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Research Article

MORBIDITY AND MORTALITY PROFILE OF NEONATES ADMITTED IN NEONATAL INTENSIVE CARE UNIT IN A TERTIARY CARE HOSPITAL, SOUTH-EASTERN RAJASTHAN, JHALAWAR MEDICAL COLLEGE, JHALAWAR: A RETROSPECTIVE STUDY

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ABSTRACT

Objective: The objective of this study was to study the morbidity and mortality patterns in a special newborn care unit (SNCU)/neonatal intensive care unit (NICU) of a tertiary care teaching hospital.

Methods: A retrospective study was carried out in the SNCU/NICU of Jhalawar Medical College, Jhalawar. The duration of the study was 3 years. A retrospective case record review and analysis was done. Secondary data collected from the online SNCU Software (National Health mission Government of India).

Results: Eight thousand seven hundred and forty-eight neonates were admitted in NICU. 2488 (59.9%) were male and 1657 (40.1%) were female, 4047 (46.3%) were normal birth babies, and 4701 (53.7%) were low birth weight babies. According to the outcome, total 6753 (77.19%) were discharged successfully, 1464 (16.66%) died, 382 (4.36%) were referred, and 149 (1.7%) were leave against medical advice. Birth asphyxia was the most common morbidity 2404 (27.36%) followed by neonatal sepsis (18.06%) and neonatal jaundice (15.44%). Birth asphyxia were more in inborn unit ($p<0.0001$). Sepsis is more prevalent in out born unit ($p<0.0001$). Hypoxic ischemic encephalopathy/moderate-to-severe birth asphyxia was the most common cause of death (28.23%), followed by neonatal sepsis (20.62%) and respiratory distress syndrome (19.35%), and major congenital malformations were cause of death in 106 (7.24%). Mortality due to neonatal sepsis was significantly high in outborn unit ($p<0.0001$).

Conclusion: Birth asphyxia, neonatal sepsis, and respiratory distress syndrome were the leading causes of mortality in this study. These leading causes of mortality in the study could be prevented by adequate training of nursing staff and doctors, timely referral to tertiary care if required.

Keywords: Neonatal mortality, Neonatal morbidity, Neonatal intensive care unit.

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INTRODUCTION

The first 28 days of life – the neonatal period – is the most vulnerable time for a child's survival. Children face the highest risk of dying in their 1st month of life at an average global rate of 18 deaths/1000 live births in 2021, down by 51% from 37 deaths/1000 live births in 1990. In comparison, the probability of dying after the 1st month and before reaching age 1 was estimated at 11 deaths/1000, and the probability of dying after reaching age 1 and before reaching age 5 was estimated at 10 deaths/1000 in 2021. Globally, 2.3 million children died in the 1st month of life in 2021 – approximately 6400 neonatal deaths every day [1].

Childhood mortality and morbidity reflect the overall development of a nation. According to National Family Health Survey-5 data, neonatal mortality rate is 24.9/1000 live birth in India and 20.2/1000 live births in Rajasthan [2].

A new national health policy was announced in 2017 with the goal of reducing the under-five mortality rate to 23, the infant mortality rate to 28, and the neonatal mortality rate to 16 by 2025 [3]. Children who die within the first 28 days of birth suffer from conditions and diseases associated with lack of quality of care at or immediately after birth and in the first few days of life [4].

The common causes of neonatal mortality in India are low birth weight (LBW), perinatal asphyxia, and sepsis. The high number of neonatal deaths is reported from African countries and Southeast Asian countries due to their poor socioeconomic condition and population burden [5]. The knowledge of the morbidity and mortality profile of neonates helps in developing and strengthening health policies for reducing neonatal mortality. The morbidity and mortality profile of neonates differ in different special newborn care unit (SNCU)/neonatal intensive care unit (NICU).

There is a need to study morbidity and mortality profiles of neonates from this South-eastern region of Rajasthan. The Department of Paediatrics, SHKBM Hospital, Jhalawar Medical College, Jhalawar, is a tertiary care teaching hospital where patients from all over the Jhalawar District and border area of Madhya Pradesh are being referred and cared for. Hence, this study was undertaken with the following aim to study the morbidity and mortality profile of neonates admitted in SNCU/NICU.

