"ONE YEAR CROSS-SECTIONAL STUDY OF THE CRITICALLY ILL OBSTETRIC PATIENTS REQUIRING INTENSIVE CARE UNIT ADMISSIONS AND PREDICTING MORTALITY BY USING SIMPLIFIED ACUTE PHYSIOLOGY SCORE II"

By

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Dissertation submitted to the
KLE University, Belgaum, Karnataka

In Partial Fulfillment
of the requirements for the degree of

M. D. (GENERAL MEDICINE)

Under the Guidance of

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BELGAUM, KARNATAKA

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KLE UNIVERSITY, BELGAUM, KARNATAKA

DECLARATION

I hereby declare that this dissertation entitled **"ONE YEAR CROSS-SECTIONAL STUDY OF THE CRITICALLY ILL OBSTETRIC PATIENTS REQUIRING INTENSIVE CARE UNIT ADMISSIONS AND PREDICTING MORTALITY BY USING SIMPLIFIED ACUTE PHYSIOLOGY SCORE II"** is a bonafide and genuine research work carried out by me under the guidance of **Dr. NAVEEN S. ANGADI** $_{\textbf{MD}}$ Assistant Professor, Department of Medicine, Jawaharlal Nehru Medical College, Nehru Nagar, Belgaum – 10.

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Place: Belgaum **Dr. VAMSIDHAR REDDY VEMPALLI**

LIST OF ABBREVIATIONS USED

AFLP	-	Acute fatty liver of pregnancy
APACHE	-	Acute physiology and chronic health evaluation
ARDS	-	Acute respiratory distress syndrome
CCF	-	Congestive cardiac failure
CVT	-	Cortical venous thrombosis
DIC	-	Disseminated intravascular coagulation
DM	-	Diabetes mellitus
DVT	-	Deep vein thrombosis
ERV	-	Expiratory reserve volume
FHF	-	Fulminant hepatic failure
FiO2	-	Fraction of inspired oxygen
FRC	-	Functional residual volume
HCO3	-	Bicarbonate
HDUs	-	High dependency units
HELLP	-	Hemolysis, Elevated Liver enzymes, Low Platelet
HIV	-	Human immunodeficiency virus
IC	-	Inspiratory capacity
ICU	-	Intensive care unit
IUD	-	Intra uterine death
MICU	-	Medical intensive care unit
MODS	-	Multi organ dysfunction
MPMs	-	Mortality probability models
OBG	-	Obstetrics and gynaecology
PaCO2	-	Partial pressure of carbon dioxide in the arterial blood

PaO2	-	Partial pressure of oxygen in the arterial blood
PIH	-	Pregnancy induced hypertension
PPH	-	Post partum haemorrhage
RV	-	Residual volume
SAPS	-	Simplified acute physiology score
TLC	-	Total lung capacity
VC	-	Vital capacity

ABSTRACT

Background and Objectives

Despite progress in medical field and improvement in health facilities provided, maternal mortality is still very high in most of the developing countries. Objectives of the present study were to describe illness characteristics of a large cohort of obstetric patients admitted to the ICU and to determine whether mortality prediction was accurate with use of the SAPS II model.

Methods

The present cross sectional study was conducted in Department of Medicine, at KLES Dr. Prabhakar Kore Hospital and Medical Research Centre, Belgaum from January 2008 to December 2008 on 41 patients. Critically ill obstetric patients requiring ICU admissions were studied for clinical picture, diagnosis, demographic profile and mortality. SAPS II score was calculated according to the different variables for predicting mortality.

Results

Majority of the patients were between 20 to 25 years of age (56.09%) and primigravida (58.54%). In obstetric disorders, PIH and Puerperal sepsis were the commonest indications for ICU admission, being present in nine patients (21.95%) and seven patients (21.95%) respectively. In medical disorders most common cause for ICU admission was CVT in 10 patients (24.39%) that is, nine post partum CVT and one antepartum CVT followed by heart disease in three patients (7.31%). Mean SAPS II score for expired patients was higher, viz., 57.1 ± 13.67 (range 40-79), compared to that of survivors, which was 28.5 ± 12.63

(range 12-56). The predictability of mortality by SAPS II model was statistically significant (p=0.000).

Conclusion

The SAPS II model is a good predictor of mortality in obstetric patients admitted for medical reasons, but slightly over-predicted the mortality rate in obstetric patients admitted for only obstetric reasons. 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

ICU admissions; Maternal mortality rate; SAPS II model; Organ failure.

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INTRODUCTION

Maternal mortality rate is very high in India. Critically ill obstetric patients form up to 7% of admissions in Indian intensive care units. Even though obstetric patients constitute a considerable portion in ICU admissions, sparse data is available in India regarding the critical care perspective of critically ill obstetric patients.

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. Separate ICUs have been developed for cardiac, respiratory, burns, pediatric and neonatal care, but an ICU only for obstetric patients is not yet widely available in developing countries.

Several disease-severity-scoring systems have evolved for predicting mortality in ICU patients. Acute Physiology and Chronic Health Evaluation (APACHE), Simplified Acute Physiology Score (SAPS) and Mortality Probability Models (MPMs) are some of the scoring systems that are commonly used for objectively assessing the clinical status and severity of disease of critically ill patients.

These scoring systems were tested, refined and validated in the developed world, mainly in the American and European ICUs, in non-pregnant patients to predict adverse outcomes based on data available in the first 24 hours of admission. Little is known regarding the ability to assess severity of illness and predict outcomes in obstetric patients. ICUs from the Indian subcontinent seldom ever participated in these studies. Critical-illness-scoring systems require modification for obstetric patients to adjust for the normal physiologic responses to pregnancy. Evidence is also available suggesting that the critical care issues in obstetric patients in India are different from those observed in patients in western countries.

Therefore, this study was designed to describe illness characteristics of a large cohort of obstetric patients admitted to the ICU to determine whether mortality prediction was accurate with use of the SAPS II model.

OBJECTIVES

The objectives of the present study were:

1. To study the spectrum of diseases requiring critical care among critically ill obstetric patients.
2. To predict mortality of critically ill obstetric patients requiring intensive care based on data available in the first 24 hours of admission in to ICUs by using SAPS II model.

REVIEW OF LITERATURE

Obstetric patients account for a small but significant number of admissions to the ICU. Several changes in organ function occur in pregnancy, including alterations in blood volume, cardiac output, respiration, endocrine function and blood levels of clotting factors and antithrombotic proteins.[1-3] These changes stress the normal physiological reserve of the human body and limit the ability of the pregnant woman to compensate for the derangements produced by acute diseases, often resulting in severe organ dysfunction. Moreover, there are several disorders peculiar to the pregnant state, including preeclampsia, placental abruption, amniotic fluid embolism and postpartum hemorrhage (PPH), all of which can produce potentially life-threatening organ failure and maternal mortality.[1-3]

Because the physiologic process of childbearing in young, healthy women may be complicated by acute potentially fatal disorders in approximately 1 to 9 per 1000 pregnancies,[2,4] healthcare systems in most countries concentrate on regular antenatal checkups to detect complications at an early stage. Many obstetric disorders reverse rapidly after delivery,[5,6] and early delivery is a useful option in these conditions. Delivery of a small preterm baby may compromise neonatal survival. With improvement in neonatal intensive care, women can give birth as early as 24 weeks of pregnancy and still have a good neonatal outcome. A combination of good antenatal care, early detection and intervention in complicated pregnancies, and timely delivery (by cesarean delivery, if necessary) has reduced the maternal mortality rate in developed countries to 4 to 20 per

100,000 deliveries.[7,8] On the other hand, maternal mortality rate is high in developing countries in Africa and Asia. Inadequate medical and surgical facilities, lack of antenatal care, high costs of treatment, social bias, and traditional customs hamper proper implementation of maternal health programs.[9,10]

High-quality neonatal intensive care is not available or is available only in large cities. Consequently, the neonatal mortality rate associated with elective premature delivery is high, and pregnant women with conditions like severe preeclampsia often refuse elective preterm delivery, exposing themselves to a high risk of organ dysfunction and possibly death.[3] As a result, although pregnancy-induced hypertension (PIH) is less common in Asian Indians than in whites,[11,12] its complications (eg, eclampsia, renal failure) are common in South Asians but rare in Americans, Canadians, and Europeans.[7,11,12]

Obstetric patients, who are admitted to ICUs, in a sense, have slipped through loopholes in the antenatal care system and have severe acute morbidity. Public health experts have studied factors leading to maternal mortality to deliver focused antenatal care to pregnant women at risk for fatal complications.[7] This approach has worked well in developed countries, where maternal deaths have declined to levels that are too low to permit statistical analysis.[13]

Consequently, in several developed countries such as the United Kingdom, medical audit is performed on pregnant women with serious illnesses, the so called "near-miss maternal mortality," to look for preventable factors and adequacy of healthcare.[14] A near-miss maternal mortality is defined as the development of a life-threatening complication during pregnancy or in the period immediately after delivery.[14] A more objective definition is admission to the ICU.[13] This definition is difficult to apply to women who may not reach the ICU; in developed countries, such women may have recovered after admission to high-dependency units (HDU) or intermediate care units,[13] whereas in poor countries with an inadequate number, ICU beds, the women may die before admission to the ICU.[9] Therefore, Mantel et al's definition of a near miss[15] may be more appropriate: "A patient with an acute organ dysfunction that could result in death if not treated appropriately."

The International Classification of Diseases version 10 defines maternal mortality as death occurring during pregnancy or within 6 weeks of delivery.[16]

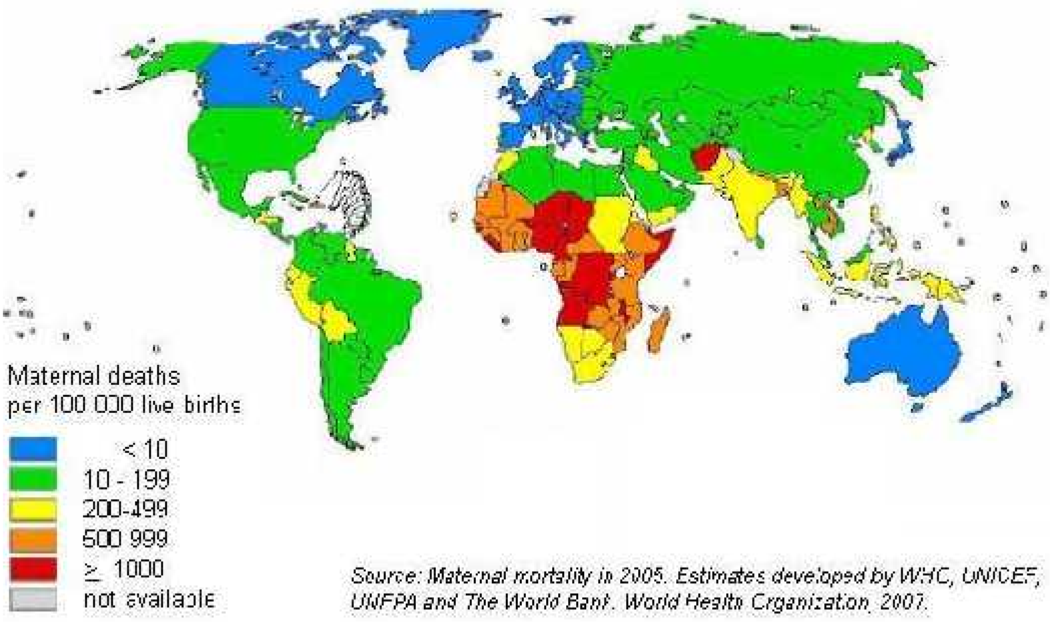


Figure 1: Maternal mortality ratio, by country, 2005[17]

