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Original Research Article

Determinants of near miss mortality in a tertiary care centre

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ABSTRACT

Background: Near misses are defined as pregnant women with severe-life threatening conditions who nearly die but, with good care or good luck survive. Because near miss situation occurs more frequently than maternal death, more comprehensive and statistically reliable analysis could be conducted to assess the quality of maternal care and to develop evidence-based management protocols. The objectives of this study were to evaluate the determinants of near miss maternal mortality in a tertiary referral Government medical college hospital in Trivandrum, Kerala.
Methods: Case control study from a defined delivery population with three randomly selected pregnant women as controls for every case. Study was conducted at Department of Obstetrics and Gynecology, Medical College Hospital Trivandrum, Kerala, India. Study duration was one year. Study population were patients admitted in Obstetrics and Gynecology Department, fulfilling the WHO criteria of near miss.
Results: Of the primary determinant factors of near miss in this study, preeclampsia contributed the main role, followed by hemorrhage and eclampsia. During the antenatal period, preeclampsia was the major determinant followed by eclampsia. Hemorrhage was the major determinant in intra op /intra natal cases and next was eclampsia. Postpartum hemorrhage, eclampsia and preeclampsia were the major determinants in post-partum /post op cases. Among the associated indicators assessed, low socioeconomic status, anaemia, high body mass index, referral status, placenta praevia and caesarean section were statistically significant.
Conclusions: Detailed analysis of near miss cases helps in identifying risk factors. It helps in formulating preventive strategies, and helps us in tackling the delays in referral process.

Keywords: Determinants, Eclampsia, Hemorrhage, Morbidity, Near miss, Preeclampsia

INTRODUCTION

Maternal and child health care is one of the eight basic components of primary health care in the declaration of Alma Ata.[1] Pregnancy is one of the important events in women's life but many times it can become dangerous for her life. Social determinants and the health system performance play a major role in the occurrence of maternal deaths. The fifth millennium development goal intended to improve maternal health and the target was to decrease the maternal mortality rate by 75% by 2015.[2] Maternal mortality ratio of Kerala is 66.[3] While the estimated maternal mortality throughout the world is over half a million, approximately eight million women are suffering from serious pregnancy related complications every year.[4] In India 60-70 thousand maternal death occur each year and possible 20-30 times that figure suffer from ill health and near misses, hence maternal health remains a huge challenge for the country. Sadly, every ten minutes a woman dies in India from pregnancy and complications of child birth. The concept of maternal near miss was defined by the World Health Organization

(WHO) in 2009 as "a women who nearly died but survived a complication during pregnancy, child birth or within 42 days after termination of pregnancy.[5,6] Maternal mortality is frequently described as "Just The Tip of The Ice berg" alluding that there is a vast base to the ice berg in the form of maternal near miss(MNM) Advantages of investigating near miss events over events with fatal outcome are;

- Near misses are more common than maternal death
- They have the same pathways which lead to deaths and provide information regarding care received and possible means of prevention
- As the woman survives, near miss review may be seen as less threatening than the death reviews, for the teams who report them
- One can learn from the women themselves as they themselves are interviewed.

WHO recommended 3 different approaches of selection criteria for identification of maternal near miss cases. They are;

- Disease specific criteria
- Management based criteria, and
- Organ Dysfunction criteria.

Disease specific criteria was a clinical criteria related to a specific disease entity such as preeclampsia, eclampsia, HELLP syndrome, severe haemorrhage, severe sepsis and uterine rupture.[7,8] These criteria had too low a threshold of morbidity to be called near miss and the most common direct cause of maternal mortality i.e. pulmonary embolism was omitted because of the difficulty of diagnosis. It also left out early pregnancy complication like ectopic pregnancy and abortions.

