Early Detection of Sepsisin High-Risk Obstetric Patients during Early Puerperium by Using MEOWS Chart

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Abstract

Background: Globally, sepsis is the cause of over 260,000 maternal deaths a year. Every death is a tragedy, but 50% of these deaths can be prevented with appropriate medical care. For this reason, Modified Early Obstetric Warning System (MEOWS) chart is developed for the obstetric population to predict early signs of deterioration, monitoring of the patient and proper management of the patient. The aim of the study was to determine the efficacy of MEOWS for the early detection of sepsis in high-risk postnatal patients.

Materials and methods: This prospective observational study was conducted in the Department of Obstetrics and Gynecology, CMCH from January 2021 to December 2021. According to inclusion and exclusion criteria 83 high-risk postnatal patients during early puerperium were selected purposively. Physiological parameters were checked hourly during the first four hours and every four hours there after until 24 hours postpartum and recorded on a MEOWS chart. Blood samples for investigation, such as total count, CRP and procalcitonin, were sent after 24 hours of observation. Serum procalcitonin level was compared with total MEOWS score.

Results: Out of total 83 patients, majority 55(66.3%) of the patient's MEOWS score was 4 and 28(23.7%) of patients had score >4, which is suspicious for sepsis. Regarding procalcitonin level 53 (63.9%) patients had normal procalcitonin level (0.5ng/ml) and 30 (36.1%) patients had abnormal level of procalcitonin (>0.5 ng/ml) which is diagnostic for sepsis. MEOWS chart was 86.7% sensitive, 96.2% specific, 92.8% accurate with a positive and negative predictive value of 92.9% and 92.7% respectively for prediction of sepsis comparing the scoring systems with procalcitonin level.

Conclusion: In low socioeconomic countries with limited resources for microbial culture and laboratory biomarkers of sepsis diagnosis, MEOWS score can be used as a bedside screening tool for early detection of sepsis and thus preventing sepsis related maternal morbidity and mortality.

Key words: MEOWS chart; Maternal complications; Peripartum period.

Introduction

Globally, sepsis is the third most common direct cause of maternal mortality, accounting for 11% of death in Low and Middle-Income Countries (LMIC).[1] The incidence of postpartum sepsis varies worldwide, with reports between 2-10% and varies by risk factors which include location of delivery, low socioeconomic status, poor nutrition, anemia, prolonged labor, multiple pregnancy, being overweight, type of delivery, more than 5 vaginal examinations during labor etc.[2,3] The physiological adaptations in pregnancy, combined with the high rates of trauma and surgical intervention that occur during the peripartum periods, put pregnant women at risk of developing infections that may go unrecognized until there is substantial clinical deterioration.[4]

Early recognition and the initiation of appropriate investigation, fluid resuscitation and antimicrobial therapy are the basis of sepsis management. For this reason, Early Warning Systems (EWSs) have gained popularity among professional organizations. Early warning systems provide quantifiable evidence that a patient's condition may be deteriorating, and more skilled clinicians must be notified to review the patient and advise on intervention.[5] To reduce delay, there have been calls for a Modified Early Obstetric Warning System (MEOWS) for routine use on all pregnant or postpartum women who have been admitted to hospital and require obstetric or gynecology services in addition to those who have already been identified as critically ill.[6,7]

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MEOWS is a way of formalizing the measurement of physiological variables (Heart rate, blood pressure, respiratory rate, oxygen saturation, temperature and state of consciousness). The values of the observations are then translated into a summary score that has a critical threshold, above which medical review and intervention are needed. It is believed that small changes in the combined physiological variables measured by MEOWS may pick up deterioration earlier than an obvious change in an individual variable. Early detection will trigger subsequent prompt intervention that will either reverse further physiological decline or facilitate timely referral to appropriate personnel.[8]

