



REVIEW ARTICLE

ROLE OF ACID-BASE IMBALANCES AND THEIR MANAGEMENT IN NEAR-MISS MORTALITY CASES IN OBSTETRICS

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ABSTRACT

Background: WHO (2008) defines Maternal Near-Miss mortality cases as “a woman who nearly died but survived a complication that occurred during pregnancy, childbirth or within 42 days of termination of pregnancy”. This study was conducted to evaluate the prevalence and impact of acid-base imbalances in near-miss mortality in obstetrics patients.

Material and Methods: A prospective cohort study was conducted from November 2015 to May 2017 at Department of Obstetrics and Gynaecology, GSVM Medical College, Kanpur. A total of 200 near-miss mortality cases were evaluated for acid-base imbalances and managed accordingly. It was further correlated with various outcomes during their hospital stay.

Results: Out of 200 patients, 78.5% severe anemia, 46.5% hypertensive disorder, 30.5% haemorrhage, 7.5% sepsis, 12.5% previous LSCS, 5% obstructed labour. Acidosis was far more common than alkalosis with almost 2:1:1 ratio among Metabolic acidosis, Respiratory acidosis and Respiratory alkalosis. The presence of acid-base imbalance was significantly related to need of ICU care (p value <0.0001, odd's ratio-3.31, 95% confidence interval = 2.31-4.73). The need of blood component transfusion was statistically significant (p value-0.0082, odd's ratio-1.45 and 95% confidence interval = 1.10-1.91).

Conclusion: Prompt diagnosis and correction of acid-base imbalance along with ICU care and blood transfusion in near-miss mortality cases can reduce maternal mortality.

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INTRODUCTION

World Health Organization (2008) defines a maternal near-miss case as "a woman who nearly died but survived a complication that occurred during pregnancy, childbirth or within 42 days of termination of pregnancy." (WHO, 2011), Severe Acute Maternal Morbidity (SAMM) refers to a life-threatening disorder that can end up in near miss with or without residual morbidity or mortality. Obstetric near-miss (ONM) or severe acute maternal morbidity is gaining interest internationally as a new indicator of the quality of obstetric care following maternal mortality statistics. "Near-miss" describes a patient with an acute organ system dysfunction, which, if not treated appropriately, could result in death (Mantel, 1998).

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It has also been described as a situation of lethal complication during pregnancy, labour or puerperium in which the woman survives either because of medical care or just by chance (WHO, 2011) and has been extensively studied in the recent past as a complement for maternal mortality and also to evaluate the quality of available services in a particular country. Near miss cases and maternal deaths together are referred to as severe maternal outcome (SMO) and assumed to be a better indicator than maternal mortality alone for designing, monitoring, follow up and evaluation of safe motherhood programs (Ronsmans, 2004; Pattinson, 2003 and Filippi, 2004). Maternal near-miss surveillance is an effective tool for improving safe motherhood programs (Maternal near miss review, 2014). Maternal mortality rate in India (2015) 174/100,000 live birth (https://www.indexmundi.com/india/maternal_mortality_rate.html). Due to the wide variation in identification of near-miss cases, it has been difficult to make a summary estimate of the prevalence of near miss globally. In

The systematic review published in 2004 the prevalence of near miss varied between 0.80% and 8.23% in studies that used disease-specific criteria while the range was 0.38%-1.09% in the group that used organ-system based criteria (Say, 2004). Rates were within the range of 0.01% and 2.99% in studies using management-based criteria (Say, 2004). In another, recent review on articles between January 2004 and December 2010 the prevalence rates of maternal near miss varied between 0.6% and 14.98% for disease-specific criteria, between 0.04% and 4.54% for management-based criteria and between 0.14% and 0.92% for organ-based dysfunction based on Mantel Criteria. Till recently there were no strict criteria for identification of these cases for routine implementation and wider application of this concept was limited. Haemorrhage, hypertensive disorders, sepsis and obstructed labour are the most important causes in the developing countries. Causes of near miss are similar to causes of maternal deaths prevailing in the area (Chhabra, 2014). Hypertensive disorders and Haemorrhage being the leading causes. The present study was undertaken to know various outcomes and manifestations of acid base imbalance in complicated pregnancies along with various management protocols available to correct them.

