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Clinical Outcome Profile of Early Preterm Neonates in a NICU at Tertiary Care Center

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ABSTRACT
Early preterm neonates (28-32 weeks gestation) face high rates of mortality and morbidity due to complications such as respiratory distress syndrome (RDS), sepsis and hyperbilirubinemia. This study aims to assess survival rates and short-term clinical outcomes of early preterm neonates admitted to a tertiary care hospital's neonatal intensive care unit (NICU). A prospective observational study was conducted over 30 months (December 2021 to June 2024) in the NICU of a tertiary care hospital. A total of 408 preterm neonates born between 28 and 32 weeks gestation were enrolled. Data on maternal characteristics, neonatal outcomes, complications and NICU stay were collected. Statistical analysis was performed using SPSS version 20, with a p-value<0.05 considered statistically significant. The overall survival rate was 67.16%, with a mortality rate of 30.15%. Respiratory distress syndrome was the most common complication, affecting 63.73% of neonates, followed by hyperbilirubinemia (48.53%) and sepsis (45.83%). The mean NICU stay was 4-6 weeks for most neonates (34.06%). Maternal factors such as gravida status and antenatal care visits were not significantly associated with neonatal survival. Early preterm neonates continue to face high morbidity and mortality rates, primarily due to RDS and sepsis. Antenatal care, including corticosteroid administration, plays a crucial role in improving outcomes. More comprehensive prenatal interventions and improved NICU protocols are essential to reduce complications and improve survival rates in this vulnerable population.

INTRODUCTION

Preterm birth, particularly early preterm birth, poses a significant challenge to neonatal healthcare. Defined as birth occurring before 37 weeks of gestation, preterm birth can be classified into categories based on gestational age. Early preterm birth, referring to neonates born between 28 and 32 weeks, is associated with a higher risk of mortality and morbidity compared to late preterm and full-term neonates. The vulnerability of these neonates is attributed to the immaturity of their organs, particularly the lungs, immune system and central nervous system[1]. Preterm infants often require specialized neonatal care and admission to neonatal intensive care units (NICUs) is essential for their survival[2]. The pathogenesis of preterm birth is multifactorial, with maternal, fetal and placental factors playing key roles. Conditions such as preeclampsia, premature rupture of membranes (PROM), infections and multiple gestations are recognized risk factors for preterm delivery[3]. Furthermore, maternal lifestyle factors, including poor nutrition and inadequate prenatal care, can contribute to the onset of preterm labor[4]. Despite advances in neonatal care, early preterm neonates continue to face significant complications, including respiratory distress syndrome (RDS), sepsis, intra ventricular hemorrhage (IVH) and long-term neurodevelopmental impairments[5]. Tertiary care hospitals, equipped with advanced neonatal facilities and specialized healthcare professionals, play a crucial role in improving the survival rates of preterm infants. However, despite such facilities, the incidence of complications and mortality remains high among early preterm neonates. This study seeks to evaluate the clinical outcome profile of early preterm neonates admitted to a tertiary care hospital, assess the prevalence of various neonatal complications and identify key factors influencing neonatal morbidity and mortality.

MATERIALS AND METHODS

This was a prospective observational study conducted in the Neonatal Intensive Care Unit (NICU) of a tertiary care hospital, focusing on neonates born between 28 and 32 weeks of gestation. The study was conducted over a 30-month period, from December 2021 to June 2024 and included neonates admitted to the NICU within 24 hours of birth. The sample size was calculated based on an expected prevalence of preterm births of 50%, with an allowable error of 5%. The required sample size was determined to be 408 neonates after accounting for a potential dropout rate of 6%. A consecutive sampling technique was used, enrolling all eligible neonates born during the study period until the target sample size was reached. Inclusion criteria were neonates born between 28 and 32 weeks of gestation and admitted to the NICU within 24 hours of birth. Exclusion criteria included neonates born before 28 weeks or after 32 weeks, those with major congenital anomalies and cases where parents refused consent. Neonates were also withdrawn from the study if parents requested withdrawal or if the neonate was transferred to another facility before completion of the study. Data were collected using a pre-tested proforma, including demographic information, maternal risk factors, neonatal complications, interventions and outcomes. The data were collected in real-time and reviewed for accuracy. Survival was defined as discharge alive from the NICU, and morbidity included any complication occurring during the NICU stay, such as respiratory distress syndrome (RDS), sepsis, intra ventricular hemorrhage (IVH) and necrotizing enterocolitis (NEC).

