Original Research Article

Evaluation of Clinical Characteristics and Outcomes of Obstetric Patients Admitted to Intensive Care Unit: A Case Control Study

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ABSTRACT:

Introduction: The need for critical care support and admission to intensive care unit (ICU) in obstetric population is infrequent. The proportion ranges from 0.1 to 8.5%. Yet, obstetric admissions to ICU and mortality continue to have a significant impact on overall maternal health care. The study of epidemiology and predictors of obstetric admissions to ICU will prove a useful proxy for better understanding maternal near miss events and mortality. **Methods**: This was a case control study reviewing all the obstetric cases admitted to ICU over a study period of five years. The individual files were recovered from the record section and data pertaining to referral status, demographics, clinical profile and ICU information were retrieved. The ICU data comprised of the length of ICU stay, indications for admission, interventions required, and outcomes. The data were then compared to historical controls. **Results**: A total of 80 patients were admitted to ICU accounting for 0.84% of total deliveries and 4.6% of total ICU admissions. Mean age was 24.84 years, mean gestational age was 32.33 weeks, and mean blood loss was 707.27 ml. Hypertensive disorder of pregnancy followed by obstetric hemorrhage were the most common indications. Lower gestational age, increased blood loss, emergency cesarean sections, and surgical interventions were noteworthy risk factors for ICU admissions. There was a mortality rate of 5%. **Conclusion**: Hypertensive disorders account for the most number of admissions to ICU followed by obstetric hemorrhage. Lower gestational age, increased blood loss and emergency cesarean section are notable risk factors for ICU admission.

Keywords: critical illness • intensive care units • maternal mortality • obstetrics • risk factors

INTRODUCTION:

Obstetric patients are in general a young and otherwise healthy cohort of patients. As such, the need for critical care support and admission to Intensive Care Unit (ICU) in them is infrequent. Yet pregnancies, though physiological and largely uneventful, can become complicated by various morbidities necessitating ICU admission.[1,2]

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Critically ill obstetric patients present a unique challenge in terms of management, often requiring active involvement of multiple specialties. This cohort of patients is different in that their management requires consideration of the physiological changes associated with pregnancy as well as concern for the well-being of the fetus.

The proportion of obstetric patients requiring admission to ICUs ranges from 0.1-1.24%, with obstetric complications as the leading indication.[3,4] Obstetric admissions to ICU and maternal mortality continue to have a significant impact on maternal health care, despite the low rate of such admissions in high-income countries.[5] This study aimed to analyze the clinical profile and outcome, and identify the potential risk factors for such admissions in low-income countries.

METHODS:

This was a case-control study conducted in

ICU of Lumbini Medical College Teaching Hospital (LMCTH) from 15th September to 30th October, 2017. During this period, the hospital records of all the obstetric cases admitted to ICU over a period of five years from April 13, 2012 to April 12, 2017 were reviewed.

Consecutive obstetric patients admitted to ICU either from maternity ward, operation theatre or emergency room were identified from the ICU admission register. The individual files were then retrieved from the hospital record section. Each patient record was reviewed in detail. Women who delivered immediately before or after the index case matched to age (within five years) and parity were taken as controls.

The data retrieved for analysis included referral status, demographics, clinical information, and ICU data (indication for admission, interventions, length of stay, and final outcome). Those cases with referral notes or pre-informed via telephone were grouped as referred and patients with at least one prior antenatal visit were classified as booked cases. Those without written or verbal referral and no prior visits were categorized as unbooked cases.

The indications for admission were classified as obstetric or non-obstetric. Obstetric indications were defined as specific pregnancy-related conditions, which occurred during pregnancy or within 42 days in the postpartum period. Non-obstetric indications were defined as all other conditions that were not specifically pregnancy-related. Interventions required were oxygen supplementation, blood transfusion, higher antibiotics (meropenem, piperacillin and tazobactam, clindamycin, cefepime), central venous pressure (CVP) monitoring, inotropic support, mechanical ventilation, surgical interventions, and magnesium sulphate administration. For maternal outcomes, data regarding whether the patient improved and was transferred to ward, referred or expired were considered. In addition, length of ICU stay was noted.

Statistical analysis:

The data were entered to and analyzed using Statistical Package for Social Sciences (SPSS™) software version 20. Descriptive results were presented in frequencies, percentages, mean, and standard deviation (*SD*). Categorical data were analyzed by *Chi square test* and differences in means were analyzed by *Student t test*. P value less than
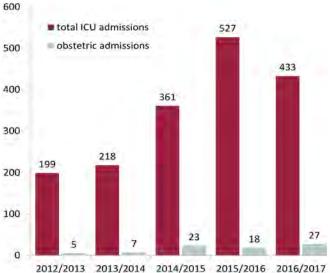
0.05 was considered statistically significant.

