International Journal of Contemporary Pediatrics
Nooreen et al. Int J Contemp Pediatr. 2026 Aug;13(8):1378-1385
https://www.ijpediatrics.com
pISSN 2349-3283 | eISSN 2349-3291

DOI: https://dx.doi.org/10.18203/2349-3291.ijcp20262411

Original Research Article

Clinical profile and outcome of neonatal thrombocytopenia in a tertiary care neonatal intensive care unit

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Received: 08 April 2026
Accepted: 01 July 2026

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ABSTRACT

Background: Neonatal thrombocytopenia is a common hematological abnormality in neonatal intensive care units (NICUs), particularly among preterm and low-birth-weight neonates. It is associated with sepsis, respiratory distress syndrome, necrotizing enterocolitis, bleeding manifestations and adverse neonatal outcome. The present study was undertaken to evaluate the clinical profile, associated risk factors, severity, management and short-term outcome of neonatal thrombocytopenia in NICU-admitted neonates.

Methods: This hospital-based observational study included 120 neonates with thrombocytopenia admitted to a tertiary care NICU. Neonatal thrombocytopenia was defined as a platelet count <150×10⁹/l and was classified as mild (100–149×10⁹/l), moderate (50–99×10⁹/l) and severe (<50×10⁹/l). It was further categorized as early onset (<72 hours of life) and late onset (≥72 hours). Maternal risk factors, neonatal morbidities, clinical manifestations, treatment details and outcomes were analyzed.

Results: Of the 120 neonates, 68 (56.7%) were males and 72 (60.0%) were preterm. Low birth weight was present in 70 (58.3%) neonates and very low birth weight in 24 (20.0%). Mild thrombocytopenia was observed in 58 (48.3%) neonates, moderate in 38 (31.7%) and severe in 24 (20.0%). Early-onset thrombocytopenia was noted in 62 (51.7%) cases. Sepsis was the commonest associated condition, seen in 59 (49.2%) neonates, followed by respiratory distress syndrome in 34 (28.3%), perinatal asphyxia in 21 (17.5%) and necrotizing enterocolitis in 20 (16.7%). Platelet transfusion was required in 26 (21.7%) neonates. Mortality increased with severity, from 3/58 (5.2%) in mild thrombocytopenia to 8/24 (33.3%) in severe thrombocytopenia.

Conclusions: Neonatal thrombocytopenia is strongly associated with prematurity, low birth weight, sepsis and necrotizing enterocolitis. Increasing severity is associated with worse clinical outcome and higher mortality.

Keywords: Low birth weight, Neonatal thrombocytopenia, NICU, Prematurity, Neonatal sepsis, Outcome

INTRODUCTION

Neonatal thrombocytopenia, defined as a platelet count below 150×10⁹/l, is one of the most common hematological abnormalities encountered in NICUs. It is seen far more frequently in hospitalized and critically ill neonates than in healthy newborns and is especially common among preterm, low-birth-weight and septic infants. In modern neonatal practice, thrombocytopenia is important not only because of the risk of bleeding, but also because it often reflects the presence of significant underlying illness and may predict poorer short-term outcomes. Recent reviews continue to describe neonatal thrombocytopenia as a clinically relevant marker of neonatal stress and disease severity.[1] The mechanisms responsible for neonatal thrombocytopenia are varied and include decreased platelet production, increased platelet destruction and excessive peripheral consumption. Reduced platelet production is more often associated with placental insufficiency, chronic fetal hypoxia, intrauterine growth restriction and maternal hypertensive disorders.[2]

In contrast, increased destruction or consumption is more commonly seen in conditions such as neonatal sepsis, necrotizing enterocolitis (NEC), disseminated intravascular coagulation and severe perinatal illness. Because these mechanisms may overlap, thrombocytopenia in a NICU neonate should be interpreted in the context of the infant's overall clinical condition rather than as an isolated laboratory abnormality.[3] The timing of presentation is clinically useful. Early-onset thrombocytopenia, occurring within the first 72 hours of life, is commonly associated with antenatal and perinatal factors, including maternal preeclampsia, placental insufficiency and fetal growth restriction. This form is often mild to moderate and may resolve with supportive care. Late-onset thrombocytopenia, occurring after 72 hours, is more often related to acquired neonatal conditions, particularly sepsis and NEC and is generally more severe and prolonged.[4]

