ORIGINAL RESEARCH

A Prospective Study of Clinical Characteristics and Interventions Required in Critically Ill Obstetric Patients

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Abstract

Introduction: Obstetric patients are a special group of patients whose management is challenged by concerns for fetal viability, altered maternal physiology, and diseases specific to pregnancy.

Materials and methods: A prospective analysis of all obstetric patients admitted to the critical care department was done to assess reasons for transfer to the critical care unit (CCU) and the interventions required for management of these patients.

Results: Between June 2013 and September 2017, obstetric admission comprised 95 women (5.9%) of the total critical care admissions. There were 77 patients (81.1%) who were discharged from the hospital and 18 patients (18.9%) died. In most of the cases, the primary reasons for shifting the patient to the CCU were severe preeclampsia with pulmonary edema (22.1%), eclampsia (8.4%), acute respiratory distress syndrome (ARDS) (14.7%), and hypovolemic shock in antepartum hemorrhage (APH) and postpartum hemorrhage (PPH) (10.5 and 13.7%, respectively). It was seen that 73 patients (76.8%) required ventilator support, 58 patients (57.4%) required vasopressor support, and intensive hemodynamic monitoring and blood/blood products were transfused in 55 patients (54.5%). The need for ventilator support was more in patients with a lower PaO_2/FiO_2 and a higher APACHE II score. Patients with a high severity of illness score and a lower PaO_2/FiO_2 had higher odds of requiring vasopressors. Low hemoglobin at the time of transfer to the CCU and a prolonged hospital stay were found to predict the need for blood transfusion.

Conclusion: Obstetric patients are susceptible to critical illnesses but timely management improves the outcome of these young women.

Keywords: Blood transfusion, Echocardiography, Obstetric critical care.

Indian Journal of Critical Care Medicine (2020): 10.5005/jp-journals-10071-23519

Introduction

Obstetric patients are a special group of patients as their care must take into account both maternal and fetal well-being. During the pregnancy and puerperium, changes take place in maternal physiology to fulfill the needs of her health, fetus, and the newborn. These changes can unmask or at times worsen the underlying comorbidities. Furthermore, there may be complications of pregnancy or delivery itself requiring admission to the critical care unit (CCU). Obstetric patients have unique needs and often require management by a multidisciplinary team. There are a variety of reasons for shifting obstetric patients to the CCU and multiple supportive interventions may be required.

The concept of obstetric critical care provided by a multidisciplinary team including an obstetrician, critical care physician, neonatologist, and anesthesiologist within the precincts of the obstetric facility has developed over the last few years, which is at present radically different between different countries.[1] Despite improved healthcare access to pregnant women, an alarmingly high maternal mortality rate still remains a challenge in developing countries. A dedicated obstetric critical care is lacking in most of the obstetric centers of India.[2]

We performed a prospective analysis of all critically ill obstetric patients admitted to the critical care department and analyzed the common reasons for transferring obstetric patients to the CCU and the treatments they required. Such recognition of these unique needs of the critically ill obstetric patients will allow better allocation of resources.

Materials and Methods

Safdarjung Hospital is a high-volume obstetric center and is a referral center for cases from various peripheral hospitals. In the period from April 2013 to August 2017, all obstetric admissions to an eight-bedded CCU under the Department of Pulmonary and Critical Care Medicine were assessed prospectively. These patients were admitted during pregnancy as well as in the first 6 weeks of the postpartum period.

The patients were managed by the critical care team, comprising critical care consultants, the referring obstetric unit, and the neonatology team. The CCU has multiparameter monitors, microprocessor-controlled ventilators, and a bedside ultrasound/echocardiography machine. The critical care physicians are trained in point-of-care ultrasonography and perform lung ultrasound along with a deep vein thrombosis (DVT) screen and echocardiography; this was routinely performed for all patients. Cardiology and nephrology consultations were sought when necessary. The hospital also has a round-the-clock laboratory

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How to cite this article: Suri J, Kumar R, Gupta A, Mittal P, Suri JC. A Prospective Study of Clinical Characteristics and Interventions Required in Critically Ill Obstetric Patients. Indian J Crit Care Med 2020;24(8):677–682.

