Section: Respiratory and Critical Care Medicine

Original Research Article

CORRELATION OF CLINICAL AND DEMOGRAPHIC PROFILES WITH THE OUTCOMES OF OBSTETRIC PATIENTS ADMITTED IN INTENSIVE CARE UNIT OF A TERTIARY CARE HOSPITAL OF NORTH INDIA

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ABSTRACT

Background: Monitoring of the physiological parameters and laboratory blood gas analysis of patients admitted in obstetric intensive care unit (ICU) results may help the physicians for their optimum management. Such obstetric critical care related studies are lacking in our country. The objective is to ascertain the role of clinical and demographic profiles in predicting the outcomes of obstetric patients admitted in intensive care unit in a tertiary care hospital of north India. **Materials and Methods:** This retrospective record-based study was conducted on critically ill obstetric patients during January-June, 2023 at the Shri Ram Murti Smarak Institute of Medical Sciences, Bareilly, UP, India. Their clinical and demographic profiles were correlated with ICU mortality. Data of arterial blood gases values, specifically pH, PaCO2, and PaO2 were also collected. Primary diagnosis of the patients was also noted. A statistical analysis was performed manually using numbers (percentages) for categorical variables. **Result:** Overall, 39 obstetric ICU patients were included in the study. Of them, 10patients (25.6%) died. Patients staying less than 5 days had a high survival as compared to those staying longer (p = 0.0008). Patients who received non-invasive ventilation had a significantly higher (p = 0.010) survival (91%) compared to those on invasive ventilation (56%). Patients with a pH of 6.8-7.35 had a lower survival (47%) compared to those with a pH of 7.36 and above (89%) (p = 0.007). Higher PaCO2 levels (65 and above) correlated with 100% mortality (p = 0.008). Patients with PaO2 values of 51-70 mmHg had a significantly lower survival (38.46%) compared to those with higher levels (p = 0.001). **Conclusion:** One fourth of obstetric ICU patients died. Patients staying for less than 5 days in ICU and who received non-invasive ventilation had a better survival. Patients with a lower pH had a poor survival compared to those with a pH of 7.36 and above. Higher PaCO2 levels had 100% mortality. Poor PaO2 levels led to significantly higher mortality.

INTRODUCTION

Intensive care units (ICU) strive to ensure survival of the critically sick patients admitted in hospitals with deranged physiology, requiring frequent resuscitation. Maternal mortality rate (MMR) is an important indicator of the healthcare quality in any country. For reducing MMR, women with pregnancy, in labour and puerperium related life-threatening complications need easy access to state-of-the-art super-specialists' care in obstetric ICU.[1]

If treated early and properly, recovery of obstetric patients is good. Quality ICU care with regular monitoring can save a mother's life. Hence, mortality is an important performance indicator for ICU administration. In general, outcome of obstetric patients is an indirect indicator of health care quality status in our country.[1,2]

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Care of critically ill obstetric patients admitted in ICU is quite challenging case for the attending intensivist / skilled providers' team. [3,4] In most cases, obstetric patients are quite healthy and young with minimum adverse event during pregnancy, in labour and puerperium. In some complicated cases, prognosis is better if they receive timely ICU referral and care.[3-5]

To monitor of the progression and severity of the underlying disease and the current physiological condition including acid–base status, analysis of arterial blood gas (ABG) is the commonest laboratory test requested in the ICU patients. It also helps in evaluating ventilation adequacy and diagnosing many diseases. Optimum management of the patient and the response to therapy is facilitated by using the results of these tests.[6,7]

Issues related to critical care of obstetric cases need to be studied to benchmark the procedures involved.[8] Such obstetric critical care related studies are lacking in our country. There is a need to conduct such research as it would highlight the actionable areas for necessary improvement for better management of obstetric ICU. Against this background the present study was conducted.

Objective

To ascertain the role of clinical and demographic profiles in predicting the outcomes of obstetric patients admitted in intensive care unit in a tertiary care hospital of north India.

MATERIALS AND METHODS

This retrospective record-based study was conducted over a span of 6 months (January-June, 2023) at the Shri Ram Murti Smarak Institute of Medical Sciences (SRMSIMS), Bareilly, UP, India, a referral center for hospitals of neighbouring districts.The data of the critically ill obstetric patients (requiring ventilator /major organ supportive therapy) admitted to the ICU until discharge or death during the study period was extracted from hospital record section after obtaining requisite permission from the medical superintendent of SRMSIMS. Data of all the patients admitted in ICU during the study period were included as per the admission criteria. There was no random sampling involved. Sample size was not calculated as it was a short-term study.