MATERIAL AND METHODS

This was a prospective study done at Department of Obstetrics and Gynaecology (UISEMH), GSVM Medical College, Kanpur over a period of 19 months from Nov,2015-May,2017. This study has been approved by the ETHICAL COMMITTEE, GSVM MEDICAL COLLEGE, KANPUR. A total of 200 pregnant females who suffered from severe pregnancy complication (severe anemia, pre-eclampsia, eclampsia, antepartum haemorrhage, obstruction of labour, abortion, etc.), had an organ system dysfunction, needed intensive care or ventilator support and were referred to our hospital with poor general condition. Non-obstetrical morbidity (accidental or incidental causes not related to pregnancy e.g morbidity from automobile, accidents, suicides, poisoning, etc) were excluded from the study. In this study, Mantel criteria were used for identification of near miss patients.(Annexure:1)

Data was collected with respect to socio-demographic factors, referral from some health facility, accompaniment with ASHA, utilization of 102 ambulance services, number of PCV,FFP and Platelets transfused, requirement of ICU care, total duration of stay in hospital and other comorbidities present in the patient which led to their "near-miss" status. The ABG was sent at the time of admission. The acid-base imbalance was studied and corrected accordingly and repeat sample was sent. The difference in various parameters of ABG were compared and analysed. For sample collection maternal heparinised arterial blood sample was sent for arterial blood gas analysis along with all routine investigations(CBC, ABORh grouping, RBS, VDRL, HIV, HBsAg, HCV status). Other investigations: Serum Electrolytes, ESR, LFT, KFT, Coagulation profile.

RESULTS

The statistical analysis has been done using MedCalc Statistical Software. During the period of this study, 10.39% near miss patients were admitted in our hospital, out of which we saved 86.16% whereas 13.83% landed in mortality.

Majority of the patients were in age group 20-35 years (85%) with a mean age of 25.7 ± 0.47 years out of which 65% were multipara.76% were referred to our hospital from a primary or secondary health centre. Presence of ASHA was only seen in 9.5%. Out of these 54% needed ICU for further monitoring. Government transportation was used by 86% (Table 1).

Table 1. Table showing various demographic, social and use of health care services among the study group

AGEGROUPS	NUMBER OF PATIENTS	PERCENTAGE(%) (N=200)
<20 year	18	9%
20-35 year	170	85% (mean age= 25.7 ± 0.47 years) 6%
>35 year	12	
PARITY		
Primipara	70	35%
Multipara	130	65%
TYPE OF REFFERAL		
Health centre	152	76%
Self	48	24%
LITERACY STATUS		
Literate	69	34.5%
Illiterate	131	65.5%
PRESENCE OF ASHA		
Yes	19	9.5%
No	181	90.5%
NEED OF ICU CARE		
Yes	108	54%
No	92	46%
NAS USAGE		
Yes	171	86%
No	29	14%

Table 2. Various co-morbid conditions in near-miss cases

	Number of Patients	Percentage (n =200)
Severe anemia	157	78.5%
Pre-eclampsia	43	21.5%
Eclampsia	50	25%
Hemorrhage	72	36%
Sepsis	16	8%
Others :medical illness	8	4%
Previous surgical history	25	12.5%
Obstructed labour		
Iud	10	5%
	44	22%

*some co-morbid conditions were over-lapping in near-miss cases.

Among the near-miss events, hypertensive disorders of pregnancy was the leading cause (46.5%) followed by hemorrhage with (36%) (Table 2). At the time of admission, 49.5% had normal ph(7.35-7.45) whereas the extremes of pH was seen only in 1.5%.Acidosis was far more common than Alkalosis with almost 2:1:1 ratio among Metabolic acidosis(41%), Respiratory acidosis(21%) and Respiratory alkalosis(14.5%).Out of 108 patients who needed ICU/HDU care,58.33% had Metabolic acidosis, 25.92% had Respiratory acidosis and 15.74% had Respiratory alkalosis. The hemorrhagic or eclamptic event occurring antenatally was accompanied with more morbidity as compared to those occurring in postnatal period The presence of severe anemia or pre-eclampsia in patients with metabolic acidosis resulted in prolonged stay in ICU whereas presence of eclampsia, haemorrhage or sepsis along with metabolic acidosis was associated with short ICU stay. Similarly severe anemia, eclampsia and haemorrhage along with respiratory acidosis increased ICU stay. In case of respiratory alkalosis ICU stay was usually short. Most of patients with metabolic acidosis and respiratory alkalosis had less stay in ICU as compared to those

Table 3. Comparison between the type of acid-base imbalance with need for icu/hdu care

Type of acid base imbalance	Number of patients	Need of icu/hdu	Number of patients managed in hdu	Patients shifted To icu	Stay in icu		Average duration of icu stay(days)
					<4 days	>4 days	
Metabolic acidosis	135	63(58.33%)	48	15	13	2	2.6±0.5
Respiratory acidosis	67	28(25.92%)	20	8	5	3	3.5±0.8
Respiratory alkalosis	66	17(15.74%)	14	3	3	-	1.5±0.3

Table 4. Comparison of duration of icu stay in near-miss cases with various co-morbid conditions of pregnancy and type of acid-base imbalance