Maternal mortality is expressed as a maternal mortality ratio, which is defined as deaths per 100,000 live births.[17] The maternal mortality ratio varies widely in different regions (Figure 1). It ranges from 11 in North America to 28 in Europe, 190 in Latin America, 260 in Oceania (excluding Australia; 6 in Australia), 330 in Asia (excluding Japan; 12 in Japan), and 820 in Africa.[7,17] There are wide variations in social customs, healthcare systems, referral patterns, medical illnesses, and obstetric diseases in different parts of the world all of which could contribute to critical illness in pregnancy and maternal mortality.[18,19]

Obstetric disorders and organ failure:

Sixty-five percent of obstetric patients in the ICU experience failure of one or more organ systems.[19,20] Organ dysfunction may occur in a variety of obstetric disorders, including pre-eclampsia, hemolysis, elevated liver enzymes and low platelet count (HELLP) syndrome, acute fatty liver of pregnancy (AFLP), amniotic fluid embolism, obstetric hemorrhage, and pelvic sepsis. In a retrospective analysis, it was[20] found that respiratory failure was the most common organ system failure in obstetric patients (32%), followed by hematologic (28%), cardiovascular (28%), renal (9%), liver (8%), and neurologic failure (1.5%). The incidence of organ affection in individual obstetric disorders is not clear. They studied 928 obstetric patients who were admitted to the ICUs of two inner-city public hospitals one in Houston, Texas, and one in Mumbai, India. Organ dysfunction was identified using the Multiple Organ Dysfunction Score criteria. Seventy-two percent of patients (668 of 928 patients) were admitted for obstetric disorders. The incidence of involvement of individual organ systems in various obstetric disorders in this cohort is calculated.

Risk factors for intensive care unit admission

Two large case-control studies identified differences between obstetric patients who required ICU admission and controls who did not.[21,22] A study done in Maryland,[21] analyzed a statewide database during the 14-year study period, and showed that there were 1023 ICU admissions and 34 deaths. Age greater than 35 years (odds ratio [OR], 1.4), black race (OR, 1.8), a racial category other than black or white (OR, 5.9), treatment in minor teaching hospitals (OR, 2.0), and transfer hospital to a higher level hospital (OR = 2.51) were predictors of the need for ICU admission.[21] In a similar study of obstetric ICU admissions from three regions in France,[22] analyzed 375 patients and 750 controls. They found that consultation at a hospital other than the hospital where admitted for delivery (OR, 2.8) and non-European nationality (OR = 2.5) were predictors of ICU admission. Other variables that independently predicted the need for ICU admission included multiple pregnancy (OR, 2.3) and parity (OR, 1.7).

Obstetric disorders versus Medical disorders:

Obstetric disorders account for 55% to 80% of ICU admissions in obstetric patients.[1,19,21,24,25] PIH and its complications (eclampsia, renal failure, HELLP syndrome, AFLP, coagulopathy), obstetric hemorrhage, and pelvic sepsis account for up to 90% of these obstetric disorders. There is only minor variation in the proportions of these three disorders in different regions of the world.[7] The spectrum of medical disorders in pregnancy, which account for the remaining 20% to 45% of ICU admissions, show wide geographic variation. Asthma, pneumonia, drug abuse, and complicated urinary tract infection are common in the developed, temperate regions of the world.[20,26,27] Malaria,[19,28] viral hepatitis,[19,29,30] attempted suicide (poisoning or burns),[19,31] valvular heart disease,[28,29] and anemia[32] are more common in less developed tropical countries. Trauma caused by motor vehicle accidents is common in developed countries,[2,33] and burns are common in developing countries.[31]

Antepartum versus postpartum admissions:

Most obstetric patients are admitted to the ICU in the postpartum period. Antepartum admissions account for 12% to 45% of all admissions. [19,33-38]

Two reasons have been cited for the predominance of postpartum ICU admissions:

1. Blood loss during and after delivery may cause hemodynamic decompensation in women with preexisting disorders,[35]

2. There may be a reluctance to move pregnant mothers away from the obstetrics area unless absolutely necessary.[35]

A study[38] found that 80% of antepartum admissions were for medical conditions, whereas 77% of postpartum admissions were for obstetric conditions. In a study from India, medical disorders accounted for 45% of antepartum admissions but accounted for only 19% of postpartum admissions.[19]

Community-acquired infections were the most common condition that required antepartum admissions. These infections included pneumonia, pyelonephritis, and chorioamnionitis in developed countries[35,36,38] and malaria and viral hepatitis in developing countries.[18,19] In postpartum patients, hemorrhage, puerperal sepsis, and complications of preeclampsia (eg, eclampsia, HELLP syndrome) were common admitting diagnoses.[19,38] Respiratory system failure is the most frequent organ system failure to occur in antepartum patients, whereas disseminated intravascular coagulation (DIC) and hemodynamic instability, including shock, are more common in postpartum cases.[19,35] Almost 80% of postpartum patients are admitted within 24 hours of delivery.[34,35]

Prognostic scores and outcomes:

Several disease-severity-scoring systems have evolved for predicting mortality in ICU patients. Acute physiology and chronic health evaluation, SAPS and MPMs are some of the scoring systems that are commonly used for objectively assessing the clinical status and severity of disease of critically ill patients.[45]

One study 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.[46]

Among patients in the ICU, Obstetric patients generally have better outcomes than do non-pregnant patients. Commonly used prognostic systems have not been accurate in the predicting outcomes of obstetric patients in the ICU. Several studies have evaluated the accuracy of the APACHE II scoring system in such patients.[19,20,34,39-41] In most studies, the mortality rate was significantly lower than that predicted by the APACHE II score. This finding has been reported in countries with low ICU mortality[39,40] and also in countries with comparatively higher rates.[19,42] Other prognostic scoring systems, such as the APACHE III, SAPS II, and MPM II, also have been studied, albeit in fewer studies, and show the same problem when applied to obstetric patients they have good discrimination but poor calibration.[26,38,43] All systems uniformly over-estimate the maternal mortality rate.[19,26,34,38,43] Two studies have shown that although the APACHE II and SAPS II systems closely predict the mortality rate in obstetric patients with medical disorders, they grossly over-predict death in patients with obstetric disorders.[19,38] Because of pregnancy-induced physiologic changes, high scores may be given to values that are normal for pregnant patients but are outside the normal range for non-pregnant individuals.[38,44] This difference partly may explain the high scores and overestimation of the number of deaths using the standard outcome prediction models. Another possible reason is that many obstetric disorders, physiologic derangements, and organ dysfunction reverse rapidly after delivery, making the initial assessment less reliable in predicting outcome,[21,39] One study[44] have shown that only the Glasgow Coma Score is as good a predictor of outcome as the APACHE II score in patients with eclampsia.

One year retrospective study conducted in Mumbai on all the obstetric patients admitted to MICU. The APACHE II score was calculated on admission in 34 patients, etiological factors needed for critical care and the number and type of organ systems affected were analyzed. In there study actual mortality was higher than that predicted by APACHE II score. This is because scoring system is based on western population and the physiologic changes during pregnancy (such as higher respiratory and heart rates) and lower hematocrit and creatinine levels, can lead to higher APACHE II scores, causing falsely elevated predicted mortality rates.[47]

Another study conducted in New Delhi suggested that SAPS II scoring system appears to be one such model which has the potential to either be customized or used as a prototype to develop locally appropriate severity scoring systems for predicting mortality in critically ill obstetric patients in India. The mean SAPS II score was significantly higher in those patients who died compared to survivors.[48]

Geographic differences

A study was conducted in obstetric patients, who were admitted to the ICU in an inner-city public hospital in Hosuton, Texas, and in a public hospital in Mumbai, India.[18] Both hospitals were similar in location and type of population served. A total of 174 United States and 754 Indian women were studied. Although the median number of organs affected was similar in the two groups, Indian patients were sicker than United States patients (median APACHE score, 16 versus 10). Neurologic dysfunction with coma and seizures, renal failure, and cardiovascular failure with shock were more common in Indian patients, whereas coagulopathy and respiratory failure were more common in United States patients. The spectrum of obstetric disorders was similar in both groups, but the medical disorders differed: Malaria, viral hepatitis infection, and cerebral venous thrombosis (CVT) were more in Indian patients, whereas ICU admissions for drug abuse, asthma, bacterial sepsis, and acute abdomen were more in the United States cohort. Fewer Indian patients received prenatal care (27% versus 86%) and presented to the hospital later (more than 24 hours after onset of acute illness, 40% versus 10%). The maternal and fetal mortality rates were higher in the Indian cohort (25% and 51%) than the United States cohort (2.3% and 13%). This study illustrates regional differences in the case mix and in intensive care requirements among these obstetric patients.[18] A region-wise analysis of studies on critically ill obstetric patients reveals other noteworthy differences.

United States and Canada

Studies from the United States and Canada show that obstetric patients account for a small proportion (< 1%) of ICU admissions.[49] A sharp decline in the mortality rate has been reported after 1995.[20,21,25-27,35,38,39,49-53] There is wide variation in the reported rates of ICU admission and mortality. This difference is pronounced when comparing reports from general medical or medical-surgical ICUs[20,26,35,49] with reports from obstetric ICUs.[25,27,50] Studies from obstetric ICUs reported higher admission rates (admissions per 100,000 deliveries) and lower mortality rates. Many of these ICUs function like intermediate care units and have a much lower admission threshold than general medical or medical-surgical ICUs. The type of hospital also seems to influence the ICU mortality rate. In one study it was found that the rate was 2.5% in minor teaching hospitals, 2.8% in community hospitals, and 8.1% in major teaching hospitals. However, when adjusted for severity of illness, these differences were not significant. The investigators concluded that the higher overall mortality rate in major teaching hospitals occurred because obstetric patients who experience complications selectively are transferred to larger hospitals.[21] Another feature of obstetric ICU admissions and maternal mortality in the United States is the large ethnic disparity.[7] Minority communities, especially blacks, have a higher likelihood of requiring ICU admission and a higher risk for death.[11,20] In some regions, the difference in the maternal mortality rate in whites and blacks may be as high as 400%.[7].The respiratory system is the most common organ to fail in obstetric patients in US ICUs[18,54] Common causes of respiratory failure include acute respiratory distress syndrome (ARDS), pneumonia, status asthmaticus, and amniotic fluid and pulmonary thrombo-embolism.[18,20,26,38,49,55] For unclear reasons, infections, such as pyelonephritis, in pregnant women are more likely to cause ARDS.[35] Approximately 50% of all obstetric patients in the ICU require mechanical ventilation. In contrast, eclampsia and acute renal failure (ARF) are uncommon when compared with rates in studies from Africa and South Asia.[18,19,32,44,56,57] About 70% of obstetric patients in the ICU are delivered by cesarean delivery, whereas 22% of pregnant women who do not require ICU admission undergo cesarean delivery.[21]

There are three major recent Canadian studies on obstetric admissions to the ICU. The case mix and ICU needs in these studies are similar to those in United States studies; however, the Canadian patients were less ill and had lower APACHE II scores and lower maternal mortality rates.[39,52,53]

Europe

Studies from England before 1995 showed a high ICU admission rate of approximately 700 admissions per 100,000 deliveries compared to studies published after 1995.[36,58] Subsequent studies have found that admission rates declined to 97 to 170 admissions per 100,000 deliveries.[13,23,43] This decline partly may be caused by the beneficial effect of the government-sponsored program of confidential enquiry into maternal deaths, in which avoidable causes that contribute to maternal mortality are identified. Another reason may be because more patients are now managed in HDUs.[4,43] After initial studies suggested that up to 60% of obstetric patients admitted to the ICU could have been managed in HDUs,[58] subsequent studies have shown that there are many benefits to managing less ill obstetric patients in HDUs. Such management reduces the need for ICU admission by 50%, reduces cost, decreases the duration of mother-infant separation, and avoids the hazards associated with transport of critically ill patients to the ICU.[4]

Several studies have shown that many obstetric patients spend less than 24 hours in the ICU, and some investigators argue that these patients could have been managed in units with a lower nurse-to-patient ratio.[43,58] In a Canadian ICU, it was found that the quantity of care required by these patients (evidenced by high therapeutic intervention scoring system scores) can be substantial. The investigators concluded that such patients should be treated in ICUs and that the patients' ICU stay is short because many obstetric disorders reverse rapidly after delivery.[39] These findings have been borne out by other similar studies.

