Research Article

A cross-sectional study of Clinical Profile, Complications, and Outcome of Preterm Neonates at a Rural Hospital from Central India

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Background- Prematurity is prevalent and a leading cause of neonatal deaths in India. Infants born preterm are prone to have the highest rates of complications and mortality.

Objectives- To determine the clinical profile, complications, and outcome of preterm neonates at a rural hospital from central India.

Methods- This cross-sectional study was done at Neonatal Intensive Care Unit (NICU) of a tertiary care Centre for 18 months duration and total 357 preterm neonates (<37 weeks) requiring NICU care were enrolled. Data for clinical features, immediate complications, and outcomes were collected. Categorical and continuous variables were analyzed using Chi-square test and student t test, respectively. Statistical significance was set at $p < 0.05$.

Result- The prevalence of prematurity was found to be 15%. The mean GA was 33.49 ± 2.88 weeks, and mean BW was 1450 ± 340 grams. The common complications were hyperbilirubinemia (30.53%), blood culture positive sepsis (20.45%), and respiratory distress syndrome (17.65%). Out of 357 preterm neonates, 76.2% neonates survived and 23.8% died. A significant association was seen between gender (n=138 vs n=55, p-0.024), GA (p=0.0001), BW (p=0.0001) and outcome among preterm neonates.

Conclusion- The mortality rate was significantly associated with male gender, lower gestational age, and low birth weight. In the study, Pregnancy induced hypertension was the leading risk factor for the preterm birth. The risk of retinopathy of prematurity and respiratory distress syndrome was higher among neonates with lower gestational age and low birth weight.

Key words - Complications, NICU, Mortality, Preterm neonates, Respiratory Distress Syndrome
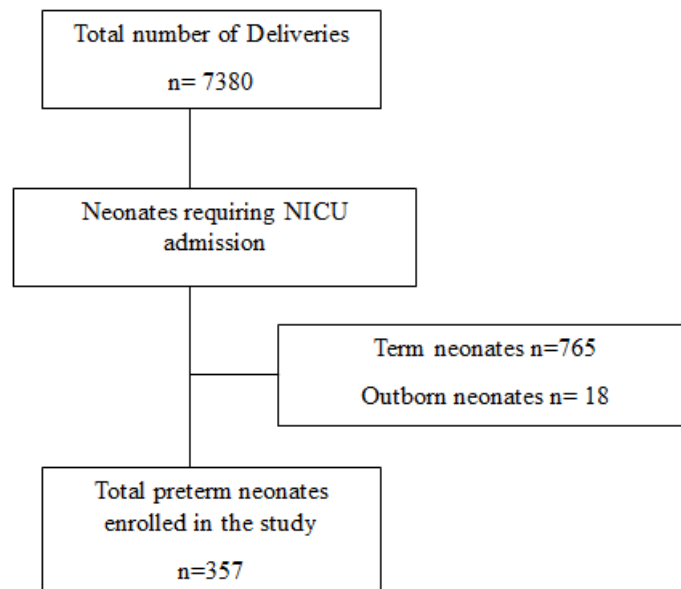
INTRODUCTION

A preterm birth is defined as birth occurring before 37 weeks of gestation. It is an important risk factor for adverse outcomes in terms of survival and quality of life.[1] As per WHO report, the rate of preterm birth ranges from 4-16% globally and resulted in approximately 9,00,000 deaths in the year 2019.[2] High income countries witness 5-7% of preterm births whereas middle and low-income countries it is as high as 18%. India witnessed 3.02 million preterm births in the year 2020 constituting to 23% of all preterm births worldwide.[2]

Premature infants are vulnerable to respiratory distress syndrome, chronic lung disease, intestinal injuries, compromised immune system, cardiovascular disorders, hearing and vision problems, and poor neurodevelopmental outcome. Without appropriate treatment and supportive care, these neonates are at increased risk of lifelong disability and poor quality of life. Infants born prematurely have the highest mortality and complication rates.[3] Therefore, global efforts are must to reduce child mortality and an urgent action plan to

address this problem is need of time. Maternal interventions shortly before or after the birth process in cases of inevitable preterm births are crucial for improving survival and health outcomes in infants.[4]

