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The pattern of admission and their related outcomes in NICU of a tertiary care teaching hospital, Udaipur, Rajasthan, India

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Introduction: To achieve MDG4 (Millennium Developmental Goals-4), a substantial reduction in early neonatal deaths will be required. The first steps in improving early neonatal survival are to document the number and rate of deaths and identify their common causes. As per the National Family Health Survey-3 report, the current neonatal mortality rate (NMR) in India is 39 per 1000 live births, neonatal deaths account for nearly 77% of all infant deaths (57/1000) and nearly half of under-five child deaths (74/1000). This study was undertaken to study the disease pattern and outcome of neonates admitted to the neonatal intensive care unit (NICU) of a tertiary care teaching hospital located in Udaipur, Rajasthan. **Material and methods:** The age, sex, gestational age, and morbidity and mortality profile of all NICU admissions in 5 years was determined and the difference between Inborn (those born in the Teaching Hospital) and Out born was calculated. Morbidity risk factors to reduce NMR in Udaipur were determined. **Results:** A total of 2648 neonates were admitted to NICU during the study period, out of which none were excluded from the study. The ratio of Male to Female admitted was 1.30:1. The major causes of morbidity were Meconium Aspiration Syndrome (16.16%), Respiratory Distress Syndrome(10.12%), Cong. Heart Defects(8.76%), Neonatal Sepsis(4.83%) and Hypoxic-Ischemic Encephalopathy(5.66%). In this study, the overall mortality rate was 9.96%. Most of the Deaths were due to MAS(25.75%), RDS(15.90%), Neonatal Sepsis(10.22%), and HIE(12.87%). Neonates with birth weight <1000g had poor outcomes compared to neonates with birth weight >2500g. **Conclusion:** This study identified Prematurity, Extremely low birth weight, MAS, and Neonatal Sepsis as major causes of Morbidity and MAS, RDS as the major contributors to neonatal mortality. Improving antenatal care, maternal health, and timely referral of high-risk cases to tertiary care hospitals will help to improve neonatal outcomes.

Keywords: Neonatal Intensive care, Morbidity, Mortality, Outcome

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Introduction

More than 8 million children die before they attain 5 years of age each year. Most of these deaths occur in developing countries, and most are caused by preventable or treatable diseases. To redeem this situation, in 2000, world leaders assembled in New York and established a goal of reducing child mortality among children less

Than 5 years to one-third of its 1990 level by 2015 as Millennium Development Goal 4 (MDG4).[1] Since the Millennium Development Goals were formed, progress toward reducing child mortality has accelerated but remains insufficient to achieve MDG4 [2]. In particular, progress toward reducing neonatal deaths—that is deaths during the first 28 days of life—has been slow and neonatal deaths now account for a greater proportion of global child deaths than in 1990 [3,4].

To achieve MDG4, a substantial reduction in early neonatal deaths will be required. The first steps in improving early neonatal survival are to document the number and rate of deaths, and identify their common causes.[5].

The neonatal period is a very vulnerable period of life due to many problems, which in most cases is preventable [6,7]. Of the 25 million babies born in India every year 1 million dies, India alone contributes to 25% of neonatal mortality around the world.

As per the National Family Health Survey-3 report, the current neonatal mortality rate (NMR) in India is 39 per 1000 live births, neonatal deaths account for nearly 77% of all infant deaths (57/1000) and nearly half of under-fi ve child deaths (74/1000) [8]. Preterm and low birth weight (LBW) babies are at increased risk of perinatal mortality and morbidity [9]. As per the report sheet published in the Lancet, the major direct causes of neonatal mortality are pre-term birth (27%), infection (26%), asphyxia (23%), congenital anomalies (7%), others (7%), tetanus (7%), and diarrhoea (3%) [10].

There are very scanty data that are available regarding neonatal mortality and morbidity pattern in India. Advancement in perinatal and neonatal care have significantly helped in reducing NMR in developed countries, but mortality and morbidity are still high in developing countries [11].

This study was undertaken to study the disease pattern and outcome of neonates admitted to the neonatal intensive care unit (NICU) of a tertiary care teaching hospital located in Umarda, Udaipur, Rajasthan, India.

For better neonatal care and prevention of the preventable causes of neonatal morbidity & mortality, we should be continuously reporting the audit of neonatal admission to our neonatal units all over the country. The purpose behind such types of audits in neonatal units should be for the identification of various deficiencies in the management of these neonates and also assist the health workers especially those at the community level for the better understanding and effective management of various neonatal problems in India.

