

A Call for Eminence Obstetrics Care by Way of “Neonatal Near Miss” Events (NNM): A Hospital-Based Case–Control Study

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About the Author



Dr. Bhavesh D. Shroff has graduated (MBBS) from Medical College Baroda, The Maharaja Sayajirao University, Vadodara, Gujarat, and completed his postgraduation (MD PSM) from the same college. At present, he is an Assistant Professor in the Department of Community Medicine at Medical College Baroda. Since the last 9 years, he is involved in teaching, training and research work for undergraduate and postgraduate students. The study was carried out as a part of the thesis of his PG student focusing on issues related to “Neonatal Near Miss” events and role of eminence obstetrics care to prevent mortality and morbidity among mothers and children.

Abstract

Background A neonatal near miss (NNM) case would refer to an infant who nearly died but survived during birth or within 28 days of extra-uterine life. The near miss concept

is being increasingly used as a tool to evaluate and improve the quality of care, especially obstetric care. All “near miss” should be inferred as free lesson and opportunities to improve the quality of service endowment.

Methods A hospital based case control study was conducted in a tertiary care hospital of central Gujarat to measure factors associated with NNM events. Mothers of those newborns, who had been admitted for critical care, and survived, were included as cases, after their discharge. Controls were selected from same settings who were not falling into defined criteria of NNM. Various antenatal factors were compared among the two groups.

Results The number of neonatal near miss events were 291 (109 newborns with birth weight less than 1500 g, 169 APGAR score <7 and 13 with gestational age <30 weeks).

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The neonatal near miss rate was 86.7 per 1000 live births. Less number of antenatal visits, history of referral and hospitalisation during ante natal period were adversely associated with near miss events.

Conclusions Incorporation of near miss events into the confidential enquiry system is worthwhile for corrective interventions like quality antenatal care, timely screening and referral of pregnant women into the primary health care system.

Keywords Neonatal near miss (NNM) · APGAR score · LBW · Gestational age

Introduction

India contributes to 17.5% of the world's population, approximately one-fifth of the total live births, 16% of global maternal death, 21% of under-5 deaths; when it comes to newborn mortality, the proportion increases to 27% [1].

In India, the neonatal mortality rate (NMR) has declined from 44 per 1000 live births in 2000 to 28 per 1000 live births in 2013 [2]. Reducing infant mortality and improved maternal health have been part of the Millenium development goals (MDGs). It is crucial to strengthen the health systems and improve the quality of care that women and children receive, in particular during childbirth, to make progress in these goals [3].

To reduce the mortality among children, analysis of child deaths provides information about the medical causes of death and it helps to identify the gaps in health service delivery and social factors that contribute to child deaths. Currently, child death review is done by either community-based child death review (CBCDR) or facility-based child death review (FBCDR). Other methods of investigation can be clinical audits or investigation of near miss events. From above all, the methods investigation of near miss events would be an effective tool to adopt corrective measures and fill the gaps in community- and facility-level service delivery [4].

A neonatal near miss case would refer to an infant who nearly died but survived a severe complication that occurred during birth or within 28 days of extra-uterine life. The near miss concept is being increasingly used as a tool to evaluate and improve the quality of care, especially for maternal health, where it has been used in clinical audits and epidemiological surveillance, similar to maternal deaths [5]. It has been hypothesised that this concept could also be useful in the neonatal context [6].

The main purpose of this study is to identify neonatal near miss events among high-risk babies. By identifying those neonates, deficiencies in the services rendered to

pregnant women may be addressed. Identification of risk factors associated with neonatal near miss may help in planning for improvement of care for pregnant women and newborns.

Methodology

Present study was carried out at Departments of Obstetrics/ Gynecology and Pediatrics of Sir Sayajirao General Hospital (SSGH), Vadodara. It is a tertiary care regional referral hospital in Gujarat having a capacity of 149 beds in maternity ward and 16 beds in neonatal intensive care unit.

Baseline data regarding profile of newborns admitted to NICU and the “special newborn care register” was used to frame the research proposal.

A hospital-based observational study was conducted using an unmatched case–control study design from February 2015 to March 2016. The sampling frame consisted of newborns admitted in neonatal intensive care unit (NICU) at SSG Hospital. From them, only those who qualified the inclusion criteria as either a case or a control were included in the analysis.

