

Original Article

Evaluation of the modified severity of obstetrical illness scoring system for predicting the outcome of critically ill obstetric patients

Jianrong Wang^{1*}, Lixia Qi^{1*}, Hui Gao², Aihua Liu¹

¹Department of Obstetrics and Gynecology, Dongying People's Hospital, Dongying, China; ²Department of Hematology, Dongying People's Hospital, Dongying, China. *Equal contributors.

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Abstract: Objective: To evaluate of the modified severity of obstetrical illness scoring system for predicting the outcome of critically ill obstetric patients. Methods: A total of 165 critically ill obstetric patients were enrolled. The modified severity of obstetrical illness score and acute physiology and chronic health evaluation (APACHE II) were used to evaluate the severity of obstetrical illness. Deaths and organ dysfunctions were recorded. Results: Severity of obstetrical illness scores of dead patients was significantly higher than survival patients and the higher scores indicated the higher death rate. Conclusion: The modified severity of obstetrical illness scoring system was efficient on the evaluation of the severity of obstetrical illness and predicting the outcome of critically ill obstetric patients.

Keywords: Maternal, acute critical illness, APACHE II, multiple organ dysfunction syndrome

Introduction

The critically ill obstetric patients pose a number of management problems to the intensive care physician. The physiological changes of pregnancy, diagnoses specific to the pregnant state and the presence of a fetus complicate their assessment and management. Outcome is influenced by the precipitous deterioration which can occur and the equally rapid recovery which may follow delivery. The need for accurate assessment of the severity of disease in critically ill obstetric patients would not only contribute to the assessment of the quality of patient care, but would also enhance risk stratification of pregnant women in the evaluation of new therapies.

Several severity of obstetrical illness scoring systems [1-3] can be used to predict the outcome of the critically ill obstetric patients [4-7], such as acute physiology and chronic health evaluation (APACHE II), simplified acute physiology score (SAPS II) and mortality probability models (MPM II). Although APACHE II was found to underestimate intensive care unit (ICU) maternal mortality [8], it was the most commonly

used scoring system for predicting the outcome of critically ill obstetric patients at present.

We modified APACHE II based on the features of obstetrics. In this study, we compared the effectiveness of APACHE II and the modified severity scoring of illness system in predicting the outcome of critically ill obstetric patients.

Methods

Patients

A total of 165 critically ill obstetric patients from January 2006 to December 2012 were enrolled in a retrospective study. The patients (age range 19-43 years; mean age 29.84±4.85 years) included 93 primiparas and 72 multiparas. The modified severity of obstetrical illness score and acute physiology and APACHE II were used to evaluate the severity of obstetrical illness. Deaths and organ dysfunctions were recorded.

All patients enrolled in the study provided informed written consent. The subjects of this study were treated according to the World

A modified severity of obstetrical illness scoring system

Table 1. The modified severity of illness scoring criteria

	0 point	1 point	2 points	3 points	4 points
T (°C)	36.0≤X<38.5	34.0≤X<36 or 38.5≤X<39	32.0≤X<34.0	30.0≤X<32.0 or 39.0≤X<41.0	<30.0 or ≥41.0
MAP (mmHg)	70≤X<110		110≤X<130 or 50≤X<70	130≤X<160	≥160 or <50
RR (per minute)	12≤X<25	10≤X<12 or 25≤X<35	6≤X<10	35≤X<50	<6 or ≥50
HR (per minute)	70≤X<110		110≤X<140 or 55≤X<65	140≤X<180 or 40≤X<55	≥180 or <40
Arterial pH	7.33≤X<7.50	7.50≤X<7.60	7.25≤X<7.33	7.15≤X<7.25 or 7.60≤X<7.70	<7.15 or ≥7.70
Na (mmol/L)	130≤X<150	150≤X<155	155≤X<160 or 120≤X<130	160≤X<180 or 110≤X<120	≥180 or <110
K (mmol/L)	3.5≤X<5.5	3.0≤X<3.5 or 5.5≤X<6.0	2.5≤X<3.0	6.0≤X<7.0	<2.5 or ≥7.0
Cr (μmol/L)	35.36≤X<82.51		<35.36 or 82.51≤X<111.97	117.86≤X<200.37	≥200.37
HCT (L/L)			17.6≤X<26.5		<17.6
WBC (10 ¹² /L)	3≤X<20		20≤X<40 or 1≤X<3		≥40 or <1
ALB (g/L)	≥25		19≤X<25	15≤X<19	<15
BGC (mmol/L)	3.4≤X<11.1	11.1≤X<19.3	≥19.3 or 2.2≤X<3.4		<2.2
STB (μmol/L)	<35	35≤X<52	52≤X<86	86≤X<135	≥135
FIB (g/L)	1.5≤X<6.0	1.0≤X<1.5	0.5≤X<1.0		<0.5
PLT (10 ⁹ /L)	≥100	50≤X<100	20≤X<50	<20	
ALT (U/L)	<40	40≤X<120	120≤X<400	≥400	
Oxygenation PaO ₂ /FiO ₂ (mmHg)	≥300	225≤X<300	175≤X<225	100≤X<175	<100
GCS score	=15 minus actual GCS score				

