Original Article

Pattern of neonatal morbidity and mortality: A retrospective study in a special newborn care unit, Mumbai

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ABSTRACT

Background: Despite advances in perinatal and neonatal care, neonatal mortality is still high in developing countries, like India. Special neonatal care units (SNCUs) have been set up at different levels of health-care delivery system to provide quality newborn care services to meet this challenge. **Aim:** This study was undertaken to study morbidity and mortality pattern of neonates admitted at SNCU. **Materials and Methods:** This retrospective study was conducted in a newly started SNCU in the Western suburbs of Mumbai, India. The study included all babies admitted between 0 and 28 days of life over a period of 1 year. The babies were categorized based on gestational age and birth weight. **Results:** A total of 531 babies were admitted during the study period, including 125 outborn babies. About 25% of babies were preterm (<37 weeks), and 40% of babies were low birth weight (LBW) including 4.14% very LBW and 2.44% extremely LBW babies. Neonatal jaundice, respiratory distress, prematurity, LBW, suspected sepsis, and perinatal depression were common indications for admission. Only 11 (2.07%) babies required antibiotics. The overall mortality rate was 1.55%, with birth asphyxia being the leading cause of death. **Conclusion:** Results of this study showed that simple measures for the prevention of morbidity and mortality related to prematurity and sepsis may avoid excessive use of antibiotics and reduce overall morbidity and mortality of neonates admitted in SNCU/neonatal intensive care units.

Key words: Clinical profile, Morbidity, Mortality, Neonatal intensive care units, Neonate, Special neonatal care units

Healthy neonatal period is imperative in establishing the foundation of healthy community, state, and nation. This period is most vulnerable time for a child's survival because most of the preventable morbidities and mortalities occur in this period. Worldwide, 26 lakh babies die every year within 28 days of birth, of these, 6.4 lakh neonatal deaths occur in India. Neonatal mortality rate (NMR) in India is 22.7 deaths per 1000 live births at the national level [1]. The neonatal deaths account for more than 70% of all infant mortality. Simple interventions such as skilled birth attendance and access to emergency obstetric care can reduce NMR by 41%. Early initiation of breastfeeding, proper umbilical cord care, and maintaining temperature of the neonate can further reduce NMR as more than 80% of the newborn deaths are caused by preventable and treatable conditions, including complications due to prematurity or during delivery, and infections such as sepsis, meningitis, and pneumonia [2,3].

As per the National Health Family Survey-4, NMR in Maharashtra is 16.2/1000 live births, which is well below the national NMR [4]. To achieve our commitment toward sustainable developmental goals (SDGs), we should lower neonatal mortality to 12/1000 live births by 2030. Deaths occurring in special neonatal care units (SNCUs) and neonatal intensive care units (NICU) have a major influence on infant mortality. Understanding the causes of death and the modifiable factors associated with death has the potential to decrease neonatal as well as infant mortality [5].

After taking into consideration, the issues of high workloads, budgetary and infrastructure constraints, poor referral and transport services, Government of India suggested operational guidelines for setting up and running the SNCU services with more emphasis on clinical assessment and best possible use of evidence-based recommendations, supported by basic infrastructure and easily available most essential investigations. Hence, we are presenting the clinical profile and outcome of newborns admitted in this newly established SNCU [6].

MATERIALS AND METHODS

It was a retrospective study conducted over a period of 1 year (January 2018–December 2018) in the newly established SNCU

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in the Western suburbs of Mumbai, India. The study population included all neonates admitted between 0 and 28 days of life and both inborn and outborn babies were included in the study. Neonates who readmitted in the neonatal nursery after their discharge from hospital and who received antibiotics for 48–72 h till blood investigations reports were received were excluded from the study.

Written informed consent was taken from the parents/guardians of the neonates. The demographic and clinical variables were recorded in a predesigned pro forma. It included age at admission, sex, place of delivery, mode of delivery, gestational age, birth weight, indication for admission, clinical features, diagnosis, duration of hospital stay, and treatment received. The study was approved by the Institutional Ethical Committee.

Possibility of sepsis was considered with one or more following clinical features according to Integrated Management of Neonatal and Childhood Illness guidelines: Convulsions, fast breathing (≥60 breaths/minute), severe chest indrawing, nasal flaring, grunting, bulging fontanelle, pus draining from ear, umbilical redness extending to the skin, fever (axillary temperature 37.5°C or above or feels hot) or low body temperature (axillary temperature less than 35.5°C or feels cold), many or severe skin pustules, lethargic or unconscious, and less than normal movement [7].

The World Health Organization guidelines were used to categorize the babies based on gestational age and birth weight. Babies were managed as per the guidelines given in Facility Based Neonatal Care Operational Guide [6]. Outcome variables were categorized as discharged, discharge against medical advice, referred, and death.

