Original Research Article

Assessing the efficacy of modified Marshall scoring system in severity assessment of acute pancreatitis in comparison to Ranson score at tertiary centre

Aakansha Vashistha*, Radha Govind Khandelwal, Prabha Om, Manish Rundla

Department of General Surgery, Sawai Mansingh Hospital, Jaipur, Rajasthan, India

*Correspondence:
Dr. Aakansha Vashistha,
E-mail: aakkisharma@gmail.com

ABSTRACT

Background: Early determination of severity of acute pancreatitis is essential for prediction of prognosis and proper treatment selection. This study aims to evaluate the effectiveness of the Modified Marshall scoring system in evaluating severity in acute pancreatitis at admission.

Methods: A hospital based prospective observational study was conducted at SMS medical college, Jaipur from May 2019 to September 2021 with a sample size of 60 patients. Modified Marshall Score and Ranson's score were done at admission and 48 hours respectively for same patient.

Results: Most patients (31.66%) were among age group 31-45 years (mean age 43.95±16.28 years) with slight female (51.55%) preponderance. The mean hospital stay was 4.883±3.405 days with maximum mortality in first week (6/8). All patients with mild pancreatitis under Modified Marshall score were discharged uneventfully while patients with severe pancreatitis, 8 (25%) died. Respiratory system failure (48.33%) was most commonly involved followed by renal (16.66%) and cardiovascular system (11.66%). Single organ failure (35%) had no mortality while 2/3 patients with all three-organ system failure died. The AUC value of ROC curve (0.863) (p<0.001) showed that Modified Marshall score is a significant predictor for severity of acute pancreatitis. The correlation coefficient was strongly positive and statistically significant (p<0.001) for the relationship between Ranson's score, Modified Marshall score and hospital stay.

Conclusions: Modified Marshall Score is simple and equally effective tool for predicting severity and prognosis early in the course of disease. Therefore, it prevents delay in aggressive treatment of critically ill patient and would contribute to decrease mortality.

Keywords: Modified Marshall score, Acute pancreatitis, Pancreatitis scoring system

INTRODUCTION

The determination of severity of acute pancreatitis is essential for predicting prognosis and proper treatment selection[1]. In 2012, the review of the Atlanta classification defined the severity of acute pancreatitis based on clinical components in first week and suggested that the persistence of a systemic inflammatory response syndrome and/or organ failure should be considered. As The Ranson's scoring system comprises of data not routinely collected at the time of hospitalization and requires minimum 48 hours to complete therefore missing a potentially valuable early therapeutic window.[1-4] APACHE and other scoring systems like Glasgow Imrie and SOFA score use many parameters which are cumbersome and difficult to obtain at the time of admission.

Table 1: Criteria for organ failure based on Modified Marshall scoring system.[6]

Parameters	Score				
Organ system	0	1	2	3	4
Respiratory (PaO_2/ FiO_2)	>400	301-400	201-300	101-200	<101
Renal (serum Creatinine in mg/dl)	<1.5	>1.5 to <1.9	>1.9 to <3.5	>3.5 to <5	>5
Cardiovascular (SBP in mmHg)	>90	<90 fluid responsive	<90 fluid unresponsive	<90 pH<7.3	<90 pH<7.2

Harmless acute pancreatitis score although simple could only predict a non-severe course hence was of no use in deciding management protocol. BISAP and SOFA score both used GCS as one of it's parameters which could be biased due to alteration in status of the patient due to sedation and drugs.

Table 2: Ranson's criteria and scoring system.[7]

Ranson Score Biliary pancreatitis	Ranson Score Non gall stone pancreatitis
At admission	
Age >70 years	Age >55 years
Tlc >18000/mm^3	Tlc >16000/mm^3
LDH >400 IU/l	LDH >350 IU/l
AST >250 IU/l	AST >250 IU/l
RBS >220 mg/dl	RBS >200 mg/dl
At 48 hours	
Drop in hematocrit >10%	Drop in hematocrit >10%
BUN increase >2 mg/dl	BUN increase >5 mg/dl
Calcium <8 mg/dl	Calcium <8 mg/dl
PO_2 <60 mmHg	PO_2 <60 mmHg
Base deficit >5 mEq/l	Base deficit >4 mEq/l
Fluid loss >4 litres	Fluid loss >6 litres

Table 3: Comparison of Modified Marshall's scoring system and Ranson's scoring system.