Although there is improved survival of preterm neonates, it still remains the leading cause of neonatal morbidity and mortality. Therefore, it is essential to have a better understanding of the causes and risk factors for preterm birth in order to design and implement   effective preventive strategies. Early identification of at risk pregnancies, timely referral to specialized obstetric centres, and care of preterm neonates in well-equipped neonatal intensive care units will help in decreasing the morbidity and mortality rate. Incidence, complications, and outcome of preterm births varies geographically and hence, more studies from various regions of our country are required to provide a more comprehensive perspective to male global and regional targeted interventions and policies towards prevention and control of premature births. This study was conducted with the aim of determining the incidence and outcome of preterm neonates in a tertiary rural hospital from central India.

Figure 1: Flowchart of study showing enrolment of study participants

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          ┌─────────────────────────┐
          │ Total number of Deliveries │
          │        n= 7380           │
          └─────────────────────────┘
                      │
          ┌─────────────────────────┐
          │ Neonates requiring NICU  │
          │       admission          │
          └─────────────────────────┘
                      │
                      │        ┌──────────────────────────┐
                      │────────│ Term neonates n=765      │
                      │        │ Outborn neonates n= 18   │
                      │        └──────────────────────────┘
          ┌─────────────────────────┐
          │ Total preterm neonates   │
          │ enrolled in the study    │
          │        n=357             │
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Material and Methods

Study Design and Setting: This cross-sectional study was conducted in a level III neonatal intensive care unit of a rural tertiary care centre from central India. It has 24 beds and there are approximately 5000 deliveries conducted annually. This centre caters to the population of districts of Vidarbha region of Maharashtra and its adjoining states.

Ethical Clearance: Ethical clearance was obtained from Institutional Ethics Committee of the hospital vide letter no. IEC/5257 before enrolment of study participants. An informed written consent was obtained from parents of the neonates for their participation and publication of the results before enrolling in the study.

Study Duration and Population:

The study was conducted for 18 months from November 2018 to April 2020. The study included all the preterm neonates delivered in the hospital and who required neonatal intensive care unit admission. All these preterm neonates were enrolled and followed up till the outcome. Total 357 preterm neonates were enrolled in the study who required neonatal intensive care admission during the study period.

Data collection: Data were collected on demographic details of neonates, antenatal factors including maternal risk factors, chorioamnionitis, antenatal corticosteroids, mode of delivery, complications such as culture proven sepsis, respiratory distress syndrome, necrotizing enterocolitis, pulmonary hemorrhage, pulmonary hypertension, intraventricular hemorrhage, pneumonia, meningitis, hypoglycemia, hyperbilirubinemia, congenital heart diseases, retinopathy of prematurity, birth asphyxia, and neonatal seizures. Outcome (discharge or death) was also noted for all the study participants. Hypoglycemia was defined as any blood glucose level <50 gm/dL during NICU stay.[5] IVH was classified as per Volpe classification, and screening for IVH depending on clinical features.[6] NEC was defined as per the Modified Bell's staging. ROP was classified as per the international classification for retinopathy of prematurity, and screening for ROP was done at 2 weeks for <28 weeks of gestation or <1200 gm birth weight and after 3 weeks for neonates <34 weeks of gestation or <2000gm. Culture positive sepsis was defined as blood positive for growth of single organism during the entire stay of NICU. Hyperbilirubinemia was defined as a serum bilirubin level $> 95^{th}$ percentile on the hour specific Bhutani nomogram. Pulmonary hypertension and congenital heart diseases were diagnosed by 2D echocardiogram. Pulmonary hemorrhage was defined as the presence of hemorrhagic fluid in the trachea with respiratory decompensation requiring increased respiratory support or intubation within 60 mins of appearance of fluid.

Data analysis: Data collected in the data collection sheet were entered in Microsoft Excel sheet. Data were expressed as descriptive statistics using SPSS software version 24. The categorical variables were analyzed using Chi-square test and continuous variables using student t test. Statistical significance was set at p< 0.05.

Results

There were 7380 deliveries and 1107 preterm deliveries during the study period. Out of these, 357 preterm neonates admitted in NICU were enrolled in the study. There were 54% males and 46% female neonates in the study. The mean gestational age was 33.49 ± 2.88 weeks, mean birth weight was 1450 ± 340 grams. In the study, 35.9% neonates were born by vaginal delivery and 35.9% by cesarean section.

