ORIGINAL RESEARCH

A study on hematological parameters in low birth weight babies

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Received: 02Sept, 2023 Accepted: 25Sept, 2023

ABSTRACT
Dramatic changes occur in the blood and bone marrow of the newborn during the first hours and days after birth and there are rapid fluctuations in the quantities of all hematologic elements. The values of most of the hematological parameters i.e mainly hemoglobin concentration, packed cell volume, reticulocyte count and red cell indices are highest on the first day of life and thereafter declines over the third day and the sixth week of life. There was daily visit to the Baby care clinic and postnatal care (PNC) ward. Neonates were examine in postnatal care ward & Baby care clinic and the parents were explain about the purpose of study. Those parents who satisfy inclusion criteria and ready for the study after counseling, their neonates were enrolled in the study and after taking informed consent from parents. Around 2 ml of venous blood was collected from baby under aseptic conditions and the sample was send to the lab for analysis. In the present study, the mean value of hemoglobin (Hb) was 13.1 ± 1.7 gm/dl (range 7.2 to 16.9 gm/dl), while 75.9% neonates had Hb level between 12-17 gm/dl and 24.1% had Hb level below 12 gm/dl. However, the mean values of Hb were significantly higher in 14-21 days old neonates compared to 22-28 days old neonates ($p<0.05$), but there was no significant difference between mean Hb levels of males and females.

Key words: Low birth weight babies, hematological parameters, hemoglobin

INTRODUCTION

Neonatal death among infants weighing 1500–2500 grams is 20 times higher than among infants of normal weight. LBW is considered as the single most important predictor of infant mortality, mainly of deaths within the first months of life. It is also a significant determinant of infant and childhood morbidity, mainly ofneurodevelopmentimpairmentsuchasmentalretardation andlearningdisability.[1] LBW infants are also at greater risk of neuro-sensory disabilities suchas mental retardation, seizure disorders, cerebral palsy, or learning disabilities. The percentage of neonatal deaths because of LBW differs depending upon the quality of care available and the prevalence of LBW. Normally, the better the quality of neonatal care the higher the ratio of death attributable to LBW. In developed countries, around 30% to 50% of neonatal death were caused by LBW but amongst these patients, the mortality was confined to the extremely premature babies.[2]

Dramatic changes occur in the blood and bone marrow of the newborn during the first hours and days after birth and there are rapid fluctuations in the quantities of all hematologic elements. The values of most of the hematological parameters i.e., mainly hemoglobin concentration, packed cell volume, reticulocyte count and red cell indices are highest on the first day of life and thereafter declines over the third day and the sixth week of life. Low birth weight (LBW) infants have diminished iron reserves and are at greater risk of developing iron deficiency. Iron supplementationwasrecommendedinLBWinfantsfrom 2monthsof age. However, in developing countries two thirds of LBW infants are born at full term but are growth restricted. Since iron transfer was believed to be related to gestational age, and similar iron nurture had been shown in small for gestational age (SGA) and appropriate for gestational age (AGA) babies.[3]

Factor responsible for decline in hematological parameters in the newborn aredecreaseinblooderythropoietinconcentrationsoonafterbirth,reducingtheerythropoietin rate. In addition, transient hemolysis is higher during the first few weeks after birth as compared to other.[4]

METHODOLOGY

STUDY DESIGN: Cross-sectional study.

STUDY POPULATION: Low birth weight neonates of the 14-28 days age who have history of delivery after term pregnancy attending Hospital.

SAMPLE SIZE: Total 245 LWB neonates were included.

STUDY TOOLS: Pre designed semi-structured questionnaire.

STUDY PERIODS: Data collected for a period of 2 years.

SAMPLE SIZE: Two hundred forty five cases meeting the criteria were included for the present study.

SAMPLING TECHNIQUE: Convenient sampling methods.

