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ORIGINAL ARTICLE

Evaluation of Obstetric Near Miss and Maternal Deaths in a Tertiary Care Hospital in North India: Shifting Focus from Mortality to Morbidity

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Abstract

Objective Near miss audit improves understanding of determinants of maternal morbidity and mortality and identifies areas of substandard care. It helps health professionals to revise obstetric policies and practices.

Methods A retrospective review of obstetric case records was performed to assess frequency ad nature of maternal near miss (MNM) cases as per WHO criteria. For each case, primary obstetric complication leading to maternal morbidity was evaluated. Obstetric complications were analyzed to calculate prevalence ratio, case fatality ratio, and mortality index.

Results There were 6,357 deliveries, 5,273 live births, 247 maternal deaths, and 633 MNM cases. As per WHO criteria for Near miss, shock, bilirubin >6 mg%, and use of vasoactive drugs were the commonest clinical, laboratory, and management parameters. Hemorrhage and hypertensive disorders of pregnancy were leading cause of MNM (45.7 and 24.2 %) and maternal deaths (28.7 and 21.5 %). Highest prevalence rate, case fatality ratio, and mortality index were found in hemorrhage (0.53), respiratory diseases (0.46), and liver disorders (51.9 %), respectively.

Conclusion Developing countries carry a high burden of maternal mortality and morbidity which may be attributed to improper management of obstetric emergencies at referring hospitals, poor referral practices, and poor access/utilization of health care services.

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Keywords Maternal near miss · Near miss audit · Severe acute maternal morbidity · Mortality index · Obstetric complications · Maternal mortality

Introduction

Maternal death audits form the mainstay of evaluation of maternal health services in developing countries where high level of maternal mortality has overshadowed severe obstetric morbidity. Unfortunately, most maternal deaths occur in unbooked emergency cases that present late to hospital so isolated maternal death audit is grossly inadequate. Recently, review of cases at the severe end of maternal morbidity spectrum, who nearly died during delivery, has been found to complement assessment of maternal health services [1, 2]. These cases are variably called maternal near miss (MNM) [3] or severe acute maternal morbidity (SAMM) [4] and an audit of these cases is called near miss audit (NMA). NMA provides an improved understanding of determinants of maternal morbidity and helps to identify areas of substandard care.

This transition from studying death to studying maternal morbidity has followed a worldwide trend because the absolute number of deaths is relatively small as compared to number of cases of MNM which thus generate more information. Secondly, data on maternal morbidity are more accessible and reliable as the woman is herself a source of information. Thirdly, NMA has a greater acceptability among individuals and institutions since death did not occur. NMAs, therefore, provide useful information to health practitioners and policy makers about the strengths and weaknesses of the emergency obstetric care provided at a facility. This helps in formulation and revision of obstetric policies and practices in the facility.

Material and Methods

To assess the frequency and nature of MNM events among obstetric cases managed at our hospital, we retrospectively reviewed the case records of patients admitted to the Department of Obstetrics and Gynecology in our hospital from May 2011 to April 2012.

Maternal near miss event was defined as "any acute obstetric complication that immediately threatens a woman's survival but does not result in her death either by chance or because of hospital care she receives during pregnancy, labor or within 6 weeks of termination of pregnancy" [5]. For identification of MNM cases, we intended to use the WHO near miss criteria (Table 1) [6] but all components could not be used in our setting. Among the laboratory-based criteria, measurement of pH and PaO_2/FiO_2 was not possible. In management-based criteria, threshold for blood transfusion was reduced from $\geq$5 units of blood to $\geq$2 units as availability of blood and blood products is scarce in our setting and women depend upon family members for donations. MNM cases were retrospectively identified from case records using structured extraction forms as per modified WHO criteria. For each case of MNM, the primary obstetric complication leading to severe acute maternal morbidity was evaluated in order to allow comparison with the common causes of maternal mortality. Simultaneously, information on maternal deaths and deliveries conducted during the reviewed period was also obtained from the records. Maternal death was defined as "death of a woman while pregnant or within 42 days of termination of pregnancy, irrespective of the duration and site of pregnancy, from any cause related to or aggravated by pregnancy or its management but not from accidental or incidental causes" [7].

