

PREDICTION AND ANALYSIS OF MATERNAL AND PERINATAL OUTCOME IN PREGNANT WOMEN ADMITTED IN OBSTETRIC INTENSIVE CARE UNIT.- A CROSS SECTIONAL STUDY

Obstetrics & Gynaecology

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ABSTRACT

This is a prospective, cohort, analytical study to evaluate the utility of intensive care unit in high risk pregnancy management and to predict the perinatal and maternal outcome utilising Risk assessment score among pregnant women admitted to Obstetric ICU. 560 High risk women with life threatening complications of pregnancy were admitted at ICU in 24 months, and were treated for their obstetrics conditions. later they were transferred out to High dependency unit (HDU) and the obstetric outcome was analysed. **Observations:** 4.3% of pregnant women were admitted in obstetric ICU among 13068 deliveries in 24 months. Maternal complications were Eclampsia-10.2%, Obstetric hemorrhage-34%, Severe anemia-8%, Diabetes in pregnancy-6.9% Septicaemia-0.2%, DIC-2.4%, Hypovolemic Shock-2.4%, ARF-2.3%, CCF-0.15%, HELLP syndrome-2.5%, Maternal Near miss-9.6%, Maternal mortality -4.82% such as COVID-19 related ARDS -1.7% and Hypertensive disorder related maternal deaths-1.6%. mean Duration of hospital stay was 10.2 days, average Blood product replacement rate-1.73. NICU transfer rate-55.7%, maximum indication for NICU transfer being preterm-61.36%, and perinatal mortality-10.7%. **Conclusion:** maternal morbidity, mortality and NICU transfer rate were high among mothers admitted at obstetric ICU, hence they need early detection of risk factors and aggressive, and timely intervention of pregnancy to achieve a good obstetric outcome. Maternal Initial assessment MEOWS of >6 correlated with high maternal and fetal adverse outcome. HDU promotes continued neonatal care by encouraging bonding and breast feeding along with continued maternal monitoring.

KEYWORDS

High dependency obstetric units (HDU), Intensive care units (ICU), Maternal Near miss, Maternal morbidity, Neonatal intensive care unit (NICU), Perinatal outcome, modified early obstetric warning score (MEOWS), Adult respiratory distress syndrome (ARDS), multi organ dysfunction (MODS).

INTRODUCTION

Pregnancy is a physiological period of women that brings joy to family. Critically ill obstetric patients present a challenge to the treating clinician because of the physiological stress and changes of pregnancy and the presence of a fetus. PW with normal physiology in pregnancy may change to critical condition, and for emerging obstetric complications or for underlying medical complications may require admission to ICU. Pregnancy and delivery are situations for maternal life threatening complications which indicate the provision of a higher level of critical care than in low health resource settings. High risk women need early referral to tertiary care hospitals with intensive care services for optimal critical care. Referral rate to tertiary care centres, maternal mortality, transfer to ICU and maternal near miss analysis indicate the quality of maternal health care services in a geographic area and its review indicates implementation of changes to improve MCH services and to channelise the resources to health programmes. An unpredictable complication or pre-existing disease of the mother or foetus can complicate pregnancy, presenting as "high risk" with the possibility of an adverse outcome. High Risk scoring system may be defined as a formalized method of recognizing, documenting, and cumulating antepartum, intrapartum, and neonatal risk factors in order to predict complications for mother and newborn^[6]. Critically ill pregnant women are initially assessed by MEOWS score at obstetric ICU and obstetric outcome is analysed.

Availability of Emergency services and critical care, ICU at Tertiary health care centres are considered as optimal interventions in Emergency obstetric care in the journey towards safe motherhood. The free Maternal Child Health beneficiary health schemes for pregnant women and new-born such as JSY, JSSK, Lakshya Maternity related quality assessment of MCH care, SUMAN initiative, free NICU services were initialised and maintained at all Government health facilities in India to reduce maternal and neonatal morbidity and mortality. Special services such as family welfare programmes, provision of safe abortion care, skilled birth attendant, capacity building interventions- such as adequate training of health care workers through skilled resource persons are implemented by Government of India to achieve MDG goals to reduce maternal and neonatal adverse outcomes. Studies are needed to analyse maternal health predictors and neonatal outcomes, to improve the quality of health services through subsidised, incentivised and free provision of maternity and neonatal health services that are aimed at provision of optimal MCH services. The present study was conducted on high-risk pregnancies among Critically ill mothers admitted at Obstetric intensive care unit for Emergency care in the ICU manned by residents trained in critical care, anaesthesiologist, Obstetricians and Paediatricians, skilled

paramedical staff in a tertiary care hospital.

This is a prospective, descriptive, analytical cohort study undertaken at a tertiary care-MCH Government maintained hospital to analyse and predict the maternal, perinatal morbidity at Shri Chamarajendra Government MCH Hospital attached to Hassan Institute of Medical Sciences, Hassan, Karnataka, India over a period of 2 years, among 13068 deliveries from January 2021-december 2022. with institutional ethical committee approval.

All women admitted at obstetric ICU in the study period were Initially assigned MEOWS score based on clinical parameters and were intensely monitored and aggressively treated, with timely interventions and the Maternal and Perinatal outcome were analysed. Objectives of study were as follows-1) To assess the ICU utilisation rate among High risk pregnancy, 2) To analyse the perinatal outcome and maternal outcome. 3) To evaluate the Utilisation of HDU as step down ICU among High risk pregnant women. 4) To analyse the predictors of maternal outcome by risk assessment of high-risk pregnancy with modified OEWS scoring criteria.