In a multicenter study, all obstetric patients who were admitted to ICUs from two administrative regions in France, were studied. They found that the mortality rate was higher in women who were delivered in a hospital different from the one that provided the prenatal care. This large study also showed that

12% of obstetric admissions to French ICUs were for thromboembolic conditions.[24] Apart from these observations, obstetric intensive care in France is similar to that in other European countries.

In a study of 41 ICU admissions, in a university hospital in Italy, the ICU admission rate was similar to that in other European studies, but only 15% of Italian women were admitted for obstetric hemorrhage. Most admissions (76%) were for complications of preeclampsia, and 5% were for peripartum cardiomyopathy.[59]

In a study of 149 women admitted to the ICU of a tertiary hospital in Spain, lower incidence of serious respiratory infection was observed and fewer women required mechanical ventilation when compared with United States patients.[54] In Spanish patients, obstetric disorders, especially PIH and its complications, were more common than medical disorders, findings that differ from those of some United States reports.[20,26,49] Although the absolute ICU mortality rate in this study (7.5%) seemed to be high, this rate amounted to only 10 deaths per 100,000 deliveries.

A study of all admissions to a university hospital during a seven year period in Finland, which has a national maternal mortality ratio of four deaths per 100,000 deliveries, found that only 22 patients (94 of 100,000 deliveries) required ICU admission, which is a low rate compared with rates found in reports from elsewhere in Europe.[24,59,61] Massive obstetric hemorrhage caused by abruptio placentae, placenta previa, abnormal placentation, and atonic hemorrhage were responsible for 73% of admissions; however, all admissions occurred in low-risk pregnancies.[60] This study shows that with increasing identification of high-risk pregnancies using administrative and public health measures, a stage is reached at which these high-risk pregnancies receive optimum care and do not need intensive care. On the other hand, women with low-risk pregnancies, which account for most pregnancies, rarely develop unforeseen complications that require ICU admission. Although seemingly paradoxical, this situation may be the ultimate result of a healthcare system that delivers ideal prenatal care.

Asia

There is a large variation in maternal mortality in Asia. The national maternal mortality ratio in some countries, such as Japan, is as low as 10 deaths per 100,000 deliveries, but is as high as 1900 deaths in Afghanistan; the average value for the continent is 330 deaths per 100,000 deliveries.[17]

Three studies have been published from Singapore (national maternal mortality ratio, 30 deaths per 100,000 deliveries), two from surgical ICUs [62,63] and one from an obstetric ICU.[64] Although the number of ICU admissions per 100,000 deliveries was much higher in the obstetric ICU, the maternal mortality rates in all three hospitals were between 9 and 15 deaths per 100,000 deliveries. In these studies, 74% to 95% of patients were delivered by cesarean deliveries. The investigators noted that obstetric patients had a low mean APACHE II score and a low mortality rate. A study from china[63] observed that no obstetric patients in their series of ICU admissions had deep vein thrombosis (DVT), a finding that sharply contrasts findings in Europe and the United States, where up to 5% of obstetric ICU admissions are because of pulmonary thromboembolic complications[24]

In a study from Hong Kong (maternal mortality ratio in Hong Kong, 56 deaths per 100,000 deliveries),[34] found that half of their patients were admitted for PPH, 14% were admitted for preeclampsia, and 8% were admitted for rheumatic valvular heart disease. The investigators observed that respiratory failure was less common in their patients than in patients from Western countries and that DVT seemed to be rare in Chinese women. The maternal mortality ratio in this study was 5 deaths per 100,000 deliveries.

There are two reports[41,65] on obstetric patients in ICUs in Israel (national maternal mortality ratio, 17 deaths per 100,000 deliveries). Obstetric patients accounted for 2% to 3% of ICU admissions in these studies, and pregnancy related sepsis was the most common reason for ICU admission (24%), followed by hemorrhage (19%) and preeclampsia (16%). As in patients from Western countries, 41% of patients required mechanical ventilation. The maternal mortality ratio was 5 deaths per 100,000 deliveries. A study from Saudi Arabia (national maternal mortality ratio, 23 deaths per 100,000 deliveries) shows similar results.[42] On average, women in this study were admitted during their sixth pregnancy.[42]

Countries in south central Asia (India, Pakistan, Bangladesh) have high maternal mortality ratios.[17] In India, obstetric patients account for 6.3% of ICU admissions in public hospitals.[66] One study done in Mumbai.[19] found that the ICU admission rate was 546 admissions per 100,000 deliveries, and the mean APACHE II score was 16, indicating that these patients were more ill than were patients in Canada or Singapore (mean APACHE II score, 6). The ICU mortality rate was 21.6%, and the maternal mortality ratio was 119 deaths per 100,000 deliveries (national maternal mortality ratio, 440 deaths per 100,000 deliveries).

A study done in India reported a similar ICU mortality rate (28%).[28] The proportions of women with obstetric disorders and with medical disorders who were admitted to Indian ICUs were similar to those in the United States, but the nature of obstetric problems differs.[18] Although the number of women with preeclampsia was similar, more pre-eclamptic Indian women were admitted with seizures, coma, and renal failure and fewer were admitted with HELLP syndrome, as compared with pre-eclamptic United States women.[18] To a large extent, this disparity is explained by differences in healthcare use by pregnant women. In a study done in[67] all obstetric cases in a rural district in India found that 85% of women delivered at home. Approximately 14.4% of all pregnancies were complicated by severe maternal morbidity, whereas 9 of 1000 deliveries experience such complications in the developed world.[2,4] Only 79% of these women were delivered in hospital, and the rest were delivered at home. The maternal mortality ratio for this region was 500 deaths per 100,000 deliveries. The situation is similar in urban areas. Sixty percent of women admitted to the ICU of a tertiary hospital in Mumbai did not seek antenatal care.[19] Most of these women reached the hospital only after they had developed life-threatening complications, and they had a higher mortality rate (OR, 1.94).

In this part of the world, medical disorders, which account for about 30% of all obstetric admissions, are different from those described in the other regions of the world. Acute viral hepatitis with fulminant hepatic failure (FHF) is common in India.[18,19,30] Most cases are caused by epidemics of hepatitis E virus infection.[68,69] In pregnant women, the mortality rate of FHF that is caused by viral hepatitis is as high as 60%,[19] which is several times higher than that in non-pregnant individuals. Severe malaria also is a common problem and occurred in 11% of patients in one study. The mortality rate in these women can reach 25%.[70] Self-poisoning in an attempt to commit suicide is common during pregnancy.[19] Social stress, poverty, societal gender bias, demands for dowry, and lack of control over decision making about health during pregnancy result in a high rate of depression during pregnancy and puerperium.[71]

The problems of critically ill obstetric patients are similar in Bangladesh and Sri Lanka. Because of a shortage of ICU beds in these countries, tertiary hospitals with ICUs receive a large number of transfers from neighboring areas.[29,72,73] These transfers also occurs in developed countries;[21,22] however, the proportion of referrals is much higher in poorer countries.[19]

In Turkey, transfers from another hospital account for 15% of all obstetric ICU admissions.[74] In another study from Turkey, the maternal mortality ratio for a tertiary hospital was 471 deaths per 100,000 deliveries,[75] compared with a national ratio of 70.[17] In a teaching hospital in Colombo, Sri Lanka, maternal deaths increased from 6 per year to 20 per year after the establishment of an ICU.[29] Before the establishment of the ICU, 19% of maternal deaths in this hospital occurred in women who were transferred from other hospitals. This rate increased to 56% after the ICU was started.[29] In the

Dhaka Medical College Hospital in Bangladesh, the maternal mortality ratio was 2440 deaths per 100,000 deliveries, compared with a national ratio of 560.[72]

These statistics illustrate the problems of inadequate ICU facilities in developing countries. Poor delivery and use of antenatal care services result in a large number of pregnant women who develop critical illness, and these countries have only a few hospitals with ICUs to treat these cases. Women in labor are transported long distances to reach hospitals with ICUs, thereby putting their lives at risk and increasing fetal mortality rates.[19]

Africa

Africa has the highest average maternal mortality ratio (880 deaths per 100,000 deliveries).[17] In a study from Tunisia in northern Africa, obstetric patients accounted 2% of all ICU admissions;[76] however, the country with the highest number of studies on obstetric patients in ICUs is South Africa,[15,44,56,77] where 95% of women attend antenatal clinics, 84% of women deliver in hospitals, and the national maternal mortality ratio is relatively low (230 deaths per 100,000 deliveries).[78] Eclampsia is the main cause of serious maternal morbidity and mortality in most parts of Africa, including South Africa. This ethnic population has a relatively high incidence of chronic hypertension and preeclampsia, as compared with whites.[11] One study found that patients with eclampsia accounted for 66% of obstetric ICU admissions.[79] The mortality rate in these patients ranges form 11% to 21%.[44,79] Acute renal failure that complicates preeclampsia is common.[56]

In a study from Burkina Fasso, 82 of 6119 obstetric patients required ICU admission. More than half of these women came from distant areas, and 65% were admitted after delivery. Eclampsia and septic shock were the main reasons for ICU admission, and the maternal mortality rate was 60%.[32] The investigators propose that setting up more ICUs may improve prognosis; however, a study from Nigeria suggests that setting up facilities does not necessarily ensure proper use of the services.[80] They found that during the initial 3 years of a new hospital, the number of obstetric admissions with complicated problems steadily increased. Sociopolitical events, such as industrial unrest, strikes, frequent fuel crises, and political unrest, resulted in a rapid decline in hospital admissions.[80]

Africa has the highest number of patients with Human immunodeficiency virus (HIV) infections,[81,82] and 25% of women admitted in a high-risk obstetrics unit in South Africa had HIV infection.[81]. When compared with controls without HIV infection, these women had a lower incidence of eclampsia (4.7% versus 17.1%) and a higher incidence of tuberculosis (6.2% versus 1.8%). There was no difference in the maternal mortality rate in the two groups.[81] HIV infection does not seem to adversely affect maternal outcome during pregnancy.