Quantitative data were analyzed using means and standard deviations, while categorical data were expressed as percentages. The Chi-square test was used for categorical variables and the t-test was employed for continuous variables. A p-value of less than 0.05 was considered statistically significant. Data analysis was performed using SPSS (IBM version 20). Ethical approval was obtained from the Institutional Ethical Committee and written informed consent was secured from all parents or guardians. In cases where parents were illiterate, verbal consent was obtained.

RESULTS AND DISCUSSIONS

Table:1 Demographic and Clinical Characteristics of Study Population

Category		No.	Percentage (%)	Mean+S.D.
Age (years)	<20	73	17.89	23.1+3.0 years.
	21-30	326	79.9	
	31-40	9	2.21	
	Total	408	100	
Gestational Age	28-32 weeks	333	81.62	31+1.8 weeks.
	32.1-34 weeks	75	18.38	
	Total	408	100	
Gender	Male	201	49.26	
	Female	207	50.74	
	Total	408	100	

A total of 408 early preterm neonates were included in the study. The maternal age of participants ranged between less than 20 years and 40 years, with the majority (79.9%) being between 21 and 30 years and a mean maternal age of 23.1±3.0 years. A smaller proportion of mothers were under 20 years (17.89%), and only 2.21% of mothers were aged between 31 and 40 years. The gestational age of the neonates ranged from 28-32 weeks, with the majority (81.62%) born between 28 and 32 weeks. The mean gestational age was 31±1.8 weeks. The remaining 18.38% of neonates were born between 32.1 and 34 weeks of gestation. The gender distribution of the neonates was almost equal, with 201 males (49.26%) and 207 females (50.74%) (Table 1).

A total of 408 early preterm neonates were included in the study and the data on birth order, birth weight, maternal gravidity, consanguinity, antenatal care (ANC) visits and mode of delivery are summarized below.

Table:2 Maternal and Neonatal Characteristics

Category		No.	Percentage (%)
Birth order	≤2	350	85.78
	>2	58	14.22
	Total	408	100
Birth weight	<1	56	13.73
	1-1.5	352	86.27
	Total	408	100
Gravida	Primigravida	224	54.9
	Multigravida	184	45.1
	Total	408	100
Consanguinity	Present	141	34.56
	Absent	267	65.44
	Total	408	100
No. of ANC visits	0	1	0.25
	1	26	6.37
	2	68	16.66
	3	106	25.98
	4	109	26.72
	5	98	24.02
	Total	408	100
Mode of delivery	NVD	313	76.72
	LSCS	95	23.28

Most neonates (85.78%) were born to mothers with a birth order of less than two, while 14.22% were born to mothers with a birth order of two or more. In terms of birth weight, 86.27% of the neonates weighed between 1 and 1.5kg, while 13.73% had a birth weight of less than 1kg. Regarding maternal gravidity, 54.9% of the neonates were born to primigravida mothers, while the remaining 45.1% were born to multigravida mothers. Consanguinity was reported in 34.56% of cases, while 65.44% of neonates were born to non-consanguineous parents. Antenatal care was another important factor, with 99.75% of mothers receiving at least one ANC visit. Specifically, 26.72% of mothers had four ANC visits, 25.98% had three visits, 24.02% had five visits, 16.66% had two visits and 6.37% had one visit. Only 0.25% of mothers had no ANC visits during pregnancy. In terms of delivery method, 76.72% of the neonates were born via normal vaginal delivery (NVD), while 23.28% were delivered by lower-segment cesarean section (LSCS) (Table 2).

