ORIGINAL ARTICLE

Oman Medical Journal [2021], Vol. 36, No. 3: e272

The Role of Modified Early Warning Score (MEWS) in the Prognosis of Acute Pancreatitis

Amena Khan, Digvijoy Sarma, Chiranth Gowda and Gabriel Rodrigues*

Department of General Surgery, Kasturba Medical College, Manipal Academy of Higher Education, Manipal, India

ARTICLE INFO

Article history:
Received: 24 March 2020
Accepted: 6 October 2020

Online:
DOI 10.5001/omj.2021.72

Keywords:
Early Warning Score; Pancreatitis; Inflammation; Systemic Inflammatory Response Syndrome.

ABSTRACT

Objectives: Modified Early Warning Score (MEWS) is a reliable, safe, instant, and inexpensive score for prognosticating patients with acute pancreatitis (AP) due to its ability to reflect ongoing changes of the systemic inflammatory response syndrome associated with AP. Our study sought to determine an optimal MEWS value in predicting severity in AP and determine its accuracy in doing so. ***Methods***: Patients diagnosed with AP and admitted to a single institution were analyzed to determine the value of MEWS in identifying severe AP (SAP). The highest MEWS (hMEWS) score for the day and the mean of all the scores of a given day (mMEWS) were determined for each day. Sensitivity, specificity, negative predictive value (NPV), and positive predictive values (PPV) were calculated for the optimal MEWS values obtained. ***Results:*** Two hundred patients were included in the study. The data suggested that an hMEWS value > 2 on day one is most accurate in predicting SAP, with a specificity of 90.8% and PPV of 83.3%. An mMEWS of > 1.2 on day two was the most accurate in predicting SAP, with a sensitivity of 81.2%, specificity of 76.6%, PPV of 69.8%, and NPV of 85.9%. These were found to be more accurate than previous studies. ***Conclusions:*** MEWS provides a novel, easy, instant, repeatable, and reliable prognostic score that is comparable, if not superior, to existing scoring systems. However, its true value may lie in its use in resource-limited settings such as primary health care centers.

Acute pancreatitis (AP) is a commonly encountered disease in the emergency triage and is characterized by pancreatic glandular inflammation and architectural disruption associated with autodigestion of the gland. The disease presentation may vary and can be completely benign and resolve fully with good conservative management.[1] On the other hand, it may also present with widespread systemic inflammation involving other organ systems. Approximately 20% develop severe AP (SAP), characterized by persistent organ failure or necrotizing pancreatitis, and is associated with 15–30% mortality. In comparison, mild AP is associated with only 0–1% mortality.[2] Organ failure is considered the most important determinant for mortality, and the key to managing this group of patients is early diagnosis.[3] Several scoring systems are available to determine the severity of AP, such as Ranson score, Glasgow Coma score, Acute Physiology and Chronic Health Evaluation (APACHE) score, etc.[4] However, these scoring systems require resource-intensive and repeated biochemical analyses and cannot be predictive before 48 hours. The Modified Early Warning Score (MEWS) is a simple bedside scoring index that evaluates the patient's physiological state based on six vital parameters; heart rate, blood pressure, respiratory rate, core body temperature, mental status, and urine output.[5] Our study sought to determine an optimal MEWS score to detect SAP and assess its accuracy in doing so.

METHODS

This observational study included patients > 18 years old with AP admitted to the Department of General Surgery at Kasturba Medical College University Hospital, Manipal, India. The study was conducted between September 2015 and August 2017 and included 200 patients for whom data was collected as per details in a proforma. The study was approved by the medical ethics committee and reported in accordance with the recommendations in the Strengthening the Reporting of Observational studies in Epidemiology guidelines for reporting

*Corresponding author: ✉gabyrodricks@gmail.com

MODIFIED EARLY WARNING SCORE (MEWS)

This should be assessed on all emergency admissions, postoperative patients following major surgery, all patients returning from intensive care unit and any patient that you are concerned about.

Date of admission							**Affix patient label here**								
Admitting unit															
Ward															
Date															
Time															
HR (beats/min)															
Systolic BP (mm Hg)															
Respiratory rate(bps/min)															
CNS (AVPU)															
Temp (°C)															
Urine (mL) or (mL/kg/h)															
SpO_2(%)															
MEWS score															
Doctor called Y/N															