Modified Marshall score	Ranson score					
	≥3		<3		Total	
	N	%	N	%	N	%
≥2	26	72.2	3	14.3	29	50.9
<2	10	27.8	18	85.7	28	49.1
Total	36	100.0	21	100.0	57	100.0

A need was felt for requirement of a simple scoring system which could be applied at the time of admission to assign the severity of acute pancreatitis and early initiation of its management. Modified Marshall scoring system is a very simple scoring system with limited parameters based on routine laboratory and diagnostic testing which can be easily obtained early in the course of admission. This study aims to evaluate the effectiveness of the Modified Marshall scoring system in evaluating severity of acute pancreatitis at the time of admission.

METHODS

It was a hospital based prospective, observational study, conducted in the Department of General Surgery at SMS Medical College, Jaipur. The study period was taken from May 2019 to September 2021. The sample size was taken as 60 patients admitted with the diagnosis of acute pancreatitis irrespective of etiology.

Exclusion criteria

Patients with recurrent pancreatitis, acute on chronic pancreatitis and known cases of chronic kidney disease and chronic liver disease were excluded from the study.

Acute pancreatitis was defined as presence of two or more of the following (as per revised Atlanta classification 2012): Characteristic abdominal pain, Serum amylase and/or lipase levels 3 times the upper limit of normal and Ultrasonography suggestive of acute pancreatitis at time of admission and/or a contrast enhanced computed tomography (CECT) of the abdomen if available.[5] Modified Marshall score was calculated at admission taking into account the arterial blood gas analysis, blood pressure and serum Creatinine while the Ranson's score was calculated on admission and completed at 48 hours for the same patient as per the mentioned parameters. A Score ≥2 was defined as organ failure as per the Modified Marshall's score while Ranson's score ≥3 at 48 hours was classified as severe pancreatitis. Results of both the scoring systems were compared to predict severity of the disease which was evaluated with number of days of hospital stay and mortality. Patients were discharged when the total leucocyte counts were normal and were accepting oral diet. Identity of the participants was kept absolutely confidential. Patients were followed up for a period of 7 days and at 4 weeks post admission.

Statistical analysis

Independent t test was used to examine differences in age; Fischer's exact test for sex; and chi square test for etiology were used. Sensitivity, specificity, positive predictive value, negative predictive value and accuracy were calculated. A "p" value of less than 0.05 was considered to be statistically significant. Data analysis was performed using SPSS software 16 version.

RESULTS

A total of 60 patients were included in the study and calculation of Modified Marshall score and Ranson's score was done at admission and 48 hours respectively for the same patient. Most of the patients (31.66%) were in the age group of 31-45 years (mean age 43.95±16.28 years) with a slight female (51.55%) preponderance. The mean duration of hospital stay was 4.883±3.405 days with the maximum number of patients (75%) discharged within the first 7 days with a mortality rate of 13.33%. Out of total mortalities (8/60) maximum death occurred in the first week (75%) (Figure 1).
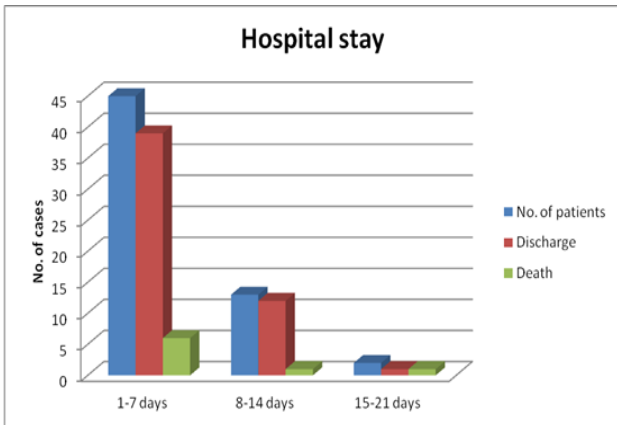

Figure 1: Number of patients discharged and death per week.

