ORIGINAL CONTRIBUTIONS

PREDICTION OF MORTALITY AND MORBIDITY BY SIMPLIFIED ACUTE PHYSIOLOGY SCORE II IN OBSTETRIC INTENSIVE CARE UNIT ADMISSIONS

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ABSTRACT

BACKGROUND: *Critical care in obstetrics has received much attention in recent times. Despite progress in medical field and improvement in health facilities provided, maternal mortality is still very high in most of the developing countries.* ***AIM:*** *To study and analyze records of patients requiring intensive care in obstetrics and to assess utility of simplified acute physiology score (SAPS II) for predicting maternal mortality.* ***SETTING:*** *A multidisciplinary intensive care unit (ICU) at a tertiary care center.* ***DESIGN:*** *Retrospective review.* ***MATERIALS AND METHODS:*** *Fifty-seven consecutive obstetric patients' records requiring ICU admissions were studied for clinical picture, diagnosis, complications, morbidity and mortality over a period of 2½ years - from 1st May 2002 to 31st Oct. 2004. SAPS II score was calculated according to the different variables for predicting mortality.* ***STATISTICAL ANALYSIS:*** *SAPS II scores were regressed on mortality status using logistic regression analysis. The predictability was assessed by goodness-of-fit test and receiver operated characteristic curve.* ***RESULTS:*** *Maternal mortality in obstetric ICU admissions was 1.15/1,000 deliveries, amounting to 40.35% of obstetric ICU admissions. The mean SAP II score was significantly higher (40.04 ± 12.97 vs. 22.6 ± 7.31) in those patients who died compared to survivors (P < 0.001%).* ***CONCLUSIONS:*** *The SAPS II accurately predicted mortality in obstetric patients admitted to ICU. Computation of the score as a routine in ICU may help in identifying those at high risk of mortality and then to reduce this risk.*

Key words: *Maternal mortality, obstetric intensive care unit, simplified acute physiology score*

Care of critically ill patients is a unique challenge in obstetrics. Hemorrhage, anemia, septicemia, toxemia are common causes of mortality and morbidity in these patients.[1] Admissions of obstetric patients to intensive care unit (ICU) occur in approximately 2-4/1,000 deliveries.[1] Separate intensive care units have been developed for cardiac, burns, respiratory, pediatric and neonatal care, but an ICU only for obstetric patients is not yet widely available in developing countries.

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Several investigators have devised different scores to predict outcome of patients in ICU in general. The Acute Physiology and Chronic Health Evaluation II (APACHE II), mortality probability model (MPM) and simplified acute physiology score (SAPS II) scores, etc., have been used to assess the severity of illness and to predict mortality in critically ill obstetric patients, with conflicting results. APACHE II is the most widely cited. However, physiologic changes during pregnancy can lead to higher APACHE II scores, leading to falsely elevated 'predicted mortality rates.'[2] El Solh and Grant found there was no significant difference between observed mortality predicted by the APACHE II, MPM and SAPS II score system in obstetric and non-obstetric critically ill patients.[3] There are few studies for the validation of this model for obstetric patients in developing countries, particularly in India. Therefore, this study was undertaken with the aim to assess the utility of SAPS II model given by Le Gall *et al*.[4] for predicting mortality in obstetric patients in ICU of our setup.

MATERIALS AND METHODS

This was a retrospective study conducted from 1st May 2002 to 31st October 2004 in the ICU of a tertiary hospital attached to a medical college. It is a 1,600-bedded institution with more than 200 beds in the department of obstetrics and gynecology. It has a 7-bedded medical ICU for medical, surgical, obstetric and gynecological patients. Separate ICUs are available for cardiac, respiratory and neonatal intensive care. Though it is a teaching hospital, referrals from primary and secondary centers are not well organized and there is no networking or coordination between the centers at the moment.