The patients were managed on daily basis by the referring obstetric unit and critical care consultants using multiparameter monitors, invasive and non-invasive ventilators, and a bedside ultrasound machine.

An attempt was made to correlate the clinical and demographic profiles of these patients with their outcomes. ICU mortality was the main outcome variable used for this analysis. Data of arterial blood gases (ABG) values, specifically pH, PaCO2, and PaO2 were also collected. Primary diagnosis of the patients / indication of ICU admission were also noted.

A statistical analysis was performed manually using numbers (percentages) for categorical variables. The association between categorical variables was analysed using Chi-square test. A P value < 0.05 was considered significant. The Institutional Ethics Committee waived the requirement for informed consent due to the anonymous and non-interventional record-based data related nature of the study.

RESULTS

Overall, 39 obstetric ICU patients were included in the study. Of them, 10 patients (25.64%) died. Table 1 shows the association of clinical and demographic profile of obstetric ICU patients with outcomes. no significant association seen was seen between the survival percentage (outcome) and area of origin, age distribution, parity, delivery type or radiological findings among the patients.

The duration of hospital stay was significantly associated with outcomes. Patients staying less than 5 days have a high survival as compared to those staying longer than 5 days (p = 0.0008). A significant difference was observed in outcomes based on the mode of ventilation (p = 0.010). Patients who received non-invasive ventilation had a significantly higher survival (90.48%) compared to those on invasive ventilation (55.56%).

Initial arterial blood gases (ABG) values, specifically pH, PaCO2, and PaO2, showed significant association with patient outcomes. Patients with a pH of 6.8-7.35 had a lower survival (46.67%) compared to those with a pH of 7.36-7.45 (93.33%) and 7.46 and above (88.89%) (p = 0.007). Similarly, PaCO2 levels of 35-44 mmHg were associated with the highest survival (94.12%), whereas higher levels (65 and above) correlated with 100% mortality (p = 0.008). For PaO2 levels, patients with values of 51-70 mmHg had a significantly lower survival (38.46%) compared to those with higher levels (p = 0.001). Further, the p/f ratio significantly affected outcomes (p = 0.002), with normal ratios associated with the highest survival (92.86%) and severe ratios with the highest mortality (75.00%). [Table 1].

Table 1: Association of clinical and demographic profile of obstetric ICU patients with their outcomes (N= 39)

Clinical and demographic profile of obstetric ICU patients	levels	Outcome				Total		p value#
		Survived		Died				
		n	%	n	%	n	%	
Area	Rural	25	73.53%	9	26.47%	34	87.2	0.757
	Urban	4	80.00%	1	20.00%	5	12.8	
Age (yrs)	20-24	3	75.00%	1	25.00%	4	10.3	0.849

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	25-29	10	66.67%	5	33.33%	15	38.5	
	30-34	12	80.00%	3	20.00%	15	38.5	
	35-39	4	80.00%	1	20.00%	5	12.8	
Delivery Type	Normal	15	75.00%	5	25.00%	20	51.28	0.145
	C-section	10	52.60%	9	47.40%	19	48.72	
Parity	Primigravida	10	90.91%	1	9.09%	11	28.21	0.466
	Multigravida	23	82.14%	5	17.86%	28	71.79	
Duration of Hospital Stay	< 5 days	18	94.74%	1	5.26%	19	48.72	0.0008
	5-10 days	11	84.62%	2	15.38%	13	33.33	
	> 10 days	2	28.57%	5	71.43%	7	17.95	
Ventilation	Invasive	10	55.56%	8	44.44%	18	46.2	0.01
	Non-Invasive	19	90.48%	2	9.52%	21	53.8	
Radiological findings	B/L Minimal Effusion	1	33.33%	2	66.67%	3	7.7	0.138
	Consolidation	9	90.00%	1	10.00%	10	25.6	
	Normal	19	73.08%	7	26.92%	26	66.7	
Ph value	6.8-7.35	7	46.67%	8	53.33%	15	38.5	0.007
	7.36-7.45	14	93.33%	1	6.67%	15	38.5	
	7.46- above	8	88.89%	1	11.11%	9	23.1	
PaCO2(mm Hg)	35-44	16	94.12%	1	5.88%	17	43.6	0.008
	45-54	10	90.91%	1	9.09%	11	28.2	
	55-64	3	42.86%	4	57.14%	7	17.9	
	65-above	0	0.00%	4	100.00%	4	10.3	
PaO2(mm Hg)	51-70	5	38.46%	8	61.54%	13	33.3	0.001
	71-90	14	93.33%	1	6.67%	15	38.5	
	91 and above	10	90.91%	1	9.09%	11	28.2	
P/F Ratio (mm hg)	Normal (>300)	13	92.86%	1	7.14%	14	35.9	0.002
	Mild (200-300)	10	90.91%	1	9.09%	11	28.2	
	Moderate (100-200)	4	66.67%	2	33.33%	6	15.4	
	Severe (<100)	2	25.00%	6	75.00%	8	20.5	
Total		29	74.36%	10	25.64%	39	100	