Aims and objectives

The objective of this study was to study the morbidity and mortality patterns in a SNCU/NICU of a tertiary care teaching hospital.

METHODS

This hospital-based observational, retrospective study was carried out in the SNCU/NICU, Department of Pediatrics at SHKBM Hospital, Jhalawar Medical College, Jhalawar. The duration of the study was 3 years from September 1st, 2020, to August 31, 2023. Our SNCU/NICU caters to the population of the Jhalawar (South-Eastern Rajasthan) district and the neighboring border district of Madhya Pradesh.

A retrospective case record review and analysis of all the newborn babies admitted to the SNCU/NICU during the study period was done. Secondary data collected from the online SNCU Software (Government of India). Secondary data regarding patient's age, sex, type of morbidity, type of delivery, age at the admission, length of stay, area they belong, type of delivery, birth weight, and cause of death were collected from SNCU software, with prior approval of the Ethical Committee.

Inclusion criteria

All neonates <28 days admitted in sick newborn care unit (SNCU/NICU) during the study period.

Exclusion criteria

Still-birth neonates who were not admitted in SNCU were excluded from the study.

The babies delivered in our hospital are categorized as inborn and babies delivered elsewhere are categorized as out-born. Predesigned pro forma will be used for data collection.

The World Health Organization guidelines were used in categorizing the babies based on gestational age and birth weights and national neonatology forum guidelines were used in diagnosing the disease conditions.

Statistical analysis

Collected data were compiled and tabulated using MS Excel 2010 and were analyzed using statistical software SPSS trial version 20. Appropriate tables and figures were generated. Appropriate statistical test was applied to determine association. The Chi-square test was used to compare differences in categorical variables and independent t-test, $p<0.05$ (at 95% confidence interval) was considered to indicate statistical significance.

Ethical issues

Ethical approval was taken from the Institutional Ethical Committee of Jhalawar Medical College, Jhalawar, before starting the study.

RESULTS AND DISCUSSION

Eight thousand seven hundred and forty-eight neonates were admitted in SNCU during this study period. Inborn was 4159 (47.46%) and outborn was 4596 (52.53%). Among inborn admissions, 2488 (59.9%) were male and 1657 (40.1%) were female. Among outborn admissions, 2878 (62.6%) were male and 1718 (37.4%) were female. Results showed higher male admission in both groups (Table 1).

According to age on admission, 4863 (55.6%) were <1 day, 2004 (22.9%) were 1–3 days, 1054 (12%) were 4–7 days, and 827 (9.5%) were more than 7 days of life (Table 2).

As per gestation, overall 3182 (36.37%) were preterm babies and 5566 (63.62%) were term babies (Table 3).

As per birth weight criteria, 4047 (46.3%) were normal birth babies and 4701 (53.7%) were LBW babies. In the inborn unit, 1976 (47.6%) were normal birth while 2176 (52.4%) were LBW. In the outborn unit, 2071 (45.1%) were normal birth weight while 2525 (54.9%) were LBW (Table 4).

According to the outcome total of 6753 (77.19%) were discharged successfully, 1464 (16.66%) died, 382 (4.36%) were referred and 149 (1.7%) were leave against medical advice (LAMA) from our NICU. In the inborn unit, 3273 (78.82%) were discharged successfully, 668 (16.08%) died, 165 (3.97%) were referred and 46 (1.1%) were LAMA. In the outborn unit, 3480 (75.71%) were successfully discharged, 796 (17.31%) died, 217 (4.72%) were referred and 149 (1.7%) were LAMA (Table 5).

Birth asphyxia was the most common morbidity in our NICU. A total of 2404 (27.36%) were admitted. The prevalence of birth asphyxia was more in the inborn unit ($p<0.0001$). Neonatal sepsis was the second most common morbidity in our NICU. A total of 1587 (18.06%) admitted during the study period. Sepsis is more prevalent in outborn unit ($p<0.0001$). Neonatal jaundice was the third most common cause of admission (15.44%). Neonatal jaundice is more prevalent in the inborn unit ($p<0.0001$). Admission due to respiratory distress syndrome (RDS)/hyaline membrane disease was 1003 (11.41%) followed by transient tachypnea of newborn (TTNB) 456 (5.1%),