Sampling was done by using the dataset of the WHO Multicountry Survey on Maternal and Newborn Health (2010–2011), where 21% newborn with APGAR score < 7 at 5 min survived with odd's 0.1667 [7]. Considering 95% CI and 80% power, sample size was estimated to be 154 including both cases and controls, as per Fleiss with continuity correction factor formula [8].

Cases were defined as newborns with one of the following criteria were selected as cases with near miss events [5].

1. Birth weight < 1500.
2. Gestational age < 30 weeks.
3. APGAR score < 7 at 5 min.

Newborns not meeting above criteria and delivered at SSG Hospital were taken as controls. Parents of neonates those not willing to participate in the study were excluded.

Data were collected by a single researcher with the help of a structured questionnaire. The data so obtained were checked for its completeness, quality and internal consistency then entered in Microsoft Excel 2010 and analysed using the MedcalC software.

Ethical Approval

Before starting enrolment of the participants, necessary clearances and permission were obtained from concerned authorities including Institutional Ethics Committee for Human Research (IECHR), Professor and Head of Paediatric Department, Professor and Head of obstetrics and Gynaecology Department and Hospital Superintendent.

Bias in the Study

To minimise possible bias, uniform format and single interviewer had taken interview which might reduce interviewer bias and used records and document to remove recall bias.

Results

Table 1 shows that 291 neonatal near miss events occurred in the study period. This included 109 newborns with birth weight less than 1500g, 169 newborns with Apgar Score <7 and 13 newborns with gestational age < 30 weeks at birth which were our neonatal near miss criteria. One neonate may have all three or any two of these criteria present. There were 51 such neonates (Tables 2 and 3). So, from total near miss events, 80 newborns and their mother were taken as near miss cases and 74 healthy newborns and their mother were taken as control for them.

Table 4 shows that 70% pregnant mothers had age of first pregnancy more than 20 years in both groups. Only one pregnant mother had first pregnancy before 18 years of age in near miss group. In near miss group, 63% mothers were primipara and 37% were multipara, whereas in control group, 58% were primipara and 42% were multipara. History of preterm baby in previous pregnancy was present in 13% pregnant mothers in near miss group and it was 6% in control group. In 60% pregnant mothers, duration between last two pregnancies (including current) was less than 2 years in near miss group while it was 48% in control group. Past history of abortion was present in 15% pregnant mothers in near miss group and it was present in 9% pregnant mothers in control group.

Twenty-five per cent mothers were hospitalised during pregnancy for different reasons in near miss group, whereas only 11% mothers were hospitalised in control group. Odds of neonatal near miss events were 2.75 times higher in pregnant mothers with hospitalisation during their pregnancy. Most common reason for hospitalisation during pregnancy was severe anaemia in near miss group. Others were severe vomiting, bleeding per vagina, preeclampsia and eclampsia, false labour pain, malaria, fever, typhoid and road traffic accidents, etc.

Most of the mothers had registered during first trimester of pregnancy in both groups. In near miss group, 75% pregnant mothers had taken ≥ 4 antenatal visits. Less number of antenatal visits were associated with higher risk of neonatal near miss events. About 59% women were referred from one or other health facility for high-risk pregnancy or no availability of NICU in near miss group, while in control group, 35.13% women were referred to

Table 1 Distribution of newborns according to “neonatal near miss” (NNM) criteria in tertiary care hospital during study period

Total live births	2737
No. of term babies	2459
No. for preterm babies (< 37 weeks of gestational age)	304
No. of low birth weight	1164
2500–1500 g	1025
1000–1499 g	118
< 1000 g	21
Total admitted in NICU	399
No. of preterm admitted in NICU	198
34–37 weeks	130
30–34 weeks	55
< 30 weeks	13
No. of babies APGAR < 7 at 5 min admitted in NICU	169
No. of babies very low birth weight admitted	109
Total near miss events in newborns admitted in NICU during study period	291

Bold values indicate miss events of selected criteria were observed during study period

study hospital. Rest of the women in both groups directly come to SSGH. History of referral was significantly associated with near miss event.

Caesarean section was seen more in near miss group (29%) compared to control group, and vaginal delivery occurred more in control group (80%) than near miss group. The common indications of cesarean section in the near miss group was foetal distress, previous LSCS, antepartum hemorrhage and preeclampsia; whereas in the control group it was foetal distress and prolonged second stage of labour.

Discussion

In the present study, we found that neonatal near miss rate was 86.7 per 1000 live births during study period. Neonatal mortality rate at study hospital was 31 deaths per 1000 live births which were quite similar to state neonatal mortality rate.

