ORIGINAL ARTICLE

A prospective study of clinical profile and outcome of critically ill obstetric patients in ICU at a tertiary level hospital in India

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ABSTRACT

Background: Pregnant women in India are at higher risk of dying as compared to middle to high income countries. Deaths can be prevented if risk factors are identified, critical illness is diagnosed early in pregnancy and timely critical care is provided.

Objectives: To appraise the obstetric admissions to the ICU in a tertiary care hospital in India in an attempt to identify the risk factors influencing maternal outcome.

Methodology: A prospective cohort study was conducted in critically ill obstetric patients over two years. Causes of admissions, interventions required, course during ICU stay and fetomaternal outcome were recorded for each patient. APACHE II and SAPS II scores were calculated.

Results: Among 224 obstetric patients admitted to the ICU, maternal mortality was 35.3%. Most patients were postpartum (61.2%). Nonsurvivors were significantly older, multiparous, had delayed admissions to ICU and longer ICU length of stay (ICU-LOS) compared to survivors. Mean APACHE II and SAPS II scores were 20.17±9.60 and 36.14±14.89 respectively, which were significantly higher among non survivors compared to survivors.

Conclusion: Obstetric hemorrhage, multiparity, illiteracy, lack of antenatal care and delay in ICU admission were major risk factors influencing maternal outcome.

Key words: Obstetric hemorrhage; ICU; Maternal mortality; SAPS II; APACHE II

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INTRODUCTION

Care of critically ill obstetric patients is dual job as it involves care of two lives and it has always been a challenge for critical care physicians. There are certain issues related to alteration of maternal physiological parameters and interaction of these parameters with disease processes, which pose threat to both pregnant woman and her baby. Hence, these women need special units to monitor and to treat complications arising from diseases during peripartum period. Timely intervention by an acute care physician coupled with young age factor improves the prognosis of critically ill obstetric patients. There has been a significant fall in maternal mortality in the last six decades in high income countries, but the low-income countries have not shown similar improvement. According to a recent systematic review, average ICU maternal mortality rate is significantly higher in developing countries (8-40%), compared to that in developed countries (0.1-3.4%).[1] National data on ICU mortality in acutely ill obstetric patients are not available. Current maternal mortality in India is 212 per 100,000 live births, and obstetric patients constitute 0.4 to 4% of admissions in Indian ICUs in public hospitals.[2,3,5]

Admission to ICU is an important indicator of maternal morbidity.[4] There are only few retrospective cohort studies with small sample size on this subject.[3,7] Hence, the present study, conducted among critically ill obstetric patients, aims to assess the reasons for their admission to ICU, evaluate their outcomes and the factors influencing

these outcomes.

Various ICU severity scoring systems have been used to estimate risk of death in obstetric population which include mainly the simplified acute physiology score (SAPS), the mortality prediction model (MPM), and the acute physiology and chronic health evaluation (APACHE II).[8,9] Among these, APACHE II and SAPS II are the most commonly used scores in western countries but validation have been persistently poor in obstetric population due to relatively younger age and physiological alterations related to pregnant state. Hence, secondary objective of this study was to compare the validity of APACHE II and SAPS II scores among critically ill obstetric patients.

METHODOLOGY

A prospective observational cohort study was conducted at a 5 bedded ICU, at an 877 bedded tertiary care teaching hospital in India. **A**fter approval by the institutional ethics committee and obtaining written consent from each patient (from relatives if the patient was unable to give consent), data from obstetric patients admitted to the ICU from September 2009 to August 2011, were collected. All critically ill women during pregnancy or within 6 weeks of delivery, with ICU length of stay (ICU-LOS) greater than 24 hours of admission were included in the study. Patients less than 18 years of age, those who were readmitted to ICU and ICU-LOS less than 24 hours of ICU admission were excluded from the present study in accordance with the original SAPS II and APACHE II criteria. All data were collected by primary author himself. Study size was dictated by available cohort for the years of collected data. Following demographic variables were recorded in formatted data-sheet for each pregnant woman: age, previous obstetric history, period of gestation, parity, parturient status (antepartum or postpartum), number of antenatal visits, educational status, ICU-LOS, pre-existing medical disorders, disorders complicating present pregnancy, mode of delivery (vaginal or cesarean), maternal and fetal outcome. All patients were followed up after discharge from ICU until discharge from hospital. Acute disorders leading to ICU admission were classified into three categories: medical, surgical and obstetric. Conditions that occur only in pregnancy or the postpartum period were classified as obstetric disorders and were diagnosed using predefined criteria.[1] Sepsis was defined according to surviving sepsis campaign guidelines, published in 2013.[10] Delay in ICU admission was defined as 'time lag from first call of request for ICU admission, to actual ICU admission'.