Source of support: Nil

Conflict of interest: None

facilities and a well-equipped blood bank. Dialysis support is also available for patients in case of renal failure in addition to a 24 hour dedicated obstetric emergency OT.

Data Collection

The data collected included basic demographic data, parity, antepartum, or postpartum admission, obstetric and medical history. The reason for transfer to the hospital was classified as following: for hematological reasons (including coagulopathy due to hepatic reasons and severe anemia requiring immediate blood transfusion), after surgery, for hemodynamic support and monitoring; for neurological reasons, for renal failure or for respiratory failure. When there were multiple reasons for transfer, the treating physician was asked to classify based on the primary reason for transfer. The CCU course, blood transfusion received, treatment, and the need for vasopressor and ventilator support were also assessed.

Statistical Analysis

Data Analysis

All obstetric admissions were analyzed for their reason for transfer to the CCU, associated medical conditions, duration of stay, need for ventilator and vasopressor support, and the need for transfusion support. Parametric data were represented as mean and standard deviations, and categorical data were presented as percentage. Logistic regression was done to estimate the odds ratio for predicting the need for blood transfusion and the need for ventilator and vasopressor support. The Chi-square test was used to compare categorical variables. A "*p* value" of less than 0.05 was considered significant.

Results

During the period from June 2013 to September 2017, the total admissions to the eight-bedded CCU were 1,598 of which the obstetric admissions accounted for 95 women (5.9%). The details of the 95 patients are shown in Table 1. The mean age of the patients was 25.11 ± 4.53 years and the mean gestational age was 31.87 ± 7.59 weeks. Only 36 patients (35.6%) had received antenatal care during the pregnancy and 66.3% of the patients were anemic. Of these 95 patients, 77 (81.1%) were discharged from the hospital and 18 (18.9%) died.

In most cases, the primary reasons for shifting the patient to the ICU were for respiratory support in cases of severe preeclampsia with pulmonary edema (22.1%), febrile illness with acute respiratory distress syndrome (ARDS) (14.7%), and for hemodynamic support in hypovolemic shock [antepartum hemorrhage (APH) and postpartum hemorrhage (PPH)] (24.2%) (Table 2). On assessing the services needed during the course of ICU stay (Table 3), it was seen that 73 patients (76.8%) required ventilator support, 35 patients (36.8%) required noninvasive ventilation, and 44 patients (46.3%) required invasive mechanical ventilation. The need for ventilator support was more in patients with a lower PaO_2/FiO_2 (OR = 0.9927; 95% CI = 0.9878–0.9977; *p* value 0.002) and a higher APACHE II score (OR = 1.09; 95% CI = 1.00–1.19; *p* value 0.034) (Table 4).

Fifty-eight patients (57.4%) required vasopressor support and intensive hemodynamic monitoring. Patients with a high severity of illness score (OR = 1.04; 95% CI = 1.02–1.07; *p* value < 0.001 for SAPS II, OR = 1.33; 95% CI = 1.14–1.56; *p* value < 0.001 for SOFA and OR = 1.14; 95% CI = 1.05–1.23; *p* value < 0.001 for APACHE II score) and a lower PaO_2/FiO_2 (OR = 0.9957; 95% CI = 0.9917–0.9997; *p* value 0.034)

Table 1: Clinical characteristics of obstetric patients in CCU

Clinical characteristic	*n = 95*
Age (years)*	25.11 ± 4.53
Parity	
Zero or 1	56 (58.9%)
2/more	39 (41.1%)
Period of gestation (weeks)*	31.87 ± 7.59
Antenatal care provided during pregnancy	30 (31.6%)
Site from transfer to CCU	
Transfer from emergency	11 (11.6%)
Transfer from medicine ward	5 (5.1%)
Transfer from obstetrics ward	79 (83.2%)
Timing of transfer	
Predelivery	32 (33.7%)
Postdelivery	54 (56.8%)
Postabortion	9 (9.5%)
Previous medical diagnosis of:	
Hypertension	7 (7.4%)
Hypothyroidism	2 (2.1%)
Diabetes mellitus	2 (2.1%)
Anemia present	63 (66.3%)
Hemoglobin*	8.81 ± 2.65
PaO_2/FiO_2*	221.64 ± 106.56
SAPII*	41.09 ± 21.85
SOFA*	8.43 ± 4.33
APACHE II*	18.29 ± 8.12
Duration of CCU stay (days)*	4.71 ± 3.24
Duration of hospital stay (days)*	6.92 ± 4.03
Maternal outcome	
Alive	77 (81.1%)
Death	18 (18.9%)
Fetal outcome (alive)	49 (51.6%)