GUIDE TO MEWS SCORING SYSTEM							
Score	3	2	1	0	1	2	3
Temperature		< 35	< 36.0	36.0–37.5		> 38.0	> 39.0
BP systolic (mm Hg)	< 80	80–89 > 40 mmHg drop normal	90–99 or 20 mmHg drop from normal	100–159	160–179	180–199	= 200
Pulse (bpm)	< 45	45–49	50–59	60–89	90–114	115–129	= 130
Respiratory rate (bpm)	< 8	< 10		10–19	20–24	25–30	> 30
SpO_2(%)	< 85	85–89	90–93	> 94			
CNS response (AVPU)		New confusion/ agitation		Alert	voice	Pain	Unresponsive
Urine output (catheterised)		< 0.5 mL/kg/h for 2 hours	< 0.5 mL/kg/h for 1 hour	0.5–3 mL/kg/h	> 3mL/kg/h		
Urine output	< 500 mL/24h	< 750 mL/24 h	1000–750 mL/24 h				

AVPU: A - Alert; V - Responds to verbal commands; P - Responds to pain only; U - Unresponsive
If the patient has score of 4 or more call the Unit PG, if no response for 10 min, call the unit staff, if no response and if score increses by 2, call Code Blue

**Core body temperatures were recorded orally.*

Figure 1: Modified Early Warning Score chart.

observational studies. The sample size was ascertained after discussion with statisticians regarding the adequate sample size that would yield significant results to be tabulated as outcomes. Patients diagnosed with acute or chronic pancreatitis and patients with recurrent pancreatitis were excluded from the study. Only patients presenting within 24 hours of symptoms onset were considered for inclusion in the study. The patient's vitals were recorded every six hours into a MEWS chart [Figure 1], and MEWS scores were calculated for these. This was repeated until the second day of admission. The outcome was measured in terms of the highest MEWS score of the day (hMEWS) (day 0, 1, and 2) and mean of total MEWS score (mMEWS) on day 0, 1, and 2 and their correlation with the final outcome of the disease. The patient was classified into mild, moderately severe, and severe pancreatitis based on the modified Atlanta criteria at the end of their hospital stay. Imaging done during the hospital stay (ultrasonography (USG) abdomen and contrast-enhanced computed tomography (CECT) of the abdomen) was taken into consideration to assess severity. Statistical analysis was done using SPSS Statistics (IBM Corp. Released 2011. IBM SPSS Statistics for Windows, Version 20.0. Armonk, NY: IBM Corp.).

The following definitions of various types of pancreatitis were considered:

1. *Mild AP:* features of AP with no evidence of organ failure, local, or systemic complications.

Table 1: Distribution of patients based on cut-off hMEWS value and severity of the disease.

Time			Severity	
			Severe	Mild
Day 0	hMEWS	> 2	59	24
		≤ 2	21	96
			83	117
Day 1	hMEWS	> 2	55	11
		≤ 2	25	109
			80	120
Day 2	hMEWS	> 2	51	14
		≤ 2	29	106
			80	120

hMEWS: high Modified Early Warning Score.

Table 2: Patient distribution as per mMEWS cut-off scores.

Time			Severity		Total
			Severe	Mild	
Day 0	mMEWS	> 1.4	61	32	93
		≤ 1.4	19	88	107
			80	120	200
Day 1	mMEWS	> 1.4	61	28	89
		≤ 1.4	19	92	111
			80	120	200
Day 2	mMEWS	> 1.2	65	28	93
		≤ 1.2	15	92	107
			80	120	200

mMEWS: mean Modified Early Warning Score.

2. *Moderately severe AP:* features of AP with evidence of organ failure that resolves within 48 hours (transient organ failure), and/or local or systemic complications without persistent organ failure.
3. *SAP:* features of AP associated with persistent organ failure lasting more than 48 hours.

Local complications included acute pancreatic fluid collection, pancreatic necrosis, walled-off necrosis, splenic, and portal vein thrombosis. Systemic complications were defined as exacerbation of a preexisting comorbidity precipitated by AP.

RESULTS

We evaluated 200 patients with AP. The mean age of patients was 37.0 years with a standard deviation of 10.0 years. The disease was more commonly encountered in males (60.0%, n = 120) and only 40.0% in females (n = 80). Of the 200 patients, 120 patients had mild AP, 65 had moderately SAP with local complications and/or transient organ failure, and the remaining 15 patients had SAP with persistent organ failure lasting for > 48 hours.

Alcohol was the most common etiological factor (n = 131). Other causes included gallstones, including bile duct calculi (n = 24). Smoking appeared to be a contributory factor along with alcohol consumption. Two cases of hypercalcemia, secondary to hyperparathyroidism from a parathyroid adenoma, were also noted. Two patients developed pancreatitis secondary to a blunt abdominal injury. One of these patients had a pancreatic duct leak that required stenting. One female patient developed pancreatitis secondary to drug intake (i.e., methotrexate and steroids). For 21 patients, no identifiable cause for AP could be ascertained.