For each case of MNM, demographic characteristics, gestational age at time of morbidity, nature of obstetric complication, details about delivery/abortion, need for transfusion, length of hospital stay, and fetal outcome were recorded. Data were entered on a Microsoft excel spreadsheet and statistical analysis was done using Epi Info 2002 software. Waiver for ethical clearance was obtained as there was no direct patient intervention or revelation of patient's identity.

Prevalence of MNM was evaluated and for each group of primary obstetric complication leading to MNM, maternal morbidity was compared to maternal mortality, and prevalence ratio, case fatality ratio (CFR), and mortality index (MI) were calculated [8]. A high CFR and MI indicate poor quality of emergency obstetric care.

$$\text{Prevalence ratio} = \frac{\text{No. of MNM cases due to a primary complication}}{\text{No. of obstetric admissions due to that complication}} \times 100$$

$$\text{Case fatality ratio} = \frac{\text{No. of maternal deaths due to a primary complication}}{\text{No. of obstetric admissions due to that complication}} \times 100$$

$$\text{Mortality index} = \frac{\text{No. of maternal deaths due to a primary complication}}{\text{No. of MNM cases} + \text{maternal deaths due to that complication}} \times 100$$

Results

A retrospective facility-based review of MNM cases was conducted from May 2011 to April 2012. In the study period, there were 6,357 deliveries, 5,273 live births, and 247 Maternal deaths leading to a MMR of 4,684/100,000 live births. Prevalence of MNM was almost 10 % ($n = 633$) of all deliveries and 94.3 % ($n = 597$) of these occurred in unbooked cases referred to our hospital with a complication. There was 1 maternal death for every 2.6 cases of MNM and 12.5 % women with MNM had more than one primary obstetric cause for severe acute maternal

Table 1 WHO criteria for maternal near miss [6]

Clinical criteria	Laboratory-based criteria	Management-based criteria
-Acute cyanosis	-Oxygen saturation <90 % for >60 min	-Use of continuous vasoactive drugs[i]
-Gasping[a]	-pH <7.1	-Intubation and ventilation for >60 min not related to anesthesia
-Respiratory rate >40 or <6/min	- PaO_2/FiO_2 <200 mm Hg	-Hysterectomy following infection or hemorrhage
-Shock[b]	-Creatinine >300 mmol/l or >3.5 mg/l	-Dialysis for acute renal failure
-Oliguria non responsive to fluids or diuretics[c]	-Acute thrombocytopenia (platelets <50,000)	-Cardio-pulmonary resuscitation
-Clotting failure[d]	-Bilirubin >100 mmol/l or 6 mg/dl	
-Loss of consciousness >12 h[e]	-Loss of consciousness and the presence of glucose and ketoacids in urine	
-Loss of consciousness and the absence of pulse/heart beat		
-Stroke[f]		
-Uncontrollable fits/total paralysis[g]		
-Jaundice in the presence of pre-eclampsia[h]		

[a] Gasping is a terminal respiratory pattern and breath is convulsively and audibly caught

[b] Shock is a persistent severe hypotension defined as a systolic BP <90 mm Hg for >60 min with a pulse rate of at least 120/min despite aggressive fluid replacement (>2 l)

[c] Oliguria is defined as urine output <30 ml/h for 4 h or < 400 ml/24 h

[d] Clotting failure can be assessed by the bedside clotting test or the absence of clotting from the IV site after 7–10 min

[e] Loss of consciousness is a profound alteration of mental state that involves complete or near complete lack of responsiveness to external stimuli. It is defined as a Glasgow Coma Scale <10 (moderate to severe coma)

[f] Stroke is a neurological deficit of cardiovascular cause that persists beyond 24 h or is interrupted by death within 24 h

[g] Condition in which the brain is in a state of continuous seizure

[h] Pre-eclampsia is defined as the presence of hypertension associated with proteinuria. Hypertension is defined as BP of at least 140 mm Hg (systolic) or at least 90 mm hg (diastolic) on at least 2 occasions and at least 4–6 h apart after 20th week of gestation in women known to be normotensive beforehand. Proteinuria is defined as excretion of ≥300 mg protein every 24 h