Table 1: Admission pattern of neonates based on mode of a mission and gender distribution in percentage (n=8748)

Gender	Inborn (%)	Outborn (%)	Total (%)
Male	2488 (46.36)	2878 (53.63)	5366 (61.33)
Female	1664 (49.09)	1718 (50.90)	3382 (38.66)
Total	4152 (47.46)	4596 (52.53)	8748

Table 2: Distribution of neonates according to age on admission

Age on admission	Number	Percentage
<1 day	4863	55.6
1–3 days	2004	22.9
4–7 days	1054	12
8–14 days	419	4.8
>14 days	408	4.7

Table 3: Distribution of neonates according to their gestational age: (n=8748)

Gestational age	Inborn (4152) (%)	Out-born (4596)	Total
<28	88 (2.1)	36 (0.8)	124 (1.4)
28–<32 weeks	300 (7.2)	248 (5.4)	548 (6.3)
32–<34 weeks	410 (9.9)	406 (8.8)	816 (9.3)
34–<37 weeks	860 (20.7)	834 (18.1)	1694 (19.4)
37–<42 weeks	2437 (58.7)	3067 (66.7)	5504 (62.9)
>42 weeks	57 (1.4)	5 (0.1)	62 (0.7)

Chi-square=120.659, $p<0.0001$*. p value > 0.05 (Statistically non significant), P value < 0.05 (Statistically significant), p value < 0.001 (Statistically highly significant).

Table 4: Distribution of neonates according to their birth weight (n=8748)

Birth weight	Inborn (4152) (%)	Outborn (4596) (%)	Total (%)
>2500 g	1976 (47.6)	2071 (45.1)	4047 (46.3)
1500 g–2499 g	1475 (35.5)	1903 (41.4)	3378 (38.3)
1000 g–1499 g	534 (12.9)	505 (11.0)	1039 (11.9)
<1000 g	167 (4.0)	117 (2.5)	284 (3.2)

Chi-square=43.648, $p<0.0001$*. p value > 0.05 (Statistically non significant), P value < 0.05 (Statistically significant), p value < 0.001 (Statistically highly significant).

Table 5: Distribution of neonates according to outcome (n=8748)

Outcome	Inborn (4152) (%)	Outborn (4596) (%)	Total (%)
Discharge/Cured	3273 (78.82)	3480 (75.71)	6753 (77.19)
Death	668 (16.08)	796 (17.31)	1464 (16.66)
Referred	165 (3.97)	217 (4.72)	382 (4.36)
LAMA	46 (1.1)	103 (2.24)	149 (1.7)

Chi square=23.947, $p<0.0001$, LAMA: Leave against medical advice. p value > 0.05 (Statistically non significant), P value < 0.05 (Statistically significant), p value < 0.001 (Statistically highly significant).

congenital malformations 403 (4.58%), congenital and acquired pneumonia 211 (2.4%), shock 199 (2.26%), and neonatal aspiration of meconium 179 (2.03%). Other cause of admission includes LBW (1.85%), acute renal failure (1.41%), hypoglycemia (0.94%), meningitis (0.56%), and DIC (0.56%). Pneumonia, shock and acute renal failure, and environmental hyperthermia of newborn were more common in outborn unit with significant (p<0.0001) (Table 6).

Hypoxic ischemic encephalopathy/moderate-to-severe birth asphyxia was the most common cause of death in our NICU. A total of 423 (28.23%) neonates were died due to birth asphyxia. There is no significant difference in mortality in the inborn and outborn unit (p=0.14156). Neonatal sepsis was the second most common cause of death in our NICU, and a total of 302 (20.62%) deaths were due to neonatal sepsis. Mortality due to neonatal sepsis was significantly high in outborn unit (p<0.0001). Respiratory distress syndrome was the third most common cause of neonatal mortality. 284 (19.35%) neonates were died due to RDS. Mortality due to RDS was similar in both inborn and outborn unit (p=0.0536). Major congenital malformations were cause of death in 106 (7.24%), followed by extreme prematurity 89 (6.06%), meconium aspiration syndrome 70 (4.77%), pneumonia 36 (2.45%), and other causes such as pulmonary hemorrhage, acute bilirubin encephalopathy, DIC, acute renal failure, sudden infant death syndrome, and intracranial hemorrhage were 119 (8.12%) (Table 7).