Based on the above results, a cut-off score was generated to identify patients with SAP. The cut-off was determined by calculating the mean of all the available scores in the given categories. Since the number of patients with SAP was small (n = 15) and unlikely to yield a significant result, for this study, patients with moderately severe and severe pancreatitis were considered as one group. A cut-off score of 2 was determined for hMEWS score of the day for all three days (day 0, 1, 2). The cut-off scores of mMEWS for day 0, 1 and 2 were 1.4, 1.4, and 1.2, respectively. Patients with SAP that had scores greater than the cut-off were considered 'true positives', and those who had scores lesser or equal to the cut-off were considered 'false negatives' [Tables 1

Table 3: Sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) for each high Modified Early Warning Score (hMEWS) cut-off score.

Day	Sensitivity, %	Specificity, %	PPV, %	NPV, %	Accuracy, %
0 (hMEWS > 2)	73.8	80.0	71.1	82.1	77.5
1 (hMEWS > 2)	68.8	90.8	83.3	81.0	82.0
2 (hMEWS > 2)	63.7	88.3	78.4%	78.5	78.5

Table 4: Sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) for mean Modified Early Warning Score (mMEWS) on day 0, 1, 2.

Day	Sensitivity, %	Specificity, %	PPV, %	NPV, %	Accuracy, %
0 (mMEWS > 1.4)	76.2	73.3	65.5	82.2	74.5
1 (mMEWS > 1.4)	76.2	76.6	68.5	82.8	76.5
2 (mMEWS > 1.2)	81.3	76.6	69.8	85.9	78.5

and 2]. The specificity, sensitivity, positive predictive value (PPV), negative predictive value (NPV), and accuracy were calculated for each score each day. The data suggested that a hMEWS value > 2 on day one is most accurate in predicting severe AP, with a specificity of 90.8% and PPV of 83.3%, as reflected by the greater area under the receiver operating characteristic curve. With regards to the mMEWS score, a mMEWS > 1.2 on day two was the accurate in predicting SAP, with a sensitivity of 81.3%, specificity of 76.6%, PPV of 69.8%, and NPV of 85.9% [Tables 3 and 4].

Clinical outcomes could be correlated with the severity of pancreatitis as seen by increased length of hospital and intensive care unit (ICU) stay in patients with severe pancreatitis. The mean number of days of hospital admissions for patients with mild, moderately severe, and severe pancreatitis were 7.5, 14.3, and 20.1 days, respectively. All patients with SAP (n = 15) and 10 patients with moderately SAP required ICU care. The mean stay in ICU was 4.5 days in the moderately severe group and 11.5 days in patients with SAP. Of the 200 patients, two patients with SAP succumbed to the disease. Of the remaining 198 patients, 11 patients returned to our hospital (at varying periods during the study period) with recurrent attacks of AP.

DISCUSSION

The primary finding of this study was that the MEWS value is a reliable prognostic indicator for the early identification of patients likely to develop SAP. Being easy to perform, it is also a dynamic score that reflects the persistent systemic inflammatory response syndrome (SIRS) in patients with SAP. It is a well-known fact that a persistent SIRS at six hours or the development of multiple organ dysfunction syndrome and hypotension despite fluid resuscitation are strong predictors of mortality in AP than biochemical or physiological variables used in alternative scoring systems.[4–7] The frequency of MEWS, which is a minimum of six-hourly, may also anticipate deterioration sooner than other scoring systems performed daily or on admission and at 48 hours.

One of the earliest studies analyzed the role of an early warning score in pancreatitis and postulated that even though the early warning score does not measure pancreas-specific variables, it could accurately measure the SIRS response in AP.[8] The authors studied 110 patients with AP and their outcomes and compared their MEWS scores with other established scoring systems. It was concluded that MEWS is the best predictor of adverse outcome (death, need for necrosectomy, and critical care admissions) in the first 24 hours following admission, and progressively deteriorating MEWS values were associated with increased risk of mortality. It also correlated with the duration of intensive therapy, hospital stay, need for ventilator support, and post-pancreatitis complications. Based on their analysis, they recommended that a MEWS of ≥ 3 is an indicator of adverse outcome in AP.[8]

Another study assessed the accuracy of MEWS scores in predicting the severity of pancreatitis.[5] They studied 142 patients with AP and concluded that an hMEWS score of ≥ 3 and an mMEWS score > 1 was accurate in predicting SAP.

