ORIGINAL ARTICLE

Outcome analysis of Neonates admitted to Neonatal Intensive Care Unit of a Border District of Uttar Pradesh

Renu Agrawal[1], Rudresh Negi[2], Sunil K Kaushal[3], Sunil K Misra[4]

[1]Associate Professor, Department of Community Medicine, Sarojini Naidu Medical College, Agra; [2]Resident, Department of Community Medicine, Sarojini Naidu Medical College, Agra; [3]Associate Professor, Department of Community Medicine, Sarojini Naidu Medical College, Agra; [4]Professor, Department of Community Medicine, Sarojini Naidu Medical College, Agra

Corresponding Author

Corresponding Author: Dr Rudresh Negi, A-965/5 Indira Nagar Lucknow – 226016, Uttar Pradesh
E Mail ID: rudreshnegi@gmail.com

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Abstract

Background: As per the Child Mortality Report 2018 by UNICEF the current neonatal mortality rate in India stands at 24 per 1000 live births with it being more than the national average for Uttar Pradesh. The neonatal morbidity and outcome pattern in terms of discharge or otherwise shows considerable national, state, district and sub-district variations due to a multitude of diverse factors contributing to it at various levels. **Aim & Objective:** The aim of the study was to explore the mortality rate and outcome in NICU setting, and factors influencing the outcomes. **Methods and Material:** This government NICU based follow-up study comprised of data analysed from 450 neonates through a semi-structured questionnaire using face to face interview technique. Data was evaluated in SPSS and; independent t test and chi square test were applied. **Statistical analysis used:** Data was evaluated in SPSS and; independent t test and chi square test were applied. **Results:** For morbidity low birth weight (LBW) (14.4%) and for mortality LBW/prematurity (56%) were the most common causes. The discharge rate was 64.4%. Good outcome in the form of successful discharge was statistically significant with birth weight (p=0.000), gestational age (0.001), length of stay at NICU (p=0.003) male sex (p=0.003) and feeding of newborn (p=0.002) **Conclusions:** The study enunciates a high discharge rate in tertiary care government NICU with a mixed morbidity and mortality profile. The causes are mainly preventable and hence can be largely mitigated through dedicated ante natal, intra natal and post-natal care.

Keywords

Neonate; Outcome; Morbidity; Mortality

Introduction

The contribution of India to the global burden of newborn deaths at 27% is higher when compared to that of maternal and under-5 deaths.(1) However India has witnessed a significant reduction in neonatal mortality rate (NMR) from 44 per 1000 live births in 2000 to 24 per 1000 live births currently.(1,2) Still it remains high as compared to the global NMR of 18 per 1000 live births. (3)

Also NMR varies widely among the different states, ranging from 6 per 1000 live births in Kerala to 35 per

1000 live births in Uttar Pradesh.(2) In India major causes of neonatal deaths are Prematurity & low birth weight (48.1%), Birth asphyxia & birth trauma (12.9%), Neonatal Pneumonia (12.0%), Other noncommunicable diseases (7.1%) and Sepsis (5.4%).(4) Mortality rate in NICU setting from different studies in India indicate a wide range from 6.6% to 36%. (5,6) Similarly morbidity pattern hints to a plethora of diversity in local researches. (6,7,8,9,10,11)

Preventable neonatal deaths are that where contributing factor is a modifiable factor, which if intervened timely can reduce the risk of child deaths in future. These modifiable factors are care during labour and childbirth and the 1st week of life; and care for the small and sick newborn. (12) Neonatal mortality and disease pattern is a sensitive indicator of availability, utilization and effectiveness of mother and child health services in the community. (13) Goal 3 target 2 of SDG calls for an end to preventable deaths of newborns and children under 5 years of age and specifies that all countries should aim to reduce neonatal mortality to at least as low as 12 deaths per 1,000 live births and under-five mortality to at least as low as 25 deaths per 1,000 live births by 2030. (14) With this background in mind, to determine accurate mortality rate and other outcomes in hospital NICU and to focus on their determinants this study was undertaken

Aims & Objectives

1. To evaluate neonatal outcome of sick neonates admitted to NICU of tertiary care government hospital
2. To assess the association between outcome and its determinants

Material & Methods

Study type: It is a NICU based prospective, follow-up study.

Study population: All neonates less than 28 days of age, fulfilling the eligibility criteria and being admitted to the concerned NICU

Study area: NICU of tertiary care government hospital catering to the population of Agra, other neighbouring districts of Uttar Pradesh, Madhya Pradesh and Rajasthan.