Ethical clearance:

Ethical clearance was obtained from the Institutional Review Committee of the institute.

RESULTS:

During the study period, a total of 9524 deliveries were conducted and 80 patients required ICU admission. This comprised 8.4 admissions per 1000 deliveries and 4.6% (*N* = 1738) of total ICU admissions. Over the years, LMCTH has witnessed a consistent rise in ICU admissions. The obstetric admissions to ICU also show more or less a parallel rise (Figure 1).

Fig 1: *Temporal trend of ICU admissions*

Of those 80 cases, 55 (68.7%) were unbooked, 23 (28.8%) were referred, and only two (2.5%) were booked cases. Seventy-three (91.25%) were obstetric cases while the other (*n* = 7, 8.75%) were non-obstetric cases. Hypertensive disorders of pregnancy (HDP) was the most common obstetric indication followed by postpartum hemorrhage (PPH). Seizure disorder was the most common non-obstetric indication on the other hand. Details of indications for ICU admission is presented in Table 1. There were 12 (15%) cases of ectopic pregnancies, two abortion complications, and three (3.75%) antepartum cases.

Mean age of the patients were similar between the two groups, in cases being 24.84 years (*SD* = 6.17) and in controls being 24.46 years (*SD* = 4.84). The difference in mean was not statistically significant (*t* = 0.43, *df* = 158, *n* = 160, *p* = 0.67).

Table 1: Indications for ICU admissions

Indications for ICU admission			Associated conditions	*n (%)*
Obstetric (*n* = 73)	Hypertensive disorders of pregnancy	Antepartum eclampsia	HELLP with AKI (1), aspiration pneumonia (2), DIC (1), SAH (1)	16 (20)
		Postpartum eclampsia		8 (10)
		Severe preeclampsia		2 (2.5)
	PPH	Atonic	Placenta accreta (1), AKI (1), preeclampsia (1)	14 (17.5)
		Traumatic		1 (1.25)
	Ectopic pregnancy			12 (15)
	Puerperal sepsis		Pneumonia (2), pleural effusion (1), respiratory failure (1), secondary PPH (1), seizure (1), AKI (1)	8 (10)
	Uterine rupture			3 (3.75)
	Antepartum haemorrhage		DIC (1)	3 (3.75)
	Cervical dystocia (LSCS)			2 (2.5)
	Suspected uterine perforation			1 (1.25)
	Abortion complications			1 (1.25)
	Vulval hematoma			1 (1.25)
	Postpartum agitation			1 (1.25)
Non-obstetric (*n* = 7)	Seizure disorder			2 (2.5)
	OP poisoning			1 (1.25)
	RHD			1 (1.25)
	SAIO			1 (1.25)
	Pulmonary embolism			1 (1.25)
	Pneumonia			1 (1.25)

AKI - acute kidney injury; SAH - sub arachnoid hemorrhage; OP - organophosphate; RHD - rheumatic heart disease; SAIO - subacute intestinal obstruction

Likewise, the gravidity of the patients between the two groups was tested with *Mann-Whitney U test* and not found statistically significant (U = 2974.5, p = 0.4). Thus, the controls were properly matched for age and gravidity.

Mean gestational age in the case and control groups were 32.33 weeks (SD = 12.42) and 39.64 weeks (SD = 1.49) respectively. The difference in mean was found to be statistically significant (t = -5.228, df = 81.27, n = 160, $p < 0.001$). This shows that gestational age was likely to be less in patients admitted to ICU compared to those not admitted.

Mean blood loss was calculated for 77 cases as three were antepartum cases. It was 707.27 ml (SD = 590.01) in cases while it was 197.87 ml (SD = 158.74) in the controls. This difference in means was statistically significant (t = 7.45, df = 155, n = 157, $p < 0.001$). There were two outliers in the case distribution which were taken care of by drawing them to the nearest highest values. Thus, blood loss was likely to be more in patients admitted to ICU compared to those not admitted.

Mode of delivery of both groups is presented in Table 2. There was a significant relationship between the two groups and mode of delivery. Further analysis with Bonferroni correction revealed that the patients admitted in ICU were more likely to undergo Cesarean section compared whereas those not admitted in ICU were more likely to deliver normally.