Severity is usually classified as mild (100–149×10⁹/l), moderate (50–99×10⁹/l) and severe (<50×10⁹/l) and this classification is useful because severe thrombocytopenia is associated with a greater risk of bleeding, a higher transfusion requirement and increased mortality.[5,6] Recent hospital-based studies have shown that thrombocytopenia in NICU settings is strongly associated with prematurity, low birth weight, sepsis, respiratory distress and NEC. A recent large newborn-unit study also confirmed that thrombocytopenia remains common in admitted neonates and that its severity is linked with adverse clinical factors and poorer outcome.[7]

Management of neonatal thrombocytopenia has also changed in recent years. Earlier practice often favored liberal platelet transfusion, especially in preterm infants. However, contemporary evidence supports a more restrictive and individualized approach.[8] The 2025 AABB/ICTMG international guideline recommends platelet transfusion in neonates with consumptive thrombocytopenia and no major bleeding when the platelet count is below 25×10³/µl, highlighting the move toward evidence-based transfusion strategies.[9]

In this background, the present study was undertaken to evaluate the clinical profile, associated risk factors, severity pattern, management and short-term outcome of neonatal thrombocytopenia in a tertiary care NICU. The study also aimed to assess the relationship of thrombocytopenia severity with prematurity, low birth weight, sepsis, NEC, transfusion requirement and mortality.

METHODS

Study design and setting

This was a hospital-based observational study conducted in the neonatal intensive care unit of a tertiary care teaching hospital.

Study period

The study was conducted over a period of 12 months from April 2024 to April 2025.

Study population

All neonates admitted to the NICU during the study period who were found to have thrombocytopenia were considered for inclusion. Neonatal thrombocytopenia was defined as a platelet count <150×10⁹/l on automated hematology analysis.

Sample size calculation

The sample size was calculated using the formula for estimation of a single proportion:

$n=Z^2\times p\times q/d^2$

Using an expected prevalence (p) of 26% based on a recent hospital-based newborn unit study by Farag et al, 202411 and taking absolute precision (d) as 8%, the sample size was calculated as:

n=required sample size

Z=standard normal deviate at 95% confidence level = 1.96

p=expected prevalence of neonatal thrombocytopenia

q=1–p

d=absolute precision

$n=(1.96)^2\times 0.26\times 0.74 / (0.08)^2$

$n=3.84\times 0.1924/0.0064$

$n=0.739/0.0064$

$n=115.5$

The minimum sample size required was 116 neonates. For convenience and completeness of analysis, the sample size was rounded to 120 neonates. The prevalence value used for this calculation is supported by recent NICU/newborn unit data.

Inclusion criteria

Neonates admitted to the NICU during the study period. Neonates with platelet count <150×10⁹/l on at least one blood sample. Both inborn and outborn neonates admitted within the neonatal period. Neonates with complete maternal history, neonatal clinical details, laboratory data, treatment data and final outcome available in the record.

Exclusion criteria

Neonates with incomplete records or missing platelet data. Neonates referred after receiving platelet transfusion elsewhere when pre-transfusion platelet counts were unavailable. Neonates with major congenital anomalies incompatible with survival, where outcome would not be attributable to thrombocytopenia-related illness. Neonates with known inherited thrombocytopenic syndromes or pre-existing hematological disorders already diagnosed before inclusion. Readmissions of the same neonate during the study period, to avoid duplicate data entry.

Operational definitions

Thrombocytopenia was categorized as mild: 100–149×10⁹/l, moderate: 50–99×10⁹/l, severe: <50×10⁹/l

Based on time of onset

Early onset thrombocytopenia: detected within 72 hours of life

Late onset thrombocytopenia: detected after 72 hours of life.

Low birth weight was defined as birth weight <2500 g, very low birth weight as <1500 g and prematurity as gestational age <37 completed weeks.

Data collection

Data were collected using a structured proforma from maternal case sheets, neonatal records, laboratory reports and NICU monitoring charts. The following variables were recorded.

Maternal variables

Maternal age, parity, pregnancy-induced hypertension/preeclampsia, gestational diabetes mellitus, antepartum hemorrhage, prolonged rupture of membranes, fever/infection during pregnancy and autoimmune disorders.

Neonatal variables

Sex, gestational age, birth weight, mode of delivery, place of birth, Apgar score, age at onset of thrombocytopenia and need for resuscitation at birth.