T, temperature; MAP, mean arterial pressure; RR, respiratory rate; HR, heart rate; Na, serum sodium; K, serum potassium; Cr, serum creatinine; HCT, hematocrit; WBC, white blood cell count; ALB, albumin; BGC, blood glucose concentration; STB, serum total bilirubin; FIB, plasma fibrinogen; PLT, platelet; ALT, alanine transaminase; GCS, Glasgow coma scale (GCS).

Medical Association Declaration of Helsinki ethical principles and the study was approved by the local Ethics Committee.

Severity of obstetrical illness scoring system

APACHE II score was derived from 12 physiologic measurements: temperature (T), mean arterial pressure (MAP), heart rate (HR), respiratory rate (RR), arterial pH, oxygenation, serum sodium (Na), serum potassium (K), and serum creatinine (Cr), hematocrit (HCT), white blood cell count (WBC), and Glasgow coma scale (GCS) score, in addition to the age and the chronic health status of the patients [9].

The modified severity of obstetrical illness scoring criteria was shown in **Table 1**. Eighteen physiological indexes were collected from the

patients to evaluate the severity of obstetrical illness, including T, MAP, RR, HR, arterial pH, Na, K, Cr, HCT, WBC, albumin (ALB), blood glucose concentration (BGC), serum total bilirubin (STB), plasma fibrinogen (FIB), platelet (PLT), alanine transaminase (ALT), oxygenation and GCS.

Statistical analysis

SPSS 13.0 was used for statistical analysis. The continuous variables following normal distribution were presented as mean ± SD ($\bar{x} \pm s$) and were compared using t test. The continuous variables of non-normal distribution were presented as median and interquartile range and compared using rank sum test. $P < 0.05$ indicated significant differences.

A modified severity of obstetrical illness scoring system

Table 2. The comparison of scores in different prognosis patients

	Survival group (n=164)	Dead group (n=1)	t	P
APACHE II	16.97±6.66	27.96±6.46	12.84	<0.01
Modified severity of illness scoring system	19.03±7.23	32.05±7.63	13.85	<0.01

APACHE II, acute physiology and chronic health evaluation.

Table 3. The prognosis of patients with scores in the different ranges

	APACHE II				Modified severity of illness scoring system			
	Survival	Death	Mortalityrate	Expected mortality rate	Survival	Death	Mortality rate	Expected mortality rate
≤10 points	62	0	0%	0.55%	48	0	0%	17.58%
11-20 points	85	0	0%	3.56%	89	0	0%	51.51%
21-30 points	17	0	0%	23.61%	25	0	0%	89.69%
≥31 points	0	1	100.00%	78.63%	2	1	33.33%	90.98%
Sum	164	1	0.61%	46.85%	164	1	0.61%	23.89%

APACHE II, acute physiology and chronic health evaluation.

Table 4. The sensitivity, specificity, false positive rate (FPR) and false negative rate (FNR) of the modified severity of illness scoring when using different points as the cut-off value

	35 points	31 points	26 points	21 points	16 points	10 points
Sensitivity (%)	100.00	61.33	85.33	94.67	97.33	100.00
Specificity (%)	0.00	93.92	84.46	61.15	36.82	6.42
FPR (%)	0.00	6.08	15.54	38.85	63.18	93.58
FNR (%)	0.00	38.67	14.67	5.33	2.67	0.00

when their scores were less than 10 points (**Table 3**).

As the results in **Table 4**, 26 points was the best cut-off value of the modified severity of obstetrical illness scoring system. Its sensitivity was 84.46%, specificity was

85.33%, diagnostic efficiency (DE) was 0.8464 and diagnostic index (DI) was 169.79. Patients with more than 35 points of the modified severity of obstetrical illness score would have a death rate of 100%. Patients would 100% survival when their scores were less than 10 points.

The correlation of the modified severity of obstetrical illness scores and organ dysfunctions

As the results in **Table 5**, critically ill obstetric patients with the modified severity of obstetrical illness scores between 21 and 30 points had higher risk of organ dysfunctions than patients with scores between 11 and 20 points ($P<0.051$). Critically ill obstetric patients whose scores were more than 31 points had higher risk of two organ dysfunctions ($P<0.05$) and three organ dysfunctions ($P<0.01$).