Data required for the calculation of severity scores; Acute Physiology And Chronic Health Evaluation II and Simplified Acute Physiology Score II (APACHE II & SAPS II) were prospectively collected. Specific interventions executed at the ICU (such as the use of mechanical ventilation, intensive monitoring, enteral nutrition, inotrope and vasopressor infusions etc.) were recorded. Causes of maternal mortality were also documented. Primary outcome variables studied were maternal mortality rate, perinatal mortality rate and length of ICU stay. Maternal mortality has been defined by WHO as a "death of a woman while pregnant or within 42 days of termination of pregnancy, irrespective of the duration and site of the pregnancy, from any cause related to or aggravated by the pregnancy or its management but not from accidental or incidental causes".[6] Perinatal mortality was defined by WHO as the "number of stillbirths and deaths in the first week of life".

Statistical analysis was performed using SPSS version 19.0. Chi-square test, Fisher's exact test, Student *t*-test, and Mann-Whitney U test were used as appropriate. Univariate analysis was performed to identify risk factors that significantly contributed to maternal mortality. A p-value < 0.05 was considered to be significant.

RESULTS

During the study period of two years, a total of 390 patients were admitted to ICU, among which 283 were admitted for obstetric reasons (72.9 % of total ICU admissions). Of 283 obstetric admissions, fifty nine patients were excluded from the study based on exclusion criteria and 224 patients were included in study. A total of 24,173 obstetric deliveries occurred during this period, giving an ICU admission rate of 1170 per 100,000 deliveries (i.e. 1.17 %). Maternal mortality rate in ICU was 35.3% (326/100,000 live births). Of 224 parturients, eighty seven (38.8 %) were admitted in the antepartum period and 137 (61.2 %) were admitted in the postpartum period.

The mean age of the patients was 27.3 ($\pm$ 4.9) years, and mean gestational age was 31.2 ($\pm$ 6.5) weeks (Table 1). Advanced maternal age and lower mean gestational age were significantly associated with higher mortality in ICU. 114 patients (50.9 %) were multiparous (parity ≥ 2). Multiparity was observed to be significantly associated with higher mortality [OR, 21.1 (9.4 - 47.5); $p < 0.0001$]. Approximately 24 % of women had no antenatal check-up and this lack of antenatal care was also found to be significantly associated with higher risk of mortality [OR, 81.6 (23.8-279.7); $p < 0.0001$]. Approximately 56% women were illiterate (no primary education). Again, illiteracy was found to be a significant risk factor [OR: 3.5 (1.9-6.5); $p < 0.001$]. Mean ICU-LOS was 2.3 $\pm$ 0.9 days. Non surviving women stayed in ICU significantly longer as compared to survivors ($p < 0.0001$). Perinatal mortality rate was 271 per 1000 live births which was also significantly higher among non survivors compared to survivors [OR, 8.2 (4.1-16.7); $p < 0.0001$]. Mean delay in ICU admission was 5.4($\pm$ 5.3)

Table 1: Demographic characteristics of parturients

Characteristics	Total (n=224)	Survivors (n=145)	**Non-survivors** (n=79)	P value	Odd's ratio (95% CI)
Maternal age in years	27.3±4.9	26.7±5.0	28.4±4.6	0.008	-
Gestational age in weeks	31.2±6.5	33.8±8.2	29.7±4.6	0.034	-
Parity					
<2, n (%)	110 (49.1)	102 (70.3)	8 (10.1)	-	0.0 (0.0-0.1)
≥2, n (%)	114 (50.9)	43 (29.7)	71 (89.9)	<0.0001	21.1 (9.4- 47.5)
Parturient status					
Antepartum, n (%)	87 (38.8)	59 (40.7)	28 (35.4)	-	0.8 (0.5-1.4)
Postpartum , n (%)	137 (61.2)	86 (59.3)	51 (68)	0.44	1.3 (0.7-2.2)
Antenatal visits					
No visit, n (%)	53 (23.7)	3 (2.1)	50 (63.3)	<0.0001	81.6 (23.8-279.7)
≥1 visit, n (%)	171 (76.3)	142 (97.9)	29 (36.7)	-	0.0 (0.0-0.0)
Literacy					
Literate, n (%)	99 (44.2)	79 (54.5)	20 (25.3)		0.3 (0.2-0.6)
Illiterate, n (%)	125 (55.8)	66 (45.5)	59 (74.7)	<0.001	3.5 (1.9-6.5)
ICU LOS (days)	2.3±0.9	2.1±0.7	2.8 ±0.9	<0.0001	-
APACHE II	20.2±9.6	16.1±7.7	27.7±8.1	<0.0001	-
SAPS II	36.1±14.9	29.5±11.4	48.3±12.8	<0.0001	-
Diagnostic category					
Medical, n (%)	96 (42.9)	62 (42.8)	34 (43)	0.96	1.01 (0.58-1.76)
Obstetric, n (%)	124 (55.3)	81 (55.8)	43 (54.5)	0.83	0.94 (0.54-1.63)
Surgical, n (%)	4 (1.8)	2 (1.4)	2 (2.5)	0.54	1.85 (0.26-13.44)
Perinatal mortality, n (%)	51 (27.1%)	14 (9.7)	37 (46.8)	<0.0001	8.2 (4.1-16.7)
Mode of delivery					
Vaginal, n (%)	118 (52.7)	77 (53.1)	41 (51.9)	0.43	0.95 (0.55-1.65)
Cesarean, n (%)	70 (31.3)	48 (46.9)	22 (48.1)	0.21	0.78 (0.43-1.42)
ICU admissions Delay (hours)	5.4±5.3	3.4±3.7	9.1±5.7	<0.0001	-