Australia

There are no reports from Australia of obstetric admissions in the ICU, except the conducted in a hospital in Brisbane. In this 10-year study, records of 126 obstetric patients requiring intensive care were analyzed. Sixteen (13%) patients were admitted because of complications of anesthesia.[83] Such complications were responsible for 3% to 26% of obstetric ICU admissions in various series from all over the world.[21,24,28,40,62,83,84] These problems occurred mainly in patients undergoing emergency cesarean delivery under general anesthesia and are the sixth most common cause of pregnancy-related deaths in the United States.[85] Complications also have been reported with regional anesthesia. Common complications include anaphylaxis, difficult tracheal intubation, aspiration of gastric contents during induction of anesthesia, cardiac arrhythmias, cardiac arrest during cesarean delivery, respiratory depression, and high spinal block.[21,62,83,84] Of 1023 ICU admissions in one study, 45 patients (4.4%) were admitted for anesthetic complications, 67% had pulmonary complications, 29% had cardiac complications, 13% had central nervous system complications, and 13% had other complications. In this study, 16% of patients had complications that affected more than one system. The number of complications of anesthesia in pregnant women has declined progressively with increasing use of regional anesthesia.[21]

The national maternal mortality ratio for Australia increased from 10.9 deaths per 100,000 confinements in 1991 to 1993 to 13.0 in 1994 to 1996.[86] This change has caused a lot of concern, and its causes are being discussed. Two reasons seem to be increasing maternal age and pregnancy in women with complex medical problems.[87]

PHYSIOLOGY OF NORMAL PREGNANCY

The pregnant patient in the ICU poses many challenges. Physicians and nurses need to understand the basic concepts of maternal physiology and fetal physiology. The physicians must care for the mother and consider the potential adverse effects that diagnostic and therapeutic interventions might have on the fetus. The physiologic adaptation of the major organs to the pregnant state should be familiar to ICU physicians.

General changes

Normal values of routine laboratory tests differ for gravid and non-pregnant states. Pregnant women adapt quickly to the gravid state because of changes in hormones such as human chorionic gonadotropin and progesterone. In general, pregnancy is characterized by progesterone-mediated hyperemia and edema of mucosal surfaces. This change is evident in the nasopharynx and oropharynx. Pregnant women tend to have more nasal congestion. Accordingly, endotracheal and nasogastric tube size should be downsized.

The diaphragm is displaced cephalad about 4 cm, and the lower chest wall widens about 5 to 7 cm.[88] These changes peak at 37 weeks' gestation. When the diaphragm is pushed upward, the heart is rotated slightly to the left, which results in electrocardiographic changes of Q waves inferiorly along with T-wave inversion.[89] The upward movement of the diaphragm is important to consider when placing a chest tube in the ICU. At 12 weeks, the bladder becomes an abdominal structure and is more susceptible to blunt trauma. At 20 weeks, the fundus of the uterus is at the level of the umbilicus and can be injured directly in blunt or penetrating trauma.

Respiratory changes

Spirometry remains normal throughout pregnancy.[90] Flow volume loops, and peak flows remain unchanged. Total lung capacity (TLC) decreases by about 4% to 5%.[91] This change mostly is caused by the upward displacement of the diaphragm. Functional residual capacity (FRC) decreases by 20% because of decreases in expiratory reserve volume (ERV) and residual volume (RV).[88.92] Diffusion capacity may remain the same or increase slightly in early pregnancy and subsequently return to normal values.[88] These alterations in pulmonary function are depicted in Figure 2

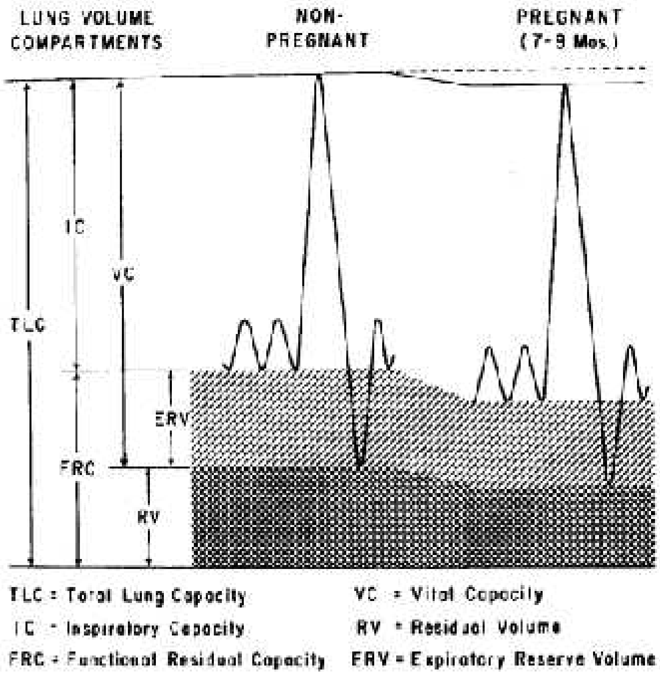


Figure 2: Changes in lung volumes in women who are seven to nine months pregnant compared with volumes in nonpregnant women.[88]

Ventilation and oxygen consumption are the major parameters that change during pregnancy. Minute ventilation increases by about 50% during pregnancy, mostly because of increased metabolic rate, changes in the mechanics of breathing, and increases in progesterone level.[91] The increase in minute ventilation is caused by an increase in tidal volume with little to no change in respiratory rate. This increase begins before the end of the first trimester and remains fairly constant during the remainder of the pregnancy.

The dyspnea of pregnancy begins in the first trimester before the gravid uterus pushes up on the diaphragm. It can occur in up to 60% of pregnant women. It is believed to be hormonally mediated because of progesterone's effects on the respiratory center.[93] Progesterone has a direct respiratory stimulant effect, and it increases the slope of the curve of ventilatory response to changes in alveolar $Paco_2$.[93] This effect is observed in the luteal phase of the menstrual cycle when hyperventilation is present, correlating with serum progesterone levels. Progesterone levels increase gradually during pregnancy from 25 ng/mL at 6 weeks' gestation to 150 ng/mL at 37 weeks' gestation.[92] The degree of hyperventilation during pregnancy correlates with the serum concentration of progesterone.

The increase in minute ventilation leads to a normal hyperventilation of pregnancy, which in turns leads to a mild chronic respiratory alkalosis with a compensatory metabolic acidosis. A normal arterial blood gas in a gravid woman is a pH of 7.40 to 7.47, with a $Paco_2$ of 30 to 32 mm Hg and a normal to slightly elevated Pao_2. The kidneys compensate partially for the alkalosis by increasing renal bicarbonate excretion, which keeps serum HCO_3 levels between 18 and 21 mEq/L (base deficit, 3-4 mEq/L). Arterial blood gas values of 7.47 for pH, 32 mm Hg for $Paco_2$, and 90 mEq/L for HCO_3 do not necessarily indicate a pathologic situation that requires further evaluation.

As minute ventilation increases, oxygen consumption increases by about

20%. This change is a result of increase in size of the uterus and fetus and an increase in maternal cardiac and respiratory work. The combination of the decrease in FRC and the increase in oxygen consumption lowers maternal oxygen reserve.

These physiologic changes are important in pregnant patients in the ICU, particularly as they relate to endotracheal intubation. FRC is a crucial variable, as it describes the amount of oxygen reserve that the lung has in face of apnea. With the increased oxygen consumption, endotracheal intubation is associated with a more precipitous decrease in Pao_2 in pregnant patients after a period of apnea.

Cardiac changes

Maternal cardiac output begins to increase at about 6 weeks' gestation. Maternal blood volume increases progressively during pregnancy by about 2 L, or 30% to 50% more than the volume during the non-gravid state.[2] Maternal red cell mass increases only 20% to 30%, which results in hemodilution and the relative anemia of pregnancy. The increase in blood volume of 1000 to 1500 mL partially offsets peripartum blood loss. The average blood loss of 0.6 L after an uncomplicated vaginal delivery and 1.0 L after a cesarean delivery usually is tolerated well.[94]

Table 1: Central hemodynamic changes in normal pregnancy[95]

Measurement	Non pregnant state	Pregnant state
Cardiac output (L/min)	4.3 ± 0.9	6.2 ± 1.0
Heart rate (beat/min)	71 ± 10	83 ± 10
Systemic vascular resistance (dynes/cm/s^{-5})	1530 ± 520	1210 ± 266
Mean arterial pressure (mm Hg)	86.4 ± 7.5	90.3 ± 5.8
Pulmonary capillary wedge pressure (mm Hg)	6.3 ± 2.1	7.5 ± 1.8
Central venous pressure (mm Hg)	3.7 ± 2.6	3.6 ± 2.5
Colloid oncotic pressure (mm Hg)	14.5 ± 2.5	10.5 ± 2.7

The study of normal hemodynamic measurements in a normal pregnancy[95] is shown in Table 1. These investigators studied 10 volunteers in the left lateral recumbent position between 36 and 38 weeks' gestation. Each patient underwent pulmonary artery catheterization and radial arterial line placement. Cardiac output was measured using a standard thermo-dilution technique. The patients were restudied between 11 and 13 weeks after delivery. Cardiac output was about 40% greater than baseline values because of an increase in heart rate and stroke volume combined with an approximate 20% to 30% decrease in systemic vascular resistance. Central venous pressure and pulmonary capillary wedge pressure were unchanged compared with non-pregnant values. Colloid oncotic pressure, a reflection of the number of solute particles in the blood (mostly albumin), declines during pregnancy.

As the uterus enlarges by about 20 weeks' gestation, the supine position may result in significant compression of the inferior vena cava, or supine hypotension syndrome. This uterine compression effectively may decrease venous return, resulting in a 20% to 30% decrease in ejection fraction. Lateral repositioning of the patient with a foam wedge or pillow placed under the right buttock can displace the uterus to the left, restoring cardiac output. This maneuver is important in the ICU during resuscitation of critically ill pregnant patients.

In the ICU, it is important to remember that blood pressure, especially the diastolic component, tends to be lower in pregnancy. Physical examination often reveals a systolic ejection murmur and a third heart sound. Echocardiography of normal pregnant patients demonstrates the following: (1) increases in all cardiac chamber dimensions, (2) increased left ventricular wall thickness, (3) small pericardial effusions, (4) mild tricuspid and pulmonic regurgitation in 90% of patients, and (5) mild mitral regurgitation in 30%.[96]

Renal changes

By 16 weeks' gestation, the glomerular filtration rate increases by 50% and remains elevated throughout pregnancy.[97] Creatinine clearance also increases, resulting in lower levels of serum creatinine, blood urea nitrogen, and uric acid.

Plasma levels of creatinine and blood urea nitrogen that exceed 0.8 mg/100 mL and 14 mg/100 mL, respectively, may indicate renal impairment.[97] Preexisting renal disease portends increased risks for premature delivery and for worsening renal function.[98] Almost 60% of infants born to women with a serum creatinine level exceeding 1.4 mg/dL are premature.[99]

Gastrointestinal changes

Gastroesophageal reflux is a common symptom in most pregnant women. Progesterone causes smooth muscle relaxation and results in a decrease in lower esophageal sphincter pressure, beginning in the first trimester. As abdominal girth increases, the stomach is displaced, causing a further decrease in the effectiveness of the sphincter. Pregnant women always should be considered at high risk for aspiration.

In terms of the liver, increased plasma volume leads to hypoalbuminema. At the end of the term, a normal value is 3.1 g/dL. Serum alkaline phosphatase concentrations (from placenta) increase above the normal range during the fifth month of gestation and continue to increase to two to four times the normal values.[100] Appendicitis is the most common nonobstetric condition of pregnancy that requires surgery, followed by cholecystitis.

METHODOLOGY

The present study was conducted in the Department of Medicine, KLES Dr. Prabhakar Kore Hospital and Medical Research Centre, Belgaum on critically ill obstetric patients admitted to MICU during the period of January 2008 to December 2008.

Study design

One year cross-sectional study.

Study period

The present study was conducted from January 2008 to December 2008.

Method of collection of data

Source of Data

Critically ill obstetric patients admitted to MICU at KLES Dr. Prabhakar Kore Hospital and Medical Research Centre, Belgaum.