Methodology

The present study is a prospective, cohort, analytical clinical study among 560 high risk pregnant women admitted in obstetric ICU at tertiary care centre-Shri Chamarajendra Government MCH hospital attached to Hassan Institute of Medical sciences, Hassan, Karnataka, India. Pregnant women with severe life threatening complications of pregnancy, medical diseases complicating pregnancy. Complications of labour, sepsis, severe pre-eclampsia, Eclampsia, and other complications were included as subjects. Criteria for admission at ICU were High risk pregnancy with life threatening complications requiring admission for extended care such as frequent monitoring of vital signs, pulse oxymetric measurements, oxygen therapy, emergency resuscitative measures, ventilatory support, need for massive transfusion of blood products, cardiac monitoring, invasive monitoring etc. The subjects were initially assigned with modified early Obstetric warning score (MEOWS) and aggressively monitored and treated accordingly with timely termination of pregnancy. The maternal demographic indicators such as admission criteria, age distribution, Gestational age category, obstetric outcomes such as Mode of termination of pregnancy, maternal complications, average duration of stay at ICU, admission to delivery events, adverse maternal outcomes such as maternal morbidity and mortality referral to higher centre, obstetric and medical interventions, utility of blood products were analysed. Foetal outcome such as Birth weight, Gestational age, Neonatal interventions/surgery, NICU transfer rate, neonatal

septicaemia, Meconium aspiration syndrome, Birth Asphyxia, need for ventilatory support Perinatal morbidity and Mortality were analysed. The final obstetric outcome, predictors for maternal adverse outcome based on meows score, HDU transfer rate, maternal and perinatal morbidity and mortality were analysed. Data was compiled and analysed using MS Excel 2007 and SPSS software (Trial version 22). The categorical variables such as age, sociodemographic details, obstetric details, present and past high-risk characteristics, and their outcomes were all tabulated and expressed as percentages. stepwise logistic regression analysis adjusting for maternal factors to assess the potential risk factors for ICU/ HDU admission & pregnancy outcome were correlated. Chi-square test was used to study the association of variables and categorical data presented as percentages, a P value <0.05 was considered significant at a confidence interval of 95%.

The subjects who recovered from acute emergency and needed less critical care were shifted to obstetric High dependency units (HDU) located near ICU and were further followed up with advantage of facilitating Neonatal care with mother, thereby promoting neonatal bonding and encouraging breast feeding by the mother with continued maternal monitoring and care by skilled nursing officers.

OBSERVATION

The study population admitted at obstetric ICU were categorised based on maternal admission assessment score by MEOWS scores and the following observations were noted.

Distribution Of Cases.

The study population admitted at obstetric ICU with maternal complications were as shown in table-1, after initial assessment in obstetric ICU. Hypertensive disorders of pregnancy was most common indication for admission 61.4%, followed by haemorrhage - 28.6%, medical disorders including COVID-19 disease in pregnancy was -24.6% and Maternal Near miss -9.6%.

Table 1- Distribution Of Cases

sl.n	Indication for admission	No.of casesn=	percentage
1	Gestational HTN	134	26.8
2	Pre-eclampsia	118	23.6
3	Imminent eclampsia	57	11.4
4	severe anemia	40	8
5	Atonic PPH	32	6.4
6	incomplete abortion with hemorrhage	28	5.6
7	GDM	26	5.2
8	Ruptured ectopic pregnancy in shock	25	5
9	Molar pregnancy in shock	22	4.4
10	IUFD	21	4.2
11	Eclampsia	51	10.2
12	Moderate anemia	20	4
13	Traumatic PPH	14	2.8
14	Placenta previa	23	4.6
15	Rupture uterus	8	1.6
16	HELLP syndrome	13	2.6
17	Abruptio Placenta	15	3
18	polyhydramnios with APH	9	1.8
19	chronic kidney disease	2	0.4
20	Overt diabetes	7	1.4
21	Fever	6	1.2
22	Plural effusion	2	0.4
23	Septic abortion	1	0.2
24	Pericardial effusion	1	0.2
25	Seizure disorder	3	0.6
26	Chicken pox	2	0.4
27	Pulmonary edema	2	0.4
28	CCF	1	0.2
29	Hypovolumic shock	3	0.6
30	Schizophrenia	1	0.2
31	LRTI	2	0.4
32	Septicemia	1	0.2
33	Twin with HTN	4	0.8
34	Peripartum cardiomyopathy	1	0.2
35	Hyperthyroidism with CCF	1	0.2
36	CVA	1	0.2

37	Obstructive pulmonary disease	2	0.4
38	Septic abortion	1	0.2
39	COVID disease in pregnancy	12	2.4
40	Maternal Near miss	48	9.6
	Total	760	100

2. Age distribution of cases: The distribution of cases as per maternal age is shown in table 2 maximum women in study group were between age 21-30 years.

