OBSTETRICS

The Sepsis in Obstetrics Score: a model to identify risk of morbidity from sepsis in pregnancy

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OBJECTIVE: We sought to design an emergency department sepsis scoring system to identify risk of intensive care unit (ICU) admission in pregnant and postpartum women.

STUDY DESIGN: The Sepsis in Obstetrics Score (S.O.S.) was created by modifying validated scoring systems in accordance with recognized physiologic changes of pregnancy. The S.O.S. was applied to a retrospective cohort of pregnant and postpartum patients from February 2009 through May 2011 with clinical suspicion of sepsis. The primary outcome was ICU admission. Secondary outcomes were telemetry unit admission, length of stay, positive blood cultures, positive influenza swabs, perinatal outcome, and maternal mortality. Receiver operating characteristic curves were constructed to estimate the optimal score for identification of risk of ICU admission.

RESULTS: In all, 850 eligible women were included. There were 9 ICU (1.1%) and 32 telemetry (3.8%) admissions, and no maternal deaths. The S.O.S. had an area under the curve of 0.97 for ICU admission. An S.O.S. $\geq$6 (maximum score 28) had an area under the curve of 0.92 with sensitivity of 88.9%, specificity of 95.2%, positive predictive value of 16.7%, and negative predictive value of 99.9% for ICU admission, with an adjusted odds ratio of 109 (95% confidence interval, 18—661). An S.O.S. $\geq$6 was independently associated with increased ICU or telemetry unit admissions, positive blood cultures, and fetal tachycardia.

CONCLUSION: A sepsis scoring system designed specifically for an obstetric population appears to reliably identify patients at high risk for admission to the ICU. Prospective validation is warranted.

Key words: disease severity score, intensive care unit, pregnancy, sepsis

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The United States currently ranks 47th (of 184 countries) in overall maternal mortality with a rate of 21/100,000, vs an average rate of 16/100,000 in developed countries.[1] Maternal sepsis, especially puerperal sepsis, is a common pregnancy-related condition and in the United States is the fourth leading cause of maternal mortality, accounting for up to 13% of maternal deaths[2] and approximately 5% of maternal admissions to the intensive care unit (ICU).[3] Unfortunately, the frequency of severe sepsis in pregnancy is increasing in the United States, from 1:15,385 in 1998 to 1:7246 in 2008, as well as sepsis-related maternal death, up 10% per year in that same time frame.[4]

The progression from the systemic inflammatory response syndrome (SIRS) to septic shock is clearly defined in the nonpregnant population using specific objective vital signs and laboratory values. Based on these parameters, critical care and infectious disease experts developed management guidelines for severe sepsis and septic shock with the Surviving Sepsis Campaign.[5] This campaign highlighted the need for appropriate assessment of the severity of sepsis to enable early detection of cases at risk for rapid clinical deterioration, leading to the development of many disease severity scoring systems related to sepsis. None included pregnant women in the initial study population and all have been shown to overestimate morbidity and mortality in an obstetric population.[6-11]

The failure of existing scoring systems to identify risk of morbidity in an obstetric population likely stems from their failure to account for the normal physiologic changes seen in pregnancy. These changes include a decrease in diastolic blood pressure by 5-10 mm Hg in the second trimester with return to baseline by the third trimester, an increase in heart rate by 17% (to 83 $\pm$ 10 beats per minute), and an elevation in leukocyte count (up to 16.9/μL by the third trimester and up to 30/μL in labor).[12-14] Temperature, systolic blood pressure, respiratory rate, blood oxygen saturation (SpO_2), and percentage of immature neutrophils are unchanged.[12-14] Little is known about the effect of pregnancy on lactic acid.

To our knowledge, no study to date has evaluated the use of a pregnancy-specific scoring system for use in an emergency

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FIGURE 1
Sepsis in Obstetrics Score

Variable	High abnormal range				Normal	Low abnormal range			
Score	+4	+3	+2	+1	0	+1	+2	+3	+4
Temperature (°C)	>40.9	39-40.9		38.5-38.9	36-38.4	34-35.9	32-33.9	30-31.9	<30
Systolic Blood Pressure (mmHg)					>90		70-90		<70
Heart Rate (beats per minute)	>179	150-179	130-149	120-129	≤119				
Respiratory Rate (breaths per minute)	>49	35-49		25-34	12-24	10-11	6-9		≤5
SpO_2 (%)					≥92%	90-91%		85-89%	<85%
White Blood Cell Count (/μL)	>39.9		25-39.9	17-24.9	5.7-16.9	3-5.6	1-2.9		<1
% Immature Neutrophils			≥10%		<10%				
Lactic Acid (mmol/L)			≥4		<4				

Scoring template for S.O.S., a sepsis scoring system designed specifically for obstetric patients.

S.O.S., Sepsis in Obstetrics Score; *SpO_2*, blood oxygen saturation.

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department (ED) to predict clinical deterioration in an obstetric population presenting with signs of sepsis. Therefore, the objective of this study was to evaluate the utility of an ED scoring system designed specifically for an obstetric population to identify risk of ICU admission for pregnant and postpartum women who presented with signs of sepsis.

Materials and Methods

We performed a retrospective cohort study of pregnant and postpartum women evaluated in the ED at Women and Infants Hospital, a large tertiary care obstetric hospital, with suspected SIRS or sepsis from February 2009 through May 2011. To identify women deemed at high risk for sepsis, only those who had blood cultures or an influenza swab sent to the clinical laboratory were included. Blood cultures or an influenza swab were used as surrogate markers for a patient presenting with signs or symptoms concerning for sepsis and were used as the sole enrollment criterion because the aim was to capture patients in whom there was a clinical suspicion of a severe infectious process as determined by the primary ED physician.

The Women and Infants ED serves as both an obstetric triage unit and a free-standing emergency room, and thus is the point of entry to the hospital for every patient, regardless of gestational age or pregnancy status. It is staffed by obstetricians who are employed as full-time ED providers. This ED is equipped with an electronic medical record that is programmed to alert the provider when a patient meets ≥2 of the following criteria, which were taken from the standard SIRS criteria: mean arterial pressure ≤65, systolic blood pressure ≤90, heart rate ≥110, respiratory rate ≥22, temperature ≥38°C or ≤36°C, and leukocyte count ≥14/μL, <4/μL, or >10% immature neutrophils. The physician then determines if there is a high clinical suspicion for sepsis and makes the decision to draw blood cultures or perform an influenza swab.

Chart abstraction was conducted for women who presented to the ED at any gestational age through the first 2 postpartum weeks. All women had been discharged from the hospital prior to data collection and analysis. Exclusion criteria included a known or suspected ectopic pregnancy, multiple gestation (because of concern regarding additional hemodynamic changes from a multiple compared to a singleton gestation), transfer from an outside hospital (because of the possibility of treatment prior to presentation), or subsequent delivery at an outside hospital (because of inability to ascertain neonatal outcome). The population of this study was restricted to the ED because the scoring system that was developed was modeled after validated ED scoring systems.

Vital sign and laboratory data were individually abstracted from the electronic medical record by 2 investigators (C.M.A. and T.N.A.). Maximum