Clinical and laboratory variables

Initial platelet count, nadir platelet count, serial platelet counts, sepsis screen, blood culture status where available, associated diagnoses such as sepsis, respiratory distress syndrome, perinatal asphyxia, NEC, meconium aspiration syndrome, intraventricular hemorrhage, DIC and bleeding manifestations such as petechiae, puncture-site oozing, gastrointestinal bleed, pulmonary hemorrhage and intracranial hemorrhage.

Treatment and outcome variables

Use of antibiotics, respiratory support, platelet transfusion, number of platelet transfusions, duration of NICU stay, discharge and death.

Outcome measures

The primary outcome measures were severity of thrombocytopenia and final outcome at discharge. Secondary outcome measures included association of thrombocytopenia severity with prematurity, low birth weight, sepsis, NEC, bleeding manifestations, platelet transfusion requirement and mortality.

Statistical analysis

Data were entered into Microsoft Excel and analyzed using SPSS version 24. Categorical variables were expressed as frequency and percentage. Continuous variables were expressed as mean±standard deviation. Associations between thrombocytopenia severity and categorical variables were analyzed using the chi-square test or Fisher's exact test where appropriate. A p value <0.05 was considered statistically significant.

RESULTS

A total of 120 neonates (100%) with thrombocytopenia were included in the study. Of these, 68 (56.7%) were males and 52 (43.3%) were females. The mean gestational age was 34.8±2.9 weeks and 72 neonates (60.0%) were preterm while 48 (40.0%) were term. The mean birth weight was 2140±640 g. Low birth weight was present in 70 neonates (58.3%) and 24 (20.0%) had very low birth weight. Thrombocytopenia was detected at a mean age of 3.9±2.4 days. Regarding mode of delivery, 54 neonates (45.0%) were delivered by caesarean section and 66 (55.0%) by vaginal delivery (Table 1).

Among the 120 thrombocytopenic neonates, 58 (48.3%) had mild thrombocytopenia, 38 (31.7%) had moderate thrombocytopenia and 24 (20.0%) had severe thrombocytopenia. Thus, mild thrombocytopenia was the most common category observed in the study. With respect to timing, 62 neonates (51.7%) had early-onset thrombocytopenia detected within the first 72 hours of life, while 58 (48.3%) had late-onset thrombocytopenia. The distribution showed that both early- and late-onset thrombocytopenia contributed almost equally to the overall burden in the NICU (Table 2).

Among maternal risk factors, pregnancy-induced hypertension/preeclampsia was noted in 24 mothers (20.0%), making it the most common maternal association. Prolonged rupture of membranes was present in 16 cases (13.3%), while diabetes mellitus was

observed in 10 cases (8.3%). Maternal infection/fever was noted in 8 cases (6.7%) and antepartum hemorrhage was seen in 6 cases (5.0%). Autoimmune thrombocytopenia/connective tissue disease was the least common maternal factor, present in only 2 cases (1.7%). No identifiable maternal risk factor was found in 54 neonates (45.0%), indicating that neonatal and postnatal causes also contributed substantially (Table 3).

Sepsis was the most common associated neonatal morbidity and was present in 59 neonates (49.2%). Respiratory distress syndrome was the next most frequent condition, seen in 34 neonates (28.3%). Perinatal asphyxia was observed in 21 neonates (17.5%), while necrotizing enterocolitis was found in 20 neonates (16.7%). Meconium aspiration syndrome occurred in 12 cases (10.0%), disseminated intravascular coagulation in 11 cases (9.2%) and intraventricular hemorrhage in 8 cases (6.7%). These findings show that infection and severe systemic neonatal illnesses were major contributors to thrombocytopenia in the study group (Table 4). Out of 120 neonates, 63 (52.5%) were asymptomatic and thrombocytopenia was detected on routine laboratory evaluation. Among symptomatic neonates, petechiae/purpura was the most common manifestation and was present in 24 cases (20.0%). Oozing from puncture sites was seen in 11 neonates (9.2%), while gastrointestinal bleeding occurred in 8 (6.7%). Major bleeding manifestations such as pulmonary hemorrhage and intracranial hemorrhage were each observed in 7 neonates (5.8%). Overall, minor bleeding manifestations were more common than major bleeding events (Table 5).

