

## ORIGINAL ARTICLE

# Assessment of hematological profile of newborn, born to mothers with gestational hypertension and Pre-Eclampsia

Harsha.M<sup>2</sup>, S. Jagadeeswari<sup>2\*</sup>, K. Naveen<sup>3</sup>, A. Arun Shriram<sup>4</sup>, S. Sundari<sup>5</sup>

<sup>12345</sup>Department of Paediatrics, Sree Balaji Medical College and Hospital, Chennai.

### ABSTRACT

*Gestational hypertension and preeclampsia contribute to significant fetal morbidity particularly due to hematological changes. Hence, this study was undertaken to know the hematological changes in these newborns. The study is to assess the hematological profile of newborn, born to mothers with gestational hypertension preeclampsia. The effects of maternal hypertension on the hematological profile of neonates were discussed and the outcome of the babies born to mothers with gestational hypertension and pre eclampsia were known.*

**Keywords:** Pre-Eclampsia, Gestational hypertension, perinatal mortality

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### INTRODUCTION

Hypertensive disorder is the commonest medical problem during pregnancy. These disorders are responsible for complications in 10%-15% of the pregnancies both in high and low-income countries causing significant perinatal and maternal mortality and morbidity [1]. Pre-eclampsia is a multisystem disorder and the uteroplacental insufficiency which occurs in this condition is responsible for fetal complications [2]. Incidence of preeclampsia is high in developing countries due to improper nutrition, hypoproteinemia, malnutrition and poor obstetric facilities. Maternal mortality in eclampsia is very high in India and varies from 2-30 %, much more in rural hospital based than in the urban counterpart. The perinatal mortality is very high to the extent of about 30-50% [6]. Maternal complications include: eclampsia, abruption, oliguria, dimness of vision, and the HELLP syndrome (hemolysis, elevated liver enzymes, and low platelet counts) [8]. HELLP syndrome occurs in about 0.5 to 0.9% of all pregnancies and complicates 10 to 20% of women with severe preeclampsia. HELLP syndrome is one of the common causes of maternal and fetal mortality among pregnant women with hypertension [9]. Newborn infants exposed to preeclampsia in utero present with hematological changes and other short-term complications in the form of respiratory distress syndrome [10]. Early and long-term hypertension may lead to uteroplacental failure, fetal distress, intrauterine growth retardation (IUGR) and preterm delivery [11, 12]. Preeclamptic mothers have proinflammatory immune state which results in disruption of fetal hematopoiesis resulting in neutropenia [10] which can present as transient but can increase the risk of nosocomial infection [13, 14]. Increase in nucleated red blood cells: secondary to uteroplacental hypoperfusion [11]. Polycythemia is more common in infants of hypertensive mothers compared to the infants of normal mothers. Reduction in T regulatory cells, and cytotoxic natural killer cell profile is increased [10]. Maternal hypertension also acts as important risk factor for polycythemia independent of fetal growth [11, 12] Neonates of preeclamptic mothers presented with reduced platelet count compared to newborns of normal mothers [13, 14].

Neonatal thrombocytopenia is significantly associated with

- 1.) Low birth weight
- 2.) Pre maturity [13, 14]

The intrauterine hypoxia might lead to suppression in megakaryocytic proliferation resulting in reduced platelet count in infants born to women with preeclampsia, similarly the fetal bone marrow suppression

secondary to uteroplacental insufficiency could lead to reduced neutrophil count (defined as absolute neutrophil count of less than 500) [10]. Hypertension during pregnancy apart from its direct effect on mother producing several mortalities, causes marked imbalance in the hematological system and coagulation profile of the neonate increasing the risk of infections, DIC and bleeding abnormalities especially affecting the preterm babies [15, 16].

The study is to assess the hematological profile of newborn, born to mothers with gestational hypertension/preeclampsia.

## **MATERIAL AND METHODS**

**STUDY DESIGN:** Observational study

**STUDY DURATION:** One year from 15 JANUARY 2019 to 14 JANUARY 2020.

**STUDY POPULATION:** The study population consists of Live born neonates (both preterm and term) born at Sree Balaji Medical College and Hospital.

**SAMPLE SIZE:** 75 cases 75 controls.

**INCLUSION CRITERIA:**

- All neonates born to mothers diagnosed with gestational hypertension and pre eclampsia .
- The mothers were diagnosed as having PIH when their blood pressure was greater than 140 /90 mmHg, with proteinuria.

**EXCLUSION CRITERIA:**

- Babies with congenital malformations.
- Severe birth asphyxia
- Babies born to mother with chronic illness like diabetes mellitus and chronic hypertension and those who received drugs like aspirin were excluded from the study.

