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The Role of Early Warning System in Predicting Severe Maternal MorbidityTaking Intensive Care Unit Admission as the Reference Standard

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ABSTRACT

Objective: To determine the diagnostic accuracy of a modified early warning system (MEOWS) for predicting severe maternal morbidity, taking intensive care unit admission as the reference standard.

Study Design: Cross-sectional study.

Setting and Duration of Study: Combined Military Hospital, Abbottabad Pakistan, from Nov 2019 to Apr 2020.

Methodology: After getting approval from the Institutional Ethical Committee, pregnant women fulfilling the inclusion criteria were included from the Labour Room of Department of Obstetrics & Gynecology. A modified early obstetric warning system chart was used to assess all women, labelling them positive or negative as per the criteria. In case of a fatal outcome or development of severe morbidity warranting intensive care unit admission, the patient was labelled as positive. Women who developed severe morbidity were managed as per standard protocols.

Results: The early warning chart showed sensitivity, specificity, positive predictive value, negative predictive value and diagnostic accuracy as 69.44%, 90.97%, 64.10%, 92.76% and 86.91%, respectively, for predicting severe obstetric morbidity considering intensive care unit admission as gold standard.

Conclusion: Modified early obstetric warning system chart effectively predicts severe obstetric morbidity. It could lead to better patient care, thus preventing severe obstetric morbidity in our local population if implemented as part of routine clinical evaluation.

Keywords: Early warning score, Intensive care unit, Modified early warning system (MEOWS), Obstetrics.

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INTRODUCTION

According to the World Health Organization (WHO), the global number of maternal deaths was around 303,000 in 2015. More than 99% of them belonged to low social settings.[1] Annually, about 27 million cases of obstetric-related complications are reported, which result in subsequent long-term complications about pregnancy and childbirth.[2] Improving patient care by early identification and correct management of these complications can be very helpful in reducing maternal mortality, severe obstetric morbidity and the associated complications.[3,4]

Most hospitals have adopted some obstetric early warning scoring criteria system for early identification of maternal morbidity in hospitalized patients. The basis of these criteria is that patients were prone to develop severe obstetric morbidity exhibit changes in different clinical parameters, which could work as early warning signs.[5] The system of early warning signs includes specially designed charts showing criteria mostly based on clinical examination, including vital signs or other clinical observations, along with the appropriate response protocols.[6] These charts are usually colour coded for facilitating a scoring system or suggesting an already decided response. Modified early obstetric warning system (MEOWS) chart considers simple physiological parameters like temperature, blood pressure, heart rate, respiratory rate, oxygen saturation, neurological response and proteinuria with defined cut-off limits for filling a specific response.[7] When appropriately used, MEOWS leads to early recognition of high-risk patients making a timely transfer before developing complications and expedites the provision of higher-level care, reducing delays by well-defined, easily understood documentation of clinical parameters and timely communication and decision-making among teams.[8] Studies have shown that MEOWS to have high sensitivity and

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specificity and could be used in obstetric population for predicting severe maternal morbidity.[9]

There is a need for more evidence and standardization despite MEOWS being a promising tool.[10] Besides, and there is a lack of local studies to help us determine the diagnostic accuracy of MEOWS charts in the local population. Considering the above facts, this study was conducted to determine the diagnostic accuracy of the MEOWS chart for predicting severe obstetric morbidity in local settings. The findings of the study are expected to highlight the role of MEOWS in improving obstetric management in the local population.

METHODOLOGY

The cross-section study was carried out at the Department of Obstetrics & Gynaecology, Combined Military Hospital, Abbottabad, from November 2019 to April 2020 after approval from the Institutional Ethical Committee (Ethical Review Committee Certificate Number ERC/DME/237). The sample size was calculated taking the expected percentage of obstetric morbidity, i.e. 20%, sensitivity of MEOWS, i.e. 86.4% with and specificity of MEOWS, i.e., 85.2%.[11] Non-probability, the consecutive sampling method was used to include patients.

Inclusion Criteria: Pregnant women aged 18 to 40 with parity <5 presenting at gestational age of >32 weeks were included.

Exclusion Criteria: Women with pre-existing chronic systemic disease like hypertension or diabetes and women with placental problems like abruption, previa, accrete, percreta, fibroids and endometriosis were excluded.

Informed consent was obtained before including participants in the study. Demographic data were recorded, including name, age, gestational age, parity, and body mass index (BMI). All women were clinically assessed, and the MEOWS chart was filled, terming it positive if one finding (alert) fell in the red category or two in the yellow category (Table-I).[12] These women were followed up in the outpatient department until delivery. They were labelled as positive in case of fatality or severe maternal morbidity, warranting intensive care unit (ICU) admission during this period. Severe maternal morbidity was diagnosed in case the patient had gestational hypertension (blood pressure ≥140/90mmHg); gestational diabetes (BR>200mg/dl); diabetic ketoacidosis; documented obstetric bleeding (>1500ml) or a three g/dL drop of Haemoglobin; eclampsia as evidenced by sudden onset seizures; pulmonary oedema; cardiac disease (abnormal ECG, EF<40%); renal failure (Creatinine>1.5mg/dl, eGFR <60ml/min); sepsis; shock; intracranial haemorrhage or coma. Women who developed severe maternal morbidity were managed per standard ICU protocol.

Statistical Package for Social Sciences (SPSS) version 24.0 was used for the data analysis. Quantitative variables were expressed as Mean±SD and qualitative variables were expressed as frequency and percentages. Sensitivity, specificity, positive predictive (PPV), negative predictive value (NPV) and diagnostic accuracy of the MEOWS chart were calculated using a 2x2 table taking ICU admission as the gold standard.