PARTICIPANT ENROLMENT

INCLUSION CRITERIA

- Term healthy low birth weight (LBW) babies of weight less than 2500 gm.
- Term neonates of 2 to 4 weeks of age.
- Exclusive breastfeed neonates.

EXCLUSION CRITERIA

Patients with below mentioned were excluded from the study

- Formula fed babies.
- Mothers with RH incompatibility.
- No history of NICU admission.
- Mothers with post-partum hemorrhage.

There was daily visit to the Baby care clinic and postnatal care (PNC) ward. Neonates were examine in postnatal care ward & Baby care clinic and the parents were explain about the purpose of study. Those parents who satisfy inclusion criteria and ready for the study after counseling, their neonates were enrolled in the study and after taking informed consent from parents. Around 2 ml of venous blood was collected from baby under aseptic conditions and the sample was send to the lab for analysis.

RESULTS

Table 1: Hematological parameters in LBW neonates

Hematological parameters	Minimum	Maximum	Mean	SD
Hemoglobin (gm/dl)	7.2	16.9	13.1	1.7
Total leucocyte count per ml	3600	17000	8192.2	2541.8
Platelet count (lakh/ml)	2.0	7.0	2.83	0.86
Packed cell volume (PCV)	23.1	51.5	40.4	5.7
Mean corpuscular volume (MCV, fl/red cell)	79.8	111.6	93.7	6.6
Mean corpuscular hemoglobin (MCH, pictograms/red cell)	25	45.4	34.6	3.3
Mean corpuscular Hb concentration (MCHC, gm/dl)	30.1	44.2	34.1	2.3

In present study among small for the gestational age babies, mean value of hemoglobin was 13.1 ± 1.7 gm/dl with minimum 7.2 gm/dl and maximum 16.9 gm/dl. Mean value of total leucocyte count was 8192.2 ± 2541.8 per ml with minimum 3600/ml and maximum 17000/ml. Mean value of platelet count was 2.83± 0.86 lakhs per ml with minimum 2.0 lakhs/ml and maximum 7.0 lakhs/ml. Mean value of total PCV was 40.4% ± 5.7% with minimum 23.1% and maximum 51.5%.

Mean value of MCV was 93.7 ± 6.6 fl/red cell with minimum 79.8 fl/red cell and maximum 111.6 fl/red cell. Mean value of MCH was 34.6 ± 3.3 picograms/red cell with minimum 25 picograms/red cell and maximum 45.4 picograms/red cell. Mean value of MCHC was 34.1 ± 2.3 gm/dl with minimum 30.1 gm/dl and maximum 44.2 gm/dl.

Table 2: Distribution of neonates based on hemoglobin level

Hemoglobin level	No of neonates	Percent
< 12 gm/dl	59	24.1
12-17 gm/dl	186	75.9
> 17 gm/dl	0	0
Total	73	100.0

In present study, more than three fourth of neonates (75.9%) had hemoglobin level between 12-17 gm/dl (n=186) and remaining 24.1% neonates had hemoglobin level below 12 gm/dl (n=59).

Table 3: Distribution of neonates based on total leucocyte count

Total leucocyte count	No of neonates	Percent
< 5150/ml	14	5.7
5150-22000/ml	231	94.3
> 22000/ml	0	0

Total	245	100.0

In present study, majority of the neonates (94.3%) had total leucocyte countbetween 5150-22000 per ml (n=231) and remaining 5.7% neonates had total leucocyte count below 5150/ml (n=14).

Table 4: Distribution of neonates based on Platelet level

Platelet level	No of neonates	Percent
< 1.5	0	0
1.5-4.5 lakhs/ml	237	96.7
> 4.5 lakhs/ml	20	3.3
Total	245	100.0

In present study, majority of neonates (96.7%) had platelet level between 1.5-4 lakhs per ml (n=225) and remaining 3.3% neonates had platelet level more than 4 lakhs/ml (n=20).