Sample size

Forty one (41) critically ill obstetric patients admitted to MICU at KLES Dr. Prabhakar Kore Hospital and Medical Research Centre, Belgaum.

Sampling procedure

As there was no data available in Hospital records particularly regarding the study subjects, a minimum sample size of 30 cases was selected on account of previous literature.

Selection criteria

Inclusion Criteria

- All Critically ill obstetric patients admitted in ICUs who require ventilatory support, hemo-dynamically unstable, may need ventilatory support or intensive care in the near future.

Exclusion Criteria

- Critically ill obstetric patients not requiring ICU care. (Those who managed in a high dependency areas/ post operative wards).
- Non obstetric patients.

Procedure

The study was approved by the Ethical and Research Committee of Jawaharlal Nehru Medical College, Belgaum. During the study period, all patients presenting with and fulfilling the inclusion criterion were included in this study after obtaining informed written consent (Annexure–I). Data was collected including demographics, present history, past medical and obstetrical history, prenatal history, delivery data, indications for ICU transfer, physiologic parameters used to calculate SAPS II, hospital length of stay and death during the hospitalization according to predesigned and pretested proforma (Annexure-II).

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. Anaesthesiologists and physicians 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 labour ward and are not included in this study.

The SAPS II was used to assess the probability of hospital deaths upon ICU admission in each patient, as described previously. This scoring system was developed as an alternative to the APACHE system to predict the risk of hospital mortality after admission to a MICU and is based on data generally available on admission to the ICU. It consisted of 15 variables each assigned a weighted score based on its deviation from normal values. The sum of the individual weighted scores for these variables yields the SAPS II score. The SAPS II score is then converted to probability of hospital mortality with a logistic regression equation, in which a higher score correlates with higher predicted mortality.

To obtain SAPS II data the most abnormal value for each variable was documented in the first 24 hours after ICU admission. The variables were then assigned a value according to the weighted scoring system.

Table 2: Variables and scores for SAPS II[104]

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 blood 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 scale	0-26
Type of admission	0-8
Chronic disease	
Metastatic cancer	9
Hematologic malignancy	10
Acquired immunodeficiency syndrome	17

Statistical methods

Data was analsysed using chi square test, student ‘t’ test and Mann Whitney U test, logistic regression analysis and goodness-of-fit model.

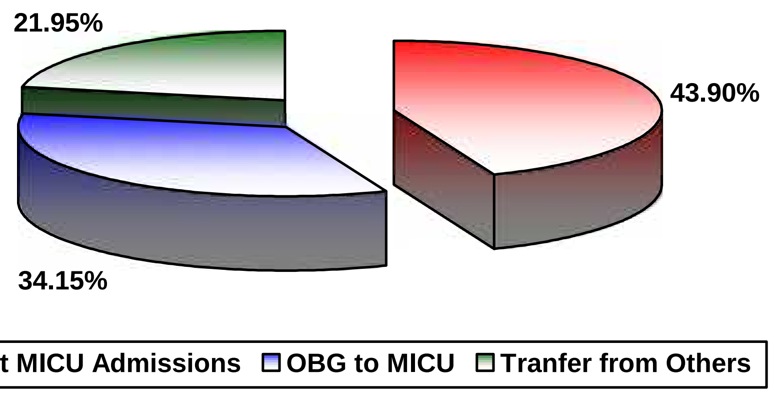
RESULTS

Present study was conducted in the Department of Medicine, KLES Dr. Prabhakar Kore Hospital and Medical Research Centre, Belgaum on critically ill obstetric patients admitted to ICU who required ventilatory support or hemodynamically unstable even after preliminary administration of intravenous fluids, oxygen, ionotropes and may need ventilatory support anytime in the near future. The observations recorded were tabulated as below.

Table 3: Distribution of patients according to admission

Source	Number	Percentage
Direct MICU admissions	18	43.90%
Obstetric department transfers to MICU	14	34.15%
Transfers from other institutes	09	21.95%

Graph 1: Distribution of patients according to admission

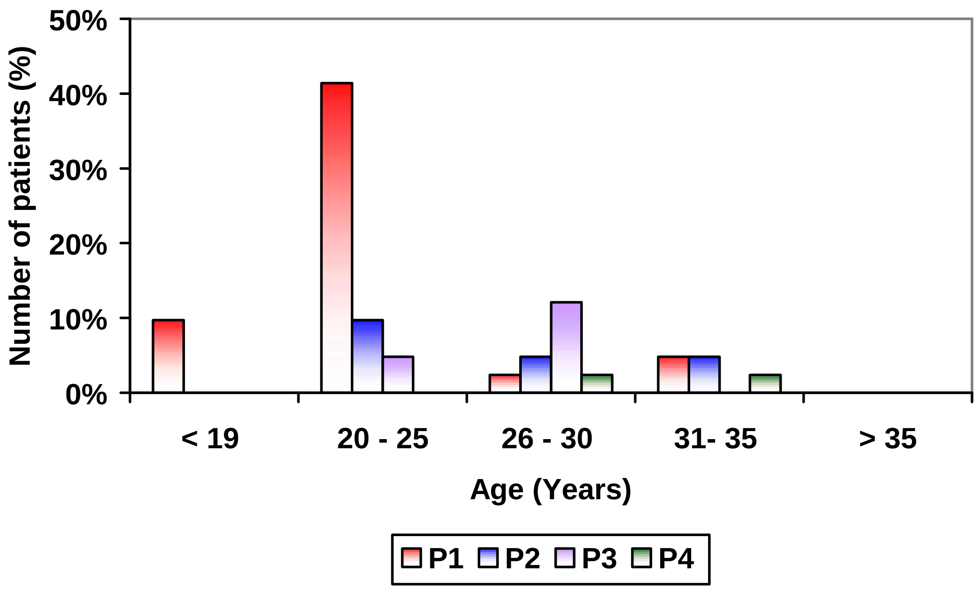


Forty one obstetric patients were admitted to ICU during the period of our study. Of these admissions, 18 (43.90%) were direct MICU admissions, 14 (34.15%) were obstetric department transfers to MICU and nine (21.95%) were transfers from other institutes which could not be managed there. These patients were first attended to in the emergency 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.

Table 4: Age and parity

Age (Years)	Parity								Total	
	P1		P2		P3		P4			
	No.	%	No.	%	No.	%	No.	%	No.	%
< 19	04	9.7	00	0	00	0	00	0	04	9.7
20 – 25	17	41.4	04	9.7	02	4.8	00	0	23	56.0
26 – 30	01	2.4	02	4.8	05	12.1	01	2.4	09	21.9
31 – 35	02	4.8	02	4.8	00	0	01	2.4	05	12.1
> 35	00	0	00	0	00	0	00	0	00	0
Total	24	58.5	08	19.5	07	17.0	02	4.8	41	100%

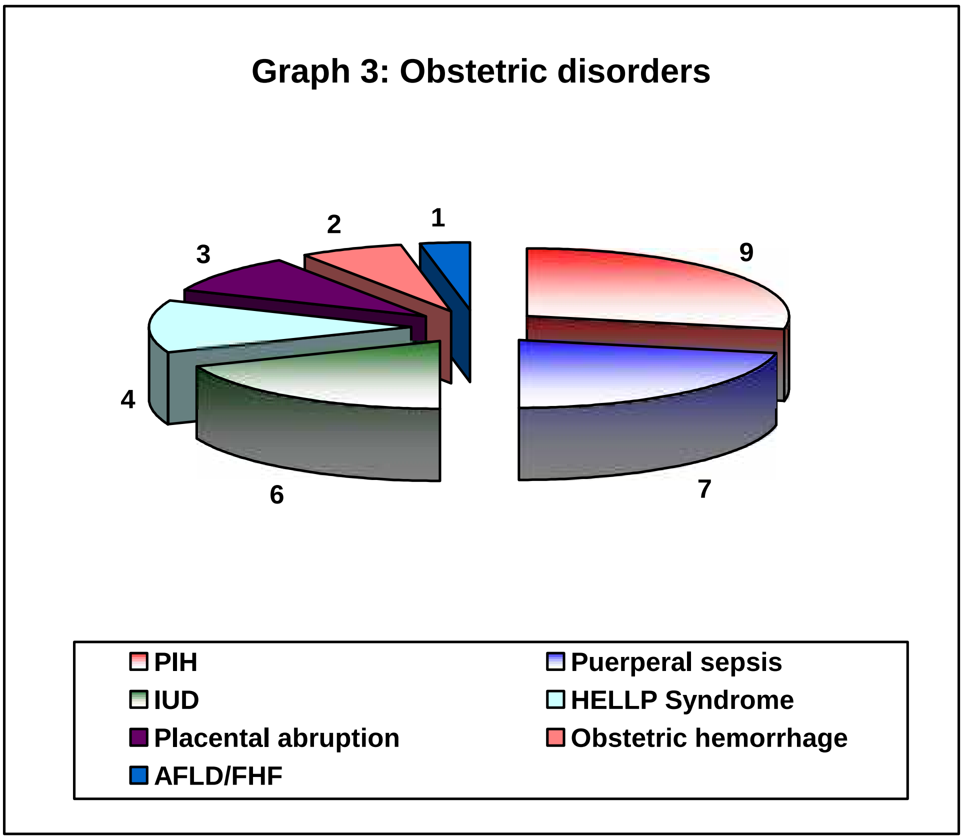
Graph No. 2: Age and parity

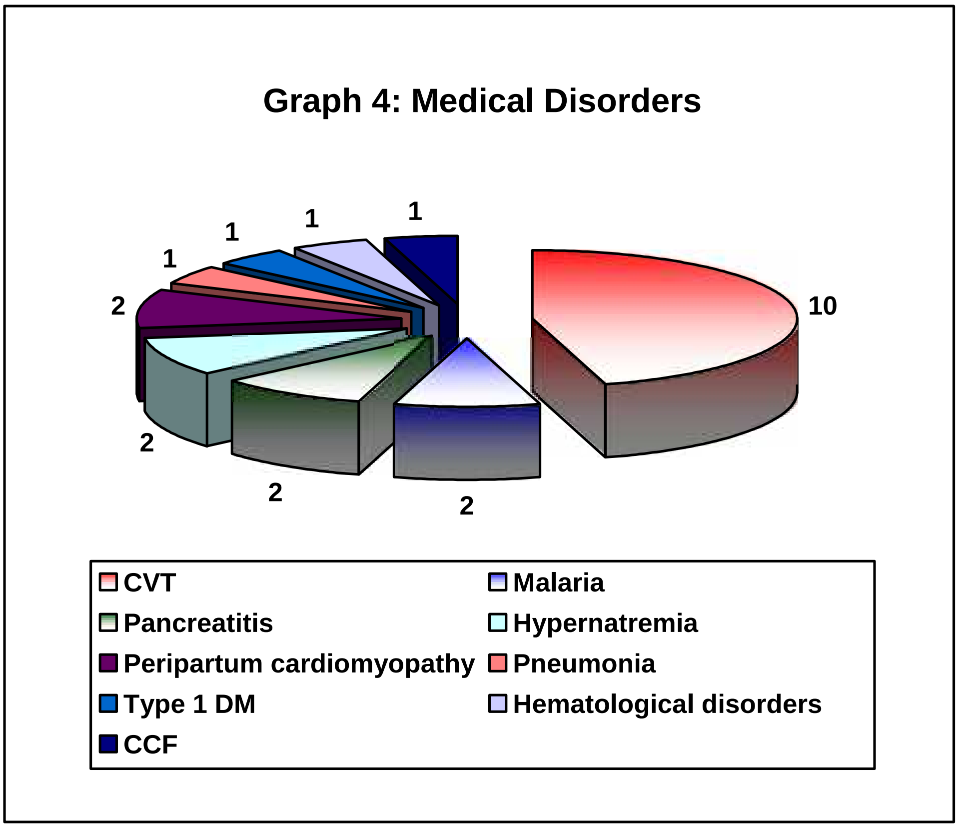


In our study majority of the patients were between 20 to 25 years of age (56.09%) and primigravida (58.54%). Advancing age adversely affects the outcome of critically ill obstetrical patients. Youth confers an advantage for obstetric patients.