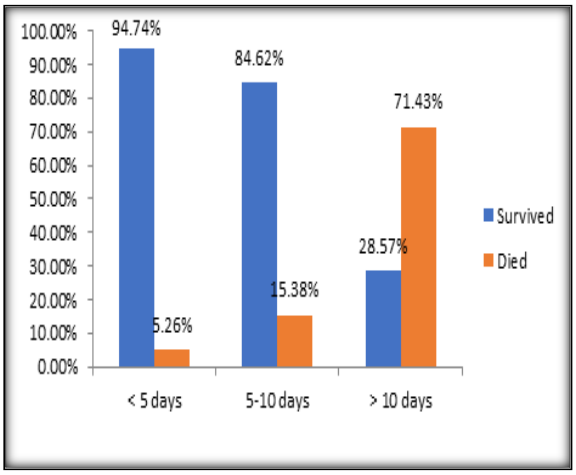

Figure 1

[Table 2] shows that primary diagnosis among the patients who succumbed included one case each of acute kidney injury, disseminated intravascular coagulation and hemorrhagic shock, intrauterine death, severe anemia and ureter / bladder repair in primi-gravida (38 weeks), post-abortal sepsis, and three cases each of septic shock, post-operative shock in lower segment caesarean section (LSCS). Case fatality rate was 100% in cases with septic shock / intrauterine death.

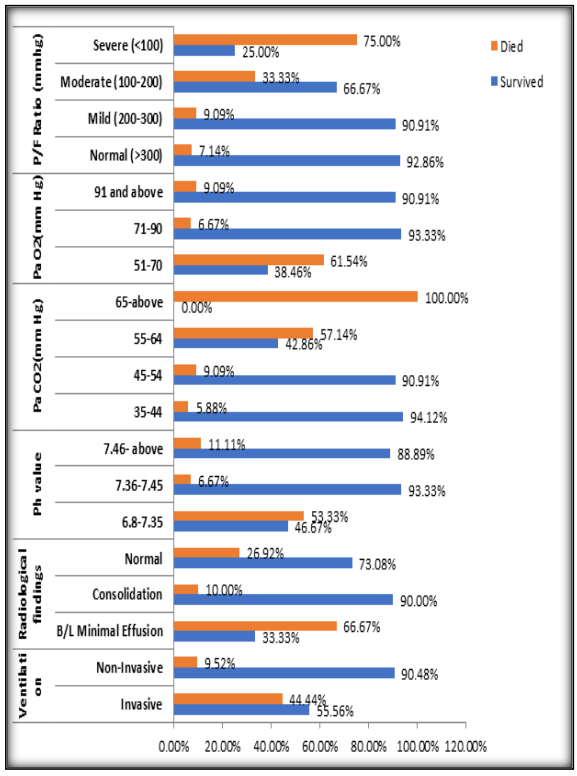

Figure 2

Table 2: Primary diagnosis of the patients / Indication of ICU admission.

Primary diagnosis of the patients / Indication of ICU admission	Survived (n=29)	Died(n=10)	Case fatality rate (%)
Acute kidney injury	1	1	50
Dilated cardiomyopathy with systolic dysfunction	1	0	0
Disseminated intravascular coagulation (DIC) and hemorrhagic shock	1	1	50
Intrauterine death in primigravida 38 weeks	0	1	100
Maternal collapse, post-abortal sepsis, and septic shock	0	3	100

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Post lower segment caesarean section (LSCS)	18	3	14.3
Seizure, seizure disorder, and seizures	3	0	0
Severe anemia and ureter and bladder repair	2	1	33.3
Placenta previa, peripartum cardiomyopathy	3	0	0