All patients categorized as mild pancreatitis under Modified Marshall score were discharged uneventfully while out of 32(53.33%) patients who had organ failure and hence severe pancreatitis 8 (25%) patients died.
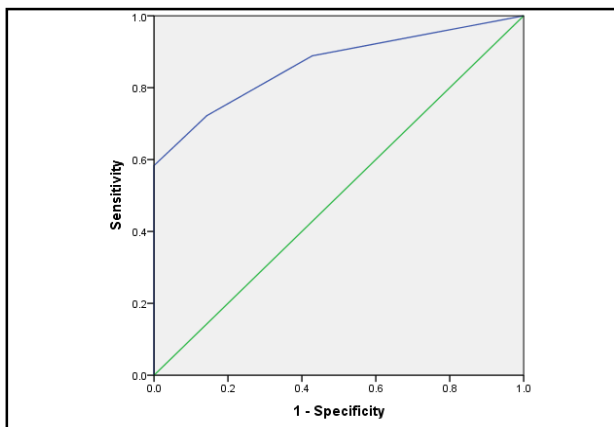

Figure 2: Receiver operating characteristic curve (ROC).

As per Ranson's score 36 patients had severe pancreatitis, out of which 31 (86.1%) patients were discharged and 5 (13.9%) patients died. 3 patients died within 48 hours of admission for which Ranson's score could not be calculated.
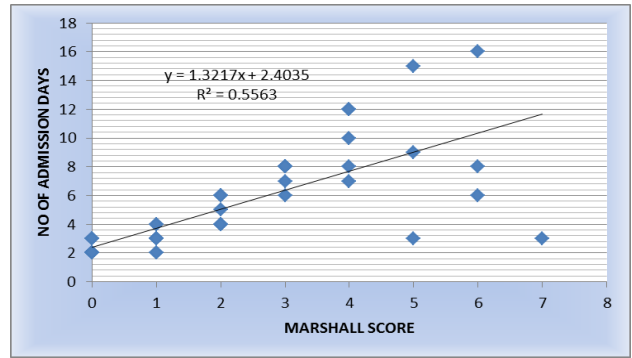

Figure 3: Correlation between Modified Marshall's score and number of days of hospital stay.

In patients with organ failure respiratory system (48.33%) was most commonly involved followed by renal (16.66%) and cardiovascular system (11.66%). In all the patients who died there was presence of minimum of 2 organ failure with one organ being the respiratory system.
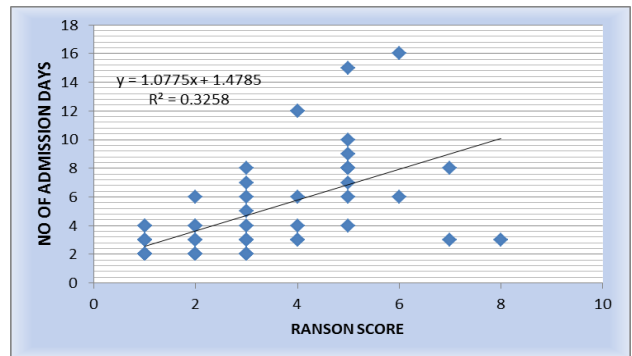

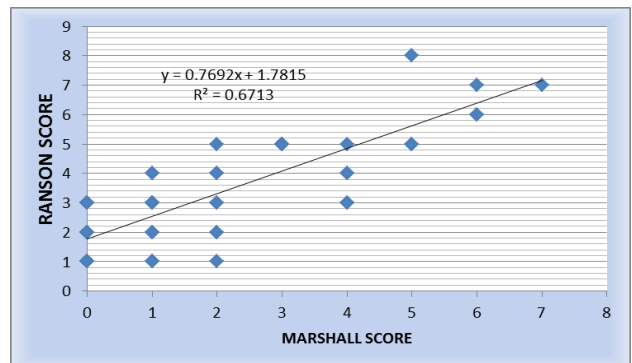**Figure 4: Correlation between Ranson's score and number of days of hospital stay.**

Figure 5: Correlation between Ranson's score and Modified Marshall's score.