Available data shows that the incidence of puerperal sepsis in Bangladesh is 4.5 per 100 live births.[9]In Bangladesh prevalence of puerperal sepsis is more due to poverty, illiteracy, malnutrition, unplanned pregnancies, unnecessary induction and delivery by unskilled personnel. Morbidity associated with puerperal sepsis includes septicemia, peritonitis, pelvic abscess, endotoxic shock and finally mortality among others.[10,11]The recognition of sepsis requires careful patient monitoring and observation. Although positive blood culture is the gold standard used for definitive diagnosis of infection, this test is limited by the length of time it takes to grow microorganism and potential for interference due to contamination.[12]

For the rapid identification of microorganisms causing sepsis, novel laboratory methods, such as cytokine molecularanalyses, have been developed. Procalcitonin has been used for sepsis diagnosis and patient outcome prediction.[13,14]As a cut-off value for the diagnosis of sepsis a value >0.5 ng/ml is abnormal and suggest sepsis. Purpose of this study is to evaluate MEOWS scoring for early detection of sepsis in high-risk postnatal women and comparing the score with the level of procalcitonin which is a novel biomarker of sepsis.

Materials and methods
This prospective observational study was conducted between the periods of January 2021 to December 2021 at the Obstetrics and Gynecology Department of Chittagong Medical College Hospital. Total 83 postnatal patients at high risk

for developing sepsis during early puerperium were included in the study.Physiological parameters (Respiratory rate, oxygen saturation, blood pressure, pulse rate, temperature and consciousness level) and pain score were checked hourly during the first four hours and every four hours thereafter until 24 hours postpartum and were recorded ona MEOWS chart and scored with 0,1,2 and 3 points according to MEOWS chart. The chart used here was adapted from that of Kettering General Hospital. We used a numeric rating scale 0-18 and a pain score. A total MEOWS score of£4 was considered normaland a score >4 was considered as suspicious of sepsis. Blood samples for total count, CRP and procalcitonin were sent after 24 hours of obsignifican. By taking serum Procalcitonin level as a standard biomarker of sepsis diagnosis, level of Procalcitonin was compared with MEOWS score for early detection of sepsis.A cut-off value of serum procalcitonin >0.5ng/ml is abnormal and suggest sepsis.The chi-square test and Mc Nemar test were used for categorical variable. Sensitivity, specificity, accuracy, positive and negative predictive value of the MEOWS score were calculated. Data Analysis was done with SPSS version-23. The p value <0.05 was considered as statistically significant.

To conduct this study written permission was taken from Ethical Review Committee, CMC andinstitutional clearance was obtained from the Director of CMCH.

Results
In this study, Regarding the MEOWS chart score, more than two-thirds (66.3%) patients had normalscore (MEOWS score ≤4), and 28 (33.7%) patients had abnormal (MEOWS score >4) (Figure I). Table I shows the socio-demographic profile of the patients. Table-II shows Majority of 20(71.4%) were multiparas, whereas 28(50.9%) had normal MEOWS scores, which was not significant between the two groups. Obstetric risk factors such asprolonged labor, prolonged rupture of membranes, fever, fowl-smelling vaginal discharge, obstructed labor and PPH were not statistically significant with the MEOWS score (p>0.05). Cesarean section was significantly associated with abnormal MEOWS scores than

normal MEOWS scores (85.7% vs 58.2%) (Table III). Table IV shows the MEOWS score maximum (>4 score) evaluation for sepsis, 26 true positive cases, 2 false positive cases, 4 false negative cases and 51 true negative cases in identification by procalcitonin. The difference was not statistically significant (p=0.687) in the Mc Nemar test. MEOWS chart was 86.7% sensitive, 96.2% specific and 92.8% accurate, with positive and negative predictive values of 92.9% and 92.7%, respectively, for the prediction of sepsis (Figure 2).
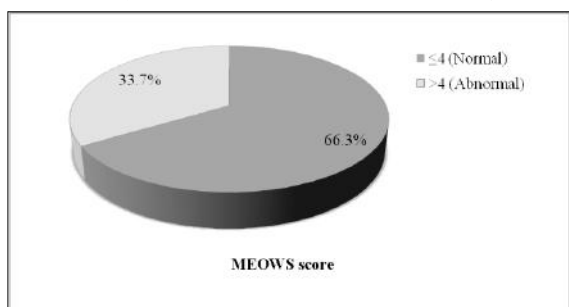
Figure 1 Distribution of the study patients according to MEOWS score (n=83)