Table 5: Disorders among the obstetric patients admitted in MICU

	Disorders	Survivors	Non survivors	Mortality rate
Obstetric disorders	PIH	8	1	11.11%
	Puerperal sepsis	4	3	42.88%
	IUD	5	1	16.67%
	HELLP Syndrome	4	0	0
	Placental abruption	2	1	33.33%
	Obstetric hemorrhage	1	1	50%
	AFLD/ FHF	0	1	100%
Medical disorders	CVT	7	3	30%
	Malaria	1	1	50%
	Pancreatitis	2	0	0%
	Hypernatremia	2	0	0%
	Peripartum cardiomyopathy	2	0	0%
	Pneumonia	1	0	0%
	Type 1 DM	1	0	0%
	Hematological disorders	0	1	100%
	Congestive Cardiac Failure (CCF)	1	0	0%


Graph 3: Obstetric disorders
9
7
6
4
3
2
1
PIH
Puerperal sepsis
IUD
HELLP Syndrome
Placental abruption
Obstetric hemorrhage
AFLD/FHF


Graph 4: Medical Disorders
10
2
2
2
2
1
1
1
1
CVT
Malaria
Pancreatitis
Hypernatremia
Peripartum cardiomyopathy
Pneumonia
Type 1 DM
Hematological disorders
CCF

In obstetrical disorders severe PIH and Puerperal sepsis were the commonest indications for ICU admission, being present in nine patients (21.95%) and seven patients (17.07%) respectively. Six patients (14.63%) were admitted with antepartum and post partum hemorrhage, six patients (14.63%) for complications of IUD and four patients (9.76%) for HELLP syndrome.

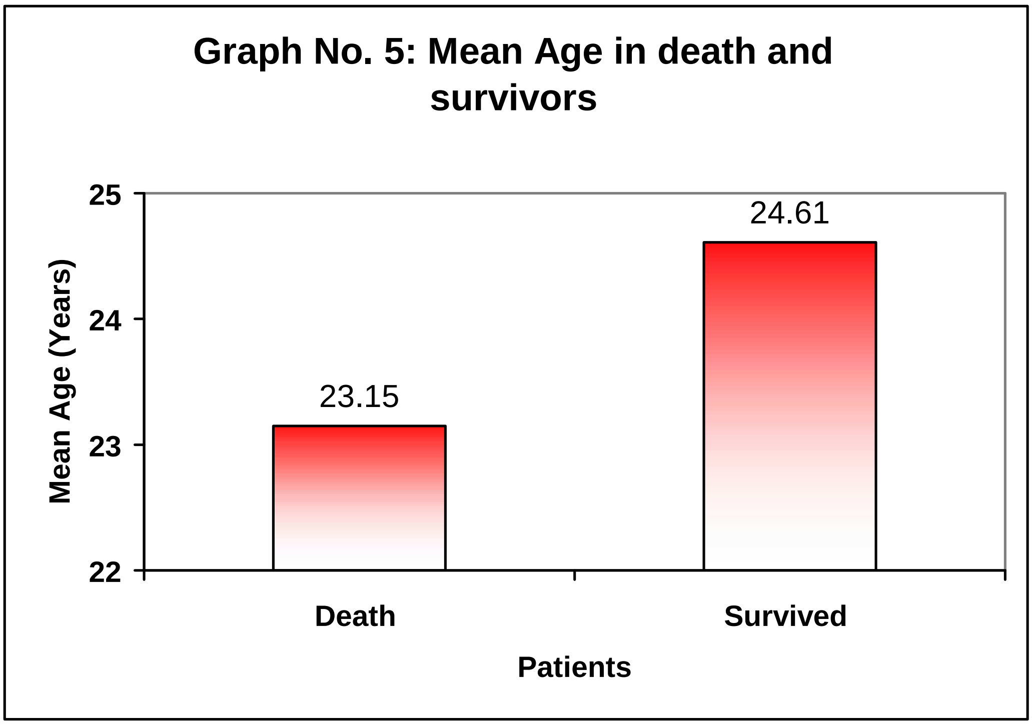
In medical disorders most common cause for ICU admission was CVT in 10 patients (24.39%) that is, nine post partum CVT and one antepartum CVT followed by heart disease in three patients (7.31%). Medical disorders like, malaria, acute pancreatitis and seizures were present in two patients (4.88%) each. Pneumonia, Hematological disorders and Type 1 DM were seen in one patient each (2.44%).

Most of the maternal deaths in our study were due to multiorgan dysfunction. CVT was the next common cause of death followed by Puerperal sepsis. Three patients died due to direct causes like Disseminated Intravascular Coagulation (DIC) and IUD. Two patients died due to circulatory shock. Two women died due to medical disorders like complicated malaria and hematological malignancy.

Majority of them required specialized interventions like ventilatory support, dialysis, and multiple transfusions of blood and blood products.

Table 6: Demographic Data

Data	Death (n=13)		Survived (n=28)		t	Df	p value
	Mean	S.D.	Mean	S.D.			
Age (Years)	23.15	4.16	24.61	4.28	1.020	39	0.314



The above table shows that there were 13 deaths (31.71%) among the 41 patients studied. The mean maternal age was 23.1±4.16 years in the patients who expired and 24.6±4.28 years in those who survived. This difference in the mean age was not statistically significant (p =0.314).

Table 7: Clinical data

Data	Death (n=13)		Survived (n=28)		p value
	Median	Range	Median	Range	
Parity	1	1-4	1.5	1-3	0.382
Hospital stay (Days)	5	1-22	12.5	3-30	0.014
Organ failure	2	1-4	1	1-3	0.000
SAPS II Score	57.15	40-79	28.5	12-56	0.000

The median parity in patients who expired was 1 (1 – 4) and 1.5 (1 -3) in patents who survived. This difference was not statistically significant. (p =0.382).

The median length of hospital stay was 12.5 days (3–30) in survivors and five days (1-22) in non survivors which was significant statistically (p=0.014).

The median number of organs failed was 2 (1 – 4) in patients who expired and 1 (1-3) in survivors. This difference was statistically significant. (p=0.000)

Mean SAPS II score for expired patients was higher, viz., 57.1 ± 13.67 (range 40-79), compared to that of survivors, which was 28.5 ± 12.63 (range 12-56). The predictability of mortality by SAPS II model was statistically significant (p=0.000).

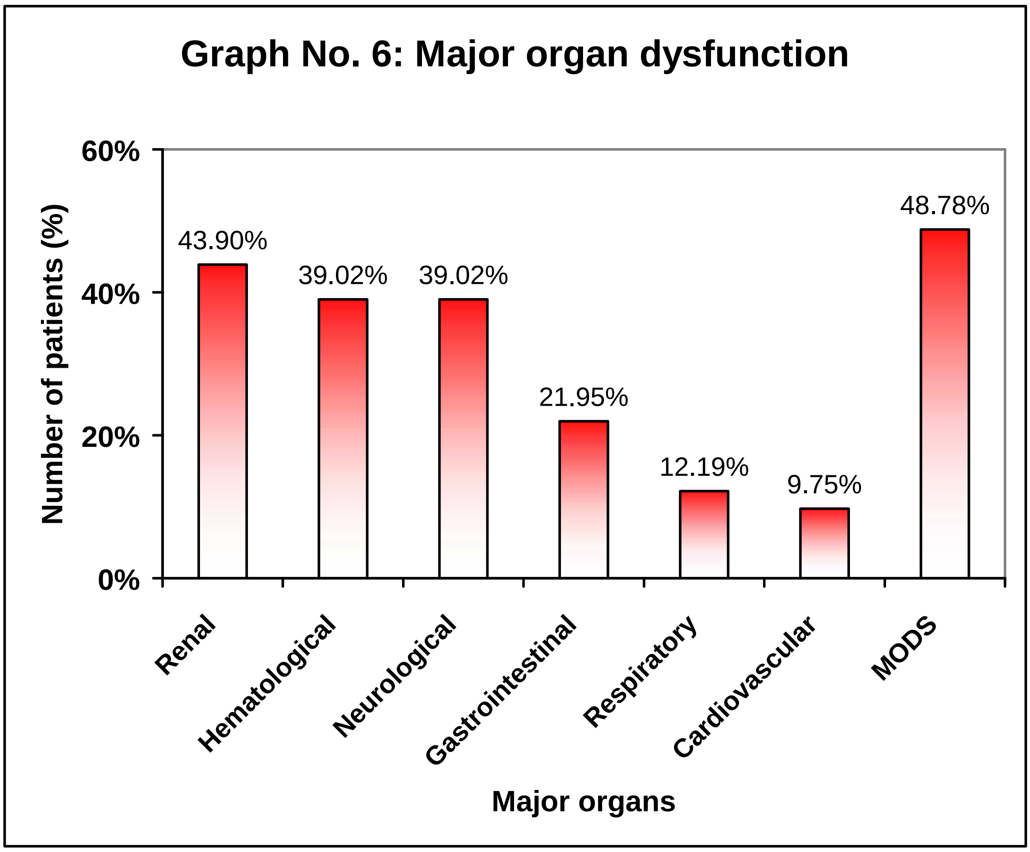
Table 8: Logistic regression analysis of outcome in SAPS II model

Observed	Predicted		
	Died	**Survived**	**Total**
Died	9	4	13
Survived	3	25	28
Total	12	29	

The above table shows that 13 patients expired out of 41 patients studied. The SAPS II model predicted mortality of 12 patients out of 41 by using logistic regression analysis. Overall percentage of agreement was 82.9% between the SAPS II model and observed mortality.

Table 9: Major organ dysfucntion

Organ dysfunction	Number	Percentage
Renal	18	43.90%
Hematological	16	39.02%
Neurological	16	39.02%
Gastrointestinal	09	21.95%
Respiratory	05	12.19%
Cardiovascular	04	9.75%
Multi-organ	20	48.78%



A significant number of women had associated organ dysfunction. Majority of patient had renal failure in 18 patients (43.90%). Neurological, hematological, hepatic and respiratory dysfunction were the next common dysfunctions seen. 20 patients (48.78%) had multi organ failure.

Table 10: Association of number of organs affected with mortality

No. of organs affected	Total (n=41)		Mortality	
	No.	Percentage	No.	Percentage
1	22	53.65%	1	4.55%
2	13	31.70%	7	53.85%
3	5	12.19%	4	80%
4	1	2.44%	1	100%

In the present study we observed that, mortality in critically ill obstetric patients was directly proportional to the number of organ failed.

Table 11: SAPS II score

SAPS II Score	Death		Survived		Total	
	No.	%	No.	%	No.	%
12 - 37	0	0	23	100	23	56.09
40 – 50	6	66.7	3	33.3	9	21.95
More than 50	7	77.8	2	22.2	9	21.95
Total	13	31.7	28	68.3	41	100

$X^2 = 24.580$ DF = 2 p=0.000

The above table shows that there was no mortality in patients with SAPS II score of 12 – 37. The mortality in patients with SAPS II score of 40 – 50 was 66.7% and 77.8% in patients with score more than 50. The predictability of mortality by SAPS II model was statistically significant.