CI, Confidence Interval, ICU-LOS, ICU length of stay; APACHE, Acute Physiology And Chronic Health Evaluation; SAPS, Simplified Acute Physiology Score

hours, which was also significantly higher in non-surviving women compared to surviving ones ($p < 0.0001$).

Table 2 lists the causes of obstetric admissions to ICU. Overall, the most common indication of ICU admission was obstetric hemorrhage (22.8%). Among antepartum women, hypertensive diseases of pregnancy (19.5%) were the most common causes of admission. Obstetric hemorrhage (35%) was the most common indication for postpartum admissions. On univariate analysis, maternal mortality showed significant correlation with congestive cardiac failure, sepsis, hepatic encephalopathy, obstetric hemorrhage, pulmonary edema and perforation peritonitis. Most common causes of death in ICU were septic shock (24 %), hemorrhagic shock (22.8%) and acute respiratory failure (22.3%).

Table 2: Causes of ICU admission

Conditions	**Total (n=224)**	**Survivors (n=145)**	**Non-survivors (n=79)**	**Odd's ratio (95% CI)**
CHF, n (%)	12 (5.4)	6 (4.1)	6 (7.6)	1.9 (0.61-6.1)
Ectopic pregnancy rupture, n (%)	16 (7.1)	12 (8.3)	4 (5)	0.6 (0.2-1.9)
Hepatic encephalopathy, n (%)	12 (5.4)	4 (2.8)	8 (10.1)	3.9 (1.2-13.6)
Viral hepatitis, n (%)	12 (5.4)	10 (6.9)	2 (2.5)	0.4 (0.1-1.6)
Hypertensive disorders, n (%) of pregnancy	39 (17.4)	29 (20)	10 (12.7)	0.6 (0.3-1.3)
Immunosuppression, n (%)	12 (5.4)	8 (5.5)	4 (5)	0.9 (0.3-3.1)
Obstetric hemorrhage, n (%)	51 (22.8)	31 (21.4)	20 (25.3)	1.3 (0.7-2.4)
Perforation peritonitis, n (%)	4 (1.8)	2 (1.4)	2 (2.5)	1.9 (0.3-13.4)
Pulmonary edema, n (%)	12 (5.4)	10 (6.9)	2 (2.5)	0.4 (0.1-1.6)
Sepsis, n (%)	20 (8.9)	9 (6.2)	11 (13.9)	2.4 (0.9-6.2)

CHF, congestive cardiac failure

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Table 3: Comparative features of SAPS II and APACHE II scores applied on obstetric critically ill patients

Score	AUROC	95 % Confidence Interval	Mortality predicted	Mortality observed	SMR
SAPS II	0.863	0.808-0.971	27.6	35.3	1.27
APACHE II	0.811	0.752-0.871	38.3	35.3	0.92

AUROC, Area under Receiver operating characteristic Curve; SMR, standardized mortality rate

Antibiotic therapy, enteral nutrition and blood products therapy were most common interventions performed in parturients during ICU stay (83.4%, 57.1% and 56.7% respectively).

Mean APACHE II and SAPS II scores were 20.17 ± 9.60 and 36.14 ± 14.89 respectively, which were significantly higher among non survivors compared to survivors (Table 1). Discrimination by SAPS II score was better than APACHE II (larger AUROC of SAPS II, Table 3) & SAPS II under predicted the mortality (SMR=1.27).

