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Original Research Article

A review of maternal near miss events in a tertiary teaching hospital- A tool for improving quality of obstetric care in developing countries: A descriptive study

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ABSTRACT

Background: In 2015, the United Nations Member States adopted the Sustainable Development Goals (SDGs), which include reducing the maternal mortality (MM) ratio by two-thirds by 2030. Maternal mortality rates are alarming, especially in low-income countries where 99% of all maternal deaths occurs. Maternal Near Miss event was described by the World Health Organization (WHO) as "A woman who is close to death survived a complication that occurred during pregnancy, delivery or up to 42 days of termination of pregnancy." This concept was launched in the health system. Maternal near-miss audit was recognized as a useful tool to improve the quality of obstetric care.

Materials and Methods: A descriptive study was conducted at PCMC's Postgraduate Institute and YCM Hospital Pimpri Pune (Maharashtra) from 1st January 2020 to 30 June 2021. During the study period, Maternal Near miss (MNM) cases were identified as per WHO criteria for enrolment. This study reviewed near-miss cases with aim to study baseline assessment, to analyse cause and intervention to improve health cases.

Results: Of total 9534 admissions, 130 mothers had severe maternal outcomes (114 maternal near-miss cases and 16 maternal deaths). 104(91.23%) MNM cases were between the ages of 20-35 years, 72.13% were from rural, 78(68.42%) were referred from health facilities.Seventy two(63.86%) were multigravida. Sixty Nine (60.53%) had hypertension in pregnancy followed by 62 (54.39%) had haemorrhage.

Conclusion: Our study concluded hypertension in pregnancy and haemorrhage are major causes of MNM cases. ICUs and blood banks play a pivotal role in the prevention of maternal mortality. Developing countries should aim to improve maternal health outcome by improving HDU/ICU facilities and blood bank to reduce maternal mortality.

1. Introduction

Maternal Near Miss event was described by the World Health Organization (WHO) as "A woman who, is close to death but survived a complication that occurred during pregnancy, delivery or up to 42 days of termination of pregnancy."[1] MNM event is related with emotional, psychological and social effects on women.

Hence, the concept MNM review was launched in the health system.[2]

MNM cases are more prevalent than the maternal death. For every maternal death, there are approximately 100 MNM.[3] Maternal near misses (MNM) are more reachable and truer as the woman is herself a source of facts. So, a review of MNM cases generates precious information regarding severe life-threatening conditions, which timely

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not intervene may result in maternal mortality.[4]

Maternal mortality rates are still alarmingly high, especially in low-income countries where 99% of all maternal deaths occur. Developing countries have a risk of maternal mortality one in 41 live births, while developed countries have a risk of one in 3300 live births.[5] The majority of maternal deaths (66%) occur in Sub-Saharan Africa, with Southern Asia contributing 22%.[6] The primary reason for this disparity is a lack of access to quality care during pregnancy, childbirth, and the postnatal period.[5,7]

In 2015, the United Nations Member States adopted the Sustainable Development Goals (SDGs), which include reducing the maternal mortality (MM) ratio by two-thirds by 2030, ultimately aiming to eliminate preventable maternal deaths.[8]

2. Materials and Methods

This descriptive study was conducted at PCMC's postgraduate institute and YCM hospital, Pimpri Pune (Maharashtra) from January 1^{st} 2020 to June 30^{th} 2021. Study was intended to review MNM cases to analyse causes and evaluate interventions for improving maternal health outcome of MNM cases and to estimate maternal near miss indicators. During this study period, MNM cases were prospectively identified and enrolled.

Our institute is a tertiary level hospital in public sector providing 150-200 obstetric outpatient services daily while conducting 28-34 deliveries per day with availability of emergency facilities , Intensive Care Unit (ICU) and blood transfusion round the clock.

2.1. Inclusion criteria

All cases fulfilling WHO inclusion criteria for MNM were enrolled.

2.2. Exclusion criteria

MNM cases turning out into maternal mortality cases were excluded. Also, participation was denied in the near-miss cases.

Technique/Methodology: Informed consent was obtained from MNM cases that were admitted and included in the study. The standard data collection format was used as specified in the data collection tool. If the subject was unable to provide consent due to medical reasons, a waiver of consent was obtained from the ethics committee and access to medical records was requested.

2.3. Ethical considerations

Approval was obtained from the Institutional Ethics Committee before the beginning of study, confidentiality of data was maintained throughout the study

2.4. Statistical analysis

Statistical analysis was conducted using Epi-info 7 software.