Data collected were entered into MS Excel spreadsheet and analyzed on completion of 1-year follow-up. It was subjected to statistical analysis using SPSS version 25.0. $p<0.05$ was taken as statistically significant.

RESULTS

During the study period, a total of 1615 babies were delivered, out of which, 1032 (63.9%) babies were delivered by normal vaginal delivery, 521 (32.26%) babies were born by lower segment cesarean section, and 62 (3.8%) were born by instrumental deliveries.

A total of 531 neonates were admitted in SNCU over a period of 1 year, of these 406 babies (76.46%) were inborn and 125 babies (23.54%) were outborn. There were 292 (54.99%) male babies and 239 (45.01%) female babies. Male newborns outnumbered the females in general and inborn-outborn distribution as well. In our study, out of 531 cases, 396 babies (74.58%) were term and 135 (25.42%) babies were preterm, and mean gestational age was 37.06±2.23 weeks. Birth weight of 399 (75.14%) babies was appropriate for gestational age while 125 (23.54%) babies were small for gestational age, and 7 (1.32%) babies were large for gestational age. There was no significant difference in age at admission and length of hospital stay among inborn and outborn babies (Table 1).

Neonatal hyperbilirubinemia (NNH) was found to be the most common cause of admission, in 138 (25.99%) babies. All babies admitted for low birth weight (LBW) care were early preterm (gestational age <34 weeks); among these 20 babies were very LBW (Table 2). Among 52 babies admitted with symptoms of sepsis (suspected sepsis), after observation and investigations, only five babies were diagnosed as cases of sepsis and required complete course of antibiotics.

We reported 18 babies in Rashtriya Bal Swasthya Karyakram (RBSK) for congenital anomalies, including congenital heart diseases such as total anomalous pulmonary venous connection, ventricular septal defect, coarctation of aorta, and patent ductus arteriosus (Table 3).

During the study period, a total of 39 babies received mechanical ventilation; among these 26 neonates were ventilated with nasal CPAP, and 13 babies' required invasive ventilation. Therapeutic surfactant therapy was administered to eight preterm babies for respiratory distress syndrome; among these, only two babies required antibiotics.

Table 1: Demographical profile of the study population

Characteristics	Inborn	Outborn	Total
	No. (%)	No. (%)	No. (%)
Total admission	406 (76.46)	125 (23.54)	531 (100)
Sex			
Male	228 (56.16)	64 (51.2)	292 (54.99)
Female	178 (43.84)	61 (48.8)	239 (45.01)
Mode of delivery			
Normal vaginal delivery	215 (52.95)	95 (76)	310 (58.38)
Lower segment cesarean section	163 (40.18)	28 (22.4)	191 (35.97)
Assisted	28 (6.87)	2 (1.6)	30 (5.65)
Gestational age (weeks)			
≥37	306 (75.37)	90 (72)	396 (74.57)
34–<37	75 (18.47)	23 (18.4)	98 (18.45)
<34	25 (6.16)	12 (9.6)	37 (6.98)
Age at admission (days)			
<1	201 (49.5)	60 (48)	261 (49.15)
1–3	63 (15.52)	26 (20.8)	89 (16.76)
4–7	87 (21.43)	19 (15.2)	106 (19.97)
>7	55 (13.55)	20 (16)	75 (14.12)
Birth weight (g)			
≥2500	256 (63.05)	67 (53.6)	323 (60.82)
1500–2499	129 (31.77)	44 (35.2)	173 (32.58)
1000–1499	13 (3.2)	9 (7.2)	22 (4.14)
<1000	8 (1.97)	5 (4)	13 (2.44)
Average age at admission (days)	4.1±3.2 days	4.8±5.1 days	4.4±4.6 days
Average hospital stay (days)	6.5±5.4 days	7.2±4.8 days	6.8±5.1 days
Mean±SD gestational age (weeks)	37.07±2.21	37.06±2.24	37.06±2.23
Mean±SD birth weight (kg)	2.594±0.571	2.593±0.575	2.593±0.573