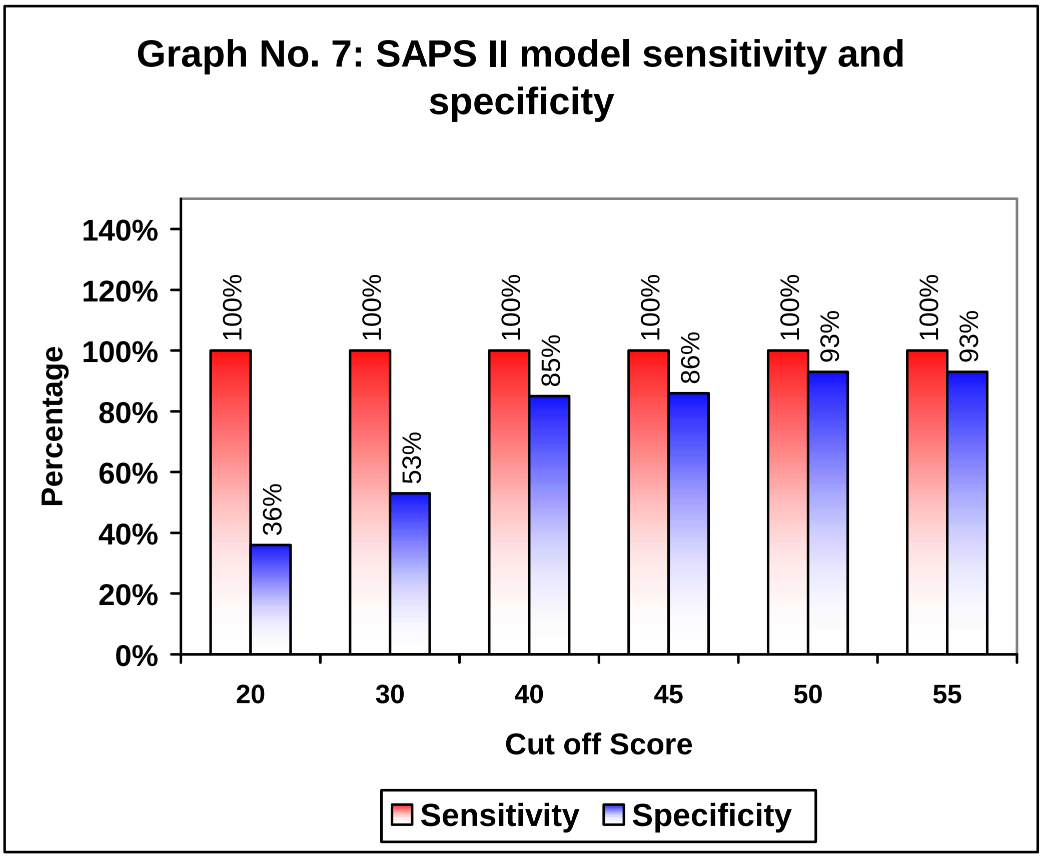
TABLE 12: Probability of survival and death by using the logistic regression model

SAPS II score	Probability of death	Probability of survival
12	0.0036	0.9964
17	0.0081	0.9919
20	0.0131	0.9869
26	0.0337	0.9663
30	0.0623	0.9377
34	0.1123	0.8877
40	0.2497	0.7503
45	0.4269	0.5731
50	0.6252	0.3748
55	0.7888	0.2112
60	0.8919	0.1081
63	0.9314	0.0686
65	0.9486	0.0514
70	0.9763	0.0237
74	0.9877	0.0123
79	0.9945	0.055

This above table shows that various SAPS II scores and their association with probability of death and survival.

Table 13: SAPS II model sensitivity and specificity

	SAPS II Scores Cut off point					
	20	**30**	**40**	**45**	**50**	**55**
Sensitivity	100%	100%	100%	100%	100%	100%
Specificity	36%	53%	85%	86%	93%	93%



The above table shows the sensitivity and specificity of SAPS II model. The sensitivity of SAPS II model was 100% for all the scores, and specificity increased significantly above the score of 40; that is 85% and 93% for the score of 40 and 55 respectively. So the best cut off point to predict mortality was SAPS II score of 40.

DISCUSSION

The critical care aspects in obstetrics are varied and demand that critical care practitioners have a thorough knowledge of fetal and maternal changes in physiology as pregnancy progresses. Pregnancy can affect every organ-system and organ-specific conditions. This study was therefore undertaken to review all critically ill obstetric patients for their presentation, diagnosis, organ failures, treatment, and 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.

Majority of the complications and deaths are preventable by essential antenatal care at domiciliary and peripheral levels.[101] Presence of skilled health care staff and trained birth attendants at deliveries result in early referrals in cases of complications, and thus prevention of most of the maternal deaths.

In the present study CVT was the most common cause for ICU admission followed by PIH and Puerperal sepsis. Another study reviewing critically ill obstetric patients, found massive PPH as the single most common cause of ICU admission (53%), followed by preeclampsia and eclampsia.[34]

In this study the average duration of stay of patients in the hospital ranged from one day to 30 days with mean stay of 11 days in hospital. This is similar to one study done in Canada which reported a mean stay of 13 days in the hospital.[52]

A significant number of patients had associated organ dysfunction; renal failure being present in 18 patients (43.9%). Coagulopathy and respiratory dysfunction were the next common dysfunctions. 20 patients (48.78%) had MODS. Majority of them required specialized interventions like ventilatory support, dialysis, and multiple transfusions of blood and blood products and surgical interventions as per the indication. Various studies have also observed these organ dysfunctions requiring similar therapeutic measures.[34,47,101,103]

The number of organs failed directly reflects on the mortality. As the number of organs failed increases, so does the mortality. This is reflected in our study where all patients with MODS died, while mortality was less in women who had less number of organs involved. This is also highlighted in different studies.[47,101]

In a study of obstetric patients requiring intensive care, APACHE II scores over-predicted the mortality rate.[19] According to one study done in Southern England, severity-of-illness scoring systems may require modification in obstetrical patients to adjust for the normal physiologic responses to pregnancy.[43] Another study done in India 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.[46]

The present study showed that SAPS II model validated our data well in obstetric patients admitted to ICU. The best cut off point to predict mortality was SAPS II score of 40. If it were higher than 40, it would have been 100% sensitive and 85% specific. So it is apparent that SAPS II score is quite useful in predicting the prognosis, particularly in terms of mortality. A study done in New Delhi showed that, if SAPS II score were higher than 43, it would have 100% sensitivity.[48]

Several investigators have reviewed critical care in obstetric patients admitted to the ICU, and a variety of scoring tools have been applied to predict the probability of mortality in critically ill patients.[20,35,39,49,53]

In a large multinational study conducted in Europe and North America during 1993 on 13,152 patients 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 ICU.[104] Our study concurred with these results.

In a recent study done in India[38] in 2003 on 233 obstetric patients admitted to MICU showed, SAPS II score accurately predicted hospital mortality among patients admitted to ICU for medical reasons but performed poorly in predicting deaths in patients admitted for only obstetric reasons.

The present study showed that SAPS II is a good predictor of mortality in obstetric patients admitted for medical reasons, but slightly over-predicted the mortality rate in obstetric patients admitted for only obstetric reasons.

Care of the critically ill pregnant patient requires a true multidisciplinary approach for optimal outcomes.[2] Early referral to a tertiary care center coupled with invasive hemodynamic monitoring and ventilatory support improves the outcome of such patients.[103]

Maternal-fetal medicine specialist is a step towards the betterment of such obstetric patients. This specialist is a member of a health care team who possesses expertise in the management of the high risk pregnancy, has advanced knowledge of obstetrics, medical, genetic, and surgical complications in the mother, fetus and the newborn, and can directly provide his services to critical care settings aimed at improving the outcome of the critically ill obstetric patients.[105]

The limitation of this study was smaller sample size. Moreover, differences in access to health care, ICU admission criteria and disease severity and admission indication (medical, obstetrical reasons) make comparison difficult.

Furthermore, 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.

CONCLUSION

PIH and postpartum CVT were most common causes of admission to ICU in critically ill obstetric patients.

There was no association of age and parity of critically ill obstetric patients with mortality.

The mortality in critically ill obstetric patients was directly proportional to the number of organs failed.

The SAPS II model is a good predictor of mortality in obstetric patients admitted for medical reasons, but slightly over-predicted the mortality rate in obstetric patients admitted for only obstetric reasons. 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.

Majority of ICU admissions are preventable. Invasive hemodynamic monitoring and ventilatory support are the two main interventions. Improving quality of care before and after admission to ICU may reduce maternal morbidity. Early admission and management of critically ill obstetric patients in the ICU decreases maternal mortality.

Physicians in the ICU should be familiar with the complications of pregnancy and should work closely with obstetricians in order to improve maternal outcome in these patients.

The admission rate to ICUs and problems faced by critically ill patients may be reduced by improving the management of hypertensive disease during pregnancy and by reducing the incidence of haemorrhagic complications.

Furthermore, thrust should be given on late consequences of PIH, postpartum CVT and sequelae of abnormal insertion of placenta. The availability of high dependency care may reduce unnecessary admissions to the ICUs.

SUMMARY

A prospective study of 41 critically ill obstetric patients was done in KLES Dr. Prabhakar Kore Hospital and Medical Research Centre, Belgaum. The inclusion and exclusion criteria were followed according to the criteria mentioned in the materials and methods of the study.

1) The age range in this study was 18 years to 35 years with majority of them between 20 to 25 years of age (56.09%).

2) Most of the patients were primigravida (58.54%).

3) Of all the 41 admissions, 18 (43.90%) were direct admissions to MICU, 14 (31.15%) were obstetric department transfers to MICU and 9 (21.95%) were transfers from other institutes.

4) The most common causes for admission to MICU were PIH and puerperal sepsis in obstetric disorders, and CVT in medical disorders.

5) In this study hospital stay, organ failure and SAPS II score were statistically significant in prognosticating the outcome.

6) The overall agreement of the SAPS II score was 82.9% in predicting the outcome.

7) This study concludes that, the best cut off point to predict mortality was a SAPS II score of 40.

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ANNEXURE I

CONSENT FORM

TITLE OF THE STUDY

"ONE YEAR CROSS-SECTIONAL STUDY OF THE CRITICALLY ILL OBSTETRIC PATIENTS REQUIRING INTENSIVE CARE UNIT ADMISSIONS AND PREDICTING MORTALITY BY USING SIMPLIFIED ACUTE PHYSIOLOGY SCORE II."

PRINCIPAL INVESTIGATOR

Dr. Naveen S. Angadi $_{MD}$

Dr. Vamsidhar Reddy V.

INTRODUCTION AND PURPOSE

1. To study the spectrum of diseases requiring critical care among critically ill obstetric patients.
2. To predict mortality of critically ill obstetric patients requiring intensive care based on data available in the first 24 hours of admission in to ICUs by using SAPS II model.

PROCEDURE

Participants will be selected from obstetric patents admitted in ICUs of KLES Dr. Prabhakar Kore Hospital and Medical Research Centre, Belgaum. Their history, clinical picture, gestational age, type of delivery, location of delivery, diagnosis and cause for transfer into ICUs will be noted. Then the SAPS II score will be calculated from the data available and out come will be predicted.

BENEFITS

By using SAPS II score, predict mortality can be predicted.

