSI categories) | Mild: 11.67 days, Moderate: 11.43 days, Severe: 12.53 days                      | F = 0.373, p = 0.691         |
| Mortality                        | 3 patients (6.0%)                                                               | —                            |
| Recovery                         | 47 patients (94.0%)                                                             | —                            |

**Fig.5 : Agreement and Correlation Between MAC and MCTSI**

| Measure                 | Value             | Interpretation                                                        |
|-------------------------|-------------------|-----------------------------------------------------------------------|
| Cohen's Kappa (1 week)  | 0.058 (p = 0.561) | Poor agreement — tools assess different disease dimensions            |
| Pearson Correlation (r) | 0.891 (p < 0.001) | Strong positive correlation — both trend together at population level |

The coexistence of poor agreement but strong correlation indicates that MAC and MCTSI evaluate complementary, not identical, aspects of disease severity.

**DISCUSSION**  
**Clinical Severity Assessment — Modified Atlanta Classification**  
The Modified Atlanta Classification effectively stratified patients at admission using clinical parameters including organ failure duration. However, its association with ICU admission (p = 0.895) and organ failure patterns (p = 0.728) was not statistically significant in this cohort. This may reflect the early, dynamic nature of clinical presentation and the impact of prompt supportive care in mitigating disease progression. These findings align with prior reports where MAC provided useful early triage but was insufficient as a standalone predictor of complications.

**Radiological Severity Assessment — Modified CT Severity Index**  
MCTSI demonstrated superior predictive performance for complications, with a statistically significant association (p < 0.001). All patients classified as moderate or severe by MCTSI at one week developed complications, while no mild MCTSI patients did. This underscores the value of delayed CT imaging (after 48–72 hours) in capturing the full extent of necrosis and extrapancreatic involvement. These findings are consistent with multiple published studies showing MCTSI superiority in predicting local complications and intervention requirements.

**Complementary Roles of MAC and MCTSI**  
The strong positive correlation (r = 0.891) between the two systems confirms that increasing clinical severity is paralleled by increasing radiological severity at a population level. However, poor individual-level agreement (Kappa = 0.058) underscores that they are not interchangeable. MAC captures systemic and clinical impact (organ failure), while MCTSI provides morphological detail (necrosis, extrapancreatic findings). An integrated approach combining both tools provides the most comprehensive severity assessment.

**CONCLUSION**  
Modified This prospective comparative study demonstrates that the Modified Atlanta Classification and Modified CT Severity Index are complementary tools for severity assessment in acute pancreatitis. While MAC enables rapid clinical stratification based on organ failure at presentation, MCTSI provides superior prognostic accuracy for predicting complications, particularly when performed after the first week. The strong correlation but poor agreement between the systems highlights that they assess overlapping but distinct dimensions of

disease severity. Neither tool should be used in isolation. An integrated approach — combining early clinical assessment using MAC with follow-up imaging and MCTSI scoring — offers the most accurate, holistic evaluation. This dual strategy facilitates timely identification of high-risk patients, guides multidisciplinary management decisions, and has the potential to improve outcomes in acute pancreatitis, particularly in resource-limited tertiary care settings.

### Clinical Recommendations

- Apply Modified Atlanta Classification within 48 hours of admission for early clinical triage
- Perform CECT and calculate MCTSI after 48–72 hours (or at one week) for morphological severity assessment
- Patients with moderate or severe MCTSI scores should receive close monitoring for complications regardless of initial clinical severity
- ICU admission decisions should integrate severity scores, organ function monitoring, and clinical judgment
- Serial reassessment using both tools is recommended to capture disease evolution
- Standardized CT reporting templates incorporating MCTSI parameters should be adopted to improve inter-rater reliability

### REFERENCES

- 1) Bailey H, Ellis BW, Brown SP. Hamilton Bailey's Emergency Surgery. 13th ed. United Kingdom: CRC Press; 2022. p. 384-392.
- 2) Fagenholz PJ, Castillo CF, Harris NS, Pelletier AJ, Camargo CA Jr. Increasing United States hospital admissions for acute pancreatitis. *Ann Epidemiol.* 2021;17:491-497.
- 3) Pezzilli R, Zerbi A, Di Carlo V, Bassi C, Delle Fave GF. Practical guidelines for acute pancreatitis. *Pancreatol.* 2016;10(5):523-535.
- 4) Bollen TL, van Santvoort HC, Besselink MG, van Es WH, Gooszen HG, van Leeuwen MS. Update on acute pancreatitis: ultrasound, computed tomography, and magnetic resonance imaging features. *Semin Ultrasound CT MR.* 2017;28(5):371-383.
- 5) Bradley EL. A clinically based classification system for acute pancreatitis. *Arch Surg.* 2021;128(5):586-590.
- 6) Bollen TL, van Santvoort HC, Besselink MG, van Leeuwen MS, Horvath KD, Freeny PC, et al. The Atlanta Classification of acute pancreatitis revisited. *Br J Surg.* 2018;95:6-21.
- 7) Larvin M, McMahon MJ. APACHE II score for assessment and monitoring of acute pancreatitis. *Lancet.* 2017;6(1):201-205.
- 8) Vincent JL, Moreno R, Takala J, Willatts S, De Mendonça A, Bruining H, et al. The SOFA score to describe organ dysfunction/failure. *Intensive Care Med.* 2016;22:707-710.
- 9) Bollen T, Singh VK, Maurer R. Comparative evaluation of the Modified CT Severity Index and CT Severity Index in assessing severity of acute pancreatitis. *AJR Am J Roentgenol.* 2019;197(3):386-392.
- 10) Mishra A, et al. Correlation of Modified Atlanta Classification with Modified CT Severity Index in acute pancreatitis. *Indian J Surg.* 2022.