Data expressed as *n* (%)
*Data expressed as mean ± SD
CCU, critical care unit; PaO_2, partial pressure of oxygen in arterial blood; FiO_2, fraction of inspired oxygen; SAPII, simplified acute physiology score; SOFA, sequential organ failure assessment; APACHE II, acute physiology and chronic health evaluation; SD, standard deviation

Table 2: Primary indications for transfer to CCU

Reason for shifting patient	*n (%)*
Severe anemia in failure	6 (6.3)
Coagulopathy with hepatic failure	4 (4.2)
Postsurgery intensive monitoring[a]	10 (10.5)
APH	10 (10.5)
PPH	13 (13.7)
Eclampsia with recurrent seizures	8 (8.4)
Puerperal sepsis with renal failure	4 (4.2)
Severe preeclampsia with pulmonary edema	21 (22.1)
Peripartum cardiomyopathy	5 (5.2)
Febrile illness with ARDS	14 (14.7)

Data expressed as *n* (%)
[a]Consisted of rheumatic heart disease, peripartum cardiomyopathy, chronic lung disorders

Table 3: Interventions used for the management of the obstetric patients

Interventions in CCU	*n (%)*
Number of patients requiring ventilator support #	73 (76.8%)
Patients requiring NIV	35 (36.8%)
Average duration of NIV (in days)*	3.97 ± 2.33
Patients requiring invasive ventilation	44 (46.3%)
Average duration of invasive ventilation (in days)*	3.50 ± 3.08
Number of patients requiring vasopressor support	58 (57.4%)
Patients receiving blood transfusion	55 (57.9%)
Patients requiring PRBC transfusion	52 (54.7%)
Patients requiring PRP transfusion	15 (15.8%)
Patients requiring FFP transfusion	8 (8.4%)
Patients requiring renal replacement therapy	6 (6.31%)

#Six patients required both invasive and noninvasive ventilation
Data expressed as *n* (%)
*Data expressed as mean ± SD
CCU, critical care unit; NIV, noninvasive ventilation; PRBC, packed red blood cells; PRP, platelet-rich plasma; FFP, fresh frozen plasma; SD, standard deviation

had higher odds of requiring vasopressors. In addition, patients on invasive mechanical ventilation also often required vasopressor support (OR = 6.66; 95% CI = 2.68–16.52; *p* value < 0.001) (Table 5).

Blood/blood product was transfused in 55 patients (54.5%). Low hemoglobin at the time of transfer to the ICU (OR = 0.64; 95% CI= 0.51–0.79; *p* value < 0.001) and a prolonged hospital stay (OR = 1.18; 95% CI = 1.02–1.36; *p* value 0.022) were found to predict the need for blood transfusion (Table 6). Six patients required renal replacement therapy and four patients required tracheostomy.

Discussion

The obstetric patients are often a young and previously healthy population with little prior comorbidity. Most of the patients in the current study were shifted to the CCU postpartum, which is in agreement with earlier observations.[3–7] This reiterates the fact that the postpartum period is the most vulnerable time for critical complications such as decompensation of a previous known or unknown heart or pulmonary disease, which was a common reason for shifting the patient to the ICU.[4]

When primary indications for transferring obstetric patients to the ICU were assessed, a previous study had reported