Table 1: Baseline characteristic of preterm neonates (n=357)

Variables	Frequency (n)	Percentage (%)
Gender		
Male	193	54.1
Female	164	45.9
Gestational Age (Weeks)		
< 28	36	10.08
28-31	42	11.7
31- 34	110	30.8
34- 37	169	47.3
Mode of Delivery		
Vaginal	229	64.1
Cesarean section	128	35.9
Birth Weight (g)		
< 1000	33	9.2
1000-1200	53	14.8
1201-1500	108	30.3
1501- 1800	123	34.5
1801-2000	27	7.6
>2001	13	3.6
Antenatal Steroids		
Yes	98	27.5
No	259	72.5
Maternal Risk factors		
Pregnancy induced hypertension	36	10.1
Gestational diabetes	18	5.1
Premature rupture of membranes	30	8.4
Chorioamnionitis	8	2.2
No complications	265	74.2

Table 2: Complications among preterm newborns (n=357)

Complications	Frequency (n)	Percent (%)
Hypoglycemia	30	8.4
Pneumonia	30	8.4
Pneumothorax	10	2.8
Pulmonary Haemorrhage	14	3.9
Pulmonary Hypertension	5	1.4
Hyperbilirubinemia	109	30.5
Blood culture positive Sepsis	73	20.4
Meningitis	6	1.7
Intraventricular Haemorrhage	12	3.4
NEC	9	2.5
Retinopathy of prematurity	28	7.8
Respiratory Distress syndrome	63	17.7
Birth Asphyxia	30	8.4
Neonatal Seizures	20	5.6
Congenital heart disease	25	7

Table 1 illustrates the baseline characteristics of preterm neonates. There were 33 neonates with weight below 1000gm, 53 neonates with weight between 1000-1200 gm, 108 neonates between 1200-1500gm, 123 neonates with 1500-1800gm, 27 neonates between 1800-2000gm, and 13 neonates with >2000gm.

In the present study, risk factors contributing to prematurity were pregnancy induced hypertension (PIH) (10%), premature rupture of membrane (8.4%), gestational diabetes (5.1%), and chorioamnionitis (2.2%). There were only 27% mothers who received antenatal steroids.

Table 2 illustrates complications seen among preterm neonates in the study. The common complications were hyperbilirubinemia (30.53%), blood culture positive sepsis (20.45%), and respiratory distress syndrome (17.65%). Other less common complications were hypoglycemia (8.4%), birth asphyxia (8.4%), pneumonia (8.4%), retinopathy of prematurity (7.84%), congenital heart disease (7%), disseminated intravascular coagulation (4.56%), pulmonary hemorrhage (3.9%), and necrotizing enterocolitis (2.5%). Pneumothorax (2.8%), pulmonary hypertension (1.4%), meningitis (1.7%) were less commonly seen complications among preterm neonates. Out of 357 preterm neonates, 76.2% neonates survived and 23.8% died as shown in **Table 3.**

Table 3: Outcome among preterm neonates during study period

Outcome	Frequency (%)
Survived	272 (76.2)
Death	85 (23.8)

Table 4: Comparison of characteristics of preterm neonates with outcome

Variable	Survived	Death	P value
Gender			
Male	138	55	0.024*
Female	134	30	
Gestational Age (weeks)			
<26	0	4	0.0001*
26-28	5	27	
28-31	17	25	
31-34	89	21	
34-37	161	8	
Birth Weight (g)			
<1000	7	26	0.0001*
1001-1200	30	26	
1201-1500	93	15	
1501-1800	110	13	
1801-2000	21	6	
>2000	11	2	
Morbidity			
Blood culture proven sepsis			
Yes	51	22	0.12
No	221	63	
Surfactant in RDS			
Yes	4	13	0.93
No	9	37	
Ventilation required			
Yes	23	85	0.0001*
No	249	0	

*Significant P value (<0.05)

A significant association was seen between gender (n=138 vs n=55, p-0.024), gestational age (p=0.0001), birth weight (p=0.0001) and outcome among preterm neonates as shown in **Table 4**. Extremely premature neonates had highest mortality and rate of mortality reduced as gestational age increased. Similarly, extremely low birth weight neonates had high mortality and neonates with birth weight between 1500-1800 g had low mortality rate. There was statistically significant association was seen between culture proven sepsis (p=0.12), use of surfactant

(0.93) and outcomes in preterm neonates. However, significant difference was seen in need of ventilation and outcomes among preterm neonates (p=0.0001).

