Abstract

Background: The modified early warning score (MEWS) is a simple clinical scoring system suitable for bedside application used to predict patients who may undergo a cardio-respiratory arrest event at the onset of admission in the hospital.

Materials and Methods: The MEWS is a tool for bedside evaluation based on five physiological parameters. Systolic blood pressure, pulse rate, respiratory rate, temperature and AVPU score (A for "alert", V for reading to vocal stimuli, P for "reading to pain", U for "unconscious were recorded". The MEWS were applied to 100 newly admitted patients to ICU. A MEWS of 4 or more represent a Critical score. The highest score reached during period of admission was labeled "score max". The diagnostic validity test was calculated together with the receiver operator characteristic (ROC) curve.

Result: In a total of 100 ICU admissions there were 38 pts who had cardiopulmonary arrest whether died or survived (i.e. the arrested group = 38) and 62 patients hadn't cardiopulmonary arrest i.e. non arrested group = 62 patient.

The MEWS score max grade of 8 or more was associated with the highest rate of cardio respiratory arrest event (sensitivity 78.9%, specificity 93.5, accuracy 88%, area under ROC curve = 0.988. The mean and SD values of SBP, RR and AVPU score in the MEWS score max had a statistically significant difference between the arrested and the non arrested group patients (p-value <0.05).

Conclusion: The physiological variables which can be associated clinically remain the fast and the simplest way for patient evaluation. The modified early warning score (MEWS) is a physiological scoring system that can predict patients at risk of deterioration and subsequent development of cardio-respiratory arrest.

Key Words: Modified early warning score – Critically ill patients – Score max.

Introduction

STUDIES have estimated that up to 84% of patients who develop a cardio-respiratory arrest event have measurable evidence of deterioration in the eight hours prior to their event [1].

Catastrophic deterioration of patients is frequently preceded by documented deterioration of physiological parameters [2,3]. Failure of clinical staff to respond to deterioration of physiological function and to increase levels of medical intervention will put patients at risk of cardio-respiratory arrest [4,5]. Inappropriate action in response to observed abnormal physiological and biochemical variables might lead to unavoidable death [6]. If these symptoms and signs could be correctly identified and acted upon, a portion of these outcomes might be avoided.

Identifying patients at risk of deterioration at an early stage by means of simple protocols based on physiological parameters may reduce the number of ICU resuscitations [7]. Patients who experience sudden, or unanticipated, physiological deterioration and subsequent cardio-respiratory arrest usually have poor outcome. In addition patients who undergo an unexpected arrest consume extensive personnel resources, receive more medications and other therapies, spend more time in intensive care units, and hence increase the coast of their treatment [8].

The "Modified Early Warning Score” [9,10,11] (MEWS) is a simple clinical scoring system suitable for bedside application used to predict patients who may undergo a cardio-respiratory arrest event at the onset of admission either from the emergency department or from the ward (Table 1).

Aims of the study:

To evaluate the ability and the feasibility of "Modified Early Warning Score" (MEWS) as a screening tool to predict the high risk critically ill patients who may develop cardio-respiratory arrest.
Material and Methods

The Modified Early Warning Score (MEWS) (Table 1) is a tool for bedside evaluation based on five physiological parameters: Systolic blood pressure, pulse rate, respiratory rate, temperature and AVPU score. Data will be collected from patients admitted to critical care units in Cairo University hospitals during twelve months (at least 100 patients) from Jan 2009 to Jan 2010.

Systolic blood pressure, pulse rate, temperature, respiratory rate and AVPU score (A for 'alert', V for 'reacting to vocal stimuli', P for 'reacting to pain', U for 'unconscious') were recorded.

Blood pressure and pulse rate were measured manually. The temperature was taken orally or axillary. The respiratory rate was counted over a full minute. AVPU scores were scored according to Patient response.

Table 1: Modified Early Warning Score [10].

<table>
<thead>
<tr>
<th>Variables</th>
<th>3</th>
<th>2</th>
<th>1</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>SBP</td>
<td>≤70</td>
<td>71-80</td>
<td>81-100</td>
<td>101-199</td>
<td>≥200</td>
<td></td>
<td></td>
</tr>
<tr>
<td>HR</td>
<td>≤40</td>
<td>41-50</td>
<td>51-100</td>
<td>101-110</td>
<td>111-129</td>
<td>130</td>
<td></td>
</tr>
<tr>
<td>RR</td>
<td>&lt;9</td>
<td>9-14</td>
<td>15-20</td>
<td>&gt;21-29</td>
<td>≥30</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Temp.</td>
<td>&lt;35</td>
<td>35-38.4</td>
<td>&gt;38.5</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AVPU</td>
<td>Alert</td>
<td>Verbal</td>
<td>Pain</td>
<td>Unresponsive</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

It was decided from previous experience to define a MEWS of 4 or more as a 'critical score'. The highest score reached during period of admission was labeled 'ScoreMax'.