Table-2 Age Distribution Of Cases

Sl.no	Age distribution in years	Number N=	Percentage
1	<20	74	13.6
2	21-25	250	44.6
3	26-30	160	28.5
4	31-35	60	10.7
5	36-40	06	1.07
6	>40	10	1.7
	Total	560	100

Distribution Of Cases On Initial Assessment On Admission:

The distribution of cases as per MEOWS score on admission is shown in table 3, and chart 1. The maternal mortality was high with MEOWS score >6 , and a single parameter score of 3+ and Majority of population under observation were below ROC indicating that the MEOWS score on admission at ICU positively predicted the maternal outcome, thus initial assessment score was a reliable predictor for pregnancy outcome among critically ill women.

Table3

Sl.n	MEOWS SCORE	Number N=	Percentage
1	0	68	12.1
2	1-4	181	32.3
3	5-6	233	41.6
4	>7	78	14.0

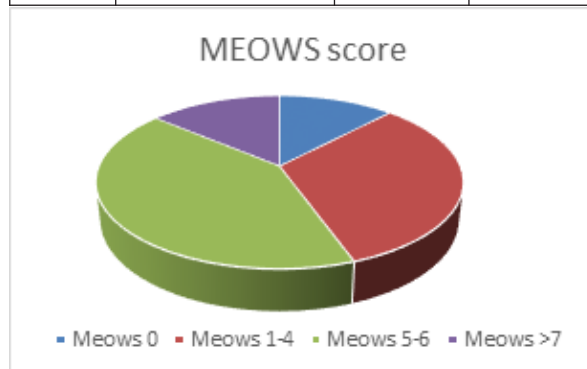


chart 1

Distribution of cases according to Gestational age:

The distribution of cases as per gestational age is shown in table-4/chart 2. 55% of pregnant women in study group were less than 36 weeks of gestational age of pregnancy.

Table4-Distribution of cases As Gestational age

Sl.no	Gestational Age In weeks	Number N=	Percentage
1	>40	10	0.2
2	36-40	245	43.8
3	33-35	140	25.5
4	28-32	131	23.4
5	<28	34	6.1
	Total	560	100

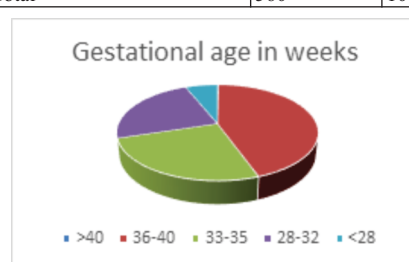


Chart2

Distribution Of Cases And Mode Of Termination Of Pregnancy:

218 of the pregnant women admitted in ICU in critical condition were delivered by caesarean delivery, 5 underwent hysterotomy and 10 underwent peripartum hysterectomy, 27 women were undelivered and pregnancy was continued after recovery, as shown in Table 5

Table 5.-Mode Of Delivery

Sl.no	Mode of delivery	Number N=	Percentage
1	PTVD	89	15.9
2	PPROM	28	5
3	FTVD	122	21.7
4	Assisted delivery	25	4.5
5	Cesarian delivery	218	39
6	Hysterotomy	05	0.9
7	Laparotomy	09	1.6
8	Peripartum hysterectomy	10	1.8
	Total	506	90.35

Maternal Complications:

The maternal complications were as shown in table-6. In 5.7% of subjects were referred to higher centre for further multidisciplinary medical care, 2.14% had per operative complications, 49% had postoperative complications such as -SSI, VAP, ARF, DVT, CAUTI, Septicaemia, ARDS, Post transfusion complications and others. There were 27 maternal deaths, out of which majority were due to COVID-19 related ARDS-09(1.7%), Hypertensive disorders of pregnancy and eclampsia-05(1.6%), obstetric haemorrhage-08(1.5%), severe anaemia with CCF-01(0.2%) and others due to medical disorders-04 (0.75%). 67.5% needed packed RBC transfusion, 12% - Fresh frozen plasma and platelet transfusion 9.1% among study population. One among the study group developed Post transfusion related acute lung injury and was referred to Higher centre. The general condition in the study group improved in 91%, with average duration of hospital stay 10.2 days and mean critical assessment MEOW's score was 6 at admission. The association between initial assessment on admission risk score >6 and the neonatal outcome was found to be statistically significant ($P = 0.05$).

Table 6-maternal Complications

Sl.no	Maternal Complication	Number of Cases N=	Percentage
1	Per operative complications	12	2.14
2	PPH	20	3.5
3	DIC	05	0.8
4	Pulmonary edema	05	0.8
5	Embolism	03	0.5
6	DVT	02	0.35
7	Ventilatory support	08	1.4
9	Referral to higher center	32	5.7
10	Peripartum hysterectomy	10	1.6
11	Postoperative complications	49	8.75
a	SSI	21	3.75
b	VAP	07	1.25
c	ARF	05	0.8
d	DVT	01	0.9
e	CAUTI	03	0.5
f	Septicemia	04	0.7
g	Laparotomy	03	0.5
h	Pulmonary complications/ARDS	05	0.8

Table 7a- Perinatal Outcome In Terms Of Birth Weight.

Sl.no	Birth weight in kg	Cases n=	Percentage
1	<1	54	10.4
2	1-1.5	81	15.6
3	1.5-2	85	16.4
4	2-2.5	171	33
5	2.5-3	73	14
6	3-3.5	28	5.4
7	3.5-4	16	3
8	>4	10	2
9	Total	518	100

Neonatal outcome in terms of birth weight is shown in table-7a. Maximum newborn were of birth weight 2 to 2.5 kg. 35% babies were delivered by Elective caesarean delivery at gestational age <38 weeks for maternal complications and for severe growth affection on admission. However 42 pregnancy continued after recovery of mother.