Interestingly the patients with single organ failure (35%) had no mortality while 2/3 patients with all three-organ system failure died. On comparing the 2 scores out of 36 patients who had severe pancreatitis by Ranson's score, 26 patients were categorized as severe pancreatitis & 10 patients as mild pancreatitis based on Modified Marshall score. Out of 21 patients categorized as mild pancreatitis

by Ranson's score, 3 patients had severe pancreatitis & 18 patients had mild pancreatitis as per Modified Marshall's score (Table 3). The area under the curve (AUC) value of the ROC curve (Figure 2) showed that Modified Marshall score is a significant predictor of severity of acute pancreatitis with value of 0.863 (p<0.001). At cut off value of Modified Marshall score for predicting severity of acute pancreatitis ≥2, the score had a sensitivity, specificity, PPV & NPV of 72.22%, 85.71%, 89.66% & 64.29% respectively. The accuracy of the score in prediction was 77.19%. The correlation coefficient was strongly positive and statistically significant (p<0.001) for the relationship between Ranson's score, Modified Marshall score and duration of hospital stay in patients of acute pancreatitis. The coefficient between duration of hospital stay and Ranson's and Modified Marshall score was 0.571 and 0.746 respectively (Figure 3-4) and that between Ranson's score and Modified Marshall score was 0.819 (Figure 5).

DISCUSSION

The majority of patients of acute pancreatitis present with a mild disease, however those with severe course require intensive management in an intensive care unit. Multi-organ dysfunction syndrome, the extent of pancreatic necrosis, infection and sepsis are the major determinants of mortality in acute pancreatitis. Occurrence of acute respiratory, cardiovascular and renal failures can predict the fatal outcome in severe acute pancreatitis. A wide range of mortality (20%-60%) has been reported in sepsis. Early diagnosis and prognostic evaluation are extremely important for initiation of appropriate treatment and may reduce the morbidity and mortality associated with severe acute pancreatitis. On account of differences in outcome between patients with mild and severe disease, it is important to define that group of patients who will develop severe pancreatitis, predicting which still represents a challenge for the treating clinician.

Most patients of acute pancreatitis recover without complications, the overall mortality rate of this illness is between 2-5%.[8,9] Multiple risk stratification tools have been developed, but their clinical usefulness is limited. Older measures and Modified Glasgow score use data that are not routinely collected at the time of hospitalization.[9] The APACHE II score which is the most widely used prediction system currently and was developed originally as an intensive care instrument, requires the collection of large number of parameters, some of which may not be even relevant as a prognostic factor. As The Ranson's scoring system contain data not routinely collected at the time of hospitalization and requires minimum 48 hours to complete therefore missing a potentially valuable early therapeutic window while APACHE and other scoring systems like Glasgow Imrie and SOFA score use many parameters which are cumbersome and difficult to obtain at the time of admission.[1-4] Harmless acute pancreatitis score although simple could only predict a non severe course hence was of no use in deciding management protocol. BISAP and SOFA score both used GCS as one

of its parameters which could be biased due to alteration in status of the patient due to sedation and drugs. For this purpose a simple and accurate clinical scoring system that is Modified Marshall scoring system was developed. It is a very simple scoring system with limited parameters based on routine laboratory and diagnostic testing within 24 hours of presentation which can be easily obtained early in the course of admission. Early recognition of severe disease would enable the clinician to consider more aggressive interventions within a time frame that could potentially prevent adverse outcomes and improve survival of the patient.