2.5. Data collection

Data was collected by resident doctors in a consistent, uniform, and reliable manner using a standard proforma throughout the week and this was reviewed by the faculty on every Saturday. Key variables, as mentioned in the data collection tool, were documented.

The following are the parameters that were considered in data collection tool for the study:

1. Demographic parameter: Age criteria, Education, Place, Socio-economic status.
2. Obstetric score: Gravida, Parity.
3. Diagnostic spectrum: Haemorrhage, Hypertension, Anaemia, and other related conditions.
4. Organ dysfunction: Cardiovascular, Respiratory, Hematologic.
5. Critical Interventions: Blood transfusions, ICU admission, Surgical interventions, etc.
6. Near miss indicators: SMOR, MNMR, MI.
7. SMOR (Severe maternal outcome Ratio) (MNM + MD) / 1000 live births (LB).
8. Maternal near miss ratio (MNMR) - (MNM/1000 live births)
9. MNM mortality ratio (MNM MR) - (MNM per 1 maternal death)
10. Mortality index(MI) – MD / MNM + MD

Aberrations : – MD maternal death ; LB livebirths ; MNM maternal near miss

Inclusion criteria for identifying near miss cases of maternal health according to WHO:

Severe maternal complications that require critical interventions or admission to the intensive care unit, including:

1. Severe postpartum hemorrhage
2. Severe pre-eclampsia or eclampsia
3. Sepsis or severe systemic infection
4. Ruptured uterus (excluding caesarean section)
5. Severe complications of abortion

Other interventions that may be required include interventional radiology, laparotomy (excluding caesarean section), and the use of blood products.

2.6. Life-threatening conditions (near-miss criteria)

2.6.1. Cardiovascular dysfunction

Shock, cardiac arrest (absence of pulse/heartbeat and loss of consciousness), use of continuous vasoactive drugs, cardiopulmonary resuscitation, severe hypoperfusion

(lactate >5 mmol/l or >45 mg/dl), or severe acidosis (pH<7.1) –

2.6.2. Respiratory dysfunction

Acute cyanosis, gasping, severe tachypnoea (respiratory rate >40 breaths per minute), severe bradypnea (respiratory rate<6 breaths per minute), intubation and ventilation not related to anaesthesia or severe hypoxemia (O2 saturation <90% for >60 min or PAO2/FiO2<200)

2.6.3. Renal dysfunction

This refers to issues related to the kidneys. Symptoms may include oliguria, which is a decrease in urine output that is not responsive to fluids or diuretics. In severe cases, dialysis may be necessary for acute renal failure or acute azotemia, which is a build up of nitrogenous waste products in the blood (indicated by creatinine levels of ≥300 μmol/ml or ≥3.5 mg/dl).

2.6.4. Coagulation/haematological dysfunction

This refers to issues related to blood clotting and other blood disorders. Symptoms may include failure to form clots, which can result in massive transfusion of blood or red cells (≥5 units). Additionally, severe acute thrombocytopenia (platelet count < 50,000/ml) may also be present.

Hepatic dysfunction with severe acute hyperbilirubinemia (bilirubin>100 μmol/l or>6.0 mg/dl) and jaundice in the presence of pre-eclampsia.

Neurological dysfunction including prolonged unconsciousness (lasting ≥12 h)/coma (including metabolic coma), stroke, uncontrollable fits/status epilepticus, and total paralysis.

Uterine dysfunction, as well as hemorrhage or infection, can lead to the need for a hysterectomy.

Adopted from WHO (2011)

Note that each critical intervention was counted separately and some cases underwent multiple interventions. Therefore, the number of interventions was greater than the number of cases.

3. Results

During the study period, there were 9534 admissions for inpatient care, 7296 deliveries, and 6898 live births in our tertiary teaching institute. Among these, 130 cases of severe maternal outcomes were reported, including 114 cases of maternal near-miss and 16 maternal deaths.

Table 1 shows that 47 (41.23%) of the patients were between the ages of 20-25 years, while 40 (35.09%) were in the 26-30 years age group. The majority of the patients were from rural areas, accounting for 66 (57.89%) of the cases. Patients withsocioeconomic status III were the most common, accounting for 55 (48.25%) cases. Most of the nearly missed mothers were literate, with 102 (89.42%) having some level of education. 78 (68.42%) of the patients were referred from a health facility, and 72 (63.86%) cases were multigravida. Based on the antepartum/postpartum status of patients at the time of admission, most cases were antepartum, accounting for 86 (75.44%) cases.