Intervention based criteria was used in most developed countries where admission to ICU or the requirement of critical care was used as the criteria to identify the near miss.[9,10] The main disadvantage is that it is based on the resources available. The most obvious problem was the inaccessibility of intensive care beds for patients requiring them. The major reasons were, when death occurred before admission, the lack of availability of beds and the distance between the maternity unit and intensive care facilities. Moreover, admission criteria to intensive care units vary. Organ system dysfunction based criteria.[11] This system is based on the concept that there is sequence of events leading from good health. The sequence is clinical insult, followed by a systemic inflammatory response syndrome (SIRS), organ dysfunction, organ failure and finally death. Near misses would be those women with organ dysfunction and organ failures who survive. The presence of any one of the markers in pregnancy from conception to forty-two days post-delivery constitutes a near miss. Having identified the case, the primary obstetric cause can then be identified and classified. This system allows for identification of all critically ill women and allows for the identification of new and emerging disease priorities. The WHO technical working group recommends that this new maternal near miss approach can be adopted by all countries. Applying this approach will also help to identify the health system shortfalls that countries need to address to reduce complications and fatal outcomes of pregnancy and child birth. This system has several advantages which includes

- Establishing the pattern of diseases causing morbidity and their relative importance
- Comparisons can be made; definition can be standardized and used in many different settings
- Health system is not a part of the definition so problems within the health system can be studied
- Cases can be flagged when they occur as a function of an ongoing audit making it a virtually prospective audit, avoiding the problem of poor recording.

Some of the disadvantages is that it is dependent on a minimum level of care in a country. There must be functioning laboratories for some specific blood test and basic critical care monitoring must be available. Retrospective identification of cases is very difficult because of the inability to identify cases from registers. Diagnostic criteria of severe maternal morbidity have been advocated by Waterstone et al, Mantel et al, and the WHO. In this study the WHO organ dysfunction criteria 2008 has been used as a study tool. WHO organ dysfunction criteria are broadly classified as cardiovascular, respiratory, renal, hepatic, coagulation, neurological and uterine dysfunctions. Cardiovascular dysfunction includes shock, cardiac arrest, severe hypoperfusion, severe acidosis (pH <7.1), use of continuous vasoactive drugs, and cardiopulmonary resuscitation.

Respiratory dysfunction includes acute cyanosis,gasping, severe tachypnoea >40 breaths/mt, severe bradypnoea<6 breaths/mt, severe hypoxaemia, intubation and ventilation not related to anaesthesia. Renal dysfunction includes oliguria not responsive to fluids or diuretics, severe acute azotemia (creatinene>3.5 mg/dl), dialysis for acute renal failure. Hepatic dysfunction includes jaundice in presence of preeclampsia, and severe acute hyperbilirubinemia with serum bilirubin levels >6 mg/dl. Coagulation dysfunction includes failure to form clots, thromboctytopenia with platelet counts <50000, massive transfusion of blood or red cell>4 units.

Neurological dysfunction includes prolonged unconsciousness or coma lasting>12 hours, stroke, uncontrolled status epilepticus, and global paralysis. Uterine dysfunction includes hysterectomy due to uterine infection or haemorrhage.

METHODS

Case control study from a defined delivery population with three randomly selected pregnant women as controls

for every case. Study conducted in Department of Obstetrics and Gynecology, Medical College Hospital Trivandrum, Kerala. On year study duration Study with patients admitted in Obstetrics and Gynecology Department, fulfilling the WHO criteria of near miss. Cases defined as "a women who nearly died but survived a complication that occurred during pregnancy, childbirth or within 42 days of termination of pregnancy." Controls were selected randomly (three women who delivered subsequent to the case not satisfying criteria case definition).

Exclusion criteria

Those women who did not give consent for the study. Sample size calculated using the following assumptions:

- Confidence level = 95%
- Type 1 error = 5%
- Type 2 error = 20%
- Power = 80%
- Ratio of case to control = 1:3
- Odds ratio = 2.5
- Expected frequency of exposure in control = 8%
- Sample size using software EPI INFO was found to be 125 cases and 375 controls.

RESULTS

Age distribution

48.8% of the cases were in the age group <25 years, as compared to 43.5% among controls. The groups were comparable.

Socio economic status

85.6%of the cases belonged to low socioeconomic group as compared to 66.1% of the controls, which was found to be statistically significant (Table 1).

Table 1: Socioeconomic status.

SES	Category				Total	
	Case		Control			
	N	%	N	%	N	%
Lower	107	85.6	248	66.1	355	71
Upper	18	14.4	127	33.9	145	29
Total	125	100	375	100	500	100

$\chi 2$ =17.254; df =1; p<0.001; OR = 3.716; 95% CI = (1.370-10.079).