Ranson's score, which requires 11 signs for computation, recorded at admission and 48hours is primarily aimed to evaluate the function of early operative intervention in patients of Acute Pancreatitis.[7] It takes 48 hours to complete and not all laboratories measure all the parameters in routine blood tests (e.g. serum lactate dehydrogenase). More recently, the APACHE II system, developed for general use in intensive care units, has supplanted Ranson's score because it can be applied at any point in time, unlike Ranson's score, which is calculated only 48 hours after admission.[10] Use of both Ranson's criteria and the APACHE II system are limited by their complexity. In our study maximum number of patients (31.66%) were in age group of 31-45 years followed by 15-30 years (25%) age group. The overall mean age was 43.95±16.28 years. A study done by Kaushik et al found the mean (±SD) age was 43.74±16.85 years, with a range of 21 to 84 years, Singh et al and Papachristou et al found it to be 49.6 years and 51.7 years respectively Lalithkumar et al noticed peak incidence of the disease in the 4th decade of life.[11-14] There was was a slight female preponderance similar with Carioca et al who enrolled 17 men and 22 women.[15] Most of our patients (75%) had a hospital stay between 1-7 days while the mean duration of hospital stay was 4.883±3.405 days. Lalithkumar et al found that the mean length of hospital stay was 12.03±6.8 days and most patients (33%) had a hospital stay between 1-7 days.[14] The maximum mortality in our study was in the first week of admission which could be owed to the acute phase of the disease. In our study all patients categorized as mild disease as per Modified Marshall score all were discharged while among those with organ failure 75% patients were discharged and 25% died. Organ failure is a common complication during the course and presents in 20% of acute pancreatitis patients and in 70% of the patients with severe acute pancreatitis.[16] 3 patients died within 48 hours of admission so, Ranson's score could not be calculated in these patients which is a major drawback in assessment of critically ill patients. Chatzicostas et al demonstrated that Ranson's criteria proved to be as powerful a prognostic model as the more complicated APACHE II and III scoring systems, but with the disadvantage of a 24-hour delay while Bernardinis et al showed that Ranson's scoring showed a poor predictive power with no added advantage over clinical judgment.[17,18]

In comparison between score severity and outcome in our study it was found that the Modified Marshall score could predict outcome accurately and all the deaths occurred in patients which had severe pancreatitis as per the scoring system (p=0.014) with positive correlation with duration of hospital stay (0.746). Although the Ranson's scoring system also predicted the outcome correctly as all the deaths occurred in patients with score ≥3 with positive correlation of the system with duration of hospital stay (0.571) but the p value was found to be insignificant (p=0.193) which could be due to less sample size as 3 patients were excluded from the calculations as Ranson's score could not be calculated for these patients due to death within 48 hours of admission. Carioca et al observed 39 acute pancreatitis patients, 11 were classified with severe acute pancreatitis by the Marshall system (score >2) and eight patients by the Ranson's score (score>3), with agreement between the two scoring systems in seven cases. Seven patients died in one week and one died after this.[15] In our study out of 52 patients which were discharged, 28 (53.84%) patients had no organ failure while most commonly involved system was respiratory system (40.38%) followed by renal system (9.61%) & cardiovascular system (3.84%). In all the patients who died there was a failure of minimum 2 organ systems. While all had respiratory organ failure, 2 patients had failure of all the three organ systems. Carioca et al also observed respiratory failure (23.07%) to be the most common, followed by cardiovascular failure (17.94%) and renal failure (15.38%). Wang et al had similar results who found respiratory failure to be the most common form of single organ failure.[15,16-19] The area under the curve (AUC) value of the ROC curve showed that the Modified Marshall score is a significant predictor of severity of acute pancreatitis as a value of 0.863 shows a good accuracy (p<0.001) at the cut off value of the score ≥2 in predicting severity. The scoring system had a sensitivity, specificity, PPV & NPV of 72.22%, 85.71%, 89.66% & 64.29% respectively and an accuracy of 77.19% compared to the Ranson's score in severity prediction.

The correlation coefficient was strongly positive and statistically significant (P<0.001) for the relationship between Ranson's score, Modified Marshall score and duration of hospital stay in patients of acute pancreatitis. The coefficient between Ranson's score and Modified Marshall score was 0.819 and that between duration of hospital stay and Ranson's and Modified Marshall score was 0.571 and 0.746 respectively. Positive correlation coefficient implies that as the value of Ranson's score increases with severity the Modified Marshall score also increases. Positive correlation between duration of hospital stay and the two scoring system indicated that with higher scores the duration of hospital stay also increases which is well evident. Cariocaet al concluded that Marshall scoring system may be used as an effective and simplified application method to assess the severity of acute pancreatitis.[15] An important feature is the recognition that acute pancreatitis is an evolving, dynamic condition and that the severity may change during the

course of the disease. Early in the disease, SIRS or organ failure indicate potentially severe disease.