A study done by Pileggi et al found the overall NNM rate to be 21.4 per 1000 live births. Oliveira TG et al showed that the predictive value of APGAR score <4 for neonatal death varied with birth weight (62% for <1kg and 5.5% for >3kg) [9]. Lansky et al have also found that NMR was high among children weighing < 1500 g born in hospitals without neonatal ICU, those with very low birth weight (< 1500 g), extreme premature (< 32 weeks), those with APGAR < 7 at the 5th minute of life [10]. Hence the criteria for NNM are justified.

Table 2 Neonatal near miss rate and neonatal mortality rate

Combination of criteria	No. of neonates
Birth weight less than 1500 and APGAR score less than 7 at 5 min	30
Birth weight less than 1500 and gestational age less than 30 weeks	13
Gestational age less than 30 weeks and APGAR score less than 7 at 5 min	3
All three	5
Total near miss newborns admitted in NICU during study period	240
Neonatal near miss rate during study period	87.6 per 1000 live births (4 times higher than deaths)
Total no. of deaths during study period	60
Neonatal mortality rate (NMR) during study period	22 per 1000 live births

Table 3 Socio-demographic profile of mothers in near miss and control group

Variable	No. in near miss group (n = 80)	No. in control group (n = 74)
Education of pregnant mother		
Illiterate	15 (19%)	12 (16%)
Primary	27 (34%)	32 (43%)
Middle school	30 (38%)	20 (27%)
Higher secondary	6 (7%)	8 (10%)
Graduate	2 (2%)	2 (2%)
Occupation of pregnant mother		
House wife	59 (74%)	58 (78%)
Labourer	21 (26%)	16 (22%)
Residence of pregnant mother		
Urban	29 (36%)	35 (47%)
Rural	37 (46%)	33 (45%)
Tribal	14 (17%)	6 (8%)
Socio-economic status		
Upper lower	69 (87%)	68 (92%)
Lower middle	10 (12%)	5 (7%)
Upper middle	1 (1%)	1 (1%)

Mode of Delivery

In this study, though the cesarean section rate was higher in the near miss group, there was no statistical difference. Investigators from Brazil have shown that those with cesarean section had higher NNM, while those with vaginal delivery had higher mortality [10, 11]. Whether mode of delivery has a role to play with NNM events needs further clarification.

Age at Pregnancy, Parity, History of Previous Pregnancy with Low Birth Weight or Preterm Neonates and Birth Interval

In the current study, no significant association was found between age at pregnancy, parity of mother and history of

previous pregnancy with low birth weight or preterm neonates. Study done by Ike Elizabeth et al. A Nigerian study showed that a significant association between mother's parity and neonatal outcome. Better experience by the mother had led to better neonatal outcomes [12]. Study by Lanksy et al showed that extremes of age (adolescent age group and age >35 years) was associated with unfavourable neonatal outcomes [10]. Study done by Viswanath K et al, found that high parity of mother was associated with perinatal death in their study. A dose-response relationship was observed with increasing parity. This finding was consistent with a study done in Kenya to determine risk factors for perinatal mortality [13].

Hospitalisation During Pregnancy

Twenty-five per cent mothers were hospitalised during pregnancy for different reasons in near miss group, whereas only 11% mothers were hospitalised in control group. History of hospitalisation during pregnancy was associated with near miss events in neonates.

Study done by Kassir et al. found that neonates whose mothers were hospitalised during pregnancy were more likely to die; previous maternal diseases and complications of pregnancy are specific situations that predispose to hypoxia and perinatal infections. In these circumstances, they require appropriate and effective care [14].

No. of Antenatal Visit Taken by Pregnant Women

In our study, odds of neonatal near miss events were 2.75 times higher in pregnant mothers those who had taken less than minimum required ANC visits (4 visits) during their pregnancy. Same finding was also seen in study done in Brazil by Kassir et al., in which odds of neonatal mortality were higher in the group of mothers with inadequate prenatal care [14]. The importance of antenatal health care and its influence on neonatal outcome is emphasized here.