**ETHICAL COMMITTEE APPROVAL:** Approved

**METHODS**

All neonates included in the study had the following done:

Detailed maternal history like age, gestational age, blood pressure recording, Headache, blurring of vision, pedal edema, proteinuria.

Details of baby like APGAR scores were noted.

Weight: Weight was observed and categorized into low birth weight and normal birth weight.

Then the 2ml of cord blood anti coagulated with EDTA was collected from these babies and Haemoglobin, Total and Differential counts, Platelet count and Red cell indices like packed cell volume (PCV), mean corpuscular volume (MCV), mean corpuscular haemoglobin (MCH), mean corpuscular haemoglobin concentration (MCHC) were estimated using automated cell counter method. Platelet count was confirmed by peripheral smear examination and REES ECKER method. Peripheral blood smear and nucleated RBC (nRBC) were examined using the smear stained with Leishman's stain. All these investigations were done at the central laboratory at Sree Balaji Medical College and Hospital.

**STATISTICAL ANALYSIS:**

Statistical analysis is done using the IBM SPSS software version 23. Data was entered in excel. Descriptive statistics is given by frequency, percentage, mean, median, interquartile range, standard deviation and graphs. Normality of data is checked using histogram and Shapiro-Wilk's test. Variables are divided into categorical and continuous groups and further analysis was done. Chi-Square test was utilized to find the association between two categorical variables. As data was not normally distributed, comparison between a group with a continuous variable is given by Mann-Whitney U test an analogue of t-test. P-value of < 0.05 is considered to be significant.

**ETHICAL ISSUES**

Parents of all babies recruited for the study were explained about the methodology and investigations in detail and consent obtained.

## **RESULTS**

An observational study was undertaken to study the hematological profile of newborn, which included 75 babies born to mothers with gestational hypertension and preeclampsia (cases) and an equal number of babies (75) born to mothers without gestational hypertension and preeclampsia (controls).

**Table 1: Age distribution of mothers of newborn studied**

Age in years	Group			
	Cases		Control	
	NO	%	NO	%
≤20	18	24.3%	16	21.4%
21-23	40	53%	34	45.3%
24-30	17	22.7%	25	33.3%
>30	0	0%	0	0%
Total	75	100%	75	100%
MEAN+_SD	22.88+_3.22		22.76+_3.27	

Age of mothers of newborns included in the study where matched between cases and controls .18 (24.3%) mothers of cases and 16 (21.4%)mothers of controls belong to the age group of<20years .40(53%)mothers of cases and 34(45.3%) mothers of controls belong to age group 21-23 years 17(22.7%)mothers of cases and 25(33.3%) mothers of controls belong to age group of 24-30 years .hence there is no significant difference in the age group of the mothers between cases and controls. Samples are age matched with P value =0.345

**Table 2: Category for hypertension**

Category for hypertension	CASES	
	No	%
Gestational hypertension	35	46.67
Pre-eclampsia	40	53.33
Total	75	100

Out of 75 mothers in the study 46.67% had gestational hypertensionand 53.33% had pre-eclampsia

**Table 3: Comparison of BP in two groups of patients studied**

BP	Group		P value
	Case	Control	
SBP	148.27±16.021	124.32±6.009	0.0001
DBP	91.89±8.107	79.25±5.217	0.0001

The mean SBP in the case group was 148.27±16.021 mm Hg while that of the control group was 124.32±6.009 mmHg had a frequency of higher level of SBP is significantly associated with cases when compared to normal controls with P <0.001. The mean DBP of the case group was 91.89±8.107 mm Hg while that of the control group was 79.25±5.217 mmHg showing t the frequency of higher level of DBP is significantly associated with cases when compared to normal controls with P <0.001.

**Table 4: Comparison of SBP (mmHg) among cases and controls**

SBP (mmHg)	CASES (N=75)	CONTROLS (N=75)
<140	6(8%)	69 (92%)
140-149	23(30.6%)	0(0%)
150-159	18(24%)	0(0%)
>160	28(37.3%)	0(0%)
Inference	Higher level of SBP is significantly associated with cases when compared to controls with P <0.001	

**Table 5: Comparison of DBP (mmHg) in two groups of patientsstudied**

DBP (mmHg)	CASES (N=75)	CONTROLS (N=75)
<90	32(42.6%)	75 (100%)
90-99	31(41.3%)	0(0%)
100-109	2(16%)	0(0%)
Inference	Higher level of DBP is significantly associated withcases when compared to normal controls with P <0.001	

This table shows that a diastolic blood pressure of <90 mmHg seen in 42.6% of cases ,90-99mmHg was seen in 41.3 %of cases ,DBP of 100- 109 mmHg was seen in 16 % of the mothers,

**Table 6: Comparison of gestational age in weeks in two groups studied**

	Group		P Value (independent t test)
	Case (n=75)	Control (N=75)	
Gestational age in weeks	37.97±3.309	38.81 ± 2.783	1.2

The gestational age of the babies in the case as well as the control group were matched in this study with a mean gestational age of 37.97+/- 3.309 weeks and 38.81+/-2.9 weeks.