Accuracy of hMEWS > 2 and mMEWS > 1.4, as determined by our study, was found to be more when compared to other studies (Suppiah et al,[5]: sensitivity 77.3–95.5%, specificity 87.5–94.2%, NPV 96–66%, and PPV 65.6–94%). Our results showed higher specificity and sensitivity for hMEWS: > 2 on day one and mMEWS: >1.4 on day two compared to a study by Garcea et al,[8] where sensitivity recorded was between 52–70% and specificity between 70–73%. The sensitivity of our study was greater when compared with the bedside index for severity AP scoring system with comparable specificity, NPV, and PPV.[9–13] In comparison to studies assessing APACHE, this study showed higher sensitivity (70–80%) and specificity patterns (70–75%).[14]

There were certain limitations encountered in our study. While being a tertiary care center, a percentage of our study group presented to us after having received conservative management at their local hospital; also, not many patients with pancreatitis present at the onset of pain. Hence, true MEWS values since onset (day 0) may not be accurate.

It was also noticed that other comorbidities (known hypertensive, patient with history of chronic obstructive pulmonary disease, underlying urosepsis) added to the score without being directly related to pancreatitis. For example, a patient with urosepsis had raised MEWS scores in view of fever and tachycardia, but clinically, had only mild AP. Perhaps a study that excludes such cases would have greater accuracy in predicting the severity of pancreatitis.

CONCLUSION

MEWS score is a reliable, safe, instant, and inexpensive score that can be used easily at all levels of health care for prognosticating patients with AP. We highlight that such a scoring system would be vital, especially in facilities with limited resources such as a primary health care unit, as it is more cost-effective and not labor-intensive. In addition, it can promote earlier referral of patients with an increasing score to a higher center for further management.

Disclosure

The authors declared no conflicts of interest. No funding was received for this study.

REFERENCES

1. Albulushi A, Siddiqi A, Alqarshoubi I, Aladawi M, Alkhadhouri G, Farhan H. Pattern of acute pancreatitis in a tertiary care center in Oman. Oman Med J 2014 Sep;29(5):358-361.
2. Sarr MG. 2012 revision of the Atlanta classification of acute pancreatitis. Pol Arch Med Wewn 2013;123(3):118-124.
3. Hecker M, Mayer K, Askevold I, Collet P, Weigand MA, Krombach GA, et al. [Acute pancreatitis]. Anaesthesist 2014 Mar;63(3):253-263.
4. Cho JH, Kim TN, Chung HH, Kim KH. Comparison of scoring systems in predicting the severity of acute pancreatitis. World J Gastroenterol 2015 Feb;21(8):2387-2394.
5. Suppiah A, Malde D, Arab T, Hamed M, Allgar V, Morris-Stiff G, et al. The modified early warning score (MEWS): an instant physiological prognostic indicator of poor outcome in acute pancreatitis. JOP 2014 Nov;15(6):569-576.
6. Ye JF, Zhao YX, Ju J, Wang W. Building and verifying a severity prediction model of acute pancreatitis (AP) based on BISAP, MEWS and routine test indexes. Clin Res Hepatol Gastroenterol 2017 Oct;41(5):585-591.
7. Bengmark S. Bio-ecological control of perioperative and ITU morbidity. Langenbecks Arch Surg 2004 Apr;389(2):145-154.
8. Garcea G, Jackson B, Pattenden CJ, Sutton CD, Neal CP, Dennison AR, et al. Early warning scores predict outcome in acute pancreatitis. J Gastrointest Surg 2006 Jul-Aug;10(7):1008-1015.
9. Wang S, Feng X, Li S, Liu C, Xu B, Bai B, et al. The ability of current scoring systems in differentiating transient and persistent organ failure in patients with acute pancreatitis. J Crit Care 2014 Aug;29(4):693.e7-693.e11.
10. Garcea G, Gouda M, Hebbes C, Ong SL, Neal CP, Dennison AR, et al. Predictors of severity and survival in acute pancreatitis: validation of the efficacy of early warning scores. Pancreas 2008 Oct;37(3):e54-e61.
11. Gomatos IP, Xiaodong X, Ghaneh P, Halloran C, Raraty M, Lane B, et al. Prognostic markers in acute pancreatitis. Expert Rev Mol Diagn 2014 Apr;14(3):333-346.
12. Ince AT, Baysal B. Pathophysiology, classification and available guidelines of acute pancreatitis. Turk J Gastroenterol 2014 Aug;25(4):351-357.
13. Anand N, Park JH, Wu BU. Modern management of acute pancreatitis. Gastroenterol Clin North Am 2012 Mar;41(1):1-8.
14. Mok SR, Mohan S, Elfant AB, Judge TA. The acute physiology and chronic health evaluation IV, a new scoring system for predicting mortality and complications of severe acute pancreatitis. Pancreas 2015 Nov;44(8):1314-1319.