RESULTS

A total of 191 females were included in the study. The mean age of the patients was 26.82±4.97 years. The gestational age ranged from 33 to 39 weeks, with the mean gestational age being 35.079±1.33 weeks. Patients having parity 1-2 were 111(58.12%), while those with parity 3-4 were 80(41.88%). Patients with a gestational age of 33-35 weeks were 128(67.01%), and those with a 36-39 were 63(32.98%).

Table-I: Limits of Alert threshold for MEOWS Parameters12

MEOWS Parameter	Red Alert	Yellow Alert
Temperature; (oF)	<95 or >100.4	95-98.8
Blood Pressure; mmHg		
Systolic	<90 or >160	150–160 or 90–100
Diastolic	> 100	90-100
Heart rate; beats/min	<40 or >120	100-120
Respiratory rate; breaths/min	<10 or >30	21-30
Oxygen saturation; %	<95	-
Neurological response	Unresponsive, pain	Voice

Table-II: Diagnostic Accuracy of MEOWS Chart as a Predictor of Severe Obstetric Morbidity Warranting ICU Admission (n=191)

		ICU Admission n(%)		Diagnostic Accuracy Parameters
		Yes	No	
MEOWS Chart Positive	Yes	25(13.1) True Positive	14(7.4) False Positive	Sensitivity: 69.44%
				Specificity: 90.97%
	No	11(5.7) False negative	141(73.8) True negative	PPV: 64.10%
				NPV: 92.76%
				Accuracy 86.91%

Out of 191 females included in the study, 39 (20.4%) were labelled positive on the MEOWS chart, while 36(18.8%) were labelled positive because of ICU

admission. The number of true positive cases was 25(69.4%), while false positive cases were 14(9%). True negative cases were 141 (91%), while false negative cases were 11(30.6%). The MEOWS chart, as a predictor of severe obstetric morbidity with ICU admission, showed a sensitivity of 69.44%, specificity of 90.97%, positive predictive value (PPV) of 64.10%, negative predive value (NPV) of 92.76% and diagnostic accuracy of 86.91% (Table-II).

DISCUSSION

This study was carried out to validate the MEOWS chart by comparing it with the frequency of ICU admission in those cases predicted positive for maternal morbidity. This was done by assessing the sensitivity, specificity and accuracy of this simple and cost-effective screening tool. The study showed that the MEOWS chart was useful in predicting severe obstetric morbidity and could contribute to improved quality of care, prevention of progressive obstetric morbidity and better health outcomes in our local population.

Our study found that the MEOWS chart, as a predictor of severe obstetric morbidity with ICU admission, had a sensitivity of 69.44%, specificity of 90.97%, PPV of 64.10%, NPV of 92.76% and diagnostic accuracy of 86.91%. Umar *et al*. showed in 2019 that MEOWS was overall 89% sensitive and 79% specific for the prediction of obstetric morbidity.[9] Similarly, Carle *et al*. reported that MEOWS had high sensitivity: 89% (72% to 97%) and specificity of 85% (67% to 98%) for prediction of severe morbidity or mortality after delivery.13 The overall sensitivity in our study was rather low as compared to these two studies. However, sensitivity was relatively high in the 3-4 parity and 36-39 weeks gestational groups, measuring 75% and 72.73%, respectively. The diagnostic accuracy in these groups also improved to 91.25% and 92.06%, respectively. This was in accordance with the findings of another study by Ryan *et al*. in 2019, which assessed sensitivity based on red and yellow alerts on the MEOWS chart.[14] Our study also suggested that the chances of recognizing isolated abnormalities in vital signs were higher when MEOWS was incorporated in our management protocol. Thus, our study emphasized including an early warning system in routine clinical assessment protocols to improve healthcare quality.

The effectiveness of an early-warning system is based on the facilitation of timely diagnosis and treatment to reduce the severity of maternal morbidity.[15,16] Whether these objectives have been achieved would require multi-centre randomized control trials instead of a study limited to a single institute with a small sample size. Factors interfering with the working environment can also affect the timely documentation and communication of the status of patients and need to be carefully assessed. Consideration of human limitations, cultural barriers and working environment will provide necessary data for an effective incorporation MEOWS chart in routine clinical evaluation in different healthcare setups.[17] In future smart monitors can be used to measure the components of MEOWS and inform the clinician for a timely appropriate action thus improving patient outcome.[18,19] Until that time we need to train staff to use this early warning system for timely identification; ensure better coordination between doctors and paramedical staff for swift management of maternal morbidity; provide management facilitation, allocate dedicated resources; ensure optimized use of information technology along with evaluating & changing the prevailing hospital practices.

LIMITATION OF STUDY

Limitations of the study were a relatively small sample size and study population of one hospital with a limited diversity of patients.

CONCLUSION

A modified early obstetric warning system chart effectively predicts severe obstetric morbidity. If imple-mented as part of routine clinical evaluation, it could lead to better patient care by preventing severe obstetric morbidity in our local population.

Authors Contribution

Following authors have made substantial contributions to the manuscript as under:

SMM: & SS: Data acquisition, data analysis, critical review, approval of the final version to be published.

HU: & RAH: Study design, drafting the manuscript, data interpretation, critical review, approval of the final version to be published.

AA: Concept, data acquisition, drafting the manuscript, approval of the final version to be published.

Authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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