[i] Continuous use of any dose of dopamine, epinephrine or norepinephrine

Table 2 Distribution of clinical, laboratory, and management markers for identification of severe acute maternal morbidity according to WHO

Clinical criteria	No of patients	Laboratory-based criteria	No of patients	Management-based criteria	No of patients
-Acute cyanosis	0	-Oxygen saturation <90 % for >60 min	52	-Use of continuous vasoactive drugs	346
-Gasping	26	-Creatinine >3.5 mg/l	75	-Intubation and ventilation for >60 min not related to anesthesia	18
-RR >40 or <6/min	112	-Acute thrombocytopenia (<50,000)	8	-Hysterectomy following infection or hemorrhage	33
-Shock	336	-Bilirubin >6 mg/dl	87	-Dialysis for acute renal failure	7
-Oliguria	75	-Loss of consciousness and the presence of glucose and ketoacids in urine	0	-Cardio-pulmonary resuscitation	2
-Clotting failure	49				
-Loss of consciousness >12 h	72				
-Loss of consciousness and the absence of pulse/heart beat	0				
-Stroke	2				
-Uncontrollable fits/total paralysis	3				
-Jaundice in the presence of pre-eclampsia	23				

Table 3 Distribution of maternal near miss cases and maternal deaths according to Primary obstetric complication affecting pregnancy

Primary complication of pregnancy	No. of maternal near miss	No. of maternal death
Hemorrhage	289	71
Sepsis	47	27
Hypertensive disorders of pregnancy	153	53
Obstructed labor/rupture uterus	37	12
Anemia without hemorrhage	131	42
Others	55	42
Heart disease	34	16
Liver disease	13	14
Respiratory disease	2	12

morbidity. The demographic characteristics of women who experienced a MNM complication were comparable to those who died. Most of the MNM cases were 18–35-year old (88.2 %) and were primigravida/primipara (34.4 %). Out of 633 cases of MNM, 66 % ($n = 418$) did not receive any antenatal care during pregnancy and 6.5 % ($n = 41$) underwent prior intervention at home by an untrained personnel/dai. 23.4 % ($n = 148$) women were referred from private hospitals, 21 % ($n = 133$) from district hospitals, and only 8.7 % ($n = 55$) from primary health centers (PHC) and community health centers (CHC). 83.6 % ($n = 529$) cases were antepartum and 13.1 % ($n = 83$) postpartum. Monitoring abortion-related hospital admission is a useful way to quantify the magnitude of adverse health effects of unsafe abortion in developing countries [9]. 3.3 % ($n = 21$) cases in our study had a post-abortal complication following an unsafe abortion. The distribution of WHO markers for identification of SAMM (Table 2) and distribution of primary obstetric complication leading to MNM and maternal death (Table 3) were analyzed.

Out of 633 MNM cases, 69.8 % ($n = 442$) were admitted to the hospital for ≥7 days, 40.9 % ($n = 259$) needed ICU care for ≥3 days, and 2.8 % ($n = 18$) required ventilatory support. 78.4 % ($n = 496$) women required blood transfusion out of which 3.8 % ($n = 24$) were transfused ≥5 units packed red blood cells, while 69.6 % ($n = 441$) received ≥2 units. 7.7 % ($n = 49$) cases required fresh frozen plasma and 1.3 % ($n = 8$) required platelet transfusion. Pregnancy was terminated at <28 weeks gestation in 26.9 % ($n = 170$) MNM cases. Out of remaining 71.9 % ($n = 463$) women who delivered beyond 28 weeks, 71.9 % ($n = 333$) had a live baby and 27.2 % ($n = 172$) babies required admission to neonatal unit.