DISCUSSION

Both ICU admission rate and overall proportion of ICU admissions were higher (80%) compared to data from developing (0.5–16.0 %) or developed countries (0.4–12.0 %).[3] The centre, where the study was conducted is a tertiary referral centre for obstetric care in Delhi, which explains the high ICU admission rates. Maternal mortality was high (35%) in our study, comparable to other studies from India.[7,12] The causes of high mortality in this subset of ICU population might be multifactorial, most crucial of which are advanced maternal age, multiparity, lower mean gestational age, lack of antenatal care, low educational level and delayed transfer to ICU.

Similar to other studies, most common causes of ICU admission were obstetric hemorrhage (22.8%) and hypertensive diseases of pregnancy (17.4%).[11,13] Routine antenatal care and regular follow–up are recommended to prevent complications of pre-eclampsia (seizures, pulmonary edema), anemia, infections (hepatitis, tuberculosis and malaria), gestational diabetes mellitus and heart diseases in pregnancy.

We observed multiparity to be a risk factor which led to high incidence of obstetric hemorrhage. Prolonged third stage of labor, multiple pregnancy, episiotomy, fetal macrosomia, and history of postpartum hemorrhage are known risk factors for PPH.[13] Anaemia, orthostatic hypotension and DIC (disseminated intravascular coagulation) are known complications of massive hemorrhage. Radical measures to prevent emergence of risk factors of obstetric hemorrhage both in antepartum and postpartum period should certainly reduce the maternal mortality.

Sepsis was the most common cause of maternal death in our study. The major cause of higher mortality due to sepsis in obstetric patients of developing countries is higher prevalence of septic abortions. Early goal directed therapy, tight glycaemic control, infection control policies and judicious use of broad spectrum antibiotics can prevent mortality due to maternal sepsis in ICU

We observed that both SAPS II and APACHE II scores were higher in our patient population compared to those in studies from other countries, which is probably due to the delay in presentation to hospital and transfer to ICU.[14,13] The causes of delayed presentation to hospital were illiteracy, financial constraints and problems associated with conveyance of patients.[12,17] Three factors are linked to lack of care, delay in decision making by patients' relatives; delay in patient transfer due to long distance, bad condition of roads or unavailability of transport; or delay in delivery of institutional care.[17] Maternal death in developing countries is attributable to a shortage of well trained staff, crucial medication and supplies, together with executive delays and clinical mismanagement. Aforementioned factors coupled with scarcity of ICU beds correspondingly leads to delayed admission to ICU. Considering that, the use of the SAPS II scores has enabled the consistent prediction of the mortality in our study; attempts should be made to compute the score as a routine in ICU and triage critically ill obstetric patients using SAPS II.

In India, women are not free to take pregnancy related decisions; they are usually dependent on either husband or mother-in-law. While poverty, illiteracy, gender disparity, unfettered fertility, anemia and infections contribute to most of the obstetric critical illnesses, the lack of infrastructure and ineffective public health services form an additional hurdle to improvement of obstetric mortality and morbidity in India.

Major limitation of this study was that it was a single centre study, hence results of this study cannot be extrapolated to general Indian population. The exclusion of women under 18 years of age and ICU stay less than 24 hours was done to meet the criteria to calculate APACHE II score. This exclusion would have confounded the estimation of actual obstetric mortality as early teen age pregnancy, which particularly carries an independent risk to obstetric mortality, is not an uncommon occurrence in India. Main positive features of this study are adequate sample size, prospective nature and reliable data collection by single investigator in a recognized obstetric centre.

We propose that additional funds must be allocated by the governments to establish closed obstetric critical care units in every tertiary level hospital, which should be adequately staffed by a multidisciplinary team of anesthesiologists, obstetricians and intensivists in order to improve the quality of care and to reduce maternal mortality. An intense political will is needed to achieve zero morbidity and mortality in critically ill obstetric patients. Health programs need to be modified in light of prevailing health conditions and sociocultural factors. Infrastructure must be upgraded and special training provided to healthcare workers in resuscitative measures and immediate care in obstetric emergencies. Appropriate policies and increasing the budget share of GDP (Gross Domestic Product) on healthcare can ameliorate many existing problems in delivering critical care to obstetric patients.

CONCLUSIONS

Mortality of obstetric patients admitted to ICUs is very high in India. Obstetric hemorrhage, lack of antepartum care and delay in ICU admission were major risk factors influencing maternal outcome in the present study. SAPS II score performed better than APACHE II (SAPS II has better discriminative power as shown by larger AUROC), but underpredicts the mortality in obstetric patients. The conscientious and full adoption of safe motherhood initiative can prevent some of the complications requiring ICU care. There is need for an increase in the number of ICU beds and enhancement of quality of care.

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