Material and methods

This hospital-based observational, retrospective study is carried out in the NICU, Department of Pediatrics, at Pacific Institute Of Medical Sciences, Udaipur, India, for 5 Years from 1st January 2015 to 31st December 2020. The Institutional Ethical Committee approved the study protocol.

Our NICU caters to the Population of the Udaipur (South Rajasthan) district and neighbouring rural(Tribal) areas like Umarda. Approximately 8000 deliveries are conducted per year in the hospital; the majority of patients belong to the below poverty line income group. Our NICU has bed strength of 15, the facility for phototherapy, surfactant administration, exchange transfusion and ventilation are available.

A Retrospective case record review and analysis of all the newborn babies admitted to the NICU during the study period was done and neonates satisfying inclusion and exclusion criteria were included in the study.

Inclusion Criteria: All Neonates admitted to NICU.

Exclusion criteria: We in our study have taken NO Exclusion Criteria. All the Neonates whether Outborn/Referred/ LAMA, or any other Related circumstances of whom the diagnosis was known were all Included in the study.

These Neonates were categorized as Inborn if delivered in the Medical College Hospital and as Outborn if born outside. The data is recorded in a predesigned Proforma.

Some Important Definitions:

- Preterm—Live born neonate delivered before 37 weeks from 1st day of last menstrual period (LMP) and confirmed clinically after delivery.
- LBW (low birth weight)—was defined as weight < 2500 gm. Neonatal infections (sepsis, pneumonia, and meningitis)—These were diagnosed on clinical grounds along with appropriate tests, which include sepsis screen, blood culture, chest radiograph, and cerebrospinal fluid analysis. Invasive infections have been grouped due to similar and overlapping presentation and management.
- Meconium aspiration syndrome (MAS)—This was diagnosed both radiographically and clinically based on the history of being born through meconium-stained amniotic fluid, chest radiograph, and respiratory distress persisting beyond 24 hours.
- Congenital malformations—These were diagnosed on clinical features and diagnostic facilities like ultrasound, echocardiography, X rays, and Electrocardiography (ECG).
- Intrapartum-related complication of birth (birth asphyxia) was diagnosed clinically (Apgar score < 7 at 5 minutes).
- Neonatal jaundice—This was diagnosed after assessment of serum bilirubin and found to be in the pathological zone in age, weight, and gestation-specific range.

Statistics

Data collected is compiled and entered in MS Excel spreadsheet and analyzed using appropriate statistical tools in Open Epi statistical software, version 2.3.1.

Results

The total number of babies admitted to NICU during the study period were 2648 out of which None of the Neonates was Excluded from the study. Thus a total of 2648 neonates are included for the data analysis. Out of this 56.64% (1500) were male and 43.35% (1148) were females, the ratio is 1.30:1. Of the total admissions 75% (1986) were Inborn neonates and 25% (662) were Outborn neonates (TABLE 1).

50% (1324/2648) neonates had birth weight >2500gm; 26.43% (700/2648) of neonates belonged to Low Birth Weight Category (1500-2499gm); 18.88% (500/2648) of neonates belonged to the Very Low Birth Weight group (1499-1000gm); 4.68% (124/2648) of neonates were of Extremely Low Birth Weight Category (<1000gm).

On applying one sample Chi-square test to see the observed frequency distribution in males and females neonates overall admitted to NICU, it was found to be statistically significant($p<0.001$).

The major causes of the morbidity for admission to NICU were Meconium Aspiration Syndrome (16.16%), Respiratory Distress Syndrome (10.12%), IUGR(6.45%), Neonatal Jaundice (15.25%), Congenital Heart Defects (8.76%), Neonatal Sepsis (4.83%) and Hypoxic-Ischemic Enchelopathy (5.66%) (TABLE 2).

In this study the overall NICU mortality rate was 9.96% (264/2648). The mortality rate in Inborn Neonates was 9.9% (198/1986) whereas the mortality rate in Outborn Neonates was 9.96% (66/662); the difference in mortality rate between Inborn and Outborn Neonates was Statistically Insignificant($P=0.285$). The major causes for mortality were: Meconium Aspiration Syndrome(25.75%), Resp Distress Syndrome (15.90%), HIE (12.87%) and Neonatal Sepsis (10.22%). (TABLE 3).

On comparing survival among different birth weight groups(TABLE 4), it was seen that there was a statistically significant difference between the Very Low Birth Weight and Normal Birth Weight group ($P<-0.05$), And also in our study, there was a statistically significant difference in survival among Low Birth Weight and Normal Birth Weight group ($P<-0.05$).