On analysis of MNM cases as per WHO criteria, shock ($n = 336$) was the commonest clinical parameter, raised serum bilirubin >6 mg% ($n = 87$) was the commonest laboratory-based parameter, and continuous use of vasoactive drugs ($n = 346$) was the commonest management-based parameter for Near miss. On evaluating the primary obstetric complication leading to MNM, hemorrhage and hypertensive disorders of pregnancy were the commonest complications associated with near miss as well as maternal death. Hemorrhage per se contributed to 45.7 % ($n = 289$) cases of MNM and included ruptured ectopic pregnancies ($n = 62$), incomplete abortions ($n = 26$), APH ($n = 131$), and PPH ($n = 70$). Severe anemia (Hb < 6 g%) without hemorrhage was conspicuously present in 20.7 % ($n = 131$) MNM cases and 17 % ($n = 42$) maternal deaths in our study.

The primary obstetric complications leading to MNM were evaluated to calculate the various indices. Highest prevalence rate of MNM was seen in hemorrhage (0.53), respiratory diseases (0.53), and heart disease with pregnancy (0.41). The maternal morbidity nad mortality data were compared and the highest case fatality ratio was seen in respiratory diseases (0.46), liver disorders in pregnancy (0.14), and sepsis in pregnancy/puerperium (0.14). Mortality index was found to be high in liver disorders (51.9 %), respiratory diseases (46.2 %), and sepsis (36.5 %; Table 4).

Discussion

Reduction in maternal mortality is one of the targets of Millennium Development Goals for 2015 [10] but in spite of efforts of national, international, and developmental health agencies, high maternal morbidity and mortality remains a major challenge in developing countries. A clinical audit of MNM cases yields useful information on pathways leading to severe morbidity and death and is proposed to be a useful approach to investigate and monitor the quality of obstetric health care system [11]. Identification of MNM has its own drawbacks like lack of standardization of defining criteria, difficulty in identification and reporting, poor maintenance of records, and limitations of retrospectively conducted studies. There has been a lot of debate regarding the criteria for defining MNM. Several approaches have been proposed like the disease-specific criteria [12], organ dysfunction criteria [13], or management criteria [14] each having its own merits and demerits. The WHO has proposed a package of 25 severity markers including clinical signs, laboratory tests, and management parameters [6] to address the need for a consensus criteria which can be used all over the world.

In this study, after identifying cases of MNM according to WHO criteria, we evaluated the primary obstetric complication leading to MNM in each case. The list of primary obstetric complications was similar to the Disease-specific criteria [12] for diagnosis of MNM. By first

Table 4 Prevalence ratio, case fatality ratio, and mortality index of various primary complications affecting pregnancy

Primary complication of pregnancy	Total no of cases	No of MNM	No of maternal deaths	Prevalence ratio	Case fatality ratio	Mortality index (%)
Hemorrhage	550	289	71	0.53	0.12	19.7
Sepsis	189	47	27	0.25	0.14	36.5
Hypertensive disorders of pregnancy	469	153	53	0.33	0.11	25.7
Obstructed labor/rupture uterus	131	37	12	0.28	0.09	24.5
Anemia without hemorrhage	362	131	42	0.36	0.12	24.3
Heart disease	83	34	16	0.41	0.19	32
Liver disease	99	13	14	0.13	0.14	51.9
Respiratory disease	26	14	12	0.53	0.46	46.2

identifying cases of MNM using standardized WHO criteria, we could overcome the lack of specificity and bias associated with Disease-specific criteria. Subsequently, evaluation of primary obstetric complication which mirrored the major causes of maternal death allowed better comparison and simplicity in interpretation.

The incidence of MNM in our study was 120 per 1,000 live births, which was much higher than <1–82 per 1,000 live births as reported from other teaching/tertiary care hospitals [14, 15]. This variation could be due to a large population with resource constraint, referral of critically ill women from periphery, poor maternal health services in rural areas, and underutilization of services by the masses. Obstetric delay due to low literacy, poor health seeking behavior, delayed decision at family level, and poor transportation facility perhaps adds to the high MNM and maternal deaths at our facility.