7b. Newborn gender distribution is -male-56.4% and female-43.6%

7c. Newborn transfer rate to NICU is as follows- NICU transfer- 62.7%, shifted to mother's side after short Observation-37.3%, intra uterine fetal deaths-04.2%.

7d. Newborn Complications rate is as shown in table -7d. In 286 neonates were healthy, 47(15%) newborn babies needed surfactant therapy out of 312 NICU admissions, and 41.5% of neonates had neonatal complications of severe grade, and the observed perinatal mortality-10.7%.

Table 7d- Newborn Complication Rate.

Sl no	Newborn complication	Cases	Percentage
1	Respiratory distress syndrome	60	27.9
2	Jaundice	60	27.9
3	Neonatal mortality	32	14.8
4	Refer to higher center	15	6.9
5	Meconium aspiration syndrome	11	5.11
6	Septicemia	09	4.18
7	Metabolic problems	09	4.18
8	Necrotising enterocolitis	07	3.3
9	Convulsions	04	1.8
10	DIC	02	0.9
11	Pneumonia	02	0.9
12	Intrathoracic tube insertion-surgical intervention	04	1.8
13	Total	215	99.5

DISCUSSION-

High risk pregnancy amounts to 15% of all pregnancies which might end in Maternal nearmiss or Maternal morbidity with high rate of ICU transfer, Neonatal care unit admissions and prolonged hospital stay. High risk pregnancy may be detected during antenatal visits of the mother and referred to high risk pregnancy evaluation and care to tertiary hospitals equipped with Intensive care unit and HDU, and multidisciplinary health care units. The prognosis among high risk pregnancy needing intensive monitoring and HDU care is unpredictable due to evolving severity of high risk disorders in pregnancy. Although Some of the high risk conditions may be predicted and prevented, most women in the study category seek health care services late due to delay in diagnosis or referral from primary health care centers. Hence the obstetric outcome is unpredictable, and prognosis largely depends on specific maternal risk factors and initial assessment on admission at tertiary care hospitals.

The present study aims to analyse the pattern of high risk pregnancy, and obstetric outcome among critically ill pregnant women. This is a facility based, prospective, descriptive clinical study for a period of 24 months (January 2021-december 2022), among high load of high risk pregnancy at Sri Chamrajendra Government MCH Tertiary hospital attached to Hassan Institute of Medical Sciences, Hassan district, Karnataka State, India.

The observations of the present study is compared with previous studies conducted by various authors. A systematic review by Pollock W et al on pregnancy admitted to ICU reported an incidence of obstetric ICU admissions in developed countries was 2-4 per 1000 deliveries compared to 12-13.5 per 1000 in developing countries. Anjel Paternia-Caicedo et al Reported ICU admission rate-14.22/1000 delivery, and maternal death of 4.1%. A South Indian study by Dr Vinutha K et al reported ICU admission of 0.7% and HDP cases 33.3% and obstetric haemorrhage being 30%, and septic abortion 3.3% of admissions among 60 obstetric admissions at ICU. These observations concurred with present study-4.3% of total delivery. B Rao Bahadur observed among 75 cases PPH in 28% and HDP-22.6% and non-obstetric reason for ICU admission were 32%. This study population was small to analyse the common indication for admission in ICU when compared to large group under study as in present study. Seema P et al observed that maximum high risk pregnancy were seen in age group of 30-35 years in 17.2%, and in the present study 73% of high risk pregnancy were seen in maternal age 21-30. A Nepal hospital-based prospective cohort study done among 346 maternal high-risk pregnancy factors showed that the prevalence of high-risk pregnancies was 14.4%.⁽¹⁸⁾ The WHO criterion was used for women with severe maternal morbidities, and it was found that the high risk pregnant women were 4.2 times at risk of developing severe maternal morbidities as compared to low-risk pregnant women⁽¹⁷⁾, the same has

been observed in present study.

Surekha Tayade¹, Neha Gangane^{2*}, Poonam Shivkumar³, et al observed an Obstetric HDU utilization rate was 11.2, a majority had no prior antenatal care, (68.42%) were admitted in ICU with obstetric reasons, while 31.57% required HDU. Medical disorders associated with pregnancy among 10.6% in a study by Seema P et al, and 24.2% in the present study medical disorders in pregnancy which is high due to high referral to the tertiary care centre for multidisciplinary intensive care. Obstetric patients constitute 1.1% of total ICU admissions in a study by Bahadur B R, which was less when compared to Nepal study by Saha R et al 0.87%, and 4.32% in present study. Most of the women admitted to the ICU were young (mean age = 24.1 ± 4.4 years). These results were similar to study by Verma et al 0.8%, Saha et al 0.8%, Chawla et al, Gupta et al, and Urvashi et al 0.7%⁽¹⁴⁾