	Duration of stay in icu				Average duration of icu stay (days)		
	Metabolic acidosis		Respiratory acidosis		Respiratory	alkalosis	
	<4 days	>4 days	<4 days	>4 days	<4 days	>4 days	
Severe anemia	8	2	7	2	2	-	2.2±0.3
Pet	3	1	1	-	-	-	3±0.9
Eclampsia	3	-	1	1	2	-	2.4±0.6
Hemorrhage	4	-	1	1	1	-	2.8±0.7
Sepsis	1	-	-	-	1	-	1.5±0.2

Table 5. Association of acid-base imbalance with different conditions in near-miss cases

Factors	P-Value	ODD' S Ratio	95% Confidence Interval
Vaginal delivery	0.1318	-	-
Lscs/ other surgical intervention	0.0933	-	-
Need of icu care	<0.0001	3.31	2.31-4.73
Pcv transfusion	0.0899	-	-
Blood components	0.0082	1.45	1.10-1.91

with respiratory acidosis (Table 3). The average duration of stay in hospital was: Metabolic acidosis (10.6 ± 4.9 days), Respiratory acidosis (12.3 ± 6.8 days) and Respiratory alkalosis (8.7 ± 3.5 days). The patients with Hemorrhage had prolonged duration of stay in hospital followed by Hypertensive patients. Association of anemia prolonged the duration in hospital. Maximum morbidity was seen associated with Respiratory acidosis (Table 4). The metabolic acidosis in most of patients was corrected by 4-6 units of bicarbonate injection. Statistically significant relationship has been seen between the presence or absence of acid-base imbalance and requirement for ICU care and blood products rather than the type of acid-base imbalance. The Regression coefficient of various types of acid base imbalances and consequent requirement of ICU was statistically not significant but presence or absence of acid-base imbalance was significantly related with requirement of ICU care (odd's ratio=3.31 and 95% confidence interval= 2.31-4.73) and blood component (p value-0.0082, odd's ratio- 1.45 and 95% C/I = 1.10-1.91). Around 56% patients did not require blood component transfusion whereas 13% needed 1 unit FFP and Platelets transfusion, 31% needed ≥ 2 unit FFP and Platelets transfusion. Whereas need of PCV, mode of delivery and other surgical interventions were not strongly related to acid-base imbalance (Table 5).

DISCUSSION

This study was conducted to evaluate the impact of acid-base imbalances in near-miss cases thus facilitating us to have a better understanding of various outcomes and their management, ultimately reducing the morbidity associated with near-miss cases and lowering the maternal mortality. Majority of patients belonged to age group of 20-35 years with mean age $25.7 \text{ years} \pm 0.47$. Since this is the most common reproductive age group of our country. As per a prospective case control study conducted by Adeoye IA et al (Adeoye, 2013) in Nigeria, 70.6% near miss cases were <35 and 22.7%

had age >35 years. According to Yasmin G et al (Yasmin, 2016) most common age group affected in the near miss cases is 20 to 35 years (71.3%). Our hospital is a tertiary referral center which caters to the city of Kanpur and its adjoining areas, we had 76% referred case; on the other hand 24% were self-admissions. This highlights the dire need of specialized obstetrics care units at primary and secondary health care units. As per Almerie et al (Yara Almerie, 2010) majority of near-miss cases (93%) were referred in critical condition from other facilities. According to Liyew EF et al (Liyew, 2017) 88.2% of maternal near miss cases were referred. The literacy and awareness levels were drastically low in near miss cases as found in this study, only 34.5% were literate whereas 65.5% were illiterate which points out the lack of primary education at grass root levels. Presence of ASHA with a near miss case was 9.5% whereas 90.5% women were not accompanied with any ASHA.

NRHM created ASHA in 2005 to integrate the villages to the health system but in present scenario ASHA has been kept restricted to basic antenatal care which includes distribution of iron and folic acid tablets and tetanus immunization only, so majority of antenatal concerns at village level could not be catered. National Ambulance Services (NAS) was initially launched in 2013 by Orissa State Government. Later this has been adopted by various other states as well, has proved to be a boon in reducing maternal mortality, usage of NAS was very appreciable in these cases thus reducing the second delay in reaching a health care facility since 86% patients used this service. In our study, 54% of near-miss cases needed intensive monitoring either in HDU or ICU. According to study conducted by Yasmin G et al. (Yasmin, 2016), most of them needed ICU admission (75.4%) whereas according to Oladapo et al (Olufemi, 2005) 4.3% were managed in ICU. In study conducted by Roopa PS et al (Roopa, 2013). ICU admissions was needed in 62.6% of near-miss patients which is similar to a study in Nepal, whereas in a study in Damascus, only 27% needed ICU admissions. This emphasizes the importance of a