Admission criteria

Critically ill patients who require ventilatory support or are hemodynamically unstable even after preliminary administration of intravenous fluids, oxygen and ionotropes and may need ventilatory support anytime in the near future are admitted to the ICU. Anesthesiologists manage the ICU in our hospital, and admission of patients is governed by the obstetric department in obstetric cases. Many times, medical and surgical opinions are sought for assuring coordinated care of patients. As the number of beds in ICU is limited and not exclusive for obstetrics or gynecology, 'Near Misses' and those not requiring ventilation are managed in a high dependency area/ postoperative ward separate from the labor ward and are not included in this study.

Data collection

Totally, there were 57 obstetric admissions to the ICU during the period of our study. Records of these admissions were retrieved from medical record section of the hospital by the authors. We recorded the demographic data, diagnosis at admission, indications for transfer to ICU, physiological parameters

used to calculate SAPS II, duration of stay in ICU and hospital and deaths during hospitalization for all 57 patients. Ethical clearance was obtained from the local review board.

For all the 57 patients, SAPS II was calculated using chart of Le Gall *et al.*[4] The variables used for computation of SAPS II were noted from the records within 24 h of ICU admission. It consists of 15 variables, each assigned a weighted score based on its deviation from normal value [Table 1]. The sum of the individual weighted scores for these variables yields the SAPS II score for that patient.

Method for prediction and validation of model SAPS II sores were applied to the model equation given by Le Gall *et al.*[4]

Logit y = -8.08 + 0.262 (SAPS II)

PDR (pr) = $e^{logit}/1+e^{logit}$

From this equation, we computed logit and probability of death/predictive death rate (PDR). Using probability of death, a decile distribution was prepared to validate the prediction made by the model on our data. Next we plotted the receiver operated characteristic (ROC) curve for different SAPS II cut off points and obtained the cutoff that best predicted sensitivity and specificity.

Table 1: Variables and scores for SAPS II (Le Gall *et al.* 1993)[4]

Variables	*Score*
Age	0-13
Heart rate	0-11
Systolic blood pressure	0-11
Body temperature	0-3
PaO_2/FiO_2	0-11
Urinary output	0-11
Serum urea or serum urea nitrogen level	0-10
WBC count	0-12
Serum potassium level	0-3
Serum sodium level	0-5
Serum bicarbonate level	0-6
Bilirubin level	0-9
Glasgow coma score	0-26
Type of admission	0-8
Chronic disease: Metastatic cancer	9
Hematologic malignancy	10
Acquired immunodeficiency syndrome	17

RESULTS

Fifty-seven obstetric patients were admitted to ICU during the period of our study. There were 23 deaths among these 57 patients. The mortality rate among these patients was 40.35%. Mean SAPS II score for expired patients was higher, viz., 40.04 (range 23-71), compared to that of surviving patients, which was 22.6 (range 9-43) [Table 2]. The difference was significant ($P < 0.001$)

We used the goodness-of-fit test model devised by Le Gall *et al.*[4] and performed the test on the 57 patients in our study. It shows the model fits our data well. It predicted 73.9% of deaths and 88.2% survival correctly - overall 82.5% correct predictions [Table 3]; the 95% CI for this is (72.5, 92.5). After removing chance agreement, actual agreement through kappa statistic and its 95% confidence interval are as follows:

Table 2: Demographic and clinical data of intensive care unit admission

	Death (n=23)	*Survived (n=34)*	*P value*
Mean age (yrs)	27.35	26.3	0.41
Median parity (range)	2 (0-5)	1 (0-6)	0.52
Un-booked patient (n) (%)	19 (82.6%)	26 (76%)	0.74
Median hospital stay (days) (range)	2 (1-29)	15 (3-45)	<0.001
Median ICU stay (days) (range)	1 (1-2)	2 (1-16)	0.39
Mean SAPS II score (range)	40.04 (23-71)	22.6 (9-43)	<0.001

Table 3: Goodness-of-fit of the model* for predicting death and survival in the present study