Table-1: Sex Distribution of admitted Neonates:

Sex	Inborn(%)	Outborn(%)	Total(%)
Male	1125(56.64)	375(56.64)	1500(56.64)
Female	861(43.35)	287(43.35)	1148(43.35)
Total Admission	1986(100) 75%	662(100) 25%	2648(100) 100%

Table-2: Morbidity profile of Neonates admitted to NICU:

Morbidity Profile	Inborn (%)	Outborn (%)	Total (%)
Meconium Aspiration Syndrome(MAS)	321(16.16)	107(16.16)	428(16.16)
Respiratory Distress Syndrome(RDS)	201(10.12)	67(10.12)	268(10.12)
Respiratory Distress(other causes)	75(3.77)	25(3.77)	100(3.77)

HIE*	113(5.68)	37(5.58)	150(5.66)
Neonatal Sepsis	96(4.83)	32(4.83)	128(4.83)
Neonatal Pneumonia	36(1.81)	12(1.81)	48(1.81)
Neonatal Meningitis	12(0.60)	4(0.60)	16(0.60)
Neonatal Jaundice	303(15.25)	101(15.25)	404(15.25)
Congenital Anomaly	104(5.23)	33(4.98)	137(5.17)
IUGR*	128(6.44)	43(6.49)	171(6.45)
CDH *	79(3.97)	27(4.07)	106(4.00)
Choledochal cyst	42(2.11)	14(2.11)	56(2.11)
NEC*	100(5.03)	34(5.13)	134(5.06)
Anorectal Malformations	34(1.71)	11(1.66)	45(1.69)
Esophageal Atresia	13(0.65)	5(0.75)	18(0.67)
Gastroschisis	3(0.15)	1(0.15)	4(0.15)
Hirshprung's Disease	7(0.35)	2(0.30)	9(0.33)
Omphalocele	4(0.2)	2(0.30)	6(0.22)
Short Bowel Syndrome	10(0.50)	3(0.45)	13(0.49)
TEF*	25(1.25)	9(1.35)	34(1.28)
Lung Lesions/Tumors	7(0.35)	3(0.45)	10(0.37)
Intestinal Blockages	48(2.41)	16(2.41)	64(2.41)
Congenital Heart Defects	175(8.81)	57(8.61)	232(8.76)
Hypothermia	24(1.20)	8(1.20)	32(1.20)
Hypoglycemia	8(0.40)	3(0.45)	11(0.41)
Others	18(0.90)	6(0.90)	24(0.90)
Total	1986(100)	662(100)	2648(100)

***HIE:** Hypoxic-Ischemic Encephalopathy

IUGR: Intrauterine Growth Retardation

CDH: Congenital Diaphragmatic Hernia

NEC: Necrotizing Enterocolitis

TEF: Tracheo-Esophageal Fistula

TABLE 3: Comparison of Deaths among Inborn and Outborn Neonates:

Causes Of Neonatal Deaths	Inborn(%)	Outborn(%)	Total(%)
Meconium Aspiration Syndrome(MAS)	50(25.25)	18(27.27)	68(25.75)
Respiratory Distress Syndrome(RDS)	31(15.65)	11(16.66)	42(15.90)
HIE*	25(12.62)	9(13.63)	34(12.87)
Neonatal Sepsis	21(10.60)	6(9.09)	27(10.22)
NEC*	9(4.54)	3(4.54)	12(4.54)
Congenital Heart Defects	13(6.56)	4(6.06)	17(6.43)
CDH*	12(6.06)	3(4.54)	15(5.68)
Hypothermia	6(3.03)	2(3.03)	8(3.03)
Omphalocele	1(0.50)	1(1.51)	2(0.75)
TEF*	3(1.51)	1(1.51)	4(1.51)
Intestinal Blockages	16(8.08)	5(7.57)	21(7.95)
Congenital Anomaly	11(5.55)	3(4.54)	14(5.30)
Total	198(100)	66(100)	264(100)

***HIE:** Hypoxic-Ischemic Encephalopathy

NEC: Necrotizing Enterocolitis

CDH: Congenital Diaphragmatic Hernia

TEF: Tracheo-Esophageal Fistula

TABLE 4: NICU Outcome in different birth weight groups:

Birth Weight	NICU Admissions (%)	Deaths (%)	Percentage of Death is Each Group (%)
>2500 gm	1324(50)	58(21.96)	4.38
Low Birth Weight(1500-2499g)	700(26.43)	76(28.78)	10.85
Very Low Birth Weight(1000-1499g)	500(18.88)	70(26.51)	14
Extremely Low Birth Weight(<1000g)	124(4.68)	60(22.72)	48.38
Total	2648(100)	264(100)	-