Table 4: Factors predicting need for ventilator support

Factors	*Ventilator support—NO (n = 22)*	*Ventilator support—YES (n = 73)*	*p value*	*Logistic regression [odds ratio (95% CI)]*
Age (years)	26.00 ± 5.03	24.84 ± 4.37	0.293	0.94 (0.85–1.04)
Parity				
Zero or 1	12 (54.5%)	44 (60.3%)	0.631	1.0
2/more	10 (45.5%)	29 (39.7%)		0.78 (0.29–2.01)
Period of gestation (weeks)	32.59 ± 6.20	31.66 ± 7.98	0.616	0.99 (0.92–1.06)
Antenatal care provided during pregnancy	8 (36.4%)	22 (30.1%)	0,607	0.96 (0.36–2.57)
Site from transfer to ICU			0.933	
Transfer from emergency	3 (13.6%)	8 (10.9%)		1.0
Transfer from medicine ward	1 (4.5%)	4 (5.5%)		1.50 (0.12–19.44)
Transfer from obstetrics ward	18 (81.8%)	61 (83.6%)		1.39 (0.34–5.81)
Timing of transfer			0.638	
Predelivery	6 (27.3%)	26 (35.6%)		1.0
Postdelivery	13 (59.1%)	41 (56.2%)		0.78 (0.26–2.31)
Postabortion	3 (13.6%)	6 (8.2%)		0.44 (0.09–2.30)
Previous medical diagnosis of				
Hypertension	1 (4.5%)	6 (8.2%)	0.486	2.04 (0.24–17.54)
Hypothyroidism	0 (0.0%)	2 (2.7%)	0.999	NE
Diabetes mellitus	0 (0.0%)	2 (2.7%)	0.999	NE
Anemia	17 (77.3%)	46 (63.0%)	0.304	0.51 (0.17–1.52)
Hemoglobin	8.15 ± 3.18	9.01 ± 2.45	0.181	1.14 (0.95–1.37)
PaO_2/FiO_2	282.81 ± 87.38	203.20 ± 105.40	**0.002**	**0.9927 (0.9878–0.9977)**
SAPSII	33.73 ± 15.40	43.32 ± 23.07	0.071	1.02 (0.99–1.05)
SOFA	7.77 ± 3.56	8.63 ± 4.54	0.418	1.04 (0.92–1.17)
APACHE II	15.09 ± 3.84	19.26 ± 8.82	**0.034**	**1.09 (1.00–1.19)**
Number of patients requiring vasopressor support	9 (40.9%)	48 (65.8%)	0.048	2.36 (0.89–6.18)
Number of patients requiring blood transfusion	10 (45.5%)	42 (57.5%)	0.340	1.59 (0.61–4.11)
Duration of ICU stay (days)	3.77 ± 2.41	4.99 ± 3.42	0.125	1.16 (0.96–1.40)
Duration of hospital stay (days)	6.36 ± 4.49	7.08 ± 3.90	0.467	1.05 (0.92–1.19)

Bold values = statistically significant

Table 5: Factors predicting need for vasopressor support and intensive hemodynamic monitoring

