Original Article

The study of hematological profile in preterm low birth weight neonates

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Abstract

Background: Hematological parameters like Hemoglobin, WBC count, and Platelet count are used to evaluate complications of Preterm LBW neonates. These parameters are affected by factors like prematurity complications, late umbilical cord clamping, sample collection time. NS is associated with neutropenia and thrombocytopenia. PNA changes hematological parameters. RDS neonates have insufficient or dysfunctional surfactant leading to low oxygen levels and hypoxia, affecting hematological parameters. The study aims to determine the hematologic profile of preterm neonates in relation to these conditions.

Methods: The study was conducted in a tertiary care center. This prospective observational study included all Preterm LBW neonates admitted in NICU. Laboratory investigation of CBC was done using automated Sysmex- XT- 2000i counter.

Results: A total of 638 preterm infants were included in this study who were admitted in NICU. All the patients CBC were determined. In this study, main causes for admission of preterm LBW neonates were NS, PNA, RDS and others (convulsions, Rh incompatibility, meningitis, pyloric stenosis, Downs syndrome). This study constitutes 58% (264) cases of NS, 23% (168) cases of PNA, 10% (126) cases of RDS and 9% (80) cases due to other causes.

Conclusion: Routine haematological screening for preterm LBW neonates must be implemented, with special attention to the high risk cases of NS, PNA and RDS. Early identification and management of haematological abnormalities are crucial. Therefore, by enhancing our understanding and management of these conditions, we can significantly improve prognosis and quality of life for these neonates.

Keywords: Neonatal sepsis; preterm; low birth weight neonates; Perinatal asphyxia; hematological profile; Respiratory distress syndrome

Introduction

The hematological parameters like Hemoglobin level, WBC count and Platelet count are commonly used diagnostic parameters to evaluate preterm low birth weight neonates. These rapid screening tests are easily available and give good sensitivity and negative predictive values.

Hematological parameters are affected by factors like prematurity complications, late clamping of umbilical cord, time of sample collection and by hypothermia, asphyxia and other prematurity related problems.

The outcome of preterm neonates is based on the variation in the values of each hematologic parameters. However, the hematological parameters of preterm neonates is not well known and well understood and thus, the normal values of term neonates are often used as the standards.

The most significant factor associated with neonatal sepsis is prematurity. Ominous prognosis can be suspected if neutropenia is a significant finding in septicemic neonates. Thrombocytopenia is a late sign of sepsis. Inflammation occurring in septicemic neonates will impair iron metabolism and then affect erythropoiesis leading to anemia.

Perinatal asphyxia in a neonate will first show changes in hematological parameters within the first hour of delivery and then systemic changes will be evident. Amongst the hematological parameters, the prognosis is related to the total WBC count.

Respiratory distress syndrome neonates have insufficient or dysfunctional surfactant leading to low oxygen levels and hypoxia. This can significantly affect the hematological parameters.

Complications of prematurity and its effects on hematological parameters are not well- known. Therefore, the aim of this study is to determine the hematologic profile of preterm neonates with respect to sepsis, asphyxia, respiratory distress syndrome and other causes.

Materials and Methods

The study was conducted in a tertiary care center. This prospective observational study included all preterm babies delivered in the hospital and were referred before 7 days of life, during the 18 months study period.

For the analysis, laboratory investigation of complete blood count (CBC) was done using automated Sysmex- XT- 2000i counter.

A 2 mL blood sample was taken in an EDTA vacutainer and was processed for HGB, WBC, and platelet count with an automated machine. The normal WBC count for newborns is reported to range from 9000 to 30000 cells/mm3 at the time of birth and for this study, leukopenia refers to a WBC count <5000 cells/mm3. At birth, normal values for the HGB in infants of >34 weeks' gestational age are 14 to 20 g/dL, with an average value of 17 g/dL. The platelet count varies based on gestational age. The mean platelet count is reported to be $\geq 200 \times 103/\mu$L in most preterm infants, and the 5th percentile is found to be $104 \times 103/\mu$L for those $\leq$32 weeks' gestation, and $123 \times 103/\mu$L for late preterm and term neonates. Neonatal thrombocytopenia is defined as a platelet count of $<150 \times 103/\mu$L and is classified as mild ($100149 \times 103/\mu$L), moderate ($5099 \times 103/\mu$L), or severe($<50 \times 103/\mu$L). Other investigations were done as clinically indicated.