In NICU, outborn neonatal admission rate was slightly higher compared to inborn (52.53% vs. 46.47%) and the ratio of neonates of inborn and outborn was 0.9:1. Among total admissions, the male neonatal admission rate was significantly higher compared to females (61.33 vs. 38.66). Male predominance has been observed in studies in developing countries. These findings were similar to Pandya and Mehta [5].

According to age, the highest admission percentage was on day 1 of life (55.6%). Term babies had the highest admission numbers in NICU (62.9%).

LBW incidence was 53.7%. A similar incidence was found in the study in tertiary care NICU in South Africa [6]. The higher incidence of preterm among intramural deliveries (39.9%) compared to extramural (33.2%) could be explained by the institute being a tertiary care center and catering to high-risk deliveries.

Table 6: Distribution of neonates according to morbidity profile

Morbidity	Inborn (4152) (%)	Outborn (4596) (%)	Total (8784) (%)	z-value (%)	p-value
Birth asphyxia/HIE of new born	1302 (31.35)	1102 (23.97)	2404 (27.36)	7.6736	<0.0001*
Neonatal sepsis	477 (11.58)	1110 (24.15)	1587 (18.06)	14.4933	<0.0001*
Neonatal jaundice	740 (17.82)	617 (13.42)	1357 (15.44)	6.4744	<0.0001*
RDS of newborn (HMD)	513 (12.35)	490 (10.66)	1003 (11.41)	2.4882	0.01278*
Transient tachypnea of newborn	335 (8.06)	121 (2.63)	456 (5.1)	11.5587	<0.0001*
Congenital malformation	203 (4.88)	200 (4.35)	403 (4.58)	1.1105	0.267
Pneumonia	70 (1.68)	141 (3.06)	211 (2.4)	5.3014	<0.0001*
Shock	68 (1.63)	131 (2.85)	199 (2.26)	4.0651	<0.0001*
Neonatal aspiration of meconium	97 (2.33)	82 (1.78)	179 (2.03)	1.653	0.09894
Other low birth weight (1000 g–2499 g) and prematurity (28–<37 weeks)	58 (1.39)	105 (2.28)	163 (1.85)	3.3396	0.0008*
Acute renal failure	15 (0.36)	109 (2.37)	124 (1.41)	7.8122	<0.0001*
Neonatal hypoglycemia	44 (1.05)	39 (0.84)	83 (0.94)	0.9412	0.34722
Extreme immaturity (<28 weeks)	39 (0.93)	13 (0.28)	52 (0.59)	3.6753	0.0002*
Meningitis	11 (0.26)	39 (0.84)	50 (0.56)	3.1219	0.0018*
Environmental hyperthermia of newborn	7 (0.16)	43 (0.93)	50 (0.56)	4.3513	<0.0001*
Convulsions of newborn	21 (0.50)	29 (0.63)	50 (0.56)	0.3401	0.72786
DIC	15 (0.36)	24 (0.52)	39 (0.38)	0.6959	0.48392
Other diagnosis (Small for gestational age [IUGR], hemolytic disease of newborn, hypothermia of newborn, intraventricular hemorrhage, pneumothorax)	182 (4.38)	159 (3.45)	341 (3.88)	2.3907	0.01684*

HIE: Hypoxic ischemic encephalopathy, RDS: Respiratory distress syndrome, HMD: Hyaline membrane disease. p value > 0.05 (Statistically non significant), P value < 0.05 (Statistically significant), p value < 0.001 (Statistically highly significant).

Table 7: Distribution of neonates according to mortality profile (Total death - 1467)