The major obstetric indications in previous studies⁽¹²⁻¹⁷⁾ were septicemia (35.08%) & PPH (29.08%) and hypertension as observed in 21.05% of women. Less common causes were post-surgical acute kidney injury, APH, chorioamnionitis and pyelonephritis. 50% of women with pre-existing medical disease had cardiovascular problems, pre-term labor (10 vs. 5; $P \leq 0.05$), respiratory failure (9 vs. 2; $P \leq 0.05$), cardiac failure (7 vs. 1; $P \leq 0.05$), duration of stay more than 10 days (15 vs. 6; $P \leq 0.05$), fetal growth restriction (6 vs. 3; $P \leq 0.05$) and prolonged recovery time. Majority were admitted for obstetric causes 51 (68%), non-obstetric causes 24 (32%). Most common indication for ICU admission of obstetric patients were hypertensive disorders and massive obstetric haemorrhage 37.5%. Betty Anne Ghana study observed 70.4% ICU admissions for HDP, 21.1% due to obstetric haemorrhage. B. Rao Bahadur et al⁽⁷⁾ observed 68% obstetric ICU admissions, 28% for PPH, and 22.6% for hypertensive disorders of pregnancy, and medical and nonobstetric ICU admissions were observed in 32%. Gestational age on admission were > 36 weeks -44%, 32-35 weeks -49.5% and <28 weeks -6%, most of the admissions were preterm in present study due to early referral from surrounding hospitals. Maternal indications for ICU admission were Severe P.I.H with complications - 71.7%, APH - 7.6%, placenta previa being more common, in concordance with study by Urvashi M et al, Sodhi et al and Joseph et al. But Ozumba et al found rupture of uterus was most common due to low health seeking behaviour of his study subjects from south east Nigeria early detection and timely referral to tertiary centres with intensive care facilities to provide optimum care of circulation, blood pressure and ventilation and termination of pregnancy could minimize multiple organ failure and mortality in critically ill pregnant women. In present study obstetric haemorrhage related admissions were high due to early referral from surrounding hospitals, and survival of mother was high due to early replacement of blood volume and surgical interventions.

Pregnancy outcome among high-risk pregnant women in the rural area in south India among 25% high-risk pregnant mothers, at Belagavi, Karnataka⁽²⁰⁾, observed 29.5% high-risk pregnancies resulted in bad fetal outcomes. As Coopland's high risk scoring increased, the chance of having good fetal outcomes decreased, and observed Maternal mortality among critically ill women was 12.28% and fetal mortality was 17.54%.

Masood A et al observed Patients in the medical group were significantly more prone for preterm delivery, organ failure, persistent hypertension, persistent left ventricle dysfunction, pulmonary embolism, longer stay at Hospital, longer time for recovery, with high maternal mortality, when compared to the obstetric group, which is in concurrence of Ghana study. Indication for ICU admission was - obstetric hemorrhage (52.8%) followed by sepsis which constitutes 26.3%. Masood Ali et al reported a high Maternal mortality, similar to this study - 6.4% and perinatal mortality - 11.6%. Earlier, Ryan M et al and LEUNG et al observed 52% and 21.6% of MMR and perinatal mortality in Indian hospital (2000).

Maternal mortality was high among high risk pregnancy who required intensive tertiary care and critical care services and interventions. R Rao Bahadur reported maternal mortality of 16% which was high in obstetric causes -66.6% vs non-obstetric causes of maternal mortality 33.3%, HDP being highest cause 33.3% followed by sepsis -25%, in comparison to Surekha Tayde et al who reported septicemia -35.08%, PPH -29.1% and HDP -21.1% and recommended an early detection and prompt referral to tertiary center with ICU facility that could reduce maternal mortality. In the present study maternal

mortality was 4.82% and most deaths due to PPH when compared to other causes such as HDP as observed by Vinutha.K et al. Most PPH are preventable when active management of labour, use of prophylactic oxytocic, early referral of high risk and affected women to higher centre are practised, which indicate that maternal care outcome was improvised in the present centre of observation.

A previous Indian study reported maternal and perinatal mortality of 12.3% and 12.3% among patients required admission to HDU⁵ and 52% and 21.6% among patients admitted to ICU respectively,¹² while in developed countries maternal mortality of HDU admissions was nil and prenatal mortality was 1.05% to 8%.³ The incidence of maternal mortality was studied in a larger observation group in the present study when compared to a smaller group of observation by the previous author. Similar studies conducted by various authors showed that majority of maternal mortality were secondary to PPH - Verma et al 19.1%, Ashraf et al -13%, Khan et al -65%, Gupta et al -41.6%, 30.6% by Urvashi M et al, 26% by Betty Anne et al Ghana study and 12.3% by Surekha Tayde, but Chavala et al observed higher incidence of ICU admissions due to hypertensive disorders.⁷ The poor obstetric outcome among patients admitted to ICU was attributed to the underlying severe medical disorders^(10,11,13,14) than obstetric complications. The medical disorder group had high fetal growth restriction, prematurity, low birth weight and intrauterine fetal demise, admission to NICU and neonatal death ($p < 0.05$) compared to those in the obstetric conditions group, as seen in present study.

Montgomery et al⁽¹⁷⁾ emphasized lack of facilities in rural areas and resultant high maternal mortality. Poor transport facilities and referral are factors contributing to high maternal mortality. Miglani et al⁽¹⁸⁾ have highlighted the different levels of delays including the pre- and intrahospital delays and their impact on fetomaternal outcomes. So, these delays may be prevented by awareness and skill training.