Interventions required in obstetric ICU admission is presented in Table 3. The most common intervention required was blood and blood products transfusion.

Table 2: Mode of delivery in the study population

Mode of delivery	Cases (*n* = 63)# *n (%)*	Controls (*n* = 80) *n (%)*	Stats
Normal	22 (29.33%)*	53 (70.67%)*	X^2 = 18.17, df = 2, $p < 0.001$
Instrumental	4 (33.33%)	8 (66.66%)	
Cesarean section	37 (66.07%)*	19 (33.93%)*	

*#12 cases were ectopic, 3 were antepartum and 2 were abortion complications; *statistically significant*

Majority (n = 72, 90%) of the patients admitted in ICU improved and were eventually shifted to ward. Four (5%) patients were referred to higher centers while next four (5%) expired.

Table 3: Interventions in ICU obstetric admissions (N = 80)

Interventions	n	%
Blood and blood products transfusion	38	47.5
Oxygen supplementation	35	43.75
Magnesium sulphate	28	35
Higher antibiotics	18	22.5
Central venous line	12	15
Mechanical ventilation	9	11.25
Inotropic support	8	10
Surgical management	7	8.75

DISCUSSION:

The ICU facility of LMCTH consists of 10 beds, each equipped with a monitor and total of four ventilators. It is efficiently managed by a dedicated team of anesthesiologists, two residents, medical officers and trained nursing staff. It caters to a number of critically ill patients within the region, often referred from the surrounding districts as well. Although ICU admissions in obstetric population is infrequent in upper middle-income and high-income countries, it constitutes as high as 8.5% in low-income countries.[3,4,6] The epidemiology of ICU utilization is a useful proxy for analyzing maternal near-miss events and mortality.[7] However, there is a paucity of published studies regarding this in our settings. We carried out this study with the aim to fulfill this very gap.

This review shows a rising trend of total ICU admissions during the study period. The ICU admissions of obstetric patients too shows an upward tendency. The increasing volume of patients utilizing the obstetric service of LMCTH overall and more referral from the peripheral health centers explain the trend. The increased awareness of medico-legal aspects and tendency of client aggression has also lowered the threshold for ICU admissions, more so in the field of obstetrics. Moreover, the ICU admission threshold in low-volume maternity units itself is low as obstetric cases requiring extensive monitoring are admitted to ICU for logistic reasons.

In this study, 80 patients were admitted to ICU accounting for 4.6% of total admissions and 0.84% of total deliveries. This is in agreement to the study done by Saha et al. in which the patients admitted to ICU constituted 0.87% of total deliveries and 4.32% of all ICU admissions.[7] This finding is comparable to that of other studies as well.[1,2,8] Obstetric admission to ICU is a management based approach largely governed by the judgment of treating consultants and availability of high dependency units (HDU) facilities. Moreover, there are no published guidelines for obstetric admission to ICU. This leads to marked heterogeneity in admission thresholds in various centers which might be the reason for relatively low ICU admission in our study in comparison to the one done by Upadhyaya et al. in which the ICU admission rate was 2.3% of total deliveries.[9]

In this study, 91.25% of the cases had obstetric indications. Among them, Hypertensive Disorders of Pregnancy (HDP) accounted for 32.5%. Most of them were eclampsia, antepartum being 16 and postpartum, eight. This was followed by PPH (18.75%) and ectopic pregnancy (15%). This finding is similar to another study in which HDP shared 42% of total indications followed by PPH.[8] HDP was the leading indication in similar studies from the region.[2,10,11] This finding highlights the fact that hypertensive disorder still tops the list of obstetric morbidities in our part of the world. The lack of proper antenatal supervision results in increased incidence of HDP. Meanwhile, increasing practice of institutional deliveries has helped in reducing the incidence of PPH. This change has led to ICUs facing more admissions for HDP than PPH in contrast to a similar study from Hong Kong where PPH was the leading indication for ICU admissions.[12] Additionally, the need for extensive monitoring in eclampsia and severe pre-eclampsia in the absence of obstetric HDUs leads to more of these cases being admitted to ICU.

Only one case of rheumatic heart disease (RHD) was admitted in ICU. In contrast, it was the most common non-obstetric indication (4.4% and 16%) in the studies reported by Jain et al.[13] and Saha et al. respectively.[8] This is probably due to the fact that pregnant women with RHD mostly seek delivery services in the higher centers with good cardiology back up.