**Table 7: Distribution of neonates according to gestational age**

Baby details	Cases n = 75	Controls n = 75
Gestation age in weeks		
>37 weeks (term)	33(44%)	60(83.3 %)
<37 weeks( preterm)	42(56%)	15(20.7%)

In this study more number of preterm babies are 42(56)% are seen in cases than in controls.

**Table 8: Association of gestational age and PIH among cases**

Study variables	Gestational Hypertension n =35	Pre eclampsia n= 40
Gestational age in weeks		
>37weeks	29	2
<37 weeks	6	38

In this study highest rate of prematurity 42 (56%) was observed in cases .

**Table 9: Comparison of birth weight in cases and controls**

Birth weight	Group		Total
	Case	Control	
Normal	36	60	96
Low	39	15	54
Total	75	75	150

39(52%) cases had low birth weight while the rest 36 (48%) cases had a normal birth weight

**Table 10: Association of birth weight among various categories of PIH mothers and controls**

	Birth weight (> 2.5 kg)	Low birth weight (<2.5 kg)
Gestational hypertension (n=35)	28(80%)	7(20%)
Pre eclampsia (n = 40)	8(20%)	32(80%)
Controls (n =75)	60(80%)	15(20%)

The babies born to mothers with preeclampsia 32(80%) of them were low birth weight babies and 8(20%) had normal birth weight. In gestational hypertension 7(20%) of them were low birth weight babies and 28(80%) had a normal birth weight .In normal mothers 15(20%)of them were low birth weight and 60 (80%) babies were with normal birth weight. Hence, from the study it was found that gestational hypertension and preeclampsia category was significantly associated with low birth weight.

**Table 11: Comparison of baby investigations in two groups studied hemoglobin, PCV and RBC**

	Group		P value (independent t test)
	Case	Control	
Hemoglobin	15.430±1.088	14.607±1.243	0.67
Packed Cell Volume	44.434±5.545	46.005±2.785	0.030
Red Blood Cell	3.872±0.494	4.533±0.351	0.764

The cases have found to have a mean hemoglobin of 15.43+/-1.088 g/dl ,while the controls had a mean Hemoglobin of 14.60+/-

1.243 g/dl. The difference was not statistically significant P value of 0.67.

**Table 12: Mean MCV, MCH and MCHC among cases and controls**

Mean CorpuscularVolume (fL)	107.594±4.242	105.103±3.237	0.108
Mean Corpuscular Haemoglobin (pg)	33.866±1.604	33.544±1.966	0.274
Mean Corpuscular Haemoglobin Concentration(g/dl)	33.492±1.472	34.400±1.403	0.354

**Table 13: Mean nRBC count among cases and controls.**

	Cases	Controls
Nrbc	26.35±8.4	11.88±3.39

**Table 14: Association of nRBC's among various categories of PIH**

PIH CATEGORY	nRBCs	
	INCREASED	NORMAL
GESTATIONAL HYPERTENSION (n = 35)	21(60%)	14(40%)
PRE - ECLAMPSIA (n = 40)	23(57.5%)	17(42.5%)
PIH CATEGORY is significantly associated with increased number of nRBC's		

**Nucleated RBCs:**

The cases showed an mean of 26.35±8.4 nRBCs per 100 WBCs while the controls showed an average of 11.88±3.39 n RBCs per 100 WBCs. The difference was found to be of statistical significant with P -value <0.001. 21 (60)% of babies born to gestational hypertension mothers showed an increased nucleated RBC count and 23(57.5%) of babies born to pre- eclampsia mothers also had a increased nucleated RBC count .normal nucleated RBC count is seen in 14 (40%) babies born to gestational hypertension mothers and 17(42.5%) babies born to mothers with pre- eclampsia. Thus increased number of nucleated RBCs was seen predominantly in babies of pre-eclampsia than in gestational hypertension.