Reference range: Anemia: Hemoglobin <15 mg/dl, Polycythemia: Hemoglobin >22 mg/ dl, Leukocytosis: WBC count >25000 cells/cumm, Leukopenia: WBC count < 5000 cells / cumm, Thrombocytosis: Platelet count > 4.5 L / cumm, Thrombocytopenia: Platelet count < 1.5 L/ cumm [1]

Results

A total of 638 preterm infants were included in this study who were admitted in NICU. CBC was evaluated in all the patients. In this study, main causes for admission of preterm low birth weight neonates were NS, PNA and RDS. Other causes were convulsions, Rh incompatibility, meningitis, pyloric stenosis, Downs syndrome. This study constitutes 58% (264) cases of NS, 23% (168) cases of PNA, 10% (126) cases of RDS and 9% (80) cases due to other causes. Hematological parameter study results were tabulated in detail.

Table 1: Hemoglobin Range

Range (mg/dL)	Neonatal sepsis	Perinatal asphyxia	RDS	Others
< 7	12 (4.5%)	18 (10.7%)	06 (4.8%)	03(3.8%)
$7- < 10$	12 (4.5%)	36 (21.4%)	06(4.8%)	09(11.2%)
$10- < 15$	146 (55.3%)	40 (23.8%)	18(14.3%)	22 (28.0%)
15–22	80 (30.3%)	68 (40.5%)	90(71.4%)	34(43.0%)
> 22	14 (5.3%)	06 (3.6%)	06(4.8%)	12(15.0%)
Total (638)	264 (100%)	168(100%)	126(100%)	80(100%)

Table 2: Total WBC count

Range (cells /mm3)	Neonatal sepsis	Perinatal asphyxia	RDS	Others
< 5000	12(4.5%)	12(7.1%)	12(9.5%)	06(7.5%)
$5000- < 9100$	24(9%)	21(12.5%)	12(9.5%)	06(7.5%)
$9100 - 25000$	162(61.4%)	108(64.3%)	84(66.4%)	46(57.5%)
> 25000	66(25%)	27(25%)	18(14.3%)	22(22%)
Total	264(100%)	168(100%)	126(100%)	80(100%)

Table 3: Platelet count

Range (cells /mm3)	Neonatal sepsis	Perinatal asphyxia	RDS	Others
< 50000	36 (13.6%)	42(25.0%)	06(4.8%)	06(7.5%)
$50,000 - 100000$	54(20.5%)	42(25.0%)	24(19.0%)	12(15.0%)
$100000- \leq 150000$	90(34.1%)	36(21.4%)	24(19.0%)	22(27.5%)
$150000 - 450000$	72(27.3%)	39(23.2%)	54(42.9%)	34(42.5%)
> 450000	12(4.5%)	09(5.4%)	18(14.3%)	06(7.5%)
Total	264 (100%)	168 (100%)	126 (100%)	80 (100%)

Table 4: Neutrophil count range

Range	Neonatal sepsis	PNA	RDS	Others
< 25	50 (18.9%)	08(4.8%)	10(7.9%)	10(12.5%)
$25 - 45$	160(60.6%)	100(59.5%)	60(47.645 − 65	36(13.6%)
50(29.7%)	36(28.5%)	30(37.5%)		
> 65	18(6.8%)	10(5.9%)	20(15.9%)	10(12.5%)
Total	264 (100%)	168 (100%)	126 (100%)	80 (100%)

Discussion

This study of blood counts in total 638 preterm neonates constitutes 64 (58%) cases of NS, 23% (168) cases of PNA, 10% (126) cases of RDS and 9% (80) cases were due to other causes.

Sepsis leads to anemia through bone marrow dysfunction or bleeding and hemolysis. HBG levels less than 15 mg/dl were observed in 40.4% (258) of neonates and had a significant association with NS, RDS and PNA. In a cross- sectional study conducted by Tiruneh Adane et al on 143 neonates with sepsis, anemia was noted in 70 / 143 (49%) neonates with neonatal sepsis, showing similar prevalence to current study. [2]

In a study conducted by Ramesh R Pol et al on 180 neonates with perinatal asphyxia, anemia was observed in 28% of neonates nearly similar to the current study. [3]