Eight (10%) cases of puerperal sepsis were also admitted to ICU. They were mostly referred cases who had home deliveries in substandard conditions and presented late to health centers. Achieving more

institutional deliveries would definitely result in safer deliveries and thus decrease the incidence of puerperal sepsis. Two cases of cervical dystocia who underwent cesarean section were admitted to ICU prophylactically for better monitoring.

Most of the cases admitted to ICU were postpartum (78.75%). Among them 58.76% had undergone lower segment cesarean section (LSCS), emergency being more than elective. This is because the cases undergoing LSCS are more likely to experience major complications. Also, these are the cases who are more likely to carry antepartum risk factors which might necessitate higher acuity monitoring. Post hoc analysis of the mode of delivery showed statistical significance between vaginal and cesarean deliveries only. Instrumental mode of delivery was not a statistically significant factor for ICU admission. Other risk factors associated with ICU admission were less gestational age and total blood loss.

Preterm deliveries were associated with more ICU admissions as most of them were iatrogenic terminations for associated maternal medical or obstetric morbidities. A significant predictor for ICU admission was total blood loss. Obstetric patients admitted to ICU had a higher average blood loss. This is because patients with PPH more often require massive blood transfusion and are liable to suffer multiple other complications arising from hypovolemic shock. Also, people with severe PPH were more likely to undergo surgical intervention as hysterectomy which itself required ICU admission. Massive blood transfusion itself needs vigilant monitoring. As in other studies, age and gravidity were not found to be statistically significant.

In the study reported by Saha et al., the most common intervention in ICU obstetric admissions was oxygen supplementation.[8] However in this study, blood and blood products transfusion was the most common (47.5%) intervention. This may be because some patients were admitted prophylactically requiring merely good monitoring with no intervention. All the 26 patients of HDP received magnesium sulphate and two patients who were eventually diagnosed as seizure disorders had also received magnesium sulphate initially. The need for meticulous monitoring in magnesium sulphate administration and blood transfusion increased the ICU admissions.

Only nine patients (11.25%) required mechanical ventilation and eight required inotropic support. This is significantly lower in comparison to other studies in which ventilator support was required in 25.3% to 40.5%.[10,14,15] Since majority (88.25%) cases required no ventilator support, it implies that most of them could have been treated in HDU. It has been shown that specialist obstetric units providing HDU facilities result lower maternal transfers to critical care units and improved continuity of care before and after labor.[5]

All the seven patients in this study who required subsequent surgical intervention were admitted to ICU. One was a case of suspected uterine perforation who underwent suction and evacuation of the retained products of conception after 24 hours of intravenous antibiotics. Three cases were vaginal deliveries ending up with peripartum hysterectomy. One case was diagnosed with placenta accreta while other two had severe PPH. The remaining three were cesarean cases who underwent re-laparotomy for PPH. Need for surgical intervention post-delivery is therefore a risk factor for ICU admission.

Ninety percent of cases admitted in ICU improved and were shifted to ward. The longest stay was seven days and the shortest was only six hours. The mean ICU stay was 2.13 days ($SD = 1.34$) which is lesser than in most studies.[1,2,8,10] Anticipatory admissions of high risk cases required shorter stays and early referrals of four patients were responsible for lowering the mean ICU stay to some extent. Less mean ICU stay also reflects the fact that majority of patients did not have further complications after ICU admission.

Four cases were referred to higher center. Three of them were potential candidates for hemodialysis while one required neurosurgical intervention. The inclusion of advanced services as hemodialysis will definitely lead to lesser number of referrals and increase the improvement percentage of ICU services.

Out of 80 obstetric ICU admissions, four patients (5%) expired. Two patients died secondary to severe PPH who had undergone subtotal hysterectomy as well. One patient expired due to pulmonary embolism while one died secondary to eclampsia. This percentage of mortality is similar to other studies within the country.[8,9] This low percentage is due to very low threshold of ICU admissions in our set ups which result in ICU admission of those cases too which could be managed in post-operative or obstetric wards with a little enhanced monitoring.

CONCLUSION:

Although obstetric cases constituted only 4.6% of total ICU admissions, they pose a unique challenge and require multidisciplinary input. Hypertensive disorders followed by obstetric hemorrhage formed the majority of indications. Lower gestational age, increased blood loss, emergency cesarean sections, surgical interventions, and associated co-morbidities were noteworthy risk factors for ICU admissions. Majority of the cases improved and did not require invasive interventions. This implies adequate antenatal supervision with consideration of high risk factors along with availability of obstetric high dependency units will significantly reduce the maternal transfer rates to ICU.

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