Characteristics	*Did not receive vasopressor support (n = 38)*	*Received vasopressor support (n = 57)*	*p value*	*Logistic regression [odds ratio (95% CI)]*
Age (years)	25.11 ± 4.15	25.11 ± 4.81	0.999	1.02 (0.93–1.12)
Parity				
Zero or 1	23 (60.5%)	33 (57.9%)	0.834	1.0
2/more	15 (39.5%)	24 (42.1%)		1.28 (0.57–2.87)
Period of gestation (weeks)	32.92 ± 6.45	31.18 ± 8.25	0.274	0.97 (0.91–1.02)
Antenatal care provided during pregnancy	15 (39.5%)	15 (26.3%)	0.186	0.52 (0.23–1.19)
Site from transfer to ICU			0.063	
Transfer from emergency	1 (2.6%)	10 (17.5%)		1.0
Transfer from medicine ward	3 (7.9%)	2 (3.5%)		0.07 (0.00–1.02)
Transfer from obstetrics ward	34 (89.5%)	45 (78.9%)		0.12 (0.01–0.96)
Timing of transfer			0.287	
Predelivery	11 (28.9%)	21 (36.8%)		1.0
Postdelivery	25 (65.8%)	29 (50.9%)		0.59 (0.25–1.42)
Postabortion	2 (5.3%)	7 (12.3%)		2.0 (0.36–11.21)
Previous medical diagnosis of				
Hypertension	3 (7.9%)	4 (7.0%)	1.000	1.26 (0.28–5.57)
Hypothyroidism	2 (5.3%)	0 (0.0%)	0.157	NE
Diabetes mellitus	0 (0.0%)	2 (3.5%)	0.515	NE
Anemia	25 (65.8%)	38 (66.7%)	1.000	1.09 (0.48–2.53)
Hemoglobin	8.95 ± 2.60	8.73 ± 2.69	0.690	0.96 (0.82–1.12)
PaO_2/FiO_2	247.68 ± 87.64	204.28 ± 114.98	**0.040**	0.9957 (0.9917–0.9997)
SAPSII	32.08 ± 11.81	47.11 ± 24.84	**0.001**	1.04 (1.02–1.07)
SOFA	6.32 ± 2.84	9.84 ± 4.59	**<0.001**	1.33 (1.14–1.56)
APACHE II	14.63 ± 3.65	20.74 ± 9.31	**<0.001**	1.14 (1.05–1.23)
Number of patients requiring blood transfusion	18 (47.4%)	34 (59.6%)	0.294	1.75 (0.79–3.88)
Number of patients requiring ventilator support*	25 (65.8%)	48 (84.2%)	**0.048**	2.36 (0.89–6.18)
Patients requiring NIV	18 (51.2%)	17 (29.8%)	0.089	0.43 (0.19–0.97)
Patients requiring IMV	7 (18.4%)	37 (64.9%)	**<0.001**	6.66 (2.68–16.52)
Duration of ICU stay (days)	4.08 ± 2.43	5.12 ± 3.65	0.125	1.13 (0.98–1.29)
Duration of hospital stay (days)	6.68 ± 3.95	7.07 ± 4.11	0.650	1.04 (0.94–1.15)

Bold values = statistically significant

hemodynamic instability as the most common cause followed by respiratory insufficiency and neurological dysfunction.[8] Another study mentioned ventilator support alone as the most common cause followed by hemodynamic instability.[9] In our experience, the common reason for transferring obstetric patients was for respiratory support in the majority of cases. This is partly explained as the CCU is under the team of pulmonary and critical care physicians and they are frequently called for the management of any respiratory failure in the hospital. We also observed that while only 24.2% were shifted to the CCU primarily for hemodynamic monitoring, after shifting, during the course of CCU stay, 60% patients required vasopressor support and intensive hemodynamic monitoring. In our experience, with the availability of bedside echocardiography and ultrasonography, we were able to detect cardiac dysfunction in the otherwise asymptomatic patients and could judiciously use vasopressors in the management of patients.

The need for services in the management of obstetric patients was also evaluated in the current study. Seventy-three patients (76.8%) required ventilator support [with 44 patients (46.3%) requiring invasive mechanical ventilation]. The ventilation rate among obstetric patients varies from 12 to 85% in studies depending on the cases admitted and the severity of illness.[6,8–19] The median duration of ventilation in our study closely agrees with most Indian studies.[8,11,20] Those patients who could be managed with noninvasive ventilation had a better outcome compared to patients who required invasive ventilation. It was also seen that patients with a high severity of illness and low PaO_2/FiO_2 were more likely to require ventilatory support.

In the present study, 57 patients (60.0%) required inotropic support and 55 patients (57.9%) required blood transfusion. We observed that the availability of bedside echocardiography was helpful in not only diagnosing but also effectively choosing the appropriate inotropic/vasopressor agent. The use of hemodynamic support and blood transfusion varies from 31 to 91%[8,11,21,22] and 46 to 70%,[10,16,22,23] respectively, in various studies. The high rate of ventilator and hemodynamic support and blood transfusion reflects the severity of illness of patients admitted as well as the tertiary referral center status of our hospital and prioritization of obstetric patients needing organ support for admission to our CCU.