Table 2: Indications for admission.

Indication for admission	Category				Total	
	Case		Control			
	N	%	N	%	N	%
Uncontrolled hypertension	20.0	16.0	15.0	4.0	35.0	7.0
HELLP	3.0	2.4	0.0	0.0	3.0	0.6
Severe preeclampsia	7.0	5.6	6.0	1.6	13.0	2.6
Eclampsia	29.0	23.2	0.0	0.0	29.0	5.8
Antepartum haemorrhage	13.0	0.4	11.0	2.9	24.0	4.8
Postpartum haemorrhage	16.0	12.8	0.0	0.0	16.0	3.2
Diabetes mellitus	4.0	3.2	2.0	0.5	6.0	1.2
Thrombocytopenia	4.0	3.2	1.0	0.3	5.0	1.0
Pulmonary embolism	2.0	1.6	0.0	0.0	2.0	0.4
Term complicated	10.0	8.0	223.0	59.5	233.0	46.6
Fever	2.0	1.6	1.0	0.3	3.0	0.6
Dyspnoea	6.0	4.8	1.0	0.3	7.0	1.4
Hypotension	1.0	0.8	0.0	0.0	1.0	0.2
Intrauterine demise	4.0	3.2	6.0	1.6	10.0	2.0
Fetal distress	1.0	0.8	9.0	2.4	10.0	2.0
Uterine inversion	1.0	0.8	0.0	0.0	1.0	0.2
PPROM	2.0	1.6	22.0	5.9	24.0	4.8
PROM	0.0	0.0	30.0	8.0	30.0	6.0
IUGR, Oligamnios	0.0	0.0	16.0	4.3	16.0	3.2
Labour pain	0.0	0.0	32.0	8.5	32.0	6.4
Total	125.0	100.0	375.0	100.0	500.0	100.0

Parity

64% of the cases were primigravida, as compared to 53.6% among controls. 36% of the cases and 46.4% of controls were multigravida.

Booking status

77.6% of the cases were referred as compared to 29.3% of the controls, which was found to be statistically significant (OR 3.202).

Admission status

88.8%of the cases were emergency admissions as compared to 37.1% of the controls, which was statistically significant.

Time of admission

67.2% of the cases were admitted during antenatal period

Indication for admission

Indications for admission are mentioned in (Table 2).

Body mass index

33.6% of the cases were overweight or obese as compared to 9.6% of the controls, which was statistically significant (OR 4.77).

History of adverse pregnancy outcome

5.6% of cases and 5.1% of control group had a history of adverse pregnancy outcome.

Presence of hypertension

53.6% of the cases were hypertensive as compared to 22.1% of the controls, which was found to be statistically significant (OR 4.06). Preeclampsia was seen in 33.8% of the cases as compared to 29.3% of the controls.

Presence of diabetes

18.5% of the cases had diabetes as compared to 16.5% of the controls. This was not found to be statistically significant.

Presence of anaemia

64%of the cases had anaemia as compared to 42.9%of the controls, which was statistically significant.

Presence of cardiac disease

This was comparable amongst cases and controls.

Other medical disorders

There was one case each of autoimmune disease and renal disorder and no case of viral hepatitis

Presence of placenta praevia

15.2% of the cases had placenta praevia as compared to 11% of the controls, which was statistically significant. (OR 5.93).

Presence of APH

13.6% had APH as compared to 2.9% of the controls, which was found to be statistically significant (OR 5.21).

High total WBC count

28.8%of the cases had abnormal total count as compared to 0.3% of the controls which was found to be highly statistically significant (Table 3).

Induction statistics

53.8% of the cases were induced as compared to 58.9%of the controls which was comparable.

Table 3: Total WBC count amongst cases and controls.

Total count	Category				Total	
	Case		Control			
	N	%	N	%	N	%
Abnormal	36.0	28.8	1.0	0.3	37	7.4
Normal	89.0	71.2	374.0	99.7	463	92.6
Total	125.0	100.0	375.0	100.0	500.0	100.0

$\chi 2$ =111.387; df=1; p<0.001(Yates correction); OR=151; 95% CI=20.455-1118.