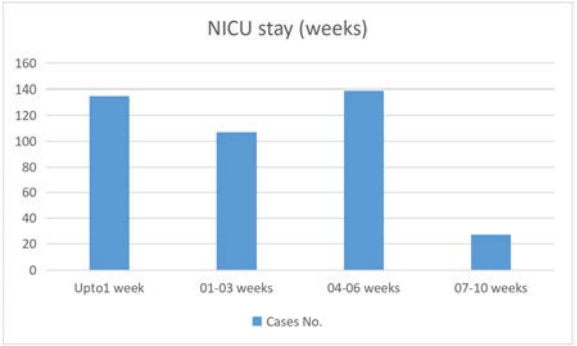

Fig. 1: Neonatal Intensive Care Unit (NICU) Stay

The duration of NICU stay varied among the 408 early preterm neonates, reflecting the diverse clinical conditions and care needs of the cohort. A significant proportion of neonates, 33.09% (135 cases), had a relatively short stay of up to 1 week in the NICU. These cases typically involved neonates who required less intensive support and were able to achieve clinical stability quickly. Another 26.23% (107 cases) of the neonates stayed in the NICU for 1-3 weeks, indicating that a substantial number of early preterm infants required extended care beyond the first week. These neonates likely faced moderate complications, such as respiratory distress syndrome or feeding difficulties, that necessitated continued monitoring and support. The largest group, comprising 34.06% (139 cases) of the neonates, remained in the NICU for 4-6 weeks. This longer stay was likely related to more severe complications, such as infections, prolonged respiratory support, or difficulty achieving independent feeding. A smaller proportion of the neonates, 6.62% (27 cases), required intensive care for 7-10 weeks. These cases represent the most vulnerable infants who likely faced significant health challenges, such as bronchopulmonary dysplasia or severe sepsis, requiring extended NICU support. In summary, while most neonates (59.32%) were discharged from the NICU within 3 weeks, a considerable number (40.68%) required prolonged care, reflecting the complex medical needs of early preterm infants (Fig.1).

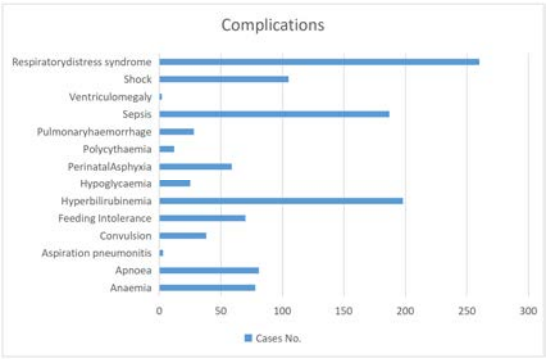

Fig. 2: Neonatal Complications

The early preterm neonates in this study experienced a range of complications during their stay in the NICU, with some conditions being more prevalent than others. The most common complication observed was respiratory distress syndrome (RDS), which affected 63.73% (260 cases) of the neonates. RDS is a common condition in preterm infants due to immature lung development, necessitating respiratory support. Hyperbilirubinemia was the second most frequent complication, affecting 48.53% (198 cases) of the neonates. This condition often required phototherapy for management. Similarly, sepsis was a major concern, with 45.83% (187 cases) of neonates diagnosed with this life-threatening infection, reflecting the vulnerability of preterm infants to infections. Shock was observed in 25.74% (105 cases) of neonates, which could be associated with sepsis or other severe

conditions. Apnea, defined as episodes of interrupted breathing, was noted in 19.85% (81 cases) of neonates, often requiring respiratory support or monitoring. Additionally, anemia was present in 19.12% (78 cases), necessitating blood transfusions in some instances. Other complications included feeding intolerance in 17.16% (70 cases), which often delayed the transition to full enteral feeding and perinatal asphyxia, observed in 14.46% (59 cases), which can have long-term neurological impacts. Convulsions occurred in 9.31% (38 cases), likely due to underlying neurological or metabolic issues. Less frequent complications included pulmonary hemorrhage (6.86%), hypoglycemia (6.13%) and aspiration pneumonitis (0.74%). Ventriculomegaly and polycythemia were rare, affecting 0.49% (2 cases) and 2.94% (12 cases), respectively (Fig.2).

Table:3 Neonatal Outcomes

Outcome	Cases	
	No.	Percentage (%)
Discharge	274	67.16
Death	123	30.15
DOR*	11	2.69
Total	408	100

The overall outcomes of the 408 early preterm neonates enrolled in the study are summarized as follows. Most of the neonates, 67.16% (274 cases), were successfully discharged from the NICU after receiving the necessary medical care and support. These neonates were considered stable enough to leave the hospital, having overcome the complications related to preterm birth.

However, the study recorded a neonatal mortality rate of 30.15% (123 cases). The high mortality rate reflects the vulnerability of early preterm infants, who often face severe complications such as respiratory distress syndrome, sepsis and other life-threatening conditions despite advanced medical interventions. Additionally, 2.69% (11 cases) of the neonates were discharged on request (DOR) by their families. These cases involved neonates whose families opted to leave the hospital before the completion of the full course of treatment, often due to personal or financial reasons (Table 3).