Table-5: Distribution of Neonates according to their Gestational Age:

Gestational Age	Inborn(%)	Outborn(%)	Total(%)
Term	1192(60.00)	397(59.96)	1589(60.00)
Pre-Term	794(39.97)	265(40.03)	1059(39.99)
Total	1986(100)	662(100)	2648(100)

Discussion

This study was conducted to delineate the morbidity pattern, outcome and factors leading to mortality of neonates admitted to NICU of a tertiary care teaching hospital. Precise data regarding mortality and morbidity pattern of NICU admissions are useful for many reasons.

In our study total of 2648 neonates were admitted of which 75% neonates were Inborn and the rest were Outborn babies (25%); Male preponderance of admission to NICU was noted similar admission pattern has been seen in a study conducted by Roy et al [12]. 26.43%of neonates admitted had LBW and 39.99% of neonates admitted were Preterm baby. This may probably be due to poor maternal health conditions, low socioeconomic status and fewer visits to the health care facility.

A similar rate of LBW and Preterm baby admission has been reported by a study conducted by Garg et al in New Delhi [13]. According to the UNICEF; "The state of the World's Children 2010" report, 28% of neonates are born with LBW in India [14]. The most common specific morbidity for admission was MAS(16.16%) followed by RDS (10.12%), Neonatal Sepsis(4.83%) and Neonatal Jaundice(15.25%).

A study conducted by Gaucham et al. in Nepal reported that neonatal Jaundice, sepsis and perinatal asphyxia as being the commonest indications for admission to NICU [15]. According to National Neonatal Perinatal Database(NNPD) , sepsis(36%) is the most common morbidity responsible for admission followed by prematurity(26.5%) and perinatal asphyxia(10%) [16]. Birth Asphyxia is an important cause of neonatal morbidity and mortality, its incidence in our study is 5.66% which is similar to the findings of Chandra et al [17]. Meconium Aspiration Syndrome acts as an important cause of morbidity and mortality especially among LBW babies.

The mortality rate observed in our study is 9.96% is similar to that of the mortality rates observed in the study conducted by Rakholia et al [18]. The most common causes of mortality were MAS (25.75%), RDS (15.90%), HIE (12.87%) and Neonatal sepsis (10.22%). A similar pattern of outcome has been reported by a study conducted by Rashid et al [19].

In contrast the study report published by ICMR reports MAS (32.8%) as the major cause for neonatal mortality followed by sepsis (22.3%) and Birth Asphyxia (16.8%) [20]. In the study done at JIPMER, MAS was the cause of death in 52.3% of neonates followed by sepsis and birth asphyxia (29.23%) [21]. The majority of deaths in our study was attributable to MAS and RDS along with birth asphyxia; this may probably be due to poor antenatal care, malnourished pregnant mother, less availability of health facility, delivery untrained professional and delay in referral from peripheral hospitals.

Birth weight <1000gm were associated with a high number of mortality in Preterm Neonates. Most of the patients admitted to our hospital were from low or very low socio-economic status and most of the neonates were brought in very bad clinical condition. High frequency ventilation and Inhaled NO was not available in our hospital.

Conclusion

According to this study MAS, RDS, Neonatal Sepsis and Birth Asphyxia are leading causes of morbidities in newborn babies. Despite many advances in neonatal care above factors continue to be the leading causes of morbidity in neonates. Common causes of Neonatal mortality were MAS, RDS, Neonatal Sepsis, HIE and Congenital Heart Defects.

The majority of morbidities and subsequently the mortalities can be prevented by improving antenatal care, maternal health, timely intervention, referring at Appropriate time to tertiary care centres for high-risk cases, preventing preterm deliveries and care of Neonates at centres with the facility.

The cause of death was determined using the data available in case record sheets. In our study we did not divide the deaths into the early and late neonatal period. As the majority of the patients presenting to us belong to low socio-economic status, the results from this study cannot be a complete reflection of the problem in the community as a whole.

What does the study add to the existing knowledge?

In this study the additional point which is added to the existing knowledge is the morbidity and mortality causes as in our NICU the most common cause of mortality was MAS and thus steps are needed further to prevent and control morbidity and mortality rates from MAS.

Author's contribution

Dr. Vivek Parasher: Concept

Dr. Rahul Khatri: Manuscript preparation

Dr. Samarth Yadav: Study design

Dr. Ujjwal Mittal: Manuscript preparation

Dr. Sayan Das: Statistical analysis

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