Table 2: Morbidity profile of the study population

Admission criteria	Inborn (%)	Outborn (%)	Frequency (%)
Neonatal hyperbilirubinemia	116(28.57)	22 (17.6)	138 (25.99)
Respiratory distress at birth	71 (17.49)	32 (25.6)	103 (19.40)
Prematurity	45 (11.08)	10 (8)	55 (10.36)
Suspected sepsis	41 (10.10)	11 (8.8)	52 (9.79)
Perinatal depression (post-resuscitation care)	24 (5.91)	8 (6.4)	32 (6.02)
Low birth weight care	24 (5.91)	7 (5.6)	31 (5.84)
Meconium aspiration syndrome	17 (4.19)	8 (6.4)	25 (4.71)
Birth asphyxia	7 (1.72)	12 (9.6)	19 (3.58)
Feeding issue	13 (3.20)	4 (3.2)	17 (3.20)
Congenital anomalies	17 (4.19)	1 (0.8)	18 (3.39)
Dehydration fever	7 (1.72)	2 (1.6)	9 (1.69)
Hypoglycemia	3 (0.74)	5 (4)	8 (1.51)
Neonatal seizure	6 (1.48)	1 (0.8)	7 (1.31)
Large for gestational age	7 (1.72)	0 (0.00)	7 (1.32)
Hypothermia	2 (0.49)	0 (0.00)	2 (0.38)
Apparent life-threatening event (choking while feeding at home)	0 (0.00)	2 (1.6)	2 (0.38)
Others	6 (1.48)	0 (0.00)	6 (1.13)
Total	406 (100)	125 (100)	531 (100)

Out of total 531 newborns admitted, only 11 (2.07%) babies received full courses of antibiotics. We have not counted those babies with suspected sepsis who received antibiotics only for 48–72 h till we get blood reports of C-reactive protein (CRP), etc. (as laboratory is closed after office hours and Sunday and holidays) and diagnosis is reviewed after reports and clinical course during interim period.

Majority of referred babies were on antibiotics, many for either leaking amniotic fluid ranging from few hours to 18 h or slightly raised CRP. Majority of them (58%) were receiving piperacillin-tazobactam and 23% were receiving meropenem. After admission at our institute, indications for starting antibiotics were reviewed and further management carried out as per the guidelines.

To promote breastfeeding, humanize care, and mother baby bonding, we encouraged mothers to take active participation in the care of their babies, as part of the efforts, kangaroo mother care was given to 79 babies weighing less than 2 kg. A total of eight babies were referred to higher center for the management of congenital heart disease, neural tube defect, ROP, TEF, acute kidney injury, and suspected inborn of error of metabolism. The difference in mortality rate was not significant among inborn and outborn neonates (Table 4).

The overall mortality rate was 1.55% in SNCU admission and birth asphyxia (50%) was leading cause of death among both inborn and outborn babies, which was followed by meconium aspiration syndrome (MAS), prematurity, and congenital anomaly. Early neonatal deaths represented about 75% of neonatal mortality and more than half of the deaths happened within 48 h of admission to SNCU (Table 5).

DISCUSSION

The present study depicts the morbidity and mortality pattern of neonates admitted at a resource limited new SNCU establishment.

Table 3: Congenital anomalies reported under Rashtriya Bal Swasthya Karyakram

Congenital anomaly	No. (%)
CTEV (club foot)	4 (22.22)
Down's syndrome	4 (22.22)
Congenital heart disease	4 (22.22)
Meningomyelocele	2 (11.11)
Cleft lip and palate	2 (11.11)
Tracheoesophageal fistula	1 (5.55)
Retinopathy of prematurity	1 (5.55)

Table 4: Outcome of total SNCU admissions

Outcome	Inborn	Outborn	Total
	Number (%)	Number (%)	Number (%)
Discharged	393 (96.8)	115 (92)	508 (95.66)
Discharge against medical advice	4 (0.98)	3 (2.4)	7 (1.3)
Referred	4 (0.98)	4 (3.2)	8 (1.5)
Death	5 (1.23)	3 (2.4)	8 (1.5)
Survival rate (%)	98.74	97.45	98.45

In this study, 76.46% admissions were inborn and 23.54% were outborn admissions, which is comparable to the studies conducted by Sridhar *et al*. and Ravikumar *et al*., where it was 71.71% and 72%, respectively [8,9]. However, Jena *et al*. and Rakholia *et al*. reported outborn admissions more than the inborn admissions [10,11].

We found slight male predominance (male 54.99% vs. female 45.01%), which was similar to that reported by Saini *et al*., Verma *et al*., and Adikane *et al*. [12-14]. This difference may be because of the biological susceptibility of the male neonates and increased importance of health intervention for male child over female child due to gender preference in society.