Cause of death	Number		Total (1464) (%)	z-value	p-value
	Inborn (668) (%)	Outborn (796) (%)			
HIE/Moderate-severe birth asphyxia	206 (30.83)	217 (27.26)	423 (28.23)	1.4715	0.14156
Sepsis	96 (14.37)	206 (25.87)	302 (20.62)	5.414	<0.0001*
Respiratory distress syndrome	144 (21.55)	140 (17.58)	284 (19.35)	1.9269	0.0536
Major congenital malformations	60 (8.98)	46 (5.77)	106 (7.24)	2.3503	0.01878*
Prematurity/ELBW	57 (8.53)	32 (4.02)	89 (6.06)	3.5963	0.0003*
Meconium aspiration syndrome	40 (5.98)	30 (3.76)	70 (4.77)	1.9606	0.0513
Pneumonia	14 (2.09)	22 (2.76)	36 (2.45)	0.8577	0.38978
Congenital heart disease	10 (1.49)	14 (1.75)	24 (1.63)	0.4471	0.6527
Meningitis	3 (0.44)	8 (1.00)	11 (0.75)	1.3467	0.17702
Other (Pulmonary hemorrhage, acute bilirubin encephalopathy, ICH, acute renal failure, DIC, aspiration pneumonitis, SIDS)	38 (5.68)	81 (10.17)	119 (8.12)	1.3944	0.1645

SIDS: Sudden infant death syndrome, ICH: Intra cranial hemorrhage, ELBW: Extremely low birth weight, HIE: Hypoxic ischemic encephalopathy. p value > 0.05 (Statistically non significant), P value < 0.05 (Statistically significant), p value < 0.001 (Statistically highly significant).

Among sick neonates, the most common causes for morbidity were sepsis (18.1%), birth asphyxia (15.6%), and RDS (11.5%). Incidence of sepsis was at par with other NICU in Pakistan and South Africa [6-12]. The incidence of RDS can be attributed to increased preterm admissions.

Morbidity profiles showed that significant differences and inborn babies had a high rate of birth asphyxia (19.1% vs. 12.4%), neonatal jaundice (17.8% vs. 13.4%), respiratory distress syndrome (12.4% vs. 10.7%), TTNB (8.1% vs. 2.6%), and extreme prematurity (<28 weeks) (0.94% vs. 0.28%) compared to out born. All these could be due to high mortality in local health-care facilities and low referral rate of extreme premature babies, birth asphyxia, and adequate facilities of the management of TTNB and neonatal jaundice in peripheral settings.

Inborn babies had a significantly lower incidence of neonatal sepsis (11.5% vs. 24.2%), shock (1.64% vs. 2.86%), congenital pneumonia (1.16% vs. 1.35%), acquired pneumonia (0.53% vs. 1.72%), meningitis (0.26% vs. 0.85%), acute renal failure (0.36 vs. 2.37%), and environmental hyperthermia (0.17% vs. 0.94%). All these morbidities could be explained by high chances of neonatal sepsis and related complications among outborn babies and referral selection of sick babies.

In the NICU, the mortality rate was 16.7%. Hypoxic ischemic encephalopathy was the leading cause of neonatal mortality (28.23%) followed by neonatal sepsis and respiratory distress syndrome. There was a significant difference as a cause of death and intramural babies died more due to prematurity (8.53% vs. 6.06%) and congenital malformation (8.98% vs. 7.77%) compared to extramural babies. This difference could be due to the high number of extremely LBW inborn babies and less congenital malformation babies referral in NICU. Outborn babies died significantly more compared to inborn babies due to sepsis (25.87% vs. 14.37%) These mortality data showed similar patterns in other studies [5-12]. In NICU, mortality can be reduced substantially if a good disinfection and hygiene practices are established as part of essential newborn care in peripheral hospital and referral center. In addition, there is a strong need to develop a good transport system for referring neonates to higher centers. Time bound in utero referral to tertiary care may reduce birth asphyxia-related mortality.

Limitation of study

The limitation of this study is that being a tertiary hospital-based study, it does not reflect the morbidity and mortality of neonates treated in the community. The second limitation was that the outcome of neonates who left against medical advice was not known.

CONCLUSION

Birth asphyxia, neonatal sepsis, and RDS were the leading causes of mortality in this study.

These leading causes of mortality in the study could be prevented by adequate training of nursing staff and doctors, timely referral to tertiary care if required.

ETHICAL APPROVAL

The study was approved by the institutional ethical committee.

AUTHOR'S CONTRIBUTION

Dr. Naresh Kumar Meena - Concept preparation for research paper, Dr. Harish Punia - Statistical analysis, Dr. Akansha Sharma - Study design and data collection, Dr. Nidhi Meena - Manuscript preparation.

CONFLICTS OF INTEREST

Academic.

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