Preterm birth was seen in 28 of 58 neonates (48.3%) with mild thrombocytopenia, 26 of 38 (68.4%) with moderate thrombocytopenia and 18 of 24 (75.0%) with severe thrombocytopenia, showing a significant increase with severity (p=0.018). Low birth weight was observed in 26 of 58 (44.8%) mild cases, 24 of 38 (63.2%) moderate cases and 20 of 24 (83.3%) severe cases, which was also statistically significant (p=0.002). Sepsis was present in 18 of 58 (31.0%) mild cases, 22 of 38 (57.9%) moderate cases and 19 of 24 (79.2%) severe cases (p<0.001). NEC was noted in 3 of 58 (5.2%) mild cases, 7 of 38 (18.4%) moderate cases and 10 of 24 (41.7%) severe cases (p<0.001). Mortality increased progressively from 3 of 58 (5.2%) in mild thrombocytopenia to 7 of 38 (18.4%) in moderate thrombocytopenia and 8 of 24 (33.3%) in severe thrombocytopenia (p=0.001). These findings indicate that severe thrombocytopenia was significantly associated with prematurity, low birth weight, sepsis, NEC and death (Table 6).

Platelet transfusion was required in 26 neonates (21.7%), indicating that about one-fifth of thrombocytopenic neonates needed platelet support. The mean number of transfusions among those who received platelets was 1.7±0.8. Mechanical ventilation was required in 34 neonates (28.3%), reflecting substantial illness severity in a significant proportion of the study population. The mean duration of NICU stay was 13.6±6.2 days. At the end of hospitalization, 102 neonates (85.0%) recovered and were discharged, while 18 (15.0%) died. Thus, the majority had a favourable outcome, although mortality remained considerable, especially among severe cases.

Table 1: Baseline demographic and perinatal profile of thrombocytopenic neonates.

Variables	N (%) or Mean±SD (n=120)
Male	68 (56.7)
Female	52 (43.3)
Mean gestational age (weeks)	34.8±2.9
Preterm	72 (60.0)
Term	48 (40.0)
Mean birth weight (g)	2140±640
Low birth weight	70 (58.3)
Very low birth weight	24 (20.0)
Cesarean delivery	54 (45.0)
Vaginal delivery	66 (55.0)
Mean age at detection of thrombocytopenia (days)	3.9±2.4

Table 2: Severity and timing of thrombocytopenia.

Variables	N (%) (n=120)
Mild thrombocytopenia	58 (48.3)
Moderate thrombocytopenia	38 (31.7)
Severe thrombocytopenia	24 (20.0)
Early onset (<72 h)	62 (51.7)
Late onset (≥72 h)	58 (48.3)

Table 3: Maternal risk factors.

Maternal factors	N (%) (n=120)
Pregnancy-induced hypertension/preeclampsia	24 (20.0)
Diabetes mellitus	10 (8.3)
Prolonged rupture of membranes	16 (13.3)
Antepartum hemorrhage	6 (5.0)
Maternal infection/fever	8 (6.7)
Autoimmune thrombocytopenia/connective tissue disease	2 (1.7)
No identifiable maternal factor	54 (45.0)

Table 4: Neonatal comorbidities associated with thrombocytopenia.

Neonatal conditions*	N (%) (n=120)
Sepsis	59 (49.2)
Respiratory distress syndrome	34 (28.3)
Perinatal asphyxia	21 (17.5)
Necrotizing enterocolitis	20 (16.7)
Meconium aspiration syndrome	12 (10.0)
Disseminated intravascular coagulation	11 (9.2)
Intraventricular hemorrhage	8 (6.7)

*Multiple conditions may coexist.

Table 5: Clinical manifestations.

Manifestations	N (%)
Asymptomatic thrombocytopenia	63 (52.5)
Petechiae / purpura	24 (20.0)
Oozing from puncture sites	11 (9.2)
Gastrointestinal bleed	8 (6.7)
Pulmonary hemorrhage	7 (5.8)
Intracranial hemorrhage	7 (5.8)

Table 6: Severity of thrombocytopenia versus key clinical variables.

Variables	Mild n=58 N (%)	Moderate n=38 N (%)	Severe n=24 N (%)	P value
Preterm birth	28 (48.3)	26 (68.4)	18 (75.0)	0.01*
Low birth weight	26 (44.8)	24 (63.2)	20 (83.3)	0.01*
Sepsis	18 (31.0)	22 (57.9)	19 (79.2)	<0.001*
NEC	3 (5.2)	7 (18.4)	10 (41.7)	<0.001*
Mortality	3 (5.2)	7 (18.4)	8 (33.3)	0.001*

The data is shown as n (%). * indicates significant (p<005); Chi Square test.

Table 7: Management and outcome.