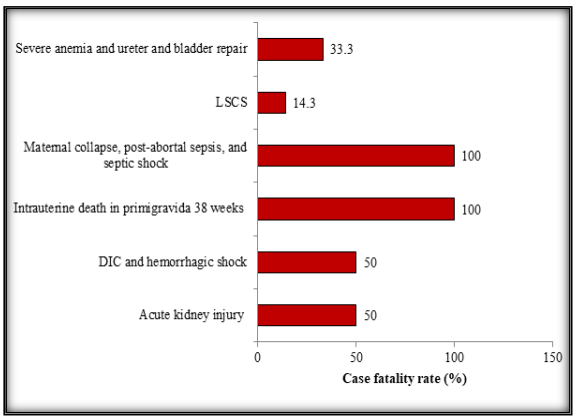

Figure 3

DISCUSSION

Universally, healthcare providers find it challenging to provide good quality care to critically ill patients for reducing high case fatality rates. This requires intensive care by specially trained providers through identification of suitable indicators like values of various laboratory blood gas analysis results and physiological parameters for prediction of prognosis mortality risks of ICU patients.[9,10]

Maternal deaths and obstetric ICU admission are sensitive health-care quality indicators in any country, while MMR is still a public health issue in developing countries. Most pregnancies do not have any serious complications. However, some cases (Hemorrhage, hypertension, sepsis), physiological alterations during puerperium can constrain the management of critically ill patients, which may prove fatal.[11]

Usually, pregnant / lactating women are healthy and young with uneventful maternity events. Still, complications often occur resulting in mortality.[3] Pregnancies as well as any obstetric/ non-obstetriccomplications (PPH, preeclampsia/ eclampsia multi-organ involvement/failure etc) during puerperium can be life threatening for women. Often there is no warning. Care of such patients is quite challenging in obstetrics. No separate special care unit for pregnant /puerperal mothers is there in most hospitals in India. These women need 24X7 personalized intensive care provision by dedicated team(s) led by obstetricians or emergency obstetric care trained competent intensivist/super-specialists with a support of well-equipped facilities. To ensure maternal safety, special ICU care and attention by a multidisciplinary team along with regular monitoring of these parameters is required. Critically ill obstetric ICU patients recover early with MMR reduction if managed properly.[1,3,12,13]

Qureshi et al reported that numbers of ICU beds and admission rates differ between countries. Like other developing countries, in Karachi, 1.34% of obstetrics patients were shifted to the ICU, with PPH as one of the commonest reasons for admission. In developed countries like the US, less than one percent of the obstetric cases are admitted in ICU. In developing countries, ICU beds are 2/100,000 population in comparison to 30.5/100,000 in the US.[3]

Very few obstetric cases may require ICU services. But their survival is usually at stake. In such patients, multiorgan failure may be prevented by addressing issues related to ventilation, circulation, and blood pressure.

Keizer et al reported that in The Netherlands less than one percent of all women required ICU admission after deliveries. Case fatality was 4.9%.[14] Kumar et al highlighted the need to reduce the MMR by preventing complications through the availability of a dedicated obstetric ICU services. Case fatality rate (CFR)of obstetric ICU admissions was 18% (33% for sepsis; 17% for pneumonia) as against 28–41% reported in India, and 19-44% for sepsis. Maternal outcome was not affected by parity. Severely ill cases and those on hemodynamic / ventilator support had higher odds of death / poor outcomes.[15]

In the present study, the duration of hospital stay was significantly associated with outcomes. Patients who had a hospital stay stayed less than 5 days had a high survival as compared to those staying longer than 5 days ($p = 0.0008$). Apparently, complicated cases required longer hospital stay/care.

A significant difference was observed in outcomes based on the mode of ventilation ($p = 0.010$). Patients who received non-invasive ventilation had a significantly higher survival (91%) compared to those on invasive ventilation (56%). This could have been so because it is natural for serious cases to be administered invasive ventilation. Gupta et al reported that amongst the maternal mortality cases mean duration of ventilation and ICU stay were of significantly lesser duration as compared to survivors.[16] Ashraf et al reported that artificial ventilation was indicated in most (85%) such patients. For ICU admission, PPH was the commonest indication.[4] Ramachandra Bhat et al reported that mechanical ventilation was the commonest intervention (63%).[17]

In another study, most (76%) ICU patients required artificial ventilation (median duration=2 days). Case fatality rate was 34%.[8] Need of ventilator support was the reason for which 46% of patients were admitted to ICU mainly due to PPH.[13] Keizer et al reported that artificial ventilation was needed in 44.4% ICU cases.[14]

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To monitor of the progression and severity of the underlying disease and the current physiological condition including acid–base status, analysis of arterial blood gas (ABG) is the commonest laboratory test requested in the ICU patients. It also helps in evaluating ventilation adequacy. Optimum management of the patient and the impact of therapy is facilitated by the results of these tests.[6]