Type of delivery

66. 4% of the cases had caesarean sections as compared to 36.3%of the controls. In the cases group the major contributors were fetal distress, severe preeclampsia with failed induction and previous CS with placenta praevia±accreta whereas in the control group the major cause was previous CS followed by fetal distress.

Major dysfunction

Major dysfunction noted was coagulatory dysfunction in 62 cases (49.6%) followed by neurological dysfunction in 22 cases (17.6%).

Hepatic dysfunction was seen in 19 cases (15.2%), uterine dysfunction in 10 cases (8%), respiratory dysfunction in 6 cases (4.8%), cardiovascular dysfunction in 3 cases (4%) and renal dysfunction in 1 case (0.8%) (Table 4).

Table 4: WHO organ dysfunction classification.

WHO criteria	Frequency	Percentage
Cardiovascular dysfunction	5.0	4.0
Respiratory dysfunction	6.0	4.8
Renal dysfunction	1.0	0.8
Coagulation dysfunction	62.0	49.6
Hepatic dysfunction	19.0	15.2
Neurological dysfunction	22.0	17.6
Uterine dysfunction	10.0	8.0
Total	125.0	100.0

Table 5: Maternal complications.

Complications	Cardiovascular	Respiratory	Renal	Coagulation	Hepatic	Neurological	Uterine	Total
Eclampsia						22		22
Severe preeclapsia				20	19			39
PPH	1			27			10	38
Sepsis		2		1				3
Pulm embolism	1	3						4
Cardiac failure	2	1						3
Thrombocytopenia				4				4
Hypotension	1							1
Abruption				10				10
Renal disease			1					1
Total	5	6	1	62	19	22	10	125

Table 6: Time of near miss.

WHO criteria	Antenatal	Intrapartum/intraop	Postpartum/postop	Total
Cardiovascular dysfunction	1	1	3	5
Respiratory dysfunction			6	6
Renal dysfunction	1			1
Coagulation dysfunction	19	17	26	62
Hepatic dysfunction	16		3	19
Neurological dysfunction	6	5	11	22
Uterine dysfunction		9	1	10
Total	43	32	50	125

Determinants of near miss

It's seen that preeclampsia was the major determinant (31.2%) followed by haemorrhage (30.4%). Others were eclampsia (17.6%), abruption (8%), pulmonary embolism (3.2%), sepsis (2.4%), cardiac failure (2.4%), thrombocytopenia (3.2%), hypotension and renal disease. (Table 5).

Time of occurrence of near miss

Maternal near miss cases of 40% (50 cases) occurred in postnatal/post op phase, 34.4% (43 cases) occurred in antenatal phase and 25.6% (32 cases) in intra partum/intra op phase (Table 6).

Determinants leading to near miss

It's seen that the major determinant leading to near miss in antepartum period was severe preeclampsia about 31cases (72.09%) of which 15 cases lead to coagulatory dysfunction and 16 cases to hepatic dysfunction. 2nd major determinant was eclampsia about 6 cases (13.95%) leading to neurological dysfunction. There were 4 cases of thrombocytopenia (2 cases due to dengue fever, 2 cases due to gestational thrombocytopenia) leading to coagulatory dysfunction. There was 1 case of ventricular tachycardia leading to ventricular fibrillation. There was 1 case of bilateral renal calculus and ureteric calculus with obstructive hydronephrosis leading to renal dysfunction (Table 7).

Table 7: Near miss determinants amongst antenatal cases.

Complications	Cardiovascular	Respiratory	Renal	Coagulation	Hepatic	Neurological	Uterine	Total
Eclampsia						6		6
Severe preeclampsia				15	16			31
PPH								
Sepsis								
Pulm embolism								
Cardiac failure	1							1
Thrombocytopenia				4				4
Hypotension								
Abruption								
Renal disease			1					1
Total	1		1	19	16	6		43

Table 8: Near miss determinants amongst intrapartum and intraop cases.