Outcome variables	N (%) or Mean±SD
Platelet transfusion required	26 (21.7)
Mean number of transfusions	1.7±0.8
Mechanical ventilation	34 (28.3)
Mean duration of NICU stay (days)	13.6±6.2
Recovered and discharged	102 (85.0)
Died	18 (15.0)

DISCUSSION

In the present study, neonatal thrombocytopenia was seen predominantly in vulnerable NICU neonates, with 72/120 (60.0%) being preterm and 70/120 (58.3%) having low birth weight. This pattern is in agreement with recent literature showing that thrombocytopenia is more common in premature and smaller infants. Farag et al

reported a prevalence of neonatal thrombocytopenia in 37.1% of admitted neonates and 69.3% of thrombocytopenic neonates in their cohort were preterm.[10] Their study also reaffirmed the inverse relationship of thrombocytopenia with gestational age and birth weight. The findings therefore support the well-established concept that prematurity and low birth weight are major backgrounds against which neonatal thrombocytopenia develops in intensive care settings. With regard to severity, the data showed 58/120 (48.3%) mild, 38/120 (31.7%) moderate and 24/120 (20.0%) severe thrombocytopenia. This distribution closely resembles contemporary NICU reports in which mild to moderate disease forms the majority and severe thrombocytopenia accounts for roughly one-fifth of cases. Dahat et al also noted that most NICU neonates had mild to moderate thrombocytopenia and cited severe thrombocytopenia in about 20% of affected neonates.[11] Similarly, Al Ghadeer et al found that among low-birth-weight neonates, 38/72 (52.8%) had mild, 20/72 (27.8%) had moderate and 14/72 (19.4%) had severe thrombocytopenia, which is strikingly similar to the pattern observed in the present study.[12]

In the study 62/120 (51.7%) neonates had early-onset thrombocytopenia and 58/120 (48.3%) had late-onset thrombocytopenia. This nearly equal distribution differs somewhat from some recent studies where late-onset thrombocytopenia predominated, especially in sepsis-heavy cohorts. Dahat et al reported 34/100 (34.0%) early-onset and 66/100 (66.0%) late-onset thrombocytopenia, while Farag et al reported 69% early-onset and 31% late-onset thrombocytopenia.[10,11] These differences across studies likely reflect variation in case mix, referral patterns, maternal risk factors and the relative burden of sepsis and NEC in different NICUs. In the cohort the balanced split between early and late onset suggests that both antenatal/perinatal causes and postnatal illnesses contributed substantially.

Among maternal risk factors in the present study, pregnancy-induced hypertension/preeclampsia was the leading factor, present in 24/120 (20.0%) mothers, followed by prolonged rupture of membranes in 16/120 (13.3%) and diabetes mellitus in 10/120 (8.3%). This is biologically and clinically plausible, as placental insufficiency and chronic fetal hypoxia are well-recognized contributors to early thrombocytopenia. Recent studies have continued to link maternal hypertensive disease, fetal growth restriction and thrombocytopenia, particularly in early-onset disease. In a study done by Tirupathi et al the most common risk factor was pregnancy induced hypertension in 13.5% neonates followed by PROM in 7.5% of the neonates.[13] In the present study, sepsis was the commonest associated neonatal condition, seen in 59/120 (49.2%) neonates, followed by RDS in 34/120 (28.3%), perinatal asphyxia in 21/120 (17.5%) and NEC in 20/120 (16.7%). Similarly in a study done by Ribeiro et al, the sepsis is the most common etiology factor the neonatal thrombocytopenia.[14] In their study they also reported that the gram-negative bacteria sepsis is the major cause for severe thrombocytopenia. Likewise Shan et al also reported that the sepsis accounted for 32.7% of deaths, while birth asphyxia and NEC accounted for 19.2% and 17.3% respectively.[15] The findings therefore closely mirror the dominant etiologic role of sepsis, respiratory illness and NEC described in recent studies.

Clinically, 63/120 (52.5%) neonates in our study were asymptomatic, while 24/120 (20.0%) had petechiae or purpura, 11/120 (9.2%) had puncture-site oozing and major bleeding manifestations such as pulmonary hemorrhage and intracranial hemorrhage were each seen in 7/120 (5.8%) neonates. This pattern is again comparable with current literature, which shows that many thrombocytopenic neonates are diagnosed on routine counts rather than overt bleeding. However, the risk of hemorrhage rises sharply in severe disease and in infants with NEC, sepsis or coagulopathy. Shan et al reported that 120/194 (61.9%) neonates with severe thrombocytopenia had hemorrhage and that neonates with NEC had the highest incidence of hemorrhage at 58.8%.[15] Likewise, Farag et al identified pulmonary hemorrhage and severe intraventricular hemorrhage as major mortality predictors in thrombocytopenic neonates.[10] These published findings support the clinical importance of the bleeding events observed in the severe subgroup.