**Table 15: Mean TLC, neutrophil and lymphocyte among cases and controls**

	Group		P Value (independent t test)
	Case	Control	
Total Leucocyte Count (x 10 <sup>9</sup> /L)	9.737±2.144	10.934±2.152	0.001
Neutrophil (x10 <sup>8</sup> /L)	44.348±9.045	61.954±6.980	0.0001
Lymphocyte (x 10 <sup>8</sup> /L)	44.397±10.179	37.717±11.675	0.0001

**Table 16: Mean TLC among cases and controls**

	Group		P value (independent t test)
	Case	Control	
Total Leucocyte Count (x 10 <sup>9</sup> /L)	9.737±2.144	10.934±2.152	0.001

Total leukocyte count : case were found to have a mean total count of 9.737±2.144 \*10<sup>3</sup> /mm<sup>3</sup> while controls had a mean of 10.934±2.152\*10<sup>3</sup>/mm<sup>3</sup>. this difference was found to be statistically significant P value=0.001

**Table 17: Mean Neutrophil count of the neonates among cases and controls**

	Group		P value (independent t test)
	Cases	Controls	
Neutrophil(X 10 <sup>8</sup> /L)	44.348±9.045 <span style="color:blue">■</span>	61.954±6.980 <span style="color:orange">■</span>	0.0001

**Neutrophil count:** Cases were found to have a mean Neutrophil count 44.348±9.045 % while controls had a mean of 61.954±6.980 %, this difference was found to be statistically significant with a P value <0.001.

**Table 18: Mean lymphocyte count of the neonates among cases and controls**

	Group		P Value (independent t test)
	Cases	Controls	
Lymphocyte (x 10 <sup>8</sup> /L)	44.397±10.179	37.717±11.675	0.0001

The mean lymphocyte percentage among the cases and the controls in this study was 44.397±10.179 % and 44.397±10.179 % respectively which was statistically significant with a P value <0.001

**Table 19: Mean absolute neutrophil count (per mm<sup>3</sup>) of the neonates among cases and controls.**

	Gestational hypertension	Preeclampsia	Controls
Mean	4239.14	4476.39	8761.27

**Absolute neutrophil count:** Cases found to have a absolute neutrophil count of 4433.750 /uL with a SD of 1576.707 against 8801.130/uL with a SD of 7953.883 in the controls. This observation was statistically highly significant with P value of <0.001

**Table 20: Distribution of baby platelet count in two groups of newborns studied**

Baby platelet count	Cases ( n = 75 )	Controls (n =75)
<1lakh	7 (9.3%)	0
1-1.50	31(41.4%)	25(33.4%)
1.5-2.0	36(48%)	40(53.33%)
2-3.0	1(1.3%)	10(13.33%)
Inference	Lower platelet count is significantly more associated with cases with P <0.001	

7 (9.3%) of the babies born to mothers with gestational hypertension and preeclampsia had a platelet count of less than 1 lakh and 31 (41.4%) babies had a platelet count between 1- 1.5 lakhs, while 36,1 babies born to mothers with gestational hypertension and preeclampsia had platelet count between 1.5-2lakhs and 2-3 lakhs respectively.

**Table 21: Correlation between neonate’s platelet count with maternal SBP**

SBP	Platelets				Total
	<1 lakh	1-1.50 lakh	1.51-2.0 lakh	≥2.1 lakh	
<140	1	7	13	0	21
140-149	1	2	6	0	9
150-159	2	9	4	0	15
≥160	2	14	13	1	30
Total	6	32	36	1	75

In this study the number of babies born to mothers with gestational hypertension and preeclampsia presenting with thrombocytopenia was higher with higher levels of maternal systolic blood pressure. When maternal SBP was <140mmHg, 140-149 mmHg, 150- 159 mmHg and > 160mmHg thrombocytopenia was found in babies of gestational hypertension and preeclampsia mothers respectively.

**Table 22: Correlation between neonate’s platelet count with maternal DBP.**

DBP	Platelets				Total
	<1 lakh	1-1.50 lakh	1.51-2.0 lakh	≥2.1 lakh	
<90	4	16	11	0	31
90-99	2	10	16	1	29
100-109	0	6	8	0	14
≥110	0	0	1	0	1
Total	6	32	36	1	75

In this study the number of babies born to mothers with gestational hypertension and preeclampsia presenting with thrombocytopenia was higher with higher levels of maternal diastolic blood pressure. When maternal DBP was <90mmHg, 90-99 mmHg, 100- 109 mmHg and > 110mmHg thrombocytopenia was

found to be present in 31, 29, 14 and 1 babies of gestational hypertension and preeclampsia mothers respectively.