Complications	Cardiovascular	Respiratory	Renal	Coagulation	Hepatic	Neurological	Uterine	Total
Eclampsia						5		5
Severe preeclampsia				3				3
PPH				4			9	13
Sepsis								
Pulm embolism	1							1
Cardiac failure								
Thrombocytopenia								
Hypotension								
Abruption				10				10
Renal disease								
Total	1			17		5	9	32

Table 9: Near miss determinants amongst post-partum/post op cases.

Complications	Cardiovascular	Respiratory	Renal	Coagulation	Hepatic	Neurological	Uterine	Total
Eclampsia						11		11
Severe preeclampsia				2	3			5
PPH	1			23			1	25
Sepsis		2		1				3
Pulm embolism		3						3
Cardiac failure	1	1						2
Thrombocytopenia								
Hypotension	1							1
Abruption								
Renal disease								
Total	3	6		26	3	11	1	50

The major determinants leading to near miss in intrapartum/ intraop cases was haemorrhage (13 cases). 9 cases were due to placenta accreta and 4 cases due to PPH followed by abruption (10 cases). The third determinant was intra partum eclampsia leading to neurological dysfunction. There was one case each of sepsis and pulmonary embolism (Table 8). The major determinant in postpartum/post op cases was PPH in 25 cases (50%) followed by eclampsia in 11 cases (22%), pre-eclampsia in 5 cases, sepsis in 3 cases, pulmonary embolism in 3 cases, cardiac failure in 2 cases and hypotension (post spinal anaesthesia) in 1 case (Table 9).

Duration of hospital stay

49.6%of the cases were admitted for 2-3 weeks. Only 2% of "controls" had this duration of stay.

Analysis

Variables which were found to have significant association with near miss during univariate analysis with p value <0.05 were subjected to multivariate analysis of binary logistic regression. Binary logistic regression found that socioeconomic status, referred status, anaemia, hypertension, high body mass index, and placenta praevia were significant predictors of near miss in this study. (Table 10, 11).

Table 10: Univariate analysis.

	Case(N=125)		Control (N = 375)		Total (N = 500)		Chi	p	OR	95% CI for OR
	N	%	N	%	N	%				
SES (Lower)	107	85.6	248	66.1	355	71	17.3	0.000	3.04	1.768-5.24
Primi	80	64	201	53.6	281	56.2	4.12	0.042	1.54	1.013-2.34
Referred	97	77.6	110	29.3	207	41.4	90	0.000	8.35	5.187-13.4
Anaemia	80	64	161	42.9	241	48.2	16.7	0.000	2.36	1.555-3.59
Hypertension	67	53.6	83	22.1	150	30	44.2	0.000	4.06	2.65-6.23
Overweight	42	33.6	36	9.6	78	15.6	41	0.000	4.77	2.874-7.9
APH	17	13.6	11	2.9	28	5.6	20.2	0.000	5.21	2.368-11.5
Abnormal total count	36	28.8	1	0.3	37	7.4	111	0.000	151	20465-1118
Placenta praevia	19	15.2	11	2.9	30	6	25	0.000	5.93	2.737-12.9

Table 11: Bivariate analysis.

	B	S. E.	p	OR	95% CI for OR	
					Lower	Upper
SES	0.998	0.332	0.003	2.713	1.414	5.205
Primi	0.149	0.269	0.580	1.161	0.685	1.967
Booking status	1.845	0.269	<0.001	6.328	3.735	10.721
Anaemia	0.889	0.264	0.001	2.434	1.450	4.086
Hypertension	1.360	0.270	<0.001	3.896	2.295	6.613
Abn BMI	1.223	0.319	<0.001	3.397	1.819	6.343
Placenta praevia	1.916	0.486	<0.001	6.793	2.618	17.625
Constant	-12.428	1.500	<0.001	0.000		

DISCUSSION

Maternal mortality rate in developing regions is 14 times higher than developed regions. Promotion of maternal nutrition and health education, with greater attention to emergency obstetric care at the district, sub centre and primary health care centre levels must be prioritized.[12] New indicators have been developed for evaluating maternal health issues more effectively and thus the concept of maternal near miss has been explored as an adjunct to maternal death confidential enquiries13.The lack of a uniform, standardized, and reproducible definition of maternal morbidity as well as the difficulty associated with ascertaining and measuring maternal morbidity has been a major challenge in research. Pregnancy and child birth can move from normal pregnancy to being complicated (acute maternal morbidity) and to becoming life threatening, referred to as “near-miss” cases. (WHO 2004).[14]