Table 4 Mothers in near miss and control groups

	No. of mothers in near miss group (<i>n</i> = 80)	No. of mothers in control group (<i>n</i> = 74)	Chi square	<i>p</i> value	Odds ratio	95% CI
Age at first pregnancy						
< 18 years*	1 (1%)	0	0.008	0.92	0.9708	0.4841–1.9467
18–20 years	23 (29%)	22 (30%)				
> 20 years	56 (70%)	52 (70%)				
Parity						
Primipara	50 (63%)	43 (58%)	0.154	0.69	1.2016	0.6294–2.2939
Multipara	30 (37%)	31 (42%)				
History of low birth weight (LBW) baby in previous pregnancy						
Yes	4 (13%)	6 (19%)	0.08	0.77	0.6410	0.1614–2.5459
No	26 (87%)	25 (81%)				
History of preterm baby in previous pregnancy						
Yes	4 (13%)	2 (6%)	0.223	0.63	2.2308	0.3769–13.2022
No	26 (87%)	29 (94%)				
Duration between current and last pregnancy						
≤ 2 years	18 (60%)	15 (48%)	0.426	0.51	1.600	0.58–4.41
> 2 years	12 (40%)	16 (51%)				
History of abortion						
Yes	12 (15%)	7 (9%)	0.639	0.42	1.68	0.62–4.55
No	68 (85%)	67 (91%)				
History of hospitalisation of mothers during pregnancy						
Yes	20 (25%)	8 (11%)	4.293	0.03	2.7500	1.1278–6.7057
No	60 (75%)	66 (89%)				
No. of antenatal care visits						
Less than four	20 (25%)	8 (11%)	4.293	0.03	2.7500	1.1278–6.7057
Four and more	60 (75%)	66 (89%)				
History of referral to higher hospital for high-risk pregnancy						
Yes	33 (41.25%)	48 (65%)	6.67	0.005	0.38	0.19–0.73
No (referred from other facility)	47 (59%)	26 (35.13%)				
Mode of delivery of neonates						
Vaginal	56 (70%)	59 (80%)	1.162	0.28	0.6190	0.2935–1.3055
Caesarean section	23 (29%)	15 (20%)				
Forceps*	1 (1%)	0				

Boldened values indicate statistically significant results

* Excluded for Chi-square test

History of Referral to Higher Hospital for High-Risk Pregnancy

About (59%) women were referred from one or other health facility for high-risk pregnancy or no availability of NICU in near miss group while in control group (35.13%) women were referred to study hospital. Rest of the women in both groups directly come to SSGH. History of referral was significantly associated with near miss event. Similar finding was seen in the study done by Lansky et al. that neonates whose mothers reported approaching more than

one hospital before being admitted had more chances of mortality [10].

Conclusion and Recommendation

Neonatal mortality rate at this hospital was 22 per 1000 live births during study period, whereas neonatal near miss rate (according to our near miss criteria) was 87.6 per 1000 live births. Neonatal near miss rate which was nearly four times higher than neonatal mortality rate in current study. This

suggests that a fully functional NICU is critical in converting a potential mortality to a near-miss event.

From the study, we conclude that lack of adequate antenatal care, history of hospitalisation during pregnancy, referral of a mother during pregnancy for any cause to another hospital, are associated with higher neonatal morbidity, but the potential for survival after a “near miss event” is encouraging. Significant findings conclude that referred women with known high-risk pregnancy during antenatal period or at the time of delivery for the reason of unavailability of NICU are more susceptible for adverse outcome.

Though factors like age at marriage, age at first pregnancy, parity and previous history of adverse events did not show statistical significance in our study, further studies may be required for clarification of the same.

We recommend the incorporation of near miss events into the confidential enquiry system existing for child death review. This might allow for more relevant data on maternal and child care being made available and inclusion of corrective interventions like quality antenatal care at regular interval, timely screening and referral of pregnant women into the primary health care system.

There is also a need for further studies at different settings and designs like retro-prospective/prospective cohort using different criteria to identify and improve the “neonatal near miss” criteria. These would be critical to prevent mortality and reduce mortality at an earlier stage and at a primary level.

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Compliance with Ethical Standards

Conflict of interest Both authors declare that they have no conflict of interest.

Ethical Approval Before starting enrolment of the participants, necessary clearances and permission were obtained from concerned authorities including Institutional Ethics committee for Human research (IECHR), Professor and Head of Paediatric Department,

Professor and Head of Obstetrics and Gynaecology Department and Hospital Superintendent.

Informed Consent At the time of data collection, the purpose of the study was clearly explained to the study subjects and they were also ensured of confidentiality of the information. The respondents were explained that they had the right to be involved or not to be involved in the study, and that non-involvement would not affect in any way the services they receive from the institutions. The participants were enrolled in the study only after taking written informed consent. The process of data collection did not pose any potential risk or harm to the participants as no kind of intervention or any interference with treatment was implicated.

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