Mode of termination of pregnancy among high risk ICU admission was - cesarean delivery -39%, assisted vaginal delivery 4.5%, hysterectomy -0.9%, perterm vaginal delivery 20.9%, Full term vaginal delivery -22%, Laparotomy -1.6% and peripartum hysterectomy -1.8% in present study. Most common mode of termination of pregnancy was emergency LSCS 39 (52%) followed by vaginal delivery 12 (16%). Mechanical ventilation was needed in 44 (58.7%) followed by inotropic support in 30 (40%), haemodialysis in 8 (10.7) in S. Tayde and Masood studies.

Many women with Obstetric complications need early and obstetric/surgical interventions to control obstetric haemorrhage such as vascular occlusion, or hysterectomy. Surgical intervention of pregnancy and complications were needed in 43.4%, when compared to 25% in a report of surgical interventions with caesarean delivery among 58% by Urvashi M et al, B Rao Bahadur observed that Majority of the pregnancy admitted to ICU were terminated by emergency LSCS ($n=39$, 52%), or shifted to ICU after delivery for the management of PPH. Obstetric indications were the significant causes of morbidity and ICU transfer (68%), as compared to non-obstetric causes (32%), in which medical disorders constituted 30.6% and surgical cause constituted 1.3%. The major obstetric causes were obstetric haemorrhage ($n=29$, 38.6%), hypertensive disorders (severe preeclampsia, eclampsia, HELLP) ($n=17$, 22.6%) and sepsis ($n=5$, 6.7%). B Rao Bahadur observed PPH in 80%, peripartum hysterectomy and LSCS rate reported by Ashraf et al (63.3%), Saha R et al (70%). Sudha et al reported 69.2% as preventable maternal deaths.

Poor neonatal outcome were reported among women admitted in ICU with critical illness. The perinatal mortality rate is an important indicator of maternal health and care. It varies from 20/1,000 total births in developing nations. In a prospective cross-sectional study on 124 subjects, Miglani et al. reported an increase in perinatal mortality with rising APACHE II admission scores, Maternal shock, blood transfusions and lower mean gestational age. Desmukh IS et al in their study positively correlated maternal anemia, malnutrition, eclampsia with low birth weight babies. Moujara Hoque and Shahnaz Hoque⁽⁶⁾ found that eclampsia was the risk factor in association with pre term and low birth weight. Mohammed N Barakat et al⁽⁷⁾ -observed significantly higher risk of caesarian delivery among women with gestational diabetes.

Newborn complication Rate was high among pregnant women admitted in ICU. Various authors studied the neonatal outcome and

complication rate and similar observations were seen in present study. Neonatal intubation and ventilator support were needed in 27.42 %, transfer to NICU 29.71%, 11.2% neonates needed surfactant therapy and PNM-- 15.71 %, neonatal Morbidity-1.68%. among HDU admissions. Arjuchand singh et al in his descriptive study among 626 women observed among 15.8% high risk pregnancy, the adverse fetal outcome of low birth weight rate 66.6%, stillbirth of 33.3% among hypertensive disorders of pregnancy. Bahadur B R et al reported 58.6% live births, 18.6% IUFD, early termination of pregnancy 12.5% and NICU admission rate of 59%. In the present study early termination of pregnancy resulted in preterm births - 29.5% at 32 weeks, 42.4% of low birth weight babies were born with NICU transfer rate- 70% . Similar high PNM was reported by Jyotsna suri, zeba khanum in a review article 21.42%, and Devabhaktuni et al, 17.5% by Surekha tayde, 31.06%, mignali et al, 47.2% PNM by ozumba et al.

Sudha et al reported NICU transfer rate-55.7% maximum indication for NICU transfer being preterm-61.36% and perinatal mortality-10.7%, 69.2% maternal deaths ,with-Neonatal intubation and ventilator support were needed in 27.42 %, transfer to NICU 29.71%, PNM-- 15.71 %, Morbidity-1.68%. where as Urvashi et al reported 31.06% of PNMR. The NICU admission rate in present study concurred with Bahadur B R and Arjuchand singh et al and preterm babies needing surfactant therapy was 15%. Availability of adequate neonatal facility in the present Hospital resulted in low neonatal mortality of 14.5%. Verma et al reported live birth rate 83.5% in comparison to 58.68 by Bahadur B R -58.6% and Khan et al-40.5%, present study reported live birth rate-42.4% which is in par with Khan et al Pregnant women with acute massive blood loss needed multiple transfusions of blood products to save mothers from consequences of hypovolemic shock. Bahadur B R utilised 74.6% blood and blood product transfusion, Verma et al , 64.12%. In present study among 560 study subjects, (67.5%) needed packed RBC transfusion, 68/560 (12%) needed Fresh frozen plasma and 51/560 (9.1%) needed platelet transfusion .one among the study group developed Post transfusion transfusion related acute lung injury and was referred out to Higher center. Urvashi Miglani et al reported obstetric hemorrhage-37.1% and HDP 25.8% as common indication for ICU admission and blood and blood product transfusion among 83.9%. This observation indicates early blood transfusion initiation in present study, that indicates the availability of adequate facility at present centre.