Decile	*Deaths*		*Survival*	
	Observed	*Expected*	*Observed*	*Expected*
1.	0	0.04	5	4.96
2.	0	0.18	6	5.82
3.	0	0.36	5	4.64
4.	1	0.73	5	5.27
5.	1	1.36	5	4.64
6.	3	2.15	3	3.85
7.	2	2.53	3	2.47
8.	5	4.17	1	1.83
9.	5	5.51	1	0.49
10.	6	5.98	0	0.02

*Model equation used from Le Gall *et al.*[4]

Kappa is 0.63, $P < 0.001$, 95% CI: (0.42, 0.84) Figure 1 shows the ROC curve that was plotted using SAPS II scores. The area under the ROC curve is 0.92, which again shows a good fit. The best cutoff on ROC curve was score 26.5 (rounded to 27). It has 95.6% sensitivity and 73.5% specificity.

During the study period, there were 23,000 obstetric admissions in our hospital. Fifty-seven obstetric patients required ICU admission during this period. Frequency of admissions in ICU was 2.47 per 1,000 patients. Mean age was 23.68 years [Table 2]. Seventy-nine percent of these were referred from other centers for obstetric complications that occurred in remote peripheral centers and could not be managed there. These patients were first attended to in the emergency of obstetrics department. As mentioned earlier, they were shifted to ICU 'if needed,' either directly from casualty or after the necessary surgical intervention. The need for ventilatory support was mainly decided by the anesthesiologist whose opinion was taken even in casualty or after surgical intervention. Mean hospital stay was 11.87 days (range 1-45 days), and ICU stay was 3.4 days (range 1-16 days) [Table 2].

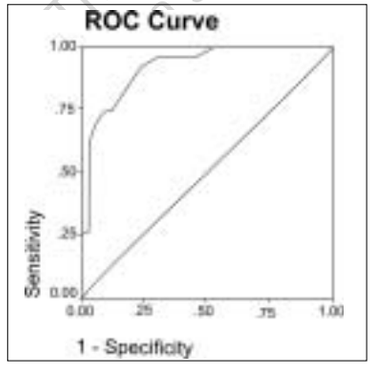

Figure 1: ROC curve (image)

Twenty-one patients (36.8%) had a diagnosis of either antepartum or postpartum hemorrhage. Hypertensive disorders and eclampsia were found in 17 (29.8%) patients and ectopic pregnancy in 5 (8.7%) patients. There was septic abortion in 4 (7%) patients and intrauterine death in 4 (7%) patients. Four (7%) patients were admitted for predominantly medical complications like heart disease, bronchospasm, disseminated intravascular coagulation. Two (3.5%) patients undergoing medical termination of pregnancy (MTP) with laparoscopic ligation had bronchospasm and so were shifted to ICU management.

Surgical intervention in the form of cesarean section was resorted to in 28 patients. Nineteen out of 28 cesarean sections were associated with cesarean hysterectomy to control massive hemorrhage. Other surgical procedures were exploratory laparotomy for ectopic pregnancy in 5 patients and emergency hysterectomy for septic abortion in 2 patients. Two patients of MTP with

laparoscopic ligation had bronchospasm intra-op and needed ventilatory support.

The most common reasons for transfer to ICU were hemorrhagic shock (30, 52.6%) and respiratory support (20, 35%). Other reasons were uncontrolled and severe hypertension in pregnancy with/without eclampsia (4, 7%) and medical complications (3, 6%). Nine patients had more than one reason for transfer to ICU.

Hemorrhagic shock (11, 47.8%), multiple organ failure (7, 30.4%) and eclampsia (5, 17%) were causes of death in ICU admissions.

DISCUSSION

Our study showed that SAPS II score system validated our data well in obstetric patients admitted to ICU. If it were higher than 43, it would have been 100% sensitive. So it is apparent that SAPS II score is quite useful in predicting the prognosis, particularly in terms of mortality.

