Validation of Severity-of-Illness Scores in Critically Ill Obstetric Patients: A multicenter cohort study

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Background

obstetrical critical care patients are at an increased risk of dying. Despite the development of clinical prediction models for the general population, pregnant or postpartum women were excluded from these development studies, and the usefulness of previous scores to predict mortality is still questioned due to physiological changes of pregnancy. Data of a previous study by our group established that MPM0-II was a better predictor of death than the other mortality prediction scores. However, this was a retrospective database in a single center.

Objectives

The aim of this study was to perform external validation of Mortality Probability Model-II (MPM-II), Mortality Probability Model-III (MPM-III), Simplified Acute Physiology Score-2 (SAPS-2), and Simplified Acute Physiology Score-3 (SAPS-3) in a multicenter cohort of obstetric critical care patients.

Material and methods

We recruited women from six intensive care units from Colombia, South America in a retrospective and prospective cohort study. We started prospective data collection in January 2016 and ended in July 2017. Retrospective data collection varied by center, from 2006 onwards. We calculated the probability to die according to the four scores, and assessed in the cohort discrimination (through area under the curve, AUC) and calibration (test of Hosmer-Lemeshow and mortality ratio). A p-value under 0.05 was considered significant.

Table 1. Characteristics of the population in the population in the complete-case and the multiple imputation datasets, stratified survival status at discharge.

Parameter	Complete-case dataset, n: 2215		
	Survived n: 2115	Died n: 100	P-value
Age	25 (IQR, 20 – 31)	25.5 (IQR, 22 – 30.5)	0.36
Parity	1 (IQR, 0 - 2)	1 (IQR, 1 – 2)	0.0001
Number of pregnancies	2 (IQR, 1 - 3)	3 (IQR, 2 - 4)	0.0001
Urinary output	1 (IQR, 0.5 – 1.6)	0.5 (IQR, 0.2 – 1.1)	0.0001
Blood systolic pressure	125 (IQR, 105 – 144)	90 (IQR, 76 – 104)	0.0001
Blood diastolic pressure	78 (IQR, 64 – 92)	60 (IQR, 40 – 78)	0.0001
Temperature	36.8 (IQR, 36.4 – 37)	36 (IQR, 35 – 36.4)	0.0001
Heart rate	95 (IQR, 81 – 110)	119 (IQR, 106 – 136)	0.0001
Respiratory rate	20 (IQR, 18 – 24)	23 (IQR, 20 – 29)	0.77
Glasgow comma scale (GCS)	15 (IQR, 15-15)	13.5 (IQR, 6-15)	0.0001
Platelets	194000 (IQR, 127000-270000)	160000 (IQR, 92000-259000)	0.007
White blood cells	12390 (IQR, 9340-16100)	14700 (IQR, 9700-24200)	0.001
Alanine aminotransferase (ALT)	22 (IQR, 13.5 – 48.8)	45 (IQR, 24 – 106)	0.0001
aspartate aminotransferase (AST)	30 (IQR, 20 – 58.2)	61 (IQR, 29 – 205)	0.0001
Creatinine	0.8 (IQR, 0.64 – 0.97)	1 (IQR, 0.7 – 1.35)	0.0001
Bilirubin	0.7 (IQR, 0.41 - 1)	1.12 (IQR, 0.8 – 2.6)	0.0001
Lactate dehydrogenase (LDH)	558 (IQR, 378 - 854)	892 (IQR, 515 - 1511)	0.0001
Chloride	106.4 (IQR, 103.4-109.6)	107 (IQR, 102.9-111)	0.28
Bicarbonate	19.5 (IQR, 17.2 – 21.8)	15.5 (IQR, 12.25 – 19.3)	0.0001
Blood urea nitrogen (BUN)	9.8 (IQR, 7 – 13.8)	12.8 (IQR, 8 – 21)	0.0001
pH	7.41 (IQR, 7.37-7.45)	7.34 (IQR, 7.2-7.42)	0.0001
Sodium	136.7 (IQR, 134-139)	138 (IQR, 135-140)	0.02
Potassium	4.09 (IQR, 3.68-4.46)	4.01 (IQR, 3.41-4.5)	0.32

Figure 1. Distribution of missing data for each variable used in the complete-case and after multiple imputation.