Study duration: The study was completed in a period of 24 months from October 2016 to September 2018

Sample size calculation: Taking the mortality rate at 11% from the research by Verma J et al conducted in Bhopal, Z=1.96. and allowable error at 2.9% the minimum sample size was calculated as 447 using the formula

N= z2p(1-p)/d2

The sample size was rounded off to 450.

Sampling Strategy: Three visits per week were made to the NICU preferably on alternate days and neonates fulfilling the eligibility criteria were recruited till the sample size was achieved.

Data collection tools: A face validated, pilot tested, semi structured questionnaire was used for data collection through interview of the respondents. Data on outcome and morbidity profile of the neonates was obtained from the register of the NICU.

Operational Definitions: Neonate /Newborn Period - It refers to the period of less than 28 days after birth. An infant is called a newborn or neonate during this phase. Early neonatal period refers to the period before 7 days of age. Late neonatal period refers to the period from completion of 7 days to <28 days of life. (15,16)

Intramural / Inborn neonate- A baby born within premises of our center (17,18)

Extramural / Outborn neonate- Baby not born within premises of our center. (17,18)

Pre term - Gestational age of less than 37 completed weeks (i.e. less than 259 days) (17)

Term - Gestational age of 37 to less than 42 completed weeks (i.e. 259 to 293 days) (17)

Low Birth Weight (LBW)- Birth weight of less than 2500 gm irrespective of gestational age. (16)

Outcome for the purpose of statistical analysis was classified as:

1) **Discharged**: The neonates were successfully discharged from the NICU facility on completion of treatment. This represented a favourable or desired outcome

2) **Others:** It included death of neonate, left against medical advice (LAMA), discharged on patients'/ guardian request (DOPR) and referral to higher centre. These together represent unsuccessful, unfavourable or undesired outcome.

Inclusion criteria: Neonates admitted to NICU of tertiary care government hospital of Agra within less than 28 days of birth.

Exclusion criteria:

1. Refusal to give informed written consent.
2. Non availability of a reliable respondent at the time of visit.

Ethical Issues: Prior to the start of the study due permission was obtained from the Institution Ethics

Committee (IEC/2017/35), principal of the medical college and the medical officer responsible for the NICU. Written informed consent was also obtained from the parents or relatives of the neonate who were actively involved in his or her care.

Data Analysis: The data collected on study form was entered into Microsoft Excel 2016 and cleaned for typing errors. Then it was imported in to Statistical package for social sciences (SPSS version 23) and analysed. Values were represented as means, standard deviations, proportions and percentages. Independent t test for continuous data and Chi square test for discrete data were appropriately applied and p value <0.05 was considered statistically significant.

Results

The five main specific causes for illness in decreasing order of frequency was low birth weight (LBW) (14.4%), prematurity (13.8%), neonatal sepsis (12.9%), respiratory distress syndrome (12.7%) and perinatal asphyxia (10%). (Table 1)

Almost two-thirds (64.4%) of neonates were successfully discharged, 14.7% succumbed to death, 14.2% left against medical advice (LAMA), 3.8% were discharged on guardian request (DOPR) and 2.9% were referred to higher centre after stabilization. (Table 2)

The primary causes of mortality observed was LBW/ prematurity (56%), Apnea/Perinatal asphyxia(14.1%) and RDS/ Respiratory Distress (12.1%). (Table 3)

Higher total distance traversed by neonate (p=.041), longer total time taken in transport (p=.004) and greater duration of NICU stay (p=.003) were significantly associated with more successful outcome in newborns. Higher gestation period (p=.001) and birth weight (p=.000) were statistically highly significant with favourable outcome of discharge post treatment. (Table 4)

The outcome is significantly associated with sex (p=.033) of the newborn with males having higher chances (OR=1.5) than females of being discharged from NICU. There was a significant association between decision maker of family (p=.010), presence of complications during pregnancy (p=.002), gestational age (p=0.003) and the outcome. The odds of getting discharged were significantly less where complications were present (OR=.502) or the neonate was pre term (OR=0.552). There were statistically significant chances of favourable outcome in feeding neonates (p=0.014; OR=1.96). Significant association of outcome was also observed with duration of stay at other health facilities (p=0.029) before reaching our NICU. (Table 5)