Majority of the patients were either directly coming to our hospital in poor condition, treated by either quacks or *dais* or referred from peripheral health centers. They belonged to low socioeconomic strata, had not received antenatal care and also had come without adequate treatment - these factors accounting for high mortality in these patients. They were also found to be having low hematocrit levels and were undernourished. Cesarean sections and cesarean hysterectomy were the most common surgeries associated with ICU transfers. Marked association was observed between postpartum hemorrhage, whether during normal delivery or cesarean section, and hemorrhagic shock and acidosis, which led to ICU admission and mortality. Tang *et al.,* in their review of critically ill obstetric patients, found massive postpartum hemorrhage as the single most common cause of ICU admission (53%), followed by preeclampsia and eclampsia.[5]

Several investigators have reviewed critical care in obstetrics patients admitted to the intensive care unit, and a variety of scoring tools have been applied to predict the probability of mortality in critically ill patients.[6-11] In a large multinational study conducted by Jean Roger Le Gall *et al.* in 1993 on 13,152 patients, the authors concluded that SAPS II provided estimate of risk of death without having to specify a primary diagnosis; that is why it can become a starting point of future evaluation of the efficiency of intensive care units.[4]

In 1996, Solh *et al.* found that APACHE II, SAPS II and MPM II scores accurately predicted the ICU outcome of critically ill obstetric as well as non-obstetric female patients of similar age groups.[3]

In a recent study by Gilbert *et al.*[1] in 2003 of 233 obstetric patients admitted to medical ICU, SAP II score accurately predicted hospital mortality among patients admitted to ICU for medical reasons but performed poorly in predicting deaths for patients admitted for only obstetric reasons and for postpartum hemorrhage. Our study concluded that SAPS II is a good predictor of mortality in obstetric

patients. Differences in patient populations, viz., with respect to race, socioeconomic status and nutritional status, besides late arrivals in critical state at our institution, might account for the observed variations.

Karnad *et al.,* in their study of obstetric patients requiring intensive care, found that APACHE II scores overpredict mortality rate.[2] According to Hazelgrove *et al.,* severity-of-illness scoring systems may require modification in obstetrical patients to adjust for the normal physiologic responses to pregnancy.[12] Kim *et al.* evaluated the predictive validity of APACHE III, SAPS II, MPM II in critically ill patients and concluded that APACHE III and SAPS II systems have excellent efficiency in mortality prediction and calibration.[13]

The primary outcome measure was calculation of SAPS II score for predicting maternal mortality in obstetric ICU admissions. The secondary outcome measures were cause of deaths and the factors leading to death during hospitalization as well as duration of stay in ICU and hospital.

The limitation of our study was that data were collected retrospectively and the sample size was small. Moreover, differences in access to health care, ICU admission criteria and disease severity and admission indication (medical, obstetrical reasons) make comparison difficult. So, future research should be directed in using the SAPS II score prospectively for predicting mortality. Furthermore, if found suitable, attention should be focused on prevention of factors leading to high score. Improvement in antenatal care to primarily achieve optimum hematocrit levels and availability of blood products and teaching/education of rural units and health personnel would help in decreasing mortality, particularly due to hemorrhage.

Lastly, a short period of training in the ICU for all residents of obstetric and gynecology and other clinical specialties for better health care should be mandatory.

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Summary of review of literature

Study / authors	*Mortality / conclusions*
Roger J. JAMA 1993; 270: 24	SAPS II estimates risk of death without having to specify primary diagnosis, future evaluation needed
El Solh AA *et al.* chest 1996;110:1299-1304	APACHE II, MPM, SAPS II similar in predicting mortality in critically ill obstetric as well as non-obstetric patients
Gilbert TT *et al.* Am Co of Ob and Gyn, 2003; 102	3.4% in obstetrics SAPS II good predictor in obstetrics patients with medical complication
Karnad DR *et al.* Critical Care Med 2004;32:1418-1419	21.6% in obstetrics, APACHE II scores overpredict mortality rates
Kim EK *et al.* J Prev Med Pub Health 2005;38:276-282	APACHE III and SAPS II excellent mortality prediction in critically ill patients in multidisciplinary ICU
Present studyTempe A *et al.* 2005 unpublished	40% in obstetricsSAPS II good predictor of obstetric mortality

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Source of Support: Nil, **Conflict of Interest:** None declared.

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