## DISCUSSION

The hypertensive disorders in pregnancy can cause various pregnancy-related maternal morbidities. However, gestational hypertension and preeclampsia also carry higher rates of morbidities and mortalities in neonates. Gestational hypertension and preeclampsia is a multi-system disorder associated to the adaptive changes in fetal circulation also leads to great imbalance in hemostatic system of the mother as well as neonate [7]. Various studies in literature have observed that neonates of hypertensive mothers, especially the ones born to women with preeclampsia, are more liable to have hematological abnormalities with disrupted fetal hematopoiesis probably because of the proinflammatory state associated with the pre eclampsia [10]. Recently various studies indicate that measurement of the hematological markers, might provide better diagnostic and prognostic clues in the diseases in newborns<sup>2</sup>. Apart from the reduction in morbidity early hematological screening especially in the babies born to hypertensive mothers might also pave way for improvement in growth, development, survival of baby [10]. In present study the mean systolic BP and mean diastolic BP in cases were found with 148 mm hg and 91 mm hg respectively that were high in the controls and this is statistically significant ( $p=0.0001$ ). This is comparable to the studies by El sayed *et al* [2] and Mouna *et al* [1] but lower than observed by Elgari *et al* [2] where the recorded mean systolic and diastolic BP respectively (155 mmhg and 110 mmhg ), (151mmhg and 105mmhg ) and (160 mmhg and 104 mmhg ) presented with a significantly higher among the cases. The Mean APGAR scores in cases to be  $7.11\pm 0.6$  and showed no significant difference .However in the study by El sayed *et al* [2] the APGAR score was found be significantly decreased respectively in term ( $7.7 \pm 0.8$ ) well as pre term  $6.5\pm 0.7$ ) neonates of pre eclamptic mothers ,however the studies by Elgari *et al*<sup>7</sup> have the mean APGAR scores of  $8.2\pm 1.2$  and  $8.5 \pm 1.2$  respectively. Hemoglobin concentration observed by us showed a mean with 115.43 g/dl that was significantly high when compared to controls. Whereas studies by Mouna *et al* [1], Sivakumar *et al* [8] and Bolat *et al* [11] had reported higher hemoglobin concentrations of 17.6, 17.98 and 16.1 g/dl in their cases respectively. The mean platelet count in babies born to mothers with gestational hypertension and preeclampsia was noted to 1.505 lakhs. This was significantly low in comparison to the babies born to normotensive mothers 3.400 lakhs ( $P<0.001$ ). Mouna *et al* [1] noted a similar finding of neonatal thrombocytopenia with a mean platelet count of  $94.2\pm 10.3$  ( $\times 10^3/\text{mm}^3$ ) in cases that was lesser than the controls  $202.6\pm 31.05$  ( $\times 10^3/\text{mm}^3$ ). Bolat *et al* [11] also found a similar observation in his study where the platelets count was significantly low in babies of hypertensive mothers ( $16-359 \times 10^3/\text{mm}^3$ ) as compared to babies with normal blood pressure ( $121-415 \times 10^3/\text{mm}^3$ ) ( $P < 0.001$ ). Similarly studies by Siva kumar *et al* [8] and El sayed *et al* [2] show a comparable change in the mean platelet count in both term and preterm babies when compared to babies born to mothers without pregnancy induced hypertension. Further Elsayed *et al* [2] also noted a significantly greater prothrombin time (PT) and lower prothrombin concentration (PC) in the babies of preeclamptic mothers compared to controls ( $p=0.001$ ). A highly significant observation was made in study by Siva Kumar *et al* [8] ( $P$  value  $< 0.001$ ). Out of 64 Babies with thrombocytopenia less than 1 lakh maternal systolic BP of 150 – 159 mmhg and  $\geq 160$  mmhg was observed in 40.6 % and 37.5% respectively. Similarly majority of the babies (71.9 %) with thrombocytopenia  $< 1$  lakh, were newborns of mothers with diastolic BP  $> 100$  mmhg.

Hence neonatal thrombocytopenia has a significant association with the maternal blood pressure.

## CONCLUSION

Out of 75 mothers in the study 46.67% had gestational hypertension and 53.33% had pre-eclampsia. Symptoms like Headache, pedal edema and blurring of vision were commonly found among the cases. Highest rate of pre maturity was found in babies born to mothers with gestational hypertension and pre-eclampsia. The incidence of low birth weight was found to be higher in babies of pre eclamptic mothers. There is increased number of nucleated RBCs in babies of pre- eclampsia than in gestational hypertension The total leucocyte count, mean neutrophil count and absolute neutrophil count were significantly low among the cases. The incidence of thrombocytopenia increased with higher levels of maternal systolic blood pressure.

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