Results

Descriptive analysis:

1- Physiological parameters on admission:

Overall, (57)% of patients were males, and 43% were females. The mean age of patients was 56 years old (SD 31.28, range 20-85).

Regarding MEWS; the mean and the SD values for measured physiological parameters on admission were as follows: Systolic BP (117) mmHg (SD 35.8mmHg), pulse rate 110bpm (SD 20.9bpm), respiratory rate 25bpm (SD 6.2bpm), temperature 37.7°C (SD 0.8C). Admission scores ranged from 0 to 11 (median of 6).

Before ICU admission; (60) Patients were admitted from the ER and (40) patients were transferred to the ICU from the ward.

2- During follow-up:

Eight pts were discharged from the ICU, 54 were transferred to another department, 38 had cardio pulmonary arrest, 36 pts died and 2 were survived (One of the two was discharged and the other was transferred).

In short, out of a total of 100 ICU admissions, there were 38 who had cardio pulmonary arrest (36 could not resuscitated) and 62 patients hadn’t cardio pulmonary arrest event whether discharged or transferred (i.e. the non arrested group = 62).

A- Statistical Analysis for the outcome parameters.

B- MEWS (i.e.; ScoreMax):

A Score Max of 8 or more was associated with an increased risk of cardio-respiratory arrest (OR 28.12, 95% CI 7.6 to 93.5).

Score max grade of 8 or more (i.e. best cutoff point) was associated with the highest efficacy at which the sensitivity was 88.2%, specificity was 93.5%, positive predictive value was 88.2%, Negative predictive value was 87.9%, efficacy was 88.00%, with area under curve (AUC) = 0.928 (See Fig. 1).

There was a score max ≥8 in 33 pts in the arrested group (38 patients) with a percentage of 86.8% and 5 pts by the score less than 8 with a percentage 13.2% in the same group. Score max less than 8 occurred in 54 pts (87.1%) in the non arrest group, while score max of 8 and more than 8 occurred in 8 pts 12.9% in the non arrested group.

Table 2

<table>
<thead>
<tr>
<th>Score Max &lt;8</th>
<th>Score ≥8</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arrest</td>
<td>5 (13.2%)</td>
<td>33 (86.8%)</td>
</tr>
<tr>
<td>Non Arrest</td>
<td>54 (87.1%)</td>
<td>8 (12.9%)</td>
</tr>
</tbody>
</table>

Regarding the MEWS ScoreMax physiological variables: The patients of the arrested group were significantly older and had significant lower systolic BP (p<0.001), higher respiratory rate (p>0.05) significant and a lower conscious level (p<0.001) (i.e. lower AVPU score) (see below Table 3).
Table 3: The statistical difference between the arrested and the non-arrested group.

<table>
<thead>
<tr>
<th>Item</th>
<th>In MEWS Max</th>
<th>Arrested group</th>
<th>Non arrested group</th>
<th>p-value</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>SD</td>
<td>Mean</td>
<td>SD</td>
<td></td>
</tr>
<tr>
<td>SBP</td>
<td>80.78947</td>
<td>14.59018</td>
<td>127.2581</td>
<td>37.24836</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>HR</td>
<td>115.7632</td>
<td>28.92248</td>
<td>109.0968</td>
<td>21.6717</td>
<td>&gt;0.05</td>
</tr>
<tr>
<td>Resp rate</td>
<td>28.65789</td>
<td>5.696259</td>
<td>24.51613</td>
<td>6.764764</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Temp</td>
<td>38.07895</td>
<td>1.257229</td>
<td>38.11129</td>
<td>1.189035</td>
<td>&gt;0.05</td>
</tr>
<tr>
<td>AVPU</td>
<td>2.6579</td>
<td>0.70811</td>
<td>0.6935</td>
<td>0.73749</td>
<td>0</td>
</tr>
<tr>
<td>Age</td>
<td>57.1053</td>
<td>15.53338</td>
<td>55.4355</td>
<td>14.21339</td>
<td>0.592</td>
</tr>
</tbody>
</table>

The statistical different between the two groups for the age, HR and the body temperature are not significant.

The ScoreMax of the arrested group (Mean 10, SD 2.59) is higher than that of the non-arrested group (Mean 5.17, SD 2.21) the (p-value is <0.001) (i.e. highly significant).

Figure 1: ROC curve analysis showing the diagnostic performance of MEWS for discriminating arrested patients from those discharged and the Area Under Curve = 0.928.

Discussion

Our Study had demonstrated that The Modified Early Warning Score (MEWS) is a valid screening tool to predict the high risk critically ill patients who may develop cardio-respiratory arrest.

From the clinical point of view-in our study-the SBP, RR and the conscious level were the physiological variables which had the high statistical difference between the arrested group and the non arrested group (see above Table 3).