Table 5: Distribution of neonates based on Mean Corpuscular Volume (MCV)

Mean Corpuscular Volume (MCV)	No of neonates	Percent
< 93.3 fl/red cell	112	45.7
93.3-118.3 fl/red cell	133	54.3
> 118.3 fl/red cell		
Total	245	100.0

In present study, more than half of neonates (54.3%) had Mean Corpuscular Volume (MCV) between 93.3-118.3 fl/red cell (n=133) and remaining 45.7% neonates had MCV below 93.3 fl/red cell (n=112).

Table 6: Distribution of neonates based on Mean Corpuscular Hemoglobin

Mean Corpuscular Hemoglobin (MCH)	No of neonates	Percent
<30.8 picograms/red cell	15	6.1
30.8-39.2 picograms/red cell	214	87.3
> 39.2 picograms/red cell	16	6.5
Total	245	100.0

In present study, more than four fifth of neonates (87.3%) had Mean corpuscular hemoglobin (MCH) between 30.8-39.2 picograms/red cell (n=214) and 6.5% neonates had MCH > 39.2 picograms/red cell (n=16) and 6.1% neonateshad MCH < 30.8 picograms/red cell.

Table 7: Distribution of neonates based on MCHC

Mean Corpuscular Hemoglobin Concentration (MCHC)	No of neonates	Percent
< 28.2 gm/dl	0	0
28.2-36.7 gm/dl	228	93.1
> 36.7 gm/dl	17	6.9
Total	245	100.0

In present study, majority of neonates (93.1%) had Mean corpuscular hemoglobin concentration (MCHC) between 28.2-36.7 gm/dl (n=228) and 6.9% neonates had MCHC > 36.7 gm/dl (n=17).

DISCUSSION

In the present study, the mean value of hemoglobin (Hb) was 13.1 ± 1.7 gm/dl (range 7.2 to 16.9 gm/dl), while 75.9% neonates had Hb level between 12-17 gm/dl and 24.1% had Hb level below 12 gm/dl. However, the mean values of Hb were significantly higher in 14-21 days old neonates compared to 22-28 days old neonates (p<0.05), but there was no significant difference between mean Hb levels of males and females. Although, the mean value of PCV was 40.4% ± 5.7% (range 23.1% to 51.5%), which was significantly higher in 14-21 days old neonates compared to 22-28 days old neonates (p<0.05), but no significant difference was observed between males and females.

The mean hemoglobin level in Patidar *et al*. [5] study was significantly higher in SGA babies (16.4±2.8 gm/dl) compared to AGA babies (15±2 gm/dl). The hematocrit and RBC count were also significantly higher among SGA babies (43.1±8.4% and 4.3±0.7* 106/L respectively). While the mean serum ferritin was significantly lower in SGA babies compared to AGA babies, serum iron was not significantly lower in SGA babies. They finally concluded that even though the Hb content was higher in SGA neonates, they were deficient in iron stores at birth, suggested by lower serum ferritin level.

A study by Maria Proytcheva6 had found that mean hemoglobin level was higher in 2-3 weeks old healthy term babies (15.6±2.6 gm/dl) compared to 3-4 week old babies (14.2±2.1 gm/dl). They also found that mean values of hematocrit were higher in 2-3 week old babies (54% ± 8.3%) compared to 3-4 week old babies (43% ± 2.1%). Both the hemoglobin and hematocrit values decreased in 3-4 week old healthy term babies compared to 2-3 week old babies, which was comparable with SGA babies in the present study. Ozyurek *et al*. [7] had found higher mean values of normoblast count, Hb, hematocrit, and RBC count among SGA neonates compared to AGA neonates onfirst day of life. Though, on 7th day no significant difference in the mean values of Hb, hematocrit, normoblast count, and RBC count in both the groups. From 1st day to 7th day, SGA babies had shown significantly higher change in these parameters compared to AGA babies. Fustolo-Gunnink *et al*. had found erythroblastosis in 43% SGA babies compared to 10% AGA babies and leukocytopenia was found in 21% SGA babies compared to 6% AGA neonates.