Table I Sociodemographic characteristics of the study patients (n=83)

Sociodemographic characteristics	Number of patients	Percentage
Age (Years)		
≤20	21	25.3
21-25	24	28.9
26-30	22	26.5
31-35	15	18.1
>35	1	1.2
Mean ±SD	25.5	±5.5
Occupational status		
Housewife	81	97.6
Garments worker	1	1.2
Employer	1	1.2
Monthly income (Taka)		
Lower-middle	70	84.3
Upper-middle	13	15.7

Table II Comparison betweenantenatal history MEOWS score (n=83)

Antenatal history	MEOWS score				p value
	Abnormal (n=28)		Normal (n=55)		
	n	%	n	%	
Parity					
Primi	8	28.6	28	50.9	0.052[ns]
Multi	20	71.4	27	49.1	
Obstetric Risk Factors					
Prolonged labor	6	21.4	19	34.5	0.218[ns]
Prolonged rupture of membranes	4	14.3	8	14.5	0.626[ns]
Fever, fowl smelling vaginal discharge	8	28.6	8	14.5	0.126[ns]
Obstructed labor	7	25.0	11	20.0	0.601[ns]
PPH	4	14.3	10	18.2	0.454[ns]

ns= not significant, p value obtained from the Chi square test.

**Table III** Comparison between mode of delivery and MEOWS score (n=83)

Mode of delivery	MEOWS score				p value
	Abnormal (n=28)		Normal (n=55)		
	n	%	n	%	
Spontaneous vaginal delivery	2	7.1	14	25.5	
Assisted vaginal	2	7.1	9	16.4	0.039[s]
Caesarean section	24	85.7	32	58.2	

s= significant, p value obtained from the Chi square test.

Table IV Comparison between the MEOWS score and procalcitonin evaluation for sepsis (n=83)

MEOWS score	Procalcitonin	
	Sepsis (n=30)	Not sepsis (n=53)
Sepsis (n=28)	26 (True positive)	2 (False positive)
Not sepsis(n=55)	4 (False negative)	51 (True negative)

p value=0.687[ns] not significant, p value reached from McNemar test.
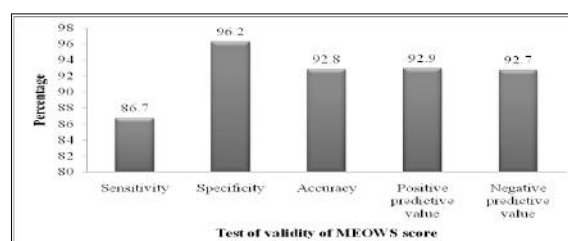
Figure 2 Sensitivity, specificity, accuracy, positive and negative predictive values of the MEOWS score evaluation for the prediction of sepsis

Discussion

The present study showed that the majority of 25(30.1%) patients had obstetric risk factors of prolonged labor, 18 (21.7%) had obstructed labor, 16(19.3%) had fever and fowl smelling vaginal discharge, 14(19.3%) had Postpartum Hemorrhage (PPH), and12(14.5%) had prolonged rupture of membranes, History of prolonged labor, prolonged rupture of membranes, fever, fowl-smelling vaginal discharge, obstructed labor and PPH were not statistically significant with the MEOWS score (p>0.05). Previous literatures highlight that hemorrhage, lacerations, multiple vaginal examination, mode of delivery are major contributors to sepsis that may develop within a few hours of giving birth.[15,16]