Discussion

In our research the main causes of morbidity in neonates was LBW (14.4%), prematurity (13.8%), neonatal sepsis (12.9%), respiratory distress syndrome (12.7%), and perinatal asphyxia (10%).Similarly LBW was at 19% in study by Thenmozhi M et al (2017).(19) Contrary to our study Kawale S et al (2016) and Kumar M K et al (2012) found a higher percentage of 34.47% and 39.8% of sickness contributed by LBW .(20,21) This deviation from our study was since these two studies had multiple responses for morbidity pattern , however our study used single most relevant response as judged by treating paediatrician for morbidity pattern In accordance to our study prematurity was observed at 12.5% and 16% in studies by Kotwal YS et al (2018) and Kawale S et al (2016) respectively.(8,20) Contrary to current study , prematurity was the cause of morbidity in 44% and 20.8% of newborns in study by Mishra AK et al (2017) and Prasad V et al (2011).(11,22) This may be since Mishra AK et al (2017) used multiple responses, and Prasad V et al (2011) combined prematurity and RDS in the study. In congruence with our study research by Narayan R et al (2017), Baghel B et al (2016) and Punitha P et al (2016) found neonatal sepsis at 12.57%, 12.98% and 12% respectively.(10,23,5) Sepsis, Pneumonia and meningitis were taken together in the studies by Sridhar PV et al (2015),) and Rakholia R et al (2014) at 28.8%, and 19 % respectively and so perhaps contributed a higher percentage to morbidity than our study.(24,25) In concordance with our study RDS was 15.04%, 17%, 18.2% and 18% in researches by Kawale S et al (2016), Prasad V et al (2011), Kumaravel KS et al (2015) and Punitha P et al (2016).(20,22,26,5) Similar to the current study perinatal asphyxia was observed in the studies by Kotwal YS et al (2018), Shah HD et al (2018) andNarayan R et al (2017) at 7%, 12%and 9.14%. respectively.(8,9,10) However slightly higher perinatal asphyxia was observed in studies by Kawale S et al (2016), Prasad V et al (2011) and Punitha P et al (2016) at 14.19%, 16.28% and 15 % and may be due to use of multiple responses, being an older study and regional difference in study from southern India respectively.(20,22,5) Some variations in morbidity profile may be due to

evolving pattern of diseases with respect to time and region.

In this study of the total neonates admitted in the current study the outcome was as follows: discharged 64.4%, LAMA 14.%, death 14.7%, referred 2.9% and DOPR 3.8% . A substantial percentage of LAMA may reflect the lack of confidence in the treating facility or hopelessness of disease condition. Similar rate of discharge was observed in studies by Verma J et al (2018), Shah HD et al (2018), Kawale S et al (2016) and Rakholia R et al (2014) at 70%, 67%,69.52% and 66.57% respectively. (7,9,20,25) In accordance to current study mortality in researches by Kotwal YS et al (2018), Dwivedi et al (2017), Jeganathan S et al (2016), Narayan R et al (2017) and Mishra AK et al (2017) was at 9.73%, 12.74%, 9.5%, 17.14% and 12%.(8,27,28,10,11) Discharge on request was mentioned in only one study by Baghael B et al (2016) at 15.54%.(23) LAMA was at 12.74% and 10% in researches by Dwivedi K et al (2017) and Shah HD et al (2018) respectively and is comparable to current study. (27,9). Lower rates of LAMA in studies by Garg P et al (2005), Kawale S et al (2016) and Raikwar P et al (2018) at 4.2%, 7.52% and 8% may be due to better agreement on treatment modality, satisfaction with care, financial security and social support system.(29,20,6) Variation in outcome in these studies may be due to reasons like differences in clinical condition of neonates on arrival, delays on reaching the centre, satisfaction of family members to the treatment, and availability of adequate finances.

The type of diseases leading to neonatal mortality suggest the area of neglect and the need to take corrective action in this regard. The major causes of death in our study were prematurity/LBW (56%) Apnea/Birth asphyxia (14.1%), RDS/respiratory distress (12.1%), HIE (6.1%) and sepsis (4.5%). National level data from annual report of Department of Health and family welfare 2017-18 enlists the major causes of neonatal deaths as prematurity and low birth 48.1%, birth asphyxia and trauma 12.9%, neonatal pneumonia 12% and sepsis 5.4% and is similar to our study findings.(30) Similarly prematurity was cause of death for maximum neonates in studies by Verma J et al (2018), Patil RB et al (2014) and Kumar MK et al (2012) at 47.5%, 42.1% and 46.9% respectively.(7,31,21)