separate obstetrics HDU as well as ICU in every tertiary care hospital. The most prevalent cause of near-miss according to our study was Hypertensive diseases of pregnancy (HDP) (46.5%) followed by Hemorrhage (30.5%). Adeoye IA et al (Adeoye, 2013), reports major cause of near miss events were severe haemorrhage 41.3%, hypertensive disorder of pregnancy 37.3%, prolonged/obstructed labour 18.6%, severe sepsis 14.6% and severe anemia 13.3%. According to Yasmin G et al⁽¹¹⁾ most common cause of near miss events was hemorrhage- 54 cases(44.3%), followed by hypertensive disorders of pregnancy- 42 cases (34.4%) and dystocia-18 cases (14.8%). Other causes were sepsis- 3 cases (2.4%). As per Oladapo et al (Olufemi, 2005) hypertensive disorders in pregnancy and haemorrhage were responsible for 61.6% of all near miss events. In contrast to our study Hemorrhage was the most common cause for near miss mortality in study by David et al (David, 2014) and HDP was the second most common cause. Similar to our study, a study conducted by Almerie et al (Yara Almerie, 2010), showed HDP (52%) to be the most common cause followed by haemorrhage and a study in Ethiopia concluded obstructed labour (45%) to be the most predominant cause followed by haemorrhage. The African studies also revealed infections to be amongst the common causes for near miss along with haemorrhage. Since anemia was seen associated with 78.5% near miss cases either directly or indirectly so blood transfusions were required in 90% patients whereas 10% did not require any blood transfusion in our study. About 63(32%) patients were managed with a single blood transfusion whereas around 60% required ≥ 2 units. The need of packed cell transfusion was studied in near-miss cases with acid-base imbalance but it was not found to be statistically significant. Around 57% patients did not require blood component transfusion whereas 13% needed 1 unit FFP and Platelets transfusion, 31% needed ≥ 1 unit FFP and Platelets transfusion. As per study done by Yasmin G et al (Yasmin, 2016) massive blood transfusion were needed in 42.6% of patients which was similar to Shrestha J et al (Shrestha, 2015), and but differed from other studies Gedefaw M et al (Gedefaw, 2014). The outcome of patients in terms of mode of delivery was vaginal delivery (45%), LSCS (37%), hysterectomy (2%), laparotomy (4%). The patients who deliver at home/other health facility were 12%. According to Yasmin G et al (Yasmin, 2016) laparotomy for either rupture uterus or ruptured ectopic were done in 31.1%. Hysterectomy was done in 7 cases. Many near miss patients needed more than one intervention during their management. 42.6% delivered by LCSC, while 23% were delivered normally (Yasmin, 2016). Laparotomy was needed to save the life of the patients in 31.1%, whereas another study showed its need only in 5%. 10 Hysterectomy was done in 7 cases in our study, whereas it was done in 4 and 43 cases respectively in other studies. In an Ethiopian study most of them delivered by vaginal route (61%) and only 13% delivered by LSCS.

Conclusions

“To Prevent is To Pre-empt. It is the basic premise that disease is the end result of failure of prevention.” Near miss is a stage where and when acted properly could prevent Maternal Mortality. These cases share many characteristics with maternal mortality and can directly tell about the obstacles that had to be overcome after the onset of an acute complication thus providing valuable information about obstetrics care. Treating the underlying cause along with acid-base imbalance improves the patient in terms of need for ICU/stay in ICU,

total hospital stay and morbidity. Hence, evaluation of the circumstances surrounding near miss can give us an idea to know the exact etiology, treat it in its early stage and prevent the death of mother. It can be done by proper and efficient management of haemorrhage, hypertensive disorders and anemia. A wide gap exists between the health system and antenatal patients which could be fulfilled by Government of India by proper education and training of health care personnel, even at primary level for identification of high risk cases and timely referral to a higher centre whenever necessary. Government of India could train ASHA in basic paramedics thus enabling her in identification of high-risks cases which would lessen near-miss cases. The government could also increase the financial support provided to ASHA as well as to the pregnant female.

Creating awareness among the women regarding the importance of pre-conceptual counselling, routine antenatal check-up is pivotal for healthy mother and child.

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Annexure 1

	DESCRIPTION	ADVANTAGES
Clinical criteria related to a specific disease entity	Disease specific definitions used for common conditions and clinical criteria defined for severe morbidity e.g. Pre-eclampsia is a disease and complications such as eclampsia, renal failure and pulmonary edema identify severe cases.	Easy to interpret cases or be identified retrospective. Quality of care of the disease can be identified.
Management specific	Management or intervention to disease e.g. hysterectomy, blood transfusion or admission in ICU.	Simple to use in identification of cases.
Organ system dysfunction or failure	Based on the concept that there is a consequence of events leading from good health to death. Death is preceded by organ dysfunction and organ failure. Markers for organ system dysfunction or failure are specified e.g. jaundice in the presence of pre-eclampsia.	Allows for identification of critically ill women Keeps focus on severe diseases.