This study showed that more than two-thirds (67.5%) of patients had a cesarean section, 16 (19.3%) had spontaneous vaginal delivery, and 11(13.3%) had assisted vaginal delivery. C-section was significantly higher in abnormal MEOWS scores than in normal MEOWS scores (85.7% vs. 58.2%). A similar study performed by Singh et al. showed that normal delivery was found to be 83.2% in the non-triggered group and 64.4% in the triggered group. Cesarean section was 14.3% in the non-triggered group and 28.9% in the triggered group.[17] Singh et al. reported that they were also more likely to have undergone an emergency obstetric intervention (Caesarean section, ventouse or forceps delivery): 46% vs. 16%, respectively, p <0.0001.[18]

Regarding the MEOWS chart score, more than two-thirds (66.3%) patients were normal (MEOWS score 4) and 28(33.7%) were abnormal (MEOWS score >4). It was observed that the MEOWS chart was 86.7% sensitive, 96.2% specific, and 92.8% accurate, with positive and negative predictive values of 92.9% and 92.7%, respectively, for the prediction of sepsis. Singh et al. showed that the MEOWS chart was 86.4% sensitive and 85.2% specific, with positive and negative predictive values of 53.8% and 96.9%, respectively, for the prediction of obstetric morbidity.[17] In a published literature, the MEOWS chart in the UK population has been found to be 89% sensitive and 79% specific with positive and negative predictive values of 39% and 98%respectively, in highly lethal conditions such as sepsis, identifying its severity determines the patient's outcome.[17]

Zohra et al. showed a modified early obstetrics warning system with a sensitivity of 84.38%, specificity of 97.11%, diagnostic accuracy of 95%, positive predictive value of 84.38%, and negative predictive value of 97.11% (p=0.001) for the prediction of maternal morbidity.[19] In a study by Ryan et al. (2017), MEOWS showed a sensitivity of 96% and a specificity of 54% for the prediction of maternal morbidity.[20]

Regarding procalcitonin level, 53(63.9%) patients had normal level of serum procalcitonin which exclude the presence of sepsis and 30 (36.1%) patients had abnormal level of procalcitonin which is diagnostic of sepsis.Number of patients diagnosed as having sepsis based on the serum procalcitonin level and MEOWS score was 30 (36.1%) and 28(33.7%). Number of patients diagnosed as not having sepsis based on serum procalcitonin level and MEOWS score was 53(63.9%) and 55(66.30%). Hoebeor et al. evaluated the diagnostic accuracy of procalcitonin for bacteraemia in different subgroups of adult hospitalized patients suspected of infection or sepsis. Overall, at a cut off level of >0.5 ng/ml, PCT had a fair diagnostic accuracy for bacteraemia with an area under the SROC curve of 0.79.[21]

Limitation
Multicentered studies with large samples were not included in this study.

Conclusion
Sepsis is a worldwide highly prevalent syndrome, associated with significant maternal morbidity and mortality. The main aspects of sepsis management are early diagnosis as well as timely treatment. In Low socioeconomic country like ours with limited resources for microbial culture and laboratory biomarkers of sepsis diagnosis like procalcitonin, MEOWS score can be used as a bedside screening tool for early detection of sepsis.

Recommendation
The MEOWS chart should be used routinely for the early recognition of any critical illness and periodic documentation of physiological parameters. Further studies can be undertaken by including a large number of patients in different centers.

Contribution of authors
TT-Conception, design, acquisition of data, data analysis, manuscript writing & final approval.
FIC-Data analysis, critical revision & final approval.
LD-Acquisition of data, design, drafting & final approval.
FA-Acquisition of data, design, drafting & final approval.
DS-Acquisition of data, design, drafting & final approval.

SH-Acquisition of data, design, drafting & final approval.

SC-Conception, critical revision & final approval.

SA-Interpretation of data, critical revision & final approval.

Disclosure

All the authors declared no competing interest.

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