The organ dysfunction scores have several attractions: the score is calculated with a relevant and comprehensive set of biological data; indicate patients requiring intensive care, and indicate patients with higher risk of adverse events. Because of better association with severity and outcome, SOFA and Modified Marshall score are now recommended by the Pancreas Club in the revised Atlanta Classification scheme to assess the severity and the need of intensive therapy in acute pancreatitis patients.[5,20] But these systems are less informative in detection of local complications. Already pointed out and used in other studies as a way to assess acute pancreatitis severity, the Modified Marshall scoring system emerged in the literature as a better applicability proposal due to its ease of use.[21-23] Moreover, its specificity is greater than 90% for predicting severity of acute pancreatitis at 24 and 48 hours.[23] We also found positive correlation of high Ranson scores with high Marshall scores. Thus, considering that the determination of gravity is essential to the proposed treatment and that this, in turn, is critical for prognosis, it is necessary to use methods that render the best classification in acute pancreatitis cases. When considering organ dysfunction or failure as the central prognostic factor, methods that cover these characteristics have been used with excellent results. In our study out of 60 cases, on day 7 of admission 37 cases were discharged, 15 cases were still undergoing treatment and 8 patients had died. On 30th day follow-up, out of 52 cases, 50 cases were uneventful & one case was re-admitted & one case had died. In our study overall 9 patients died over a period of 30 days. Patients with mild acute pancreatitis are usually discharged during the early phase and do not require pancreatic imaging, and mortality is very rare.[24] Based on the hospital policy and surgeon's choice patients with mild biliary pancreatitis can either be discharged for interval cholecystectomy or can be discharged after laparoscopic cholecystectomy. Moderately severe acute pancreatitis may resolve without intervention (as in transient organ failure or acute fluid collection) or it may require prolonged specialist care (as in extensive sterile necrosis without organ failure). Mortality of moderately severe acute pancreatitis is far less than that of severe acute pancreatitis.[25] Patients who do not respond to aggressive fluid resuscitation in the emergency ward should be considered for admission to a intensive care unit for aggressive fluid resuscitation, hemodynamic monitoring, and management of necrosis or organ failure.[26]

Multiple parameters makes the Ranson's score cumbersome and raise the cost of scoring which is an important factor in the Indian scenario with a huge case load in the surgical wards and poor patients. It takes 48 hours to complete and not all laboratories measure all the parameters in routine blood tests (e.g., serum lactate dehydrogenase). Timely calculation of Modified Marshall score on admission is simple, uninfluenced by etiology, cost effective and a significant predictor of disease

severity. This study helped us in changing our institute policy for laying down a criteria for ICU admissions with need for aggressive monitoring. It can also be used in peripheral hospitals for assessment and need for referral to higher centre and hence the case load can be distributed with timely referral of the severe cases to the higher centre while the mild cases can be managed there itself with cholecystectomy performed before discharge if possible. This decreases overall cost by decreased readmissions due to recurrent attacks or possibility of severe disease in the future in gall stone pancreatitis.

CONCLUSION

We concluded that the Modified Marshall score is equally effective in evaluation of severity and predicting mortality in patients with acute pancreatitis as Ranson's score. Moreover, its components are easily available and it does not require 48 hours for completion of assessment like the Ranson's score and can be used for reassessment during period of hospitalization unlike the Ranson's score which is calculated once only after admission at 48 hours. Considering that the Modified Marshall scoring system corresponded with the clinical course of acute pancreatitis patients and the need for a method to evaluate severity in early course of hospital admission to prevent delay in aggressive management of critically ill patients. So, we conclude that the Modified Marshall scoring system can be used as an effective and simplified application method to assess the severity of acute pancreatitis.

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