Indications for admission to ICU comprise the established causes of acute severe maternal morbidity, which also carry very high CFR reflecting the quality of obstetric care, e.g., obstetric hemorrhage, eclampsia, septic shock, severe features of preeclampsia, and pulmonary embolism. The maternal and perinatal mortality in the ICU is significantly higher in under-resourced countries when compared with data from developed countries.[1,12] Wanderer et al reported that ICU utilization rate was 419 per 100,000 deliveries with minimum for postpartum conditions as compared to ante- / intra-partum. Sepsis was among the commonest ICU diagnoses.[18]

Jain et al reported from Delhi that ICU admission was more likely for women of poor social strata having complaints for more than 12 hours after having had hysterectomy.[19] In Zeeman study ICU admission was indicated in cases of massive hemorrhage and hypertension.[20] In Qureshi et al study, sepsis and PPH were among the diagnosis of the obstetric ICU patients.[3]

In India, with high MMR, many obstetric patients are admitted in ICU usually with complications related to cardiovascular/ nervous/ respiratory system, DIC, and viral hepatitis.[21] In another study, main causes of admission to ICU and primary cause of MMR were PPH and haemodynamic instability / hypovolemic shock.[16]

Ramachandra Bhat et al reported that PPH was among the two common indications for ICU admissions. CFR of obstetric ICU admissions was 34%.[17] Ashraf et al reported that CFR was 13% mainly attributable to DIC and multiorgan failure after PPH in obstetric ICU admissions.[4] In another study, PPH (35%) and multi-organ failure (41%) were the commonest indications of ICU admission (median stay= 5 days).[8]

Admissions to obstetric ICU is usually indicated when laboratory / clinical findings show a value of pH outside the range 7.1 to 7.7; PaO2 <6.6 kPa and/or PaCO2 >8.0 kPa; SaO2 <90%.

Ozumba et al and Price et al opined that initial management of obstetric patients ICU focuses upon circulation maintenance and airways patency protection to ensure adequate breathing. This may require respiratory support through assisted artificial ventilation for improving the oxygen saturation / supplementation.[12,22]

Monitoring of arterial blood gas is commonly done to diagnose many metabolic disorders via assessment of ventilation, acid-base status, and oxygenation in ICU patients.[7] In the present study also, initial arterial blood gases (ABG) values, specifically pH, PaCO2, and PaO2, showed significant association with patient outcomes. Patients with a pH of 6.8-7.35 had a lower survival (46.67%) compared to those with a pH of 7.36-7.45 (93.33%) and 7.46 and above (88.89%) ($p = 0.007$). Similarly, PaCO2 levels of 35-44 mmHg were associated with the highest survival (94.12%), whereas higher levels (65 and above) correlated with 100% mortality ($p = 0.008$). For PaO2 levels, with values of 51-70 mmHg had a significantly lower survival (38.46%) compared to those with higher levels ($p = 0.001$). Further, the p/f ratio significantly affected outcomes ($p = 0.002$), with normal ratios associated with the highest survival (92.86%) and severe ratios with the highest mortality (75.00%).[15] Lower FiO2/ PaO2 and a highly severe illness indicate higher chances of death.

Bhadade et al reported that higher maternal age/ parity was linked to a higher postpartum case fatality (39%).[5]

One limitation of our study was the inherent bias of the single-centre design with a small sample size.

CONCLUSION

An analysis of obstetric ICU patients' characteristics may help in prognosticating their clinical course. Patients staying for less than 5 days in ICU had a high survival as compared to those staying longer. Patients who received non-invasive ventilation had a significantly higher survival rate as compared to those on invasive ventilation. Of the 39 patients, 10 (25.6%) died. CFR was 100% in patients with septic shock / intrauterine death.

Patients with a pH of 6.8-7.35 had a lower survival compared to those with a pH of 7.36 and above. A PaCO2 levels of higher 65 mmHg and above correlated with 100% mortality. For PaO2 levels, patients with values of 51-70 mmHg had a significantly lower survival. Severe p/f ratio had the highest mortality (75%).

Recommendations

Physiological parameters of obstetric ICU patients need to be closely monitored to stabilise their situation before intervention for improving the outcome.

Prospective studies with a trial format using a larger sample size are needed to validate our results. To further bring down the MMR, facility of skill-based services in dedicated ICU, with state-of-the-art equipment and technology and a team of appropriately trained professionals are the need of the hour.

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