VOUNTARY PARTICIPATION / WITHDRAWAL

Taking part in the study is voluntary. I may choose not to take part in this study, or if I decide to take part I can later change my mind and withdraw from the study. My decision will not change the present or future health care or other services that I receive. The study doctor or the sponsor may stop my participation in this study I will tell of my important new findings that may change my willingness to continue to take part. If I choose not to take part in the study I will receive the standard treatment for patients with my conclusion.

COSTS

Nil

COMPENSATION

In the event that I become injured as a result of taking part in the study, treatment will be offered to me, of I will be given information about where to receive medical care; but I or my insurance company will be responsible for the costs. No reimbursement, compensation or free medical care is given.

CONFIDENTIALITY

All information collected about me during the course of the study will be kept confidential to the extent permitted by the law, I will be identified I this research record by the code numbers. Information from this study may be published but my identity will be confidential in any publication

QUESTION

If any enquires in the future or in case of research related injury illness, you may contact following person.

Principal Investigator **Dr. Vamsidhar Reddy.V.**

Guide **Dr. Naveen S. Angadi MD**
Assistant Professor,
J. N. Medical College, Belgaum

CONSENT TO PARTICIPATE IN RESEARCH STUDY

I voluntarily agree to take part in this study by signing on the line below. I may withdraw at any time. I am not giving up any of my legal rights by signing this form. My signature below indicate that I have read, or it has been read to me, this entire consent form, and have had all my questions answered. I will be given a copy of this consent form.

Signature of the participant or legally authorized representative

Participants name: ____

Signature: ____

Name of the legally authorized representative: _________________

Signature: ____

Witness's name: ____

Signature: ____

Investigators name and signature: ___________________________

Date and Place: ____

ANNEXURE II

PROFOMA

Name: DOA:

Age: DOD:

Sex: IP No:

Address:

Occupation:

Presenting Complaints:

Gestational age:

Type, indications, location of delivery:

Past History:

Medical disorders:

Chronic disease:

Obstetric disorders:

General Physical Examination:

Built:	Pallor:
Nourishment:	Icterus:
Blood pressure:	Cyanosis:
Systolic	Clubbing:
Diastolic	Lymphadenopathy:
Pulse rate:	Edema:

Systemic examination:

CVS: CNS:

RS: PA:

Clinical Diagnosis:

Cause for transfer in to ICU:

On data available in the first 24 hours of admission SAPS II scores will be calculated by using following parameters.

Variables		**Score**
Age in years	< 40	0
	40 - 59	7
	60 - 69	12
	70 - 74	15
	75 - 79	16
	≥ 80	18
Heart rate (per minute)	< 40	11
	40 - 60	2
	70 - 110	0
	120 - 159	4
	≥ 160	7
Systolic blood pressure (mm of Hg)	< 70	13
	70 - 99	5
	100 - 199	0
	≥ 200	2
Body temperature in o C	< 39	0
	≥ 39	3
PaO2 / FiO2	< 100	11
	100 - 199	9
	≥ 200	6
Urinary output (Lit / 24 hrs)	< 0.5	11
	0.5 - 0.999	4
	≥ 1	0
Urea (mg / dl)	< 28	0
	28 - 83	6
	≥ 84	10
WBC count (cells / cmm)	< 1000	12
	1000 - 19000	0
	≥ 20000	3
S. Sodium (mEq / L)	< 125	5
	125 – 144	0
	≥ 145	1

S. Potassium (mEq / L)	< 3	3
	3 - 4.9	0
	≥ 5	3
S. Bicarbonate (mEq / L)	< 15	6
	15 - 19.9	3
	≥ 20	0
Bilirubin level (mg / dl)	< 4	0
	4 - 5.9	4
	≥ 6	9
Glasgow coma scale	< 6	26
	6 – 8	13
	9 - 10	7
	11 – 13	5
	14 - 15	0
Type of admission	Unscheduled surgery	8
	Medical	6
	Scheduled surgery	0
Chronic disease	None	0
	Metastatic carcinoma	9
	Hematologic malignancy	10
	AIDS	17

Total Score

Outcome

Investigations done

Blood and Biochemistry:

C.B.C (Hb, Tc, Dc, Peripheral smear)

Arterial blood gas analysis

Blood urea

Serum electrolytes

LFT

Other investigations as when required Depending on etiology:

Smear for MP

Platelet count

Serum creatinine

Urine routine and Microscopy

Coagulation profile

D- dimer

Imaging – chest X ray, USG, CT scan, MRI

ECHO

Hepatitis markers

ANNEXURE III

KEY TO MASTER CHART

ALI	-	Acute lung injury
AML	-	Acute myeloid leukemia
ARDS	-	Acute respiratory distress syndrome
ARF	-	Acute renal failure
CCF	-	Congestive cardiac failure
CNS	-	Central nervous system
CVS	-	Cardiovascular system
CVT	-	Cerebral venous thrombosis
DIC	-	Disseminated intravascular coagulation
DKA	-	Diabetic ketoacidosis
DM	-	Direct MICU
E	-	Expired
GIT	-	Gastrointestinal system
HELLP Syn	-	Hemolysis elevated liver enzymes low platelet syndrome
I	-	Improved
ICU	-	Intensive care unit
IP No.	-	Inpatients Number
IUD	-	Intrauterine death
MODS	-	Multi organ dysfunction
N	-	No
No	-	Number

OTM	-	Obstetrics to medical ICU
PIH	-	Pregnancy induced hypertension
PPH	-	Post partum haemorrhage
RS	-	Respiratory system
SAPS	-	Simplified acute physiology score
Sl. No.	-	Serial Number
T1DM	-	Type 1 Diabetes mellitus
TFOH	-	Transfer from other hospitals
Y	-	Yes

ANNEXURE III - MASTER CHART

Sl. No.	IP. No.	Age (Years)	Parity	Reason for ICU transfer	Hospital Stay (Days)	ORGAN FAILURE						No. of organ failure	SAPS II score	Predicted mortality	Maternal outcome	Admission type
						CVS	RS	CNS	GIT	Renal	Haematological					
1	242355	22	1	Pneumonia, septicemia, ALI	14	N	Y	N	N	N	Y	2	30	10.6	I	OTM
2	247908	24	1	PIH, HELLP syn, ARF	30	N	N	N	Y	Y	N	2	32	12.8	I	OTM
3	248453	23	1	Puerperal sepsis, DIC, MODS	16	N	N	N	N	Y	Y	2	56	59.8	I	DM
4	249928	30	2	Postpartum CVT, anemia	16	N	N	Y	N	N	N	1	12	1.3	I	DM
5	250801	19	1	Septic shock, ARF, CVT	22	N	Y	Y	N	Y	Y	4	74	88	E	OTM
6	251097	24	3	Abruption placenta, circulatory shock	15	N	N	Y	N	Y	Y	3	40	24.7	E	TFOH
7	251452	25	1	IUD, Acute fulminant hepatitis	1	N	N	Y	Y	N	N	2	71	85	E	TFOH
8	259271	23	3	Postpartum CVT	13	N	N	Y	N	N	N	1	34	15.3	I	TFOH
9	260783	21	1	Severe PIH, ARF, concelled abruptio	26	N	N	N	N	Y	Y	2	40	24.7	I	OTM
10	261541	27	3	Puerperal sepsis, ARF	3	N	N	N	Y	Y	N	2	55	57.5	I	DM
11	262530	20	1	IUD, AML-L3, ARF, pulm edema	7	N	Y	N	N	Y	Y	3	44	32.6	E	OTM
12	262851	20	3	Type 1 DM, DKA, scalp cellulitis	30	N	N	N	N	N	Y	1	31	11.7	I	DM
13	264507	20	1	Acute pancreatitis	7	N	N	N	Y	N	N	1	12	1.3	I	DM
14	264512	27	3	Abruptio placenta, IUD, DIC	5	N	N	N	N	N	Y	1	31	11.7	I	OTM
15	264650	28	3	Postpartum CVT	14	N	N	Y	N	N	N	1	12	1.3	I	DM
16	265074	22	1	PIH, peripartum cardiomyopathy	7	Y	N	N	N	N	N	1	26	7.2	I	DM
17	266149	20	1	Puerperal sepsis, ARF	11	N	N	N	N	Y	Y	2	69	82.6	E	TFOH
18	266265	23	2	Severe PIH, ARF	5	N	Y	N	N	Y	N	2	66	78.5	E	DM
19	266602	20	1	Postpartum CVT	12	N	N	Y	N	N	N	1	17	2.6	I	DM
20	266884	35	1	Peripartum cardiomyopathy, PIH	6	Y	N	N	N	Y	N	1	29	9.7	I	OTM

Sl. No.	IP. No.	Age (Years)	Parity	Reason for ICU transfer	Hospital Stay (Days)	ORGAN FAILURE						No. of organ failure	SAPS II score	Predicted mortality	Maternal outcome	Admission type
						CVS	RS	CNS	GIT	Renal	Haematological					
21	268409	20	1	Acute pancreatitis	3	N	N	N	Y	N	N	1	13	1.5	I	OTM
22	268831	24	1	Peurparial sepsis, ARDS	10	N	N	N	N	Y	N	1	12	1.3	I	OTM
23	269651	22	1	Antepartum CVT	20	N	N	Y	N	N	N	1	20	3.7	I	DM
24	270066	32	2	HELLP syn, PIH	4	N	N	N	Y	N	N	1	18	2.9	I	OTM
25	273102	30	2	IUD, severe PPH, HELLP syn	11	N	N	N	Y	N	N	1	24	5.8	I	OTM
26	273115	32	2	Placenta Acreta, severe PPH, DIC	19	N	N	N	N	N	Y	1	47	26.6	I	TFOH
27	273838	28	3	Postpartum CVT, complex partial seizures	17	N	N	Y	N	N	N	1	19	3.3	I	DM
28	275531	26	3	HELLP syn, severe PIH, ARF	20	N	N	N	Y	Y	N	2	37	19.6	I	TFOH
29	276541	32	1	Postpartum CVT, ARF	7	Y	N	Y	N	Y	N	3	48	41.5	E	DM
30	288950	23	1	Severe anemia, peurparial sepsis	2	Y	N	N	N	N	Y	2	40	24.7	E	TFOH
31	289525	18	1	Complicated malaria, ARF	9	N	N	Y	N	Y	N	2	46	37	E	DM
32	290159	23	2	Cerebral malaria	3	N	N	Y	N	N	N	1	34	15.3	I	TFOH
33	292460	24	2	Postpartum CVT, Seizures	11	N	N	Y	N	N	N	1	18	2.9	I	DM
34	294032	22	1	Postpartum CVT, uncal herniation	4	N	N	Y	N	N	N	1	63	73.6	I	DM
35	294771	30	4	Atonic PPH, DIC, circulatory shock	2	N	N	N	N	Y	Y	2	79	91.9	I	OTM
36	301686	20	1	Hypernatremic Encephalopathy	21	N	N	Y	N	N	N	1	36	18.1	I	DM
37	302585	25	2	Puerperal sepsis, septic shock, ARDS,ARF	2	N	Y	N	N	Y	Y	3	50	46.1	E	DM
38	304030	21	1	Puerperal sepsis, severe anemia	3	N	N	N	N	N	Y	1	32	12.8	I	TFOH
39	304126	20	1	IUD, septic shock, MODS	3	N	N	N	Y	Y	Y	3	53	53	E	OTM
40	308113	25	2	Severe anemia, PIH, IUD, in CCF	4	N	N	N	N	N	Y	1	26	7.2	I	OTM
41	312932	20	1	Postpartum hypernatremia, seizures	20	N	N	Y	N	Y	N	2	45	34.8	I	DM