India contributes to one-fourth of all maternal deaths globally. Of the primary determinant factors of near miss in this study, preeclampsia contributed the main role, followed by hemorrhage and eclampsia. In the antenatal period, preeclampsia was the major determinant followed by eclampsia. Hemorrhage was the major determinant in intra op /intra natal cases and next was eclampsia. Post-partum hemorrhage, eclampsia and preeclampsia were the major determinants in post-partum /post op cases This is in agreement with the FOGSI study which was a 3 year retrospective observational study from January 2005 to December 2007 in India as a whole, where the leading cause of maternal death was hypertensive disorders in pregnancy 15 followed by hemorrhage. Fourth determinant in this study was abruption.

A prospective study was conducted by Adeoye IA et al in a tertiary health care facility to identify the factors associated with maternal miss.[14] This study also found that the referral status of women was a major determinant. Women who were referred from another facility had a fourfold risk (OR = 3.84) of experiencing near miss as compared to those who were not referred, the probable reason being late referrals. In this study also referred cases constituted 77.6 % of the cases.

The incidence of caesarean section amongst cases was high (67.2%) and it is possible that the principal determinant of this rate was the severe morbidity itself, since the rate of caesarean sections was significantly higher in the women who developed severe morbidity during pregnancy compared to those who developed it during the peurperium. In this study 64% of the cases were primigravida. In this study, it did not emerge as a significant risk factor. In a cross sectional study conducted by Morse MH et al in regional reference

hospital 33.7% of the cases were primigravida.[15,16] Another study by Roopa P et al in tertiary Hospital at Karnataka found that primigravidae were more in near miss group.[17] In an audit inducted by Prem D'Chunha in Father Muller Hospital, a tertiary level hospital showed that most common age group for near miss was 20-30 years as in this study.

Among the associated indicators assessed, anaemia and caesarean section were important. In this study anaemia was seen in 64 % of the cases. A study conducted by and Goffman et al 18 in Dealer Hospital of the Albert Einstein College of Medicine found that obesity (BMI >29) was significantly associated with near miss. In our study BMI>24.5 was statistically significant. Ten women in our study underwent obstetric hysterectomies of which nine cases were due to placenta accreta and one case was due to secondary PPH. This is in agreement with the case control study conducted by Knight et al and Jennifer J et al in UK where they noted that both uterine rupture and placenta accreta were strongly associated with peripartum hysterectomy risk.

The limitation in this study was that our institution being a referral institution, the correct information regarding the number of antenatal visits could not be obtained and the "delays" in referral could not be verified in each referred patient.

Recommendations

- Based on this study the measures that can be taken to prevent near miss are;
- Improving antenatal care to help early identification of high risk pregnancies especially pre-eclampsia;
    a. Detection of urine albumin should be a routine investigation in all hypertensive patients
    b. All health care personnel should be made aware regarding preeclampsia and the importance of detecting proteinuria.
- Correcting anaemia in the antenatal period itself
- Raising the awareness in patients about hypertension and its complication and the need for regular follow up
- Developing protocols to prevent /manage PPH including the awareness about using active management during third stage of labour. Management protocol for obstetric hemorrhage in the form of "PPH Drill" should be displayed all labour rooms
- Training obstetric health professional in managing infrequent but fatal condition like sepsis
- Strengthening the peripheral health centres and timely referral system
- A multidisciplinary approach in patient management where facilities exist.

CONCLUSION

In this case control study, it is seen that the variables that were found to be significantly associated with near miss were, low socio economic status, referred cases, anaemia, hypertension, over weight (BMI>24.9) and placenta praevia. The major determinants leading to near miss were pre-eclampsia, haemorrhage, eclampsia, and abruption. Cases of pulmonary embolism, thrombocytopenia due to dengue fever and gestational thrombocytopenia, Sepsis, Cardiac failure, hypotension and renal disease were also noted. Detailed analysis of such cases would throw some light on preventive strategies, and also help us in tackling the "delays" in referral process.

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