In this study, we evaluated the clinical outcomes and complications of early preterm neonates (28-32 weeks gestation) admitted to a tertiary care NICU. The findings are consistent with those from other studies on similar populations, highlighting common complications and the impact of gestational age and birth weight on neonatal outcomes. Our study found a neonatal survival rate of 67.16%, with a mortality rate of 30.15%. This is comparable to other studies of early preterm neonates, although slight variations exist. For instance, a study by Marques[6] reported a 37.5% mortality rate in preterm infants <29 weeks of gestation, with intraventricular hemorrhage and sepsis being the leading causes of death[6]. In another study from China, Kong[7] reported a 36% mortality rate for infants born between 24-31 weeks gestation, which aligns with the high vulnerability of preterm neonates[7]. Antenatal steroid use was found to improve survival rates in several studies, highlighting the importance of prenatal care. Our results show that respiratory distress syndrome (RDS) affected 63.73% of the neonates, hyperbilirubinemia occurred in 48.53%, and sepsis was present in 45.83%. The high incidence of RDS is consistent with global studies. Stoll *et al.* reported that 93% of neonates born at <28 weeks were diagnosed with RDS, indicating the frequency of this complication in preterm populations[8]. Sepsis remains a leading cause of neonatal mortality and morbidity, as highlighted by Nanda *et al.*, who reported a sepsis rate of 64.6% in preterm neonates[9]. The average NICU stay in our study was most commonly 4-6 weeks, reflecting the time required for preterm neonates to overcome major complications. Similarly, Mesbah *et al*. found that 62.5% of neonates born with preterm premature rupture of membranes (PPROM) required NICU admission for an extended period, often due to RDS and infections[10].

In our study, 23.28% of neonates were delivered by cesarean section (CS) and no significant differences in survival outcomes between vaginal and CS deliveries were noted. However, Baran *et al.* highlighted that specific causes of preterm labor, such as chorioamnionitis, were more likely to lead to neonatal complications like sepsis and RDS in CS deliveries[11]. Our study's findings align with global data on early preterm neonates, confirming that survival rates improve with gestational age, but high rates of RDS, sepsis and other complications persist. These complications are often more severe in neonates with lower gestational age and birth weight, as confirmed by various studies and the use of antenatal corticosteroids plays a critical role in improving neonatal outcomes. Continued advancements in NICU care are essential to reduce morbidity and mortality in this vulnerable population.

CONCLUSION

This study provides valuable insights into the clinical outcomes and complications of early preterm neonates (28-32 weeks gestation) admitted to a tertiary care NICU. The findings reveal that while the overall survival rate was relatively high (67.16%), a significant proportion of neonates (30.15%) succumbed to complications such as respiratory distress syndrome, sepsis and other morbidities. These complications, particularly respiratory distress syndrome and sepsis, continue to be the most common and serious

conditions affecting early preterm neonates, with rates of 63.73% and 45.83%, respectively. Our study emphasizes the critical importance of timely antenatal care, including the use of antenatal corticosteroids, in improving neonatal outcomes. The data also suggests that the mode of delivery, while not significantly impacting overall survival rates, may influence the prevalence of certain complications, especially in cases involving chorioamnionitis. Prolonged NICU stays reflect the complex medical needs of these neonates, with many requiring intensive monitoring and intervention to achieve clinical stability. his study has several limitations, including its single-center design, which limits the generalizability of the findings to other settings, as NICU care protocols and outcomes may vary across institutions. Additionally, while data collection was prospective, some reliance on medical records introduces the possibility of incomplete or biased information. The study also focused only on short-term outcomes, without assessing long-term neurodevelopmental consequences for the neonates. Furthermore, potential confounding factors, such as variations in prenatal care quality, socioeconomic status and environmental influences, were not fully controlled. Future research should include multi-center studies for broader applicability, incorporate long-term follow-up of preterm neonates to assess neurodevelopmental outcomes and emphasize the importance of early and consistent antenatal care. Hospitals should also adopt standardized NICU protocols for the early detection and management of complications like respiratory distress syndrome and sepsis to further improve neonatal outcomes.

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