The MMR at our facility was 4,684 per 100,000 live births and maternal death to Near miss ratio was 1:2.6 which is much higher than 1:117–223 reported from the west [14]. The dismal ratio could be attributed to the fact that ours is a tertiary care referral center receiving a high load of complicated obstetric cases, mismanagement at source of referral, and lapses in referral chain. 94.3 % ($n = 597$) MNM cases at our hospital were unbooked and most were referred in a critical state from other public/private hospital (53.1 %) strongly suggesting a delay in optimal obstetric care. Lack of proper antenatal care is another contributing factor as 66 % ($n = 418$) MNM cases in this study did not receive any antenatal care before reporting to the hospital with a complication. Although some authors suggest that MNM cases referred to a hospital in a critical state should not be used to assess the quality of care [12], the proportion of referred MNM cases reflects the ability of a health facility to prevent maternal deaths even in unmanaged, mismanaged, and unanticipated situations. In order to address the high MMR in developing countries, efforts should be made to improve standard of care and utilization of services at FRUs and primary and secondary healthcare units which are the main source of MNM cases managed at the tertiary care hospital.

In our study, 83.1 % cases of MNM were due to direct obstetric complications viz. hemorrhage, hypertensive disorders of pregnancy, sepsis, and obstructed labor/rupture uterus. Like other studies [12, 15–17] hemorrhage and hypertensive disorders of pregnancy were the leading cause of MNM (45.7 and 24.2 %, respectively) and maternal deaths (28.7 and 21.5 %, respectively) in our setting too. Life-threatening obstetric hemorrhage was the commonest with a high prevalence ratio of 0.53, but mortality index of this condition was low (19.7 %) emphasizing a key role of timely management and blood transfusions in saving these women. Improving protocols and resources for combating PPH and focussed strategies for managing APH and early pregnancy hemorrhage can further help in reducing morbidity due to this condition. Hypertensive disorder of pregnancy was the second commonest cause of MNM and maternal death with a high mortality index of 36.5 %. Early diagnosis of hypertension by proper antenatal care and timely management with Magnesium sulfate must be made universally available to prevent this condition.

Sepsis contributed significantly to MNM (7.4 %) and maternal mortality (10.9 %) with a prevalence ratio of 0.25 and mortality index of 36.5 %. Prior intervention by untrained personnel (dai) at home in 6.5 % cases perhaps played an important role in increasing sepsis. Out of all deaths due to sepsis, 63 % ($n = 17$) cases were post-abortal (induced) who were admitted in septic shock with multi-organ failure. 131 cases of obstructed labor/rupture uterus were referred to our hospital out of which 37 were MNM cases and 12 died leading to a mortality index of 24.5 %. Emergency transfers late in labor are frequent in developing countries where delay in transportation often leads to rupture uterus and many women are in shock by the time they reach a tertiary care center. In our study, 23 cases of MNM underwent hysterectomy for PPH, rupture uterus, or infection out of which 13 (56.5 %) died. Early hysterectomy is reported to decrease morbidity and

mortality [18, 19] but many women died in our hospital due to life-threatening blood loss coupled with pre-existing anemia and inadequate replenishment of blood products for lack of donors.

Anemia without hemorrhage was the commonest indirect cause of MNM (20.7 %). It contributed significantly to maternal mortality (Mortality index 24.3 %) and also increased the severity of other causes of MNM. A high prevalence ratio of 0.36 indicates poor antenatal prophylaxis and management of anemia at community level. Among other indirect causes of maternal morbidity and mortality, hepatic disorders and respiratory disorders in pregnancy were only responsible for 2.1 and 2.2 % MNM cases but the mortality index was very high (51.9 and 46.2 %, respectively). These medical complications of pregnancy pose a significant threat to survival of affected patients and require a more focused approach toward management.

Conclusion

Low resource countries like India carry the highest burden of maternal mortality and morbidity. Despite an increase in institutional deliveries, most pregnant women do not receive any antenatal care and are at risk for obstetric complications. NMA aids maternal mortality audit in identification of factors contributing to high maternal morbidity and mortality. In this study, the large magnitude of MNM cases may be attributed to improper management of obstetric emergencies at referring hospitals, poor referral practices, inefficient transport system, limited availability of blood products, and poor access/utilization of health care services. A major limitation of this study was its retrospective nature. Poor documentation could have interfered with case identification and data collection leading to a clinical bias. Prospective surveillance of severe maternal morbidity will permit epidemiological surveillance and aid in generating interventions to reduce unnecessary maternal deaths.

Conflict of interest None.

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