Table 6: Factors predicting need for blood product transfusion

Characteristics	*Did not receive blood transfusion (n = 40)*	*Received blood transfusion (n = 55)*	*p value*	*Logistic regression [odds ratio (95% CI)]*
Age (years)	25.22 ± 4.59	25.02 ± 4.52	0.828	0.99 (0.90–1.08)
Parity				
Zero or 1	26 (65.0%)	30 (54.5%)	0.399	1.0
2/more	14 (35.0%)	25 (45.5%)		1.55 (0.67–3.58)
Period of gestation (weeks)	31.18 ± 8.06	32.38 ± 7.26	0.447	1.02 (0.97–1.08)
Antenatal care provided during pregnancy	12 (30.0%)	18 (32.7%)	0.826	1.13 (0.47–2.73)
Site from transfer to ICU			0.667	
Transfer from emergency	4 (10.0%)	7 (12.7%)		1.0
Transfer from medicine ward	3 (7.5%)	2 (3.6%)		0.38 (0.04–3.34)
Transfer from obstetrics ward	33 (82.5%)	46 (83.6%)		0.79 (0.22–2.94)
Timing of transfer			0.691	
Predelivery	13 (32.5%)	19 (34.5%)		1.0
Postdelivery	22 (55.0%)	32 (58.2%)		0.99 (0.41–2.42)
Postabortion	5 (12.5%)	4 (7.27%)		0.55 (0.12–2.43)
Previous medical diagnosis of				
Hypertension	5 (12.5%)	2 (3.6%)	0.128	0.26 (0.05–1.43)
Hypothyroidism	0 (0.0%)	2 (3.6.%)	0.507	NE
Diabetes mellitus	1 (2.5%)	1 (1.8%)	1.000	0.72 (0.04–11.90)
Anemia	19 (47.5%)	44 (80.0%)	**0.002**	**4.42 (1.78–10.94)**
Hemoglobin	10.23 ± 2.09	7.78 ± 2.53	**<0.001**	**0.63 (0.50–0.79)**
PaO_2/FiO_2	233.43 ± 106.62	213.06 ± 106.67	0.361	0.9982 (0.9943–1.0021)
SAPSII	38.68 ± 19.64	42.85 ± 23.34	0.360	1.01 (0.98–1.03)
SOFA	7.80 ± 4.05	8.89 ± 4.49	0.227	1.06 (0.96–1.17)
APACHE II	15.35 ± 5.76	20.44 ± 8.93	**0.002**	1.10 (1.03–1.18)
Number of patients requiring vasopressor support	20 (50.0%)	37 (67.3%)	0.096	2.05 (0.89–4.75)
Number of patients requiring ventilator support*	28 (70.0%)	45 (81.8%)	0.221	1.93 (0.74–5.05)
Patients requiring NIV	14 (35.0%)	21 (38.2%)	0.831	1.15 (0.49–2.68)
Patients requiring IMV	15 (37.5%)	29 (52.7%)	0.152	1.86 (0.81–4.26)
Duration of ICU stay (days)	4.08 ± 2.54	5.16 ± 3.63	0.107	1.12 (0.97–1.30)
Duration of hospital stay (days)	6.45 ± 3.63	7.25 ± 4.30	0.339	1.05 (0.94–1.17)

Bold values = statistically significant

In the current study, we tried to assess the reasons for which obstetric patients are shifted to the CCU and the services that are required in their management. Obstetric patients frequently require ventilatory support (invasive and noninvasive), intensive hemodynamic monitoring (inotropic and vasopressor support), and blood transfusion; an adequately stocked blood bank is often instrumental in reducing maternal mortality.[24] In addition, we felt that having the bedside ultrasound and echocardiography machine helped in effectively managing the patients.

The provision of these facilities in an obstetric CCU can help in effectively managing these patients and preventing mortality, which is the need of the hour. Our hospital has now established a dedicated obstetric CCU that is running successfully under the supervision of the obstetricians and with active involvement of the critical care team and the Department of Anesthesiology.

The limitation of our study is that being a single-center study, the sample size was modest. In addition, it was not always feasible to transfer all critically ill obstetric patients to the CCU and consequently, this study does not accurately represent all the critically ill obstetric patients treated in our center.

Conclusion

Obstetric patients are generally young and healthy. Despite this, maternal morbidity and mortality continues to occur and has implications for the family as well as the society. It is hoped that early detection and prompt referral to intensive care units could minimize the maternal mortality. The current study attempts to highlight the services that a dedicated obstetric critical care facility should have in order to effectively manage such patients.

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