Maternal serious complications were high among ICU admissions. Khan et al observed need for dialysis among obstetric ICU admissions-10%, Bahadur B R -9.3%, Saha R et al-4%, Ashraf et al-4.5% for acute kidney injury indicated as a complication of HELLP syndrome. Surekha tayde et al noted that patients with medical diseases had more preterm labour, respiratory failure, cardiac failure and longer duration of hospital stay of more than 10 days. Betty anne in PLOS ONE Ghana study⁽²³⁾ at low resource country reported 28.9% intubation among obstetric ICU admissions compared to 95% and 90% in Malawi and Nigeria respectively. In present study 1.4% needed Respiratory ventilatory support. While Urvashi M et al reported 66.12% mechanical ventilation.

Mortality and ICU admissions for non-obstetric indications among pregnancy was 17.7% in Ghana study compared to 7.6% in the present study. The low rate of ICU admission for medical conditions could be due to early detection, referral and initiation of treatment.

Betty Anane-Fenin et al, Ghana ⁽¹³⁾ study in their retrospective review conducted in tertiary hospital observed ICU admission rate 25.7%, commonest indication being HDP-70.4%, obstetric hemorrhage 14.4%, sepsis-9.3% and. The global incidence of obstetric ICU admission is reported as 0.4-16% and 0.7-13.5 per 1000 delivery with lowest rate in developed countries, as observed by Zieleskiewicz L et al, Primm et al, Ntuli T's et al, south Africa. Hypertensive disorders were most commonest indication for ICU admission that is consistent with global picture, followed by hemorrhage and sepsis.

In the present study 98% mothers were in reproductive age, 80% were booked antenatally elsewhere, but were referred to tertiary center with maternal complications. Incidence of admission in ICU 4.31%. Criteria for admission at ICU were- High risk pregnancy with life threatening complications requiring Intensive care unit and high risk pregnancy monitoring for frequent monitoring of vital parameters, intensive monitoring including invasive monitoring after initial

assessment using critical case scoring ,and monitoring with pulse oxymetric measurements, oxygen therapy, emergency resuscitative measures, cardiac monitoring Etc.

The admission rate at ICU was 4.31% in the present study which is higher than that observed by Urvashi M e al⁽¹⁴⁾ Begum⁽¹²⁾ 1.2% by Surekha tayde and padmavathi et al, ozumba et al (1.7%) probably due to wide admission criteria and large referral network of peripheral low resource hospitals and early referral to government tertiary care hospitals and availability of free transport facility for referral.

Identifying high-risk pregnancy using a scoring system is useful to identify women at risk of developing maternal and perinatal complications as caesarean deliveries, maternal complications, low birth weight, and NICU admissions were mostly seen in severe high-risk (60%) and high-risk pregnancies (26%) than in low-risk pregnancies (15%). [10]. The study of pregnancy outcomes among HRP women in rural Belagavi, Karnataka, India^(20,21) was found to be good among 103 (70.5%) and bad among 43 (29.5%) mothers. Coopland's high-risk pregnancy scoring used as a screening tool to predict the HRP outcome showed that 40.4% of the pregnant women had low-risk scores; 45.9% had high-risk scores, and 13.7% had severe-risk scores. The overall mean SD Coopland's pregnancy score was 3.5 in study population. The low-risk group showed 80% good outcomes compared to 45% bad out comes among severe-risk mothers. Coopland scoring helps to identify HRP by health workers in the community. The scoring system can be used by health workers/general practitioners, especially at the periphery where obstetricians may not be available, but it cannot prognosticate the obstetric outcome. Hence various Risk assessment scoring systems such as SOFA score, Apachhe score, EOWS and modified Early Obstetric warning score were practised to predict the obstetric outcome among high risk pregnancy. Various models and maternal assessment scores are utilised to predict maternal outcome results. The Early Warning sign score were later validated and modified. In 2007 cemar recommended that a national obstetric Early Warning Scoring system should be used in all sick pregnant women (pw). Apache II Scoring within 24hrs of admission may not accurately predict the maternal outcome. and third day Apache ii score of cutoff 17 could be a biomarker to predict maternal mortality. A validation study CEMAC 2008, and by Singh et al in 2012 , Bercher 2022 tried modifications by replacing colour codes by scores. In Modified Early Warning Sign score, total score Of >3 MEWS score of >3 and ,or an observation in any one parameter >3 called for a meticulous observation more frequently by Resident doctors. Anjel paternia-Calcedo^(1,22) et al analysed the performance of OEWS in 830 critically ill patients and reported. OEWS was higher in non survivors 10-13 score v/s Survivors score 4-9, those with high OEWS >6 had maternal mortality rate of 6%, and , <5 OEWS had no maternal deaths, the observation was similar in present study. A cohort study at VMMC , New Delhi, India⁽²²⁾ observed 250 icu admitted pw with comparison of OEWS, SOFA AND APACHE-II scores and concluded that auROC analysed for prediction of maternal mortality with OEWS score is as effective as conventional SOFA AND APACHEII scores to prognosticate maternal outcome ,and since EOWS score is based only on clinical criteria, it can be done immediately on admission and indicates early decision to allocate resources, to decide frequency of monitoring and to decide on need to refer to higher centres for multi disciplinary speciality team. In present study clinical asseesment based Carl's MEOWS score including hourly urine output was utilised to predict maternal outcome. subjects with MEOWS >6 or one parameter score >=3 had mortality rate of 6%, among ICU admissions for obstetric indications, based on AUROC of MOEWS in discrimination for maternal mortality, thus overall prediction was significant Among many scoring systems that included clinical and biochemical investigations to prognosticate which delayed in initialisation of definitive treatment, MEOWS scoring appears to be a simple, rapid, bed side, clinical observation based Risk assessment scoring system- MEOWS was followed in present study, which correlated in prognostication of subjects under study that positively predicted with adverse maternal outcome among those with MEOWs score more than 6, and a single parameter score 3.