Discussion

The incidence of preterm birth is on rise due to assisted reproductive techniques, physical and psychological stress in mothers. It is affected by various maternal, social, and environmental risk factors. The overall incidence of preterm birth in our setting was found to be 15%. Previous studies from India have reported similar prevalence of preterm births.[7,8] However, a study by Robert C L et al[9] from Australia (5.5%), and Morten N H et al[10] (5-6%) from Sweden reported a lower incidence of preterm births. Higher incidence of premature birth in this study could be due to young age at conception, poor nutritional status, and anemia among pregnant women in our country.

Mean gestational age was 33.49 ± 2.88 weeks, mean birth weight was 1450 ± 340 g and male predominance (54%) was reported in this study. These results were in accordance with previously published studies.[11-13]

In the present study, the risk factors for prematurity were pregnancy induced hypertension (10.1%), premature rupture of membranes (8.4%), gestational diabetes mallitus (5.1%) and chorioamnionitis (2.2%). There were 74.2% neonates who had no risk factor for prematurity. These results are in accordance with those reported in studies by Jahromi B N et al[16], Shetty M et al[9] and Abolfotouh M A et al[15]. In a study by Jahromi B N, premature rupture of membranes (17.5%) was found to be the most common risk factor followed by pregnancy induced hypertension and gestational diabetes (6.7%).[14] Similarly, Abolfotouh M A reported premature rupture of membranes in 20.3% of mothers while gestational diabetes in 8.5% mothers and chorioamnionitis in 7.3% mothers.[15]

In the present study, 27.4% of mothers received antenatal steroid. Previously published studies by Tibaijuka et al[11] and Diggikar S[16] have reported a higher rate of antenatal steroid use. This could be due to high risk mothers presenting late in advanced stages of labor with inadequate time for antenatal steroids.

Hyperbilirubinemia (30.5%), blood culture proven sepsis (20.4%), and respiratory distress syndrome (17.7%) were common complications reported in the study. Retinopathy of prematurity was seen in 7.8% of neonates. A study by Dwivedi A from India reported a higher incidence of 30% for ROP among preterm neonates.[15]

In the study, mortality rate of 23.8% was seen among preterm neonates. The highest rate of mortality was seen in neonates <26 weeks of gestation (100%) followed by 26-28 weeks of gestation (84.4%). A higher rate of mortality was reported in a study by Dhaded S M et. Al.[18] which compared mortality rate among preterm neonates from India and Pakistan (n=615, 38% vs 62%). Similarly, DeNIS study from Delhi reported a mortality rate of 45.4% which was higher than reported in this study.[19] The present study showed that birth weight (p=0.001), gestational age (p=0.001), gender (p=0.024) were significantly associated with mortality among preterm neonates. This was in accordance with the results of study by Callaghum W M et al.[20]

Strengths and Limitations of the study-

The strength of this study was prospective cohort design with highly qualified and representative data. The study was conducted at a tertiary hospital from rural area which provides the baseline data for risks and outcomes of prematurity in rural population. However, this study is limited to only the short-term outcome and does not include the long term morbidity and mortality among these neonates. Few neurological and cardiovascular morbidities were not evaluated due to non-availability of some bedside sophisticated investigations. Some maternal and neonatal risk factors are not addressed in this study.

 Conclusion

 In this study, the rate of premature birth was reported 15%. The mortality rate was significantly associated with male gender, younger gestational age, and low birth weight. Pregnancy induced hypertension was the leading risk factor for the preterm birth in the study. The risk of retinopathy of prematurity and respiratory distress syndrome was higher among neonates with younger gestational age and low birth weight. In this study, the mortality rate was 23.8% among preterm neonates.

Conflict of Interest: None

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