Table 2 shows that the diagnostic spectrum and organ dysfunction in near-miss cases were mainly hypertension in pregnancy, accounting for 69 (60.53%) cases, followed by hemorrhage in 62 (54.39%) cases andanaemia in 22 (19.30%) cases. Covid-19 was also found in 24 cases, representing 21.05% of cases with overlapping diagnoses. In terms of organ dysfunction, respiratory dysfunction was the most common, accounting for 28 (24.56%) cases, while coagulation/haematological dysfunction and cardiovascular dysfunction accounted for 26 (22.81%) and 24 (21.05%) cases, respectively.

Critical intervention as mentioned in Table 3 shows that 97 (85.08%) cases were admitted to the ICU, and 74 (64.91%) cases required the use of blood and blood products, followed by IV antibiotics use in 72 (63.16%) cases. Out of the 74 cases requiring blood products, 38 (51.35%) cases required only PCV, while 28 (37.84%) required PCV + FFP + Platelets transfusion.

Table 4 shows that the maximum number of stays of MNM cases in the ICU was 8 days, while in the hospital, it was 41 days.

Various maternal near-miss indicators were shown in Table 5. There were 9534 admissions for In-patient Department (IPD), 7296 deliveries and 6898 live births. Out of these, there were 114 cases of maternal near-miss and 16 maternal deaths. The severe maternal outcome ratio (SMOR) was calculated as Severe maternal outcome (MNM + MD) / 1000 live births (LB), and in our study, the SMOR was 18/1000 live births. The MNM ratio in our study was 16, and the MNM mortality ratio was 7.1 per 1 MD. The mortality index in our study was 0.12 (12%).

4. Discussion

In the medical field, there are different ways to define maternal near-miss (MNM) cases. These include disease-specific, organ dysfunction, and management criteria. Each approach has its strengths and weaknesses.[5–7] For our study, we followed the World Health Organization's (WHO) criteria which are similar to disease-specific criteria.[5] We included MNM cases and evaluated their obstetric causes.

During our study period 9534 patients were admitted with 7296 deliveries and 6898 livebirths. We recorded 130 severe maternal outcomes out of which 114 were MNM and 16 were maternal deaths. Among 114 maternal near miss cases 6 cases were explored for ruptured ectopic pregnancy & 10 cases were admitted with incomplete abortion. Out of 114 MNM cases, 4 cases were managed antenatally (2 cases for severe anemia with congestive cardiac failure and 2 cases for COVID-19 pneumonia). During the study period, which coincided with the global COVID-19 pandemic, there

Table 1: Demographic parameters

Demographic Parameters	MNM cases	Percentage
Age distribution of cases		
<20 year	04	3.51
21-25year	47	41.23
26-30 year	40	35.09
31-35 year	17	14.91
36-40 year	04	3.51
41-45 year	02	1.75
Mean ± SD of age: 25.35 ± 05.19		
Place distribution		
Rural	66	57.89
Urban	48	42.11
Socioeconomic status (Modified BG Prasad Classification)		
I	11	09.65
II	25	21.93
III	55	48.25
IV	20	17.54
V	03	02.6
Educational status of MNM		
Illiterate	12	10.53
Education <8^{th} standard	45	39.47
Education >8^{th} standard	57	50.00
Admition methods		
1. Direct admition	36	31.58
2. Referral	78	68.42
Referred from health facility	69	60.53
Referred from more than one health facility	09	7.89
Obstetric score of MNM		
Primipara	42	36.84
Multipara	72	63.16

were 114 near-miss cases, out of which 24 cases had COVID-19 pneumonia. Unfortunately, the pandemic had a significant impact on maternal mortality, with 16 maternal deaths occurring during the study period. Out of these deaths, 9 were found to be COVID-19 positive.[8]

In our study 104(91.23%) MNM cases were found in the age group of 20-35 years with 3.51% below 20 years of age and 5.26% above 35 years of age. Out of 114 MNM cases 66(57.89%) were from rural and 48 (42.11%) from urban. According to BG Prasad classification 2019 Patients with socioeconomic status III are 55 (48.25%). Most MNM cases were literate 102 (89.47%) while 50% having studied above 8th standard. Hospital based case control study from Western Ethopia Kumela L et al. studied 61 MNM cases and reported 73.77% MNM cases in the age group of 20-34 years while 6.56% below 20 years and 19.67% above 35 years. Most of MNM cases were 72.13% from rural and 27.87% from urban.[9]

Facility based case control study conducted in four selected tertiary hospital in benadir region Somalia by Dahie et al. noted 72.5% MNM cases from urban and 71.9% cases were illiterate.[10] In our study 78(68.42%) MNM cases were referred from health facility .72(63.86%) were multipara. However, Dahie et al. reported most of cases were multipara and 31.5% cases were referred from health facility.[10,11]