Results

We recruited 2,115 women admitted to critical care in all centers. Mean age of the cohort was 26,2 years (95%CI, 25,9–26,5). A total of 100 deaths occurred in the cohort during the study period resulting in a mortality rate of 4.7%. Area under the curve was 0.84 (0.79-0.88) for the MPM0-II model, 0.86 (0.81-0.90) for MPM0-III, 0.90 (0.83-0.96) for SAPS-2, and 0.90 (0.85-0.94) for SAPS-3 with the South American equation. All models except MPM0-II overestimated mortality after multiple imputation. MPM0-II model was the only model with a non-significant mortality ratio (0.84 (0.68-1.02); p=0.057). The test of Hosmer-Lemeshow was significant for all models.

Table 2. Validation of mortality prediction scores in obstetric critical care patients in the original complete-case and the multiple imputation datasets.

	Median score Survivors	Median score Non-survivors	Predicted (observed) deaths	Area Under the Receiver Operator Characteristic Curve (95% CI)	Mortality Ratio (95% CI)
Complete-case					
Mortality Probability Model II (n=)	N.A.	N.A.	100 (117)	0.84 (0.79-0.88)	0.85 (0.70-1.03)
Mortality Probability Model III (n=)	N.A.	N.A.	100 (121)	0.86 (0.81-0.90)	0.83 (0.68-1.00)
Simplified Acute Physiology Score 2 (n=)	15	38	35 (95)	0.90 (0.83-0.96)	0.37 (0.26-0.50)
Simplified Acute Physiology Score 3 (n=)	34	54	49 (116)	0.90 (0.85-0.94)	0.42 (0.31-0.55)
Multiple imputation (n=2,115)					
Mortality Probability Model II	N.A.	N.A.	101 (120)	0.84 (0.79-0.89)	0.84 (0.68-1.02)
Mortality Probability Model III	N.A.	N.A.	101 (124)	0.86 (0.82-0.91)	0.82 (0.66-0.99)
Simplified Acute Physiology Score 2	23	43	101 (194)	0.90 (0.85-0.93)	0.52 (0.42-0.64)
Simplified Acute Physiology Score 3	35	52	101 (214)	0.88 (0.84-0.92)	0.47 (0.39-0.58)

Conclusions

This large study shows similar results to our previous assessments of models to predict death in obstetrical critical care women. MPM0-II is the model that most accurately predicts mortality in obstetrical critical care patients.

Acknowledgements

Aura Gonzalez and Maria Miranda

Source

1. Paternina-Caicedo AJ, Rojas-Suarez JA, Duenas-Castel C, Miranda-Quintero JE, Bourjeily G. Mortality risk prediction with an updated Acute Physiology and Chronic Health Evaluation II score in critically ill obstetric patients: a cohort study. J Intensive Care Med 2015;30:97-102.
2. Lapinsky SE, Hallett D, Collop N, et al. Evaluation of standard and modified severity of illness scores in the obstetric patient. J Crit Care 2011;26:535 e1-7.
3. Rojas-Suarez J, Paternina-Caicedo AJ, Miranda J, Mendoza R, Duenas-Castel C, Bourjeily G. Comparison of severity-of-illness scores in critically ill obstetric patients: a 6-year retrospective cohort. Crit Care Med 2014;42:1047-54.

Figure 2. Discrimination of Mortality Probability Model (MPM0)-II (Rose), MPM0-III (Green), Simplified Acute Physiology Score (SAPS) 2 (Blue) and SAPS 3 (Purple), in obstetric critical care patients. ROC = receiver operator characteristic.