Discussion

In this study, scores of dead patients were significantly higher than survival patients and the risk of death for critically ill obstetric patients

Results

Scores of dead patients were significantly higher than survival patients

Three patients died in this study and 162 patients survived. Scores of dead patients were significantly higher than survival patients no matter using APACHE II or the modified severity of obstetrical illness scoring system ($P<0.01$, **Table 2**). It indicated that APACHE II and the modified severity of obstetrical illness scoring system were both effective methods to predict the death of critically ill obstetric patients.

The higher scores indicated the higher death rate

Critically ill obstetric patients with the higher scores would have the higher death rate either using APACHE II or the modified severity of obstetrical illness scoring system. Patients with more than 35 points of the modified severity of obstetrical illness score would have a death rate of 100%. Patients would 100% survival

A modified severity of obstetrical illness scoring system

Table 5. Organ dysfunctions of patients with scores in the different ranges

	1 organ dysfunction (n, %)	2 organ dysfunctions (n, %)	3 organ dysfunctions (n, %)
≤10 points (n=62)	12 (19.35%)	0 (0.00%)	0 (0.00%)
11-20 points (n=85)	34 (40.00%)	2 (2.35%)	0 (0.00%)
21-30 points (n=17)	5 (29.41%)	10 (58.88%)	2 (11.76%)
≥31 points (n=1)	0 (0.00%)	0 (0.00%)	1 (100%)
Sum (n=165)	51 (30.91%)	12 (7.27%)	3 (1.82%)

increased with the increase of severity of obstetrical illness scores. Our modified severity of obstetrical illness scoring system could reflect the severity of obstetrical illness well, since the patients with higher scores had worse conditions and more risk of death. It could be applied to predicting the outcome of critically ill obstetric patients.

APACHE II was designed for ICU and it was efficient on the evaluation of the conditions of critically ill patients. However, for patients in the special group APACHE II could not be very accurate to predict the outcome of patients [10]. Studies suggested that APACHE II was not efficient on predicting the outcome of some special cases, such as trauma patients, patients undergoing total parenteral nutrition, serious surgery patients, patients with acute myocardial infarction, patients with severe congestive heart failure and elderly patients. APACHE II was rarely used in critically ill obstetric patients [11]. Bhagwanjee et al. [12] found that APACHE II without GCS score had little value for predicting the outcome of patients with pre-eclampsia.

Severe obstetric hemorrhage, placental abruption, amniotic fluid embolism and gestational hypertension disease usually involved coagulation disorders. Indexes in the modified severity of obstetrical illness scoring system, such as FIB, PLT and HCT could reflect the coagulation of patients [13, 14].

Liver disease easily occurs in pregnancy, such as acute fatty liver of pregnancy, viral hepatitis in pregnancy and intrahepatic cholestasis of pregnancy. It might result in hepatic failure and a bad prognosis, imperiling patients' lives [15]. STB, ALB and ALT would reflect the liver function. The modified severity of obstetrical illness

scoring system was composed of comprehensive testing indexes including physiological changes of ICU patients and the special conditions of pregnant women. The cut-off values of the indexes also referred to the physiological changes of pregnant women. All the 18 physiological indexes could be easily obtained from patients in the emergency department in 2 hours. Therefore, using the modified severity of obstetrical illness system could help doctors

evaluate the severity of obstetrical illness and predict the risk of death for critically ill obstetric patients quickly and accurately. It might help critically ill obstetric patients prevent the illness from becoming worse and reduce mortality.

The modified severity of obstetrical illness scores had a close relation to the severity of illness. The critically ill obstetric patients with higher scores had worse conditions and more risk of death. Less than 10 points indicated that patients' conditions were stable. Eleven to 20 points meant that changes of vital signs should be monitored for patients. Patients got 21 to 30 points should be admitted to senior ward or ICU and patients scored more than 26 points should receive multimodality therapy in ICU. When patients had scores more than 31, they would have a mortality risk of 78.63%. A critical condition notice might be issued, multimodality treatment should be used, and the prevention and control of disseminated intravascular coagulation (DIC), shock and infection must be strengthened. More than 35 points predicted an expected mortality rate of 98.99% and a critical condition notice should be issued, multimodality treatment should be used, and a contingency plan should be started.

In conclusion, the modified severity of obstetrical illness scoring system with 18 physiological indexes was efficient on the evaluation of the severity of obstetrical illness and predicting the outcome of critically ill obstetric patients.

Disclosure of conflict of interest

None.

Address correspondence to: Jianrong Wang, Department of Obstetrics and Gynecology, Dongying People's Hospital, No. 317, South First Road,

Dongying District, Dongying 257091, China. E-mail: jrwang33469@163.com

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