Hematologic abnormalities in leucocyte count is expected abnormality in NS. When severe, the WBC count maybe either below or high (<5000 / cumm or >25000/cumm). Neutrophils are mobilized from bone marrow to site of infection. Also there is decreased apoptosis due to decreased caspase 3 and NFKB activation. Hence, lifespan of neutrophils increase which plays a crucial role as first line of defense against invading microbes. In this study nearly 4.5% of NS neonates had WBC count <5000/cumm and 25% of neonates had leukocytosis with WBC count >25000/cumm. A study done by Panwar et al in both term and preterm infants that showed a leukocytosis rate of 30.5% for blood culture positive infants and a leukocytosis rate of 20.4% for blood culture negative infants which was similar to the current study. [2] In a study done by Vandana et al, showed leukopenia of < 5000 cells / cumm in 25% of neonates with septicemia. [4]

Thrombocytopenia can be an early marker of neonatal sepsis and it usually progresses rapidly, reaching its lowest within 24-48 hours. Thrombocytopenia occurs due to bone marrow dysfunction or bleeding (petechiae, purpura, oozing) and hemolysis. In the present study, lower counts were found in 68.2 % of preterm infants with Neonatal Sepsis, of which 13.6 % had platelet counts less than 50,000 cells/mm3. In a study conducted by Bhat et al on 131 culture proven sepsis neonates, thrombocytopenia was found in 41.7 % of neonates with sepsis which was less than the current study.[5]

A Alam et al study revealed that babies with perinatal asphyxia may have hematological abnormalities, and that complete blood counts (CBCs) is useful in managing the condition and hematological changes if detected early [6]

In this study, 7.2% of the study subjects were diagnosed with PNA and anemia was seen in 34.5% of neonates and 10.7 % were severely anemic. Ramesh R Pol et al study was done on 180 neonates with perinatal asphyxia and concluded that anemia was observed in 28% of neonates nearly convergent to the current study.[3]

In the present study, leucocytosis was observed in 16.1% neonates with perinatal asphyxia whereas leucopenia was observed in 7.1 % of neonates with perinatal asphyxia. In a study conducted by Mohammad et al, on 57 asphyxiated neonates the leukocyte counts were higher in 15 % of neonates which was similar to the present study. [7]

In the present study, decreased platelet count was seen in 71.4 % of neonates with perinatal asphyxia whereas in a study by Phelan et al and Boutaybi N et al showed thrombocytopenia in 36.8% and 37.5 % , respectively which was lesser as compared to present study.[8, 9]

The occurrence rate of RDS in preterm neonates was 51.3 % and the highest rates were demonstrated within groups of extremely preterm and extremely low birth weight neonates and the WBC count of the neonates with RDS was less than 5000 cells/mm3 for 9.5% and above 25000 cells/mm3 for 14.3%. In this study, both low and high WBC counts, anemia and thrombocytopenia were significantly associated with RDS. [10]

The platelet count of neonates with RDS was less than 50000 cells/mm3 and between 50000 and 100000 cells/mm3 for 4.8% and 19% of babies, respectively which is similar to the study conducted by Aboli dahat et al on The Etiological Profile of Neonatal Thrombocytopenia in Neonates observed that 21% of the neonates with respiratory distress syndrome had thrombocytopenia whereas in a study conducted by Al Ghadeer et al, on 242 neonates with thrombocytopenia, only 8.2% of neonates with respiratory distress syndrome had thrombocytopenia.[11, 12]

In the present study, leucopenia was observed in 4.8% of neonates diagnosed with RDS whereas in a study done by Mansoor Aslamzai et al, 51.3% of preterm neonates admitted to the NICU, were associated with leucopenia [13]

In the current study, neutropenia was observed in 7.9% of neonates diagnosed with RDS. Also in a study conducted by Ferreira PJ et al, neutropenia was observed in 42% neonates with RDS [14]

The key findings in this study were:

- A significant proportion of preterm LBW neonates exhibited haematological abnormalities such as anemia, thrombocytopenia and neutropenia, leucocytosis in preterm low birth weight neonates.
- The study identified a strong association between haematological abnormalities and neonatal conditions such as neonatal sepsis, perinatal asphyxia and respiratory distress syndrome.
- These conditions further exacerbate the vulnerability of preterm LBW neonates and contribute to adverse outcomes.

Conclusion

Routine haematological screening for preterm LBW neonates must be implemented, with special attention to the high risk cases of NS, PNA and RDS. Early identification and management of haematological abnormalities in preterm LBW neonates with NS, PNA and RDS are crucial. Standardized guidelines for the management of identified haematological issues should be developed to ensure consistent and effective care. Therefore, by enhancing our understanding and management of these conditions, we can significantly improve prognosis and quality of life for these neonates.

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