In the current study outcome as successful discharge as compared to other outcomes (LAMA ,DOPR, referred and death) was statistically significantly associated with a higher gestational age (34.3 weeks), more distance travelled (27.0km), more time taken for travel (1.1hr), higher birth weight (2.18kg) and longer duration of NICU stay (6.48days). Higher birth weight and gestational age perhaps indicates better initial health of newborn and therefore a higher chance of successful discharge. Longer duration of NICU stay may correspond to more detailed and meticulous care of newborn thereby increasing its chances of survival. Paradoxically more distance travelled and hence more time spent on transportation was associated with favourable outcome. This may be due to newborns coming mostly from distant rural areas and reaching the NICU directly without going through intermediate referral points, so availing better timely tertiary care directly, resulting in better outcome of discharge. Similarly association of positive outcome with higher birth weight was noted in numerous studies. (11,20,26,29,32,33,34,35,36,37,38,39) In accordance to current study many other researches also concluded a successful outcome associated with higher gestational age.(28,29,32,34,35,37,39). In congruence with our study Garg P et al (2005) (p=0.0001) also observed longer duration of stay associated with favourable outcome.

There were higher odds of successful discharge in males (OR=1.5) and neonates accepting feeds (OR=1.96). Male child preference in Indian society and better nutritional status in feeding neonates may be the probable reason for it. Similar association of gender was observed in research by Narang M et al (2013) (p=0.04) and Samms-Vaughan ME et al (2001) (p<0.05) .(37,39) In congruence to current study Elizabeth U I et al (2015) found association between outcome and feeding (p=0.000).(38)There were significantly lower chances of successful discharge in complicated pregnancy (OR=0.502), preterm neonates (OR=0.552) and twin pregnancy (OR=0.287). Similar to our study Mishra AK et al (2017) (p<0.0005) and Rathod D et al (2015) (p<0.001) noted complicated pregnancy associated with bad outcome.(11,40) In accordance to present study Dwivedi K et al (2017) (p=0.00), Rao SK et al (2015) (p=0.023), Rathod D et al (2015) (p<0.012), Kumaravel KS et al (2015) (p<0.001), Jeganathan S et al(2017) (p<0.0001) and Shalini Bet al(2017) (p-

0.001) also observed poor outcome in preterm newborns.(27,33,40,26,35,36) Also a significant association between decision maker of family and duration of stay at other health facilities with the outcome was found In congruence with current study Dwivedi K et al (2017) (p=0.448) observed no urban-rural association with neonatal outcome.(27) Similar to present study Jeganathan S et al (2016) (p=0.06), Shah S et al (2012) (p=0.96), Jeganathan S et al (2017) (p=0.646) and Narang M et al (2013) (p=0.36) found no significant association of age at admission and outcome.(28,34,35,37)In contrast to the current study Shalini B et al (2017) found pre-referral interventions to be associated with outcome.(36) Differences from our study may be on account of variations in classification of outcome and differences in quality of care provided

Conclusion

This research elucidates morbidity, mortality and outcome profile of sick neonates admitted to tertiary care government NICU and pronounces factors like birth weight, gestational age, distance travelled, time taken, length of stay at NICU, sex of neonate, feeding practice and complications during pregnancy as some of the determinants linked with neonatal outcome.

Recommendation

Based on the finding of this research it is recommended that since majority of the causes of morbidity and mortality were preventable, an equal if not greater emphasis must be laid on preventing the development of illness and laying stress on early detection of symptoms through consistent contacts with ground level health functionaries. Also the LAMA cases need to be reduced through counselling, polite, empathy behaviour of health staff and prescribing to highest quality of care standards

Limitation of the study

Since the study focuses on government set up only, it does not capture the situation of private sector NICU where substantial proportion of neonates receive primary and subsequent treatment

Relevance of the study

The study gathers local, area specific data and enunciates some of less explored outcome determinants

Authors Contribution

All authors have contributed equally in this research.

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Tables

TABLE 1 MORBIDITY PROFILE OF NEONATES ADMITTED TO NICU DURING STUDY PERIOD

	Condition	No.of Neonates N=450 n (%)
1.	Low Birth Weight (LBW)	65 (14.4)
2.	Prematurity	62 (13.8)
3.	Neonatal Sepsis	58 (12.9)
4.	Respiratory Distress Syndrome (RDS)	57 (12.7)
5.	Perinatal Asphyxia	45 (10)
6.	Hypoxic Ischemic Encephalopathy (HIE)	37 (8.2)

7.	Neonatal Jaundice	35 (7.8)
8.	Pneumonia	26 (5.8)
9.	Resp Distress	23 (5.1)
10.	Hypothemia/ hyperthermia	5 (1.1)
11.	Others	37 (8.2)