A High Maternal adverse outcome was reported in various observational studies that reported 58.7% in mechanical ventilation, inotropic supports in 40%, 66.12% needed mechanical ventilation in Urvashi M et al study⁽¹⁴⁾ Majority over 60% of maternal mortality were secondary to MODS following obstetric haemorrhage. Maternal

mortality rate of 17.6%, 37.5% and 63.4% respectively and ICU mortality rate was 26%. <35 years pregnant women were -86% in Ghana study, whereas it was 97.4% in the present study. Maternal mortality was 66.6% as observed by B. Rao Bahadur, while most common cause of death being multi organ dysfunction following hypertensive disorders of pregnancy 33.3%, followed by sepsis 25%, others being PPH -16.6%, medical diseases in pregnancy -24.9% when compared to 4.82% in the present study when the majority were due to COVID-19 related ARDS-09(1.7%), Hypertensive disorders of pregnancy and eclampsia-05(1.6%), obstetric haemorrhage-08(1.5%), severe anemia with CCF-01(0.2%) and other due to medical disorders-04(0.75%). Various authors reported maternal mortality as follows, Verma et al 19.1% (MODS), Ashraf et al 13% (DIC, PPH), Khan et al 65% (MODS, PPH), Chavala et al -28.5% (DIC liver cell failure), Gupta et al -41.6% (MODS PPH), Urvashi M -30.6%.

Mode of termination of pregnancy among women admitted to ICU was by caesarean delivery and Hysterotomy-0.9% as reported by B Rao Bahadur, reported 52% caesarean delivery, Ashraf et al -63.3%, Saha et al -70%. Since early intervention by preterm induction of labour were undertaken in the present study, the incidence of caesarean delivery was 38% is lower in the present large study group.

Mean duration of hospital stay was 7.09 ± 3.5 days as observed by Urvashi M et al in comparison with 5.26 ± 2 days in the present study, in contrast to short stay of 2.8 ± 3.2 days in Ghana, PLOS study in a retrospective review of data of 10 yrs, between 2010-2019.

CONCLUSION

critically ill pregnant women admitted at obstetric ICU had higher rate of adverse obstetric outcome and the simple Risk assessment scores based on Clinical sign based scoring correlated with maternal outcome in prognosticating and early initialisation of treatment of ICU admitted pregnant women. Emergency care at HDU followed by timely transfer and care at ICU was associated with marked objective and subjective improvement in maternal condition. Duration of stay at hospital was longer, but associated with lesser morbidity. Mothers were shifted to HDU near ICU for continued care with advantage of bonding and encouraging breast feeding. Most HDU admissions reduce the utilisation of ICU care, thereby reducing the bed occupancy at the ICU. No additional medical staffs are needed at HDU as the staffs at the HDU are also trained in emergency Obstetric and medical skills. The neonatal care and bonding is ensured by the nursing staff at maternity services in HDU, which is an additional advantage to the newborn that may be lacking in intensive care units. Modified Obstetric early warning score (MOEWS) is a Risk assessment score based on clinical parameters as an effective predictor of maternal prognosis comparable to other laboratory parameter based scoring methods of the critically ill cases such as SOFA and APACHE II scores. MOEWS appears to guide HCW as a practice, rapid approach for initial assessment of ICU admissions for initiation of therapy, based on clinical assessment rather than wait for investigation reports.

What this study adds- it is a prospective study and hence reliable, with adequate sample size.

Recommendation

This study is of Public health importance for analysis of obstetric outcomes and emphasises the need for early referral of high risk pregnancy to tertiary health centres high-risk by early detection by screening. The MOEWS risk assessment scoring system is a simple, clinical based tool to prognosticate the risk to pregnant mothers, that can be utilised for skill training of all nurses at ICU to follow treatment protocols. Early detection and prompt referral to the tertiary centre with intensive care facilities should be promoted among the medical fraternity to reduce the incidence of ICU admissions and maternal adverse events. Early Warning Score on admission in ICU can predict survival rate. Periodic emergency obstetric drills are essential for all staff working at obstetric units to improve care in critically ill mothers. Infants born to the mothers admitted to ICU through HDU, had higher rates of NICU admission, neonatal intubations, LBW, RDS, perinatal deaths and lower Apgar scores compared with infants born to non-ICU admitted mothers.

Relevance Of The Study-

ICU care is the key intervention in providing tertiary care to critically ill PW at obstetric ICU care hospitals. This study adds to the current knowledge regarding the need for early and timely referral to the

tertiary care hospitals that is the key intervention in providing care to critically ill PW at obstetric ICU.

Limitation of the study-

A long term followup of population studied was not possible as subjects were lost for follow up, although telephonic follow up for a short period was feasible.

Financial Support And Sponsorship:-Nil.

Conflicts Of Interest:-There are no conflicts of interest.

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