Table 5: Mortality profile of the study population

Characteristic	Inborn (%)	Outborn (%)	Total (%)
Cause of death			
Birth asphyxia	2 (40)	2 (66.6)	4 (50)
Meconium aspiration syndrome	2 (40)	0	2 (25)
Prematurity	0	1 (33.3)	1 (12.5)
Congenital anomaly	1 (20)	0	1 (12.5)
Gestational age (weeks)			
≥37	3 (60)	2 (66.66)	5 (62.5)
34–<37	2 (40)	0	2 (25)
<34	0	1 (33.33)	1 (12.5)
Birth weight (g)			
≥2500	3 (60)	0	3 (37.5)
1500–2499	2 (40)	2 (66.66)	4 (50)
1000–1499	0	0	0
<1000	0	1 (33.33)	1 (12.)
Age at death (days)			
<1	1 (20)	0	1 (12.5)
1–3	2 (40)	1 (33.33)	3 (37.5)
4–7	0	2 (66.66)	2 (25)
>7	2 (40)	0	2 (25)

With regard to gestational age of the study population, about 74% of neonates were term and 7% were early preterm (<34 weeks). Similarly, Adikane *et al*. found 79.72% term neonates in their study [14]. In the present study, the incidence of LBW was 40%, which was higher as compared to average incidence of LBW (30%) in India. The incidence of LBW was high among outborn babies (47%). This could be the reason for having a high incidence of LBW neonates in this study. Similar findings were observed in the study done by Sridhar *et al*. (40.55%), Verma *et al*. (54%), and Adikane *et al*. (47.35%) [8,13,14]. In this study, most of the neonates (85%) admitted to SNCU were early neonates. Kumar *et al*. and Panigrahy *et al*. also observed majority of admissions within the first 7 days of life [15,16], which indicate that this period of life is the most vulnerable and critical period.

NNH was found to be the most common indication for SNCU admission in the current study (25.99% of neonates). This finding is in line with the other studies by Adikane *et al*., Kumar *et al*., and Saharia *et al*. [14,15,17]. However, in the study published by Verma *et al*., respiratory distress was reported as the most common indication for admission, whereas Panigrahy *et al*. reported prematurity (39.2%) as the most common cause of admission [13,16].

We found the incidence of birth asphyxia significantly higher in outborn babies when compared to inborn babies. This finding is consistent with studies conducted by Ravikumar *et al*. and Malik *et al*. [9,18]. It indicates delayed referral of high-risk mothers, lack of access to health facilities, inadequate quality of intranatal care, and lack of effective neonatal resuscitation.

Clinically suspected sepsis was indication for admission in 52 (9.79%) cases but after observation and investigations, only five babies were diagnosed as confirmed cases of sepsis. Other studies by Verma *et al*., Som *et al*., and Neogi *et al*. reported higher rates of sepsis, it was 24%, 14.53%, and 18%, respectively [13,19,20].

Of 531 neonates, only 11 (2.07%) babies received full courses of antibiotics; among these, cefotaxime and amikacin were used in nine babies and piperacillin-tazobactam was given to two babies. This may be due to strict infection control and judicious use of antibiotics at our center. In a study by Chauthankar *et al*, out of 460 neonates, 374 (81.3%) received antibiotics [21].

Mortality rate in the present study is 1.55% of SNCU admissions which is lower than many developed countries. NMR of 3.1/1000 live births for inborn babies is also a very good outcome when compared with national average. It shows that minimal and timely interventions can reduce NMR significantly. Jindal *et al*. reported similar finding with 1.9% mortality, whereas majority of studies published from India reported higher mortality rate [21]. The previous studies have reported mortality rates ranging from 10.45% to 26% [9,13,15,16,18].

In this study, birth asphyxia was the major cause of mortality (50%), followed by MAS, prematurity, and congenital anomaly. Many previous have also observed perinatal asphyxia as the leading cause of death [15,16,22,23]. Pandya *et al*. found sepsis as the common cause of death [24]. In contrast to this, there was no single death due to sepsis in this study. Ravikumar *et al*., Verma *et al*., and Adikane *et al*. found prematurity and its complications as major cause of death [9,13,14].

Half of deaths happened within the first 3 days of life and three-fourth of deaths were early neonatal deaths (within 7 days of life), while only 25% deaths were late neonatal deaths (after 7 days of life). Similar findings were reported by Verma *et al*., Panigraphy *et al*., and Anurekha *et al*. [13,16,25]. There was no difference between mortality rate and cause of death among inborn and outborn babies.

The present study had a few limitations. As it was a single-center study, the results cannot be generalized. There can be inherent possibility of selection bias for referred outborn babies. This study focuses only on short-term outcome and longer term follow-up with neurodevelopmental and morbidities outcome can be more informative. Second, we did not use different statistical tests to analyze our results.

CONCLUSION

Neonatal jaundice, prematurity, LBW, perinatal asphyxia, and sepsis are the major causes for admission and morbidity. Results of this study show that simple measures for prevention of morbidity and mortality related to prematurity and sepsis may avoid excessive use of antibiotics and reduce overall morbidity and mortality of neonates admitted at SNCU/NICU.

Sepsis can be prevented in SNCU by practicing good hand hygiene, strict infection control, and judicious use of antibiotics.

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