Our study found that hypertension in pregnancy was the major underlying cause in 69 cases (60.53%). Of these, 38 cases (33.33%) were severe pre-eclampsia, 18 cases (15.79%) were eclampsia, and 13 cases (11.40%) were HELLP syndrome. Nakimuli et al. conducted prospective cohort study of 695 maternal near miss cases in Uganda, study showed 32% hypertension in pregnancy, 19% eclampsia, 11.4% severe pre-eclampsia, 1% HELLP, and 0.6% chronic hypertension.[12,13] However, a study from Turkey by Süleyman Cemil Oğlak et al. reported that 56% hypertension was the major underlying cause, which was similar to our study.[14,15] The next most frequent causes were hemorrhage in 62 cases (54.39%), anaemia in 22 cases (19.30%), sepsis in 6 cases (5.26%), obstructed labour in 4 cases (3.51%), heart disease in 1 case (0.88%), and others (including COVID-19) in 24 cases (21.05%). Obstetric hemorrhage in 62 cases (54.39%) was the second underlying cause following hypertension in pregnancy in our study. Of these, 16 cases of hemorrhage occurred in early pregnancy due to ectopic pregnancies (6 cases) and abortions (10 cases), while 46 cases of hemorrhage occurred

Table 2: Diagnostic spectrum and organ dysfunction in MNM cases

Diagnostic Spectrum of MNM		
Parameters	**MNM cases**	**Percentage**
Hemorrhage	62	54.39
1 Early pregnancy	-	-
1a. Ectopic pregnnacy	06	5.26
1b. Abortion	10	8.77
2 Llate pregnancy	-	-
2a.Abruptio placenta	09	7.89
2b. Placenta previa	12	10.53
2c. Postpartum haemorrhage	21	18.42
2d. Rupture uterus	04	3.51
Hypertension in pregnancy	69	60.53
A) Severe preeclampsia	38	33.33
B) Eclampsia	18	15.79
C) HELLP	13	11.40
Severe Anemia	22	19.30
Obstructed labor	04	3.51
Sepsis	06	5.26
Heart disease	01	0.88
Other (including COVID 19)	24	21.05
Organ dysfunction in MNM		
Parameters (organ dysfunction)	**MNM cases**	**Percentage**
Cardiovascular	24	21.05
Respiratory	28	24.56
Renal	07	06.14
Hematological	26	22.81
Hepatic	08	07.02
Neurological	07	06.14
Utrine	06	05.26
Multiple organ dysfunction	03	02.63

Note: Each diagnosis and dysfunction is counted separately. In some cases, there are multiple diagnoses or dysfunctions involved, so the number of organ dysfunctions and diagnoses is more than the total number of cases. To be noted – HELLP syndrome (Hemolysis Elevated liver enzymes Low platelet count)

Table 3: Critical interventions of maternal missed cases

Parameters	**Number of MNM cases**	**Percentage**
ICU Admission	97	85.08
Use of blood and blood products	74	64.91
Surgical intervention	69	60.52
1. B-Lynch Suture	08	7.02
2. B/L Uterine Artery Ligation	37	32.46
3. B/L Uterine Artery Ligation	14	12.28
4. Emergency obstetric Hysterectomy	04	3.51
5. Laprotomy (other than LSCS)	06	5.26
Broad spectrum Antibiotic	72	63.16
Use of Inotropic Drugs	22	19.30
- Mechanical Ventilation	26	22.81
Cardio Pulmonary Resuscitation	00	0.00
Dialysis for Acute Renal Failure	02	1.75
Blood transfusion status in near missed cases		
PCV	38	51.35
PCV + FFP	08	10.81
PCV + FFP + PRP	28	37.84
Blood transfusion of near missed cases		
Yes	74	64.91
No	40	35.09

Table 4: Comparison of hospital and ICU stay of near missed cases

Stay in days	Minimum	Maximum	Mean	Standard deviation
ICU	01	08	03.46	01.46
Hospital	07	41	20.35	07.69
p-value	t-statistic = 13.601, Degrees of freedom = 147, Two-tailed probability < 0.001, Written as: t (147) = 13.601, p<0.001, Conclusion at the 0.05 critical alpha level: The difference is significant.			