Aggarwal *et al*. 8 had found that iron supplementation in a therapeutic dose in breast fed term LBW infants resulted in marginal improvement in Hb status at one month (4.6 gm/L) and two months (8.6 gm/L) follow up. Various other studies conducted by Nunes *et al.*, Maconi *et al.* and Karaduman *et al.* had found mean values of Hb, Hct and RBC count were significantly higher among SGA neonates compared to AGA neonates. This could be attributed to the fact that chronic fetal hypoxia due to poor placental function lead increase in erythropoiesis among SGA neonates.

Previous studies done by Mukhopadhyay *et al.* [9] and Chockalingam *et al.* [10] had also concluded that term SGA babies had poor total iron reserve compared to gestational age matched AGA babies at birth. Intrauterine growth restriction (IUGR) may lead to iron shortage because of placental vascular insufficiency mediated impairment in iron transportation and raised iron requirement for the augmentedfetal erythropoiesis secondary to chronic hypoxia. Mukhopadhyay *et al.* [9] had also found that serum ferritin levels in umbilical cord blood were significantly lower in SGA babies compared to AGA babies. The proportion of neonates with 'low' umbilical cord blood ferritin levels (<40 μg/l) were significantly more in SGA. While at weeks of life, serum ferritin levels became similar in both the groups.

In the current study, the mean value of total leucocyte count (TLC) was 8192.2± 2541.8 per ml (range of 3600/ml to 17000/ml), while 94.3% neonates had TLC between 5150-22000/ml and 5.7% had TLC <5150/ml. However, the mean value of TLC showed no statistical significant difference between males and females. A study completed in Turkey by Ozyurek *et al*. [3] had found that among SGA newborns, 21.9% had neutropenia and 4.7% had absolute neutrophil counts less than 1500/µl on day 1. On both day 1 and day 7, SGA babies had higher mean absolute meta-myelocyte counts and higher mean I: T ratio (immature: total neutrophil ratio) compared to AGA babies. On day 7, SGA babies had mean absolute lymphocyte count lower compared to AGA babies.

Contrasting results were found by Christensen *et al.* [11] in United states, they foundthatinSGAbabiesneutropeniawassignificantlymorecommon(6%)compared to matched controls of non-SGA babies (1%). They found that higher nucleated red cells at birth significantly correlated with lower neutrophils. Neutropenic SGA babies (64%) also had associated thrombocytopenia. Neutropenia of SGA babies persisted for 1-week duration, which was closely related to SGA than maternal hypertension. Finally, they speculated that neutropenia in SGA babies was because of decrease in neutrophil production, not because of higher neutrophil utilization or destruction. This speculation was based on the normal I/T ratios.

A Turkish study done by Ozyurek *et al*. [7] had found that mean values of total WBC counts in the SGA babies on first to seventh days was not statistically different from the parallel values in AGA babies. On first day, SGA babies had significantly lower absolute neutrophil count compared to AGA babies but there was no significant difference on seventh days. On first day, 21.9% SGA babies had absolute neutrophil counts <4000/ll.

In the present study, the mean value of platelet count was 2.83 ± 0.86 lakh/ml (range 2 to 7 lakh/ml, while 96.7% SGA neonates had platelet levels between 1.5-4 lakhs/ml and 3.3% had platelet levels >4 lakh/ml. However, the mean platelet count showed no statistically significant difference between males and females.

Lower platelet count was found in SGA babies in a study conducted by Wasiluk *et al*. [12]. They found that SGA babies had lower platelet count (2.38 lakh/ml) compared to AGA babies (2.86 lakh/ml). They also found differences in values of platelet hematocrit; mean platelet volume, large platelet count and platelet distribution in SGA and AGA babies. They concluded that lower platelet count, platelet hematocrit and large metabolically active platelet count were observed in their study.