TABLE 2 OUTCOME PROFILE OF SICK NEONATES ADMITTED TO NICU

1.	Outcome	Number of Neonates N=450 n (%)
1	Discharge	290 (64.4)
2	LAMA	64 (14.2)
3	Death	66 (14.7)
4	Referred	13 (2.9)
5	DOPR	17 (3.8)

TABLE 3 CAUSE OF MORTALITY IN NEWBORNS ADMITTED TO NICU

	Cause of Death	Number of Deaths N=66 N (%)
1.	Low Birth Weight / Prematurity	37 (56)
2.	Apnea/ Perinatal Asphyxia	10 (14.1)
3.	RDS/ Respiratory Distress	8 (12.1)
4.	Hypoxic ischemic encephalopathy	4 (6.1)
5.	Neonatal Sepsis	3 (4.5)
6.	Hypothermia	1 (1.5)
7.	Penumonia	1 (1.5)
8.	Congenital Malformation	1 (1.5)
9.	Meconium aspirational syndrome	1 (1.5)

TABLE 4 ASSOCIATION OF NEONATAL OUTCOME WITH DETERMINANTS IN NICU ADMITTED NEWBORNS

	Variables	Outcome	Mean	SD	Independent t test p-value
1.	Gestation Period (in Weeks)	Discharged	34.3	3.5	.001
		Others	32.9	4.0	
2.	Birth weight (kg)	Discharged	2.18	.6	.000
		Others	1.88	.7	
3.	Total distance Travelled (Km)	Discharged	27.0	28.7	.041
		Others	21.7	24.9	
4.	Total time taken in transport (hr)	Discharged	1.1	1.0	.004
		Others	.9	.86	
5.	Duration of Stay at NICU (days)	Discharged	6.48	3.8	.003
		Others	5.25	4.6	

TABLE 5 NEONATAL OUTCOME AND ASSOCIATED FACTORS IN NICU ADMITTED NEWBORN

		Outcome(Total Neonates N=450)		
Variables	Categories	Discharged n (%)	Others n (%)	Chi Square Test
Age (At Time of Admission)	1. Early Neonate	213(62.6)	127(37.4)	$\chi2$ =1.9 d.f. 1 p=0.161 OR=0.79
	2. Late Neonate	77(70.0)	33(30.0)	
Sex	1. Male	196(68.1)	92(31.9)	$\chi2$ =4.5 d.f. 1 p=.033 OR = 1.5
	2. Female	94(58.0)	68(42.0)	
Residence	1. Rural	139(63.5)	80(36.5)	$\chi2$ =.177 d.f. 1
	2. Urban	151(65.4)	80(34.6)	

				p=.674 OR =.921
BG Prasad SES	1. Upper Class	6(60.0)	4(40.0)	χ2 =1.5 d.f. 4 p=.817
	2. Middle	257(65.4)	136(34.6)	
	5. Lower	27(57.4)	20(42.6)	
Decision Maker	1. Mother	13(59.1)	9(40.9)	χ2 =11.4 d.f. 3 p=.010
	2. Father	94(61.4)	59(38.6)	
	3. Grandfather	90(58.4)	64(41.6)	
	4. Grandmother	93(76.9)	28(23.1)	
Complications During Pregnancy	1. Present	179(59.5)	122(40.5)	χ2 =9.83 d.f. 1 p=.002 OR=.502
	2. Absent	111(74.5)	38(25.5)	
Delivery Place	1. Inborn	41(64.1)	23(35.9)	χ2 =0.005 d.f. 1 p=.945 OR=0.981
	2. Outborn	249(64.5)	137(35.4)	
Gestational Age	1. Pre term	139 (58.2)	100(41.8)	χ2 =8.7 d.f. 1 p=.003 OR=0.552
	2. Term	151(71.6)	60(28.4)	
Feeding of Neonate	1. Yes	229(68.6)	105(31.4)	χ2 =9.5 d.f. 1 p=.002 OR=1.96
	2. No	61(52.6)	55(47.4)	
Twin Pregnancy	1.Yes	18(37.5)	30(62.5)	χ2 =17.0 d.f. 1 p=.000 OR=.287
	2.No	272(67.7)	130(32.3)	
Pre-Referral Treatment	1. Provided	200(66.0)	103(34.0)	χ2 =1.3 d.f. 1 p=.254
	2. Not Provided	90(61.2)	57(38.8)	
Stay At other Health Facility	0-2 days	209(61.3)	132(38.7)	χ2 =9.0 d.f. 3 p=.029
	3-5 days	51(81.0)	12(19.0)	
	6-10 days	23(65.7)	12(34.3)	
	>10 days	7(63.6)	4(36.4)	