The ability of the (MEWS) to predict the high risk patients for deterioration and mortality prediction had been established in previous studies [12,13,14].

Subbe et al., study was done on 709 medical emergency admissions and the MEWS for these patients were applied for 5 days only [12]. This study reveals that the MEWS ScoreMax of 5 or more was associated with higher risk of death (OR 5.4, 95% CI 2.8-10.7) and the ROC curve reveal that the area under curve AUC = 0.67. However our study revealed that MEWS ScoreMax of 8 or more was associated with higher risk of cardiorespiratory arrest event (OR 28.12, 95%CI 7.6-93.5) and the ROC curve reveal that the area under curve was AUC = 0.928.

Another study was done on 790 medical patients presenting to the emergency department and the MEWS for these patients was applied on admission and along the whole period of patients stay [13]. This study reveals that the proportion of patients who died in hospital increased significantly as the MEWS value increased. It revealed also that the Independent predictors of in hospital death were: Abnormal systolic blood pressure (<100 or >200mm Hg), respiratory rate >30 breaths per minute and an impaired level of consciousness. Our study agrees with this as we found that increased MEWS value of 8 or more was associated with higher risk of cardio-respiratory arrest event.

We have estimated in our study that the systolic blood pressure, respiratory rate and conscious level abnormalities had a strong correlation with increased risk of cardio-respiratory arrest event and this appears obviously when comparing the MEWS ScoreMax physiological variables for the arrested and the non arrested group of patients. The patients of the arrested group had significantly lower systolic blood pressure, higher respiratory rate and a lower conscious level (i.e. higher AVPU) score which means that the SBP, RR and the conscious
level were the clinical predictors for cardio-respiratory arrest in our study (see Table 3).

In the study of Marcelo cie et al., in April 2009 which was done on 1107 patients consecutively admitted to a medical ward the MEWS for these patients was applied only on admission [14]. This study was determining the risk of death in patients groups with different MEWS grade with the patients group with (MEWS=0) and this reveals that a patient with a MEWS of 0 on admission has a very low risk of a worse in-hospital outcome [14]. This study also reveal that respiratory rate and level of consciousness had the strongest correlation with mortality, whereas temperature was the weakest, but still significant. This was nearly in agreement with our study which found that the SBP, RR and conscious level had a strong correlation with increased risk of cardio-respiratory arrest event while the age, HR and the body temperature are not significant.

Our study agrees with the other studies in that raised (MEWS) is associated with increased risk of patients’ cardio respiratory arrest event and patients’ mortality.

Our study is different from other studies in the following:
- It was concerned with the application of (MEWS) in critically ill patients (not on in-hospital patients or E.R. patients only), like other studies which mean a worse clinical condition than the ward patients.
- The management techniques in the critical care units can conserve the patient’s state with a worse clinical condition for a longer time than the ward.
- Our study calculates (MEWS) during all days of hospital stay while other studies calculate (MEWS) only on admission and/or only for few days after admission (e.g. first 5 days for example) [12].
- Our study was concerned with the use of (MEWS) as a predictor for patients deterioration and subsequent cardio-respiratory arrest while other studies dealt with (MEWS) as a predictor for patients mortality.

For the MEWS the best cut of point in our study is higher than the previous studies which mean that we have revealed that the ScoreMax of (8) or more is associated with increased risk for developing of cardio respiratory arrest while other studies state that the ScoreMax of (5) or more is associated with increased risk for patients mortality.

In our study the group of patients with Score-Max ranging from (5-7) whom did not develop a cardio respiratory arrest during their period of stay in the (ICU) the majority of them were transferred to another hospital departments where their conditions may vary during their course of treatments with incidence of death in dome of these cases.

In our study the patients whom their ScoreMax ranging from (5-7) are 37 patients 28 were transferred, 5 were discharged and 4 were died which mean that about 75.6% of these patient were transferred.

Other variables may cause these results as the severity of disease the age group of patients, management protocols, and the quality of patients care.

Our study was limited by several factors:
- It is a single-centre study in a specific local setting.
- The low sample size.
- We cannot follow-up the mortality of the critically ill patients whom transferred to another hospital department and/or discharged.

We recommend that a multi center study should be done with a larger sample size and following up the critically ill patients whom transferred to another hospital department and/or discharged is needed for better mortality detection.

Although mortality increases with the number of physiological abnormalities, little is known about our capacity to prevent deaths by means of early warning scores; randomized, controlled trials are needed to reach this point.

Conclusion:

The physiological variables which can be assessed clinically remain the fast and the simplest way for patient evaluation.

Using (MEWS) for prediction of high risk patient can be helpful to identify these patients.

The modified early warning Score (MEWS) is a physiological scoring system that identifies patients at risk of deterioration and subsequent development of cardio-respiratory arrest.

MEWS score is a useful screening tool to predict the high risk patients who have high probability to develop cardio respiratory arrest among the critically ill patients in ICU.
References