Ozyurek *et al.* [7] found thrombocytopenia in almost one-third SGA babies tested on first day. However, SGA babies had significantly higher platelet counts compared to AGA babies on both first and seventh days. Fustolo-Gunnink *et al.* found somethrombocytopeniain 53% SGA babies compared to AGA babies (20%), severe thrombocytopenia was found in 8% SGA babies and 1% AGA babies. Many other studies had also noted that small for gestational age babies had higher risk for developing thrombocytopenia.

In the present study, the mean value of Mean Corpuscular Volume (MCV) was 93.7±6.6 fl/red cell (range 79.8 to 111.6 fl/red cell), while 54.3% neonates

had MCV between 93.3-118.3 fl/red celland 45.7% had MCV <93.3 fl/red cell.

However, Mean MCV values was significantly higher in 14-21 days old neonates comparing to 22-28 days old neonates (p<0.05), but no statistically significant difference was observed between males and females.

A study in New Delhi by Patidar *et al*. found non-significantly higher mean values for MCV and RDW among SGA neonates (94±8 fl/cell and 16.5±0.8% respectively) compared to AGA neonates (92.7±8.1 fl/cell and 16.2±0.8% respectively). They concluded that higher mean values of MCV in SGA babies were because of release of large numbers of immature erythrocytes from the bone marrow into peripheral blood during raised fetal erythropoietin activity. A study in Chicago by Maria Proytcheva found that the mean MCV values were higher in 2-3week old healthy term babies (111 ± 8.2 fL) compared to 3-4 week old babies (105 ± 7.5 fL), this was comparable with SGA babies in the present study. A study by Ozyurek *et al*. [7] showed that the SGA babies had significantly higher mean value of MCV on first and seventh days compared to AGA babies.

In the present study, the mean value of MCH (Mean corpuscular hemoglobin) was 34.6 ± 3.3 picograms/red cell (range 25 to 45.4 picograms/red cell), while 87.3% babies had MCH in normal range (30.8-39.2 picograms/red cell), 6.5% had MCHabove normal and 6.1% had MCH below normal level. Though, the mean value of MCHC (Mean corpuscular hemoglobin concentration) was 34.1 ± 2.3 gm/dl (range30.1 to 44.2 gm/dl), 93.1% neonates had MCHC in normal range (28.2-36.7 gm/dl) and 6.9% had MCHC above normal range. However, the mean values of MCH and MCHC were significantly higher in 14-21 days old neonates compared to 22-28 days old neonates (p<0.05), but mean values of MCH and MCHC were nearly same in both male and females.

Higher mean values of MCH and MCHC were found by Patidar *et al*. [5]. They also found that the mean values for MCH and MCHC in SGA neonates (38% ± 3.1% and 40.13±1.5 gm/dl respectively) were non-significantly lower compared to AGA neonates (38.4% ± 3% and 40.5±2.1 gm/dl respectively).However,they supposed that the lower mean values of MCH and MCHC in SGA neonates were because of relatively high RBC mass and MCV in this group. A study by Ozyurek *et al*. [7] found that lower MCH and MCHC values in SGA newborns are due to relatively higher RBC count and relatively higher MCV in SGA babies. A Chicago study by Maria Proytcheva(90) found higher mean MCHC values in 2-3 week old healthy term babies (33.9% ± 1.9%) compared to 3-4 week old babies (33.5% ± 1.6%), similar results were found in SGA babies in the present study.

A Turkish study by Ozyurek *et al*. [7] found that SGA newborns had significantly lower mean values of MCH and MCHC compared to AGA babies on first day of life. However, on the seventh day, SGA newborns had significantly lower MCHC values, but there was no significant difference between these groups' mean values of MCH. There were no significant differences in the MCH, MCHC values and RDW from the first to seventh days between both groups.

CONCLUSION

The current observational study was conducted in term LBW neonates to evaluate the hematological parameters at 14-28 days of life. Mean value of hemoglobin, hematocrit, MCV, MCH and MCHC were significantly higher among 14-21 days old, but these values were declined in 4th week of life.

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