Table 5: Maternal near miss indicators

MNM Indicators	Values
Total admissions	9534
Number of deliveries	7296
Live births	6898
Maternal near-miss cases	114
Maternal deaths	16
Severe Maternal Outcomes (SMO)	130
SMOR {(MNM+MD)/1000LB}	18 per 1000 live birth
MNMR (MNM/1000LB)	16 Per 1000 live birth
MNM-MR (MNM : 1MD)	7.1 Per 1 MD
MI(MD/{MNM+MD})	0.12

in late pregnancy due to postpartum hemorrhage in 21 cases, placenta previa in 12 cases, abruption placenta in 9 cases, and a ruptured uterus in 4 cases.

However, a study conducted in Uganda, Nakimuli et al noted that 46.3% of obstetrics haemorrhage was the major underlying cause of 11.8% of antepartum haemorrhage, 14.7% postpartumhemorrhage, 16.5% ruptured uterus, 3.3% of abortion-related haemorrhage,[12] A retrospective study of 125 cases of maternal near miss cases from Turkey by Süleyman Cemil Oğlak et al. reported 43.2% hemorrhage was the underlying cause following hypertension in pregnancy.[14]

However, there was an overlap of diagnostic features/complications and organ dysfunction in many MNM cases, such as preeclampsia complicated by abruption. Our study found that respiratory dysfunction occurred in 28 cases (24.56%), followed by coagulation/haematological dysfunction in 26 cases (22.81%), and cardiovascular dysfunction in 24 cases (21.05%), with 7.02% of cases experiencing hepatic dysfunction and 6.14% experiencing renal dysfunction. During this study period, the COVID-19 pandemic had arrived, and as a result, respiratory dysfunction cases were higher. A prospective descriptive study of MNM cases by Chikadaya et al. included 2 tertiary public health hospitals from Zimbabwe reported 65.5% cardiovascular dysfunction, 20.9% respiratory dysfunction, 10.9% coagulation/haematological dysfunction, 3.6% renal dysfunction, and 2.7% hepatic dysfunction.[16]

In our study, 97 cases (85.08%) required admission to the ICU. Among the near missed cases, the maximum ICU stay was 8 days, while the longest hospital stay was 41 days. Proper and timely transfusion of blood and blood products can help prevent a significant number of maternal deaths. In our study, 74 cases (64.91%) required blood and blood products transfusion. Among these cases, 38 (51.35%) needed only PCV, 28 (37.84%) required PCV + FFP + PRP transfusion, and 8 (10.81%) required PCV+FFP. 72 cases (63.16%) required broad-spectrum antibiotics, and 69 cases (60.52%) underwent surgical intervention, which included B lynch suture (8 cases), uterine artery ligation (37 cases), internal iliac artery ligation (14 cases), obstetrics hysterectomy (4 cases), and laparotomy for ruptured ectopic (6 cases). Out of 97 cases admitted in ICU, 26 cases (22.8%) required mechanical ventilation, 22 cases (19.3%) were on inotropic support, and 2 cases (1.75%) were on dialysis for acute renal failure.

However, in a study conducted by Nakimuli et al, it was noted that 30.8% of cases received more than 4 units of blood transfusion, 27.7% of cases required inotropic support, 10% of cases were on dialysis for acute renal failure, and 54.6% of cases were admitted in ICU.[12] A study from Turkey conducted by Süleyman Cemil Oğlak et al reported that all 125 cases (100%) required admission to ICU. Of these cases, 1 (0.8%) was on ventilation, 2 (1.6%) were on inotropic support, and 1 (0.8%) cases were on dialysis for acute renal failure, 54(43.2%) cases were received blood transfusion.[14]

In our study, SMOR was found to be 18 per 1000 live births, while MNMR was 16 per 1000 live births. The MNMMR was 7.1 per 1 MD and the Mortality Index was 0.12 (12%). A study by Chikadaya et al. in Zimbabwe found SMOR to be 10.4 per 1000 deliveries, MNM ratio to be 9.3 per 1000, MNM mortality ratio to be 8.5:1, and Mortality Index to be 10.6%.[16] Facility based cross-sectional study conducted in 6 public health hospitals by Jabir et al. in the city of Baghdad, Iraq mentioned SMOR of 5.69 per 1000 live births, MNMR of 5.06 per 1000 live births, MNMMR

of 9 per 1 MD, and Mortality Index of 11.03%.[17]

5. Conclusion

Our study concluded that hypertension in pregnancy and hemorrhage are major causes of MNM cases. An audit of maternal near miss cases generates beneficial knowledge regarding severe life-threatening conditions that can lead to maternal mortality if left untreated. Intensive Care Units (ICUs) and blood banks play a pivotal role in the prevention of maternal mortality. Timely referrals to teaching institutes will help reduce maternal mortality.

6. Sources of Funding

None.

7. Conflict of Interest

None.

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