A key finding in the study was the progressive worsening of clinical profile with increasing severity of thrombocytopenia. Preterm birth increased from 28/58 (48.3%) in mild disease to 18/24 (75.0%) in severe disease. Low birth weight rose from 26/58 (44.8%) in mild cases to 20/24 (83.3%) in severe cases. Sepsis increased from 18/58 (31.0%) in mild thrombocytopenia to 19/24 (79.2%) in severe thrombocytopenia and NEC rose from 3/58 (5.2%) to 10/24 (41.7%). These findings are in line with Al Ghadeer et al who showed that full-term and normal-birth-weight neonates were more likely to have mild thrombocytopenia, whereas severity increased significantly in lower birth weight groups; for example, only 10/118 (8.5%) normal-birth-weight neonates had severe thrombocytopenia compared with 14/72 (19.4%) low-birth-weight neonates.[12] In a study done by Sheeja et al prematurity neonates are higher in mild thrombocytopenia cases and the neonatal sepsis is higher in moderate to severe thrombocytopenia cases.[16]

Outcome in the study was also closely linked to severity. Overall, 102/120 (85.0%) neonates recovered and were discharged, while 18/120 (15.0%) died. Mortality increased from 3/58 (5.2%) in mild thrombocytopenia to 7/38 (18.4%) in moderate disease and 8/24 (33.3%) in severe thrombocytopenia. This gradient is very similar to published data. Al Ghadeer et al reported mortality rates of 5.3% in mild, 21.8% in moderate and 25.7% in severe thrombocytopenia, with a significant association between thrombocytopenia severity and clinical outcome.[12] Getaneh et al reported an overall mortality of 21.9%

among thrombocytopenic neonates, while Shan et al reported a still higher overall mortality of 26.8% in severe neonatal thrombocytopenia.[15,17] Farag et al reported an even higher mortality of 43.2% among thrombocytopenic neonates in their tertiary referral setting, with mortality rates of 61.7% in severe, 41.8% in moderate and 38.2% in mild thrombocytopenia.[10] Compared with these studies, the overall mortality appears lower, but the consistent stepwise increase with severity remains in excellent agreement with the literature. In the present study, 26/120 (21.7%) neonates required platelet transfusion (mean 1.7±0.8 transfusions) and 34/120 (28.3%) required mechanical ventilation. These findings reflect the substantial illness burden carried by thrombocytopenic NICU neonates. Recent evidence has increasingly favored restrictive platelet transfusion practices, especially in non-bleeding neonates, because thrombocytopenia is often more a marker of disease severity than an isolated transfusion trigger. Previous studies have continued to emphasize that platelet transfusion decisions should be individualized based on bleeding, platelet nadir, sepsis, NEC and overall clinical instability rather than on platelet count alone.[18-20] The results, showing transfusion concentrated in a minority of patients while severity still strongly tracked with mortality, are consistent with the current evidence-based approach.

This study was conducted in a single tertiary care NICU, which may limit the generalizability of the findings. The study assessed only short-term in-hospital outcomes and long-term neurodevelopmental follow-up was not available. In addition, platelet transfusion practices and associated conditions may vary across institutions, potentially influencing outcome comparisons.

CONCLUSION

Neonatal thrombocytopenia is a common and clinically significant problem in NICU-admitted neonates, particularly among preterm and low-birth-weight infants. Sepsis, respiratory distress syndrome, perinatal asphyxia and necrotizing enterocolitis were the major associated conditions in the present study. Increasing severity of thrombocytopenia was associated with higher transfusion requirement, greater clinical morbidity and increased mortality. Early recognition, careful etiological evaluation and appropriate monitoring are essential for improving neonatal outcomes.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

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Cite this article as: Nooreen, Kulkarni N, Indi S, Ukkali SB, Jeergal NA, Malagi N, et al. Clinical profile and outcome of neonatal thrombocytopenia in a tertiary care neonatal intensive care unit. Int J Contemp Pediatr 2026;13:1378-85.