

# Hematological changes in cord blood of anemic and hypertensive pregnant women

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## ABSTRACT


**Background:** Infant and maternal mortality has raised serious concerns since ages. Ongoing researches in this field aim to develop insights into successful maternal and infant health-care programs. **Objective:** A comparative study of hematological changes in cord blood in anemic and hypertensive pregnant women with normal pregnant women. **Materials and Methods:** This study was undertaken in the Department of Physiology in collaboration with the Department of Pathology and Department of Obstetrics and Gynaecology of Government Medical College, Kannauj, after taking permission from the Institutional Ethics Committee. Sample size included 150 third trimester pregnant women of 20–40 years. Group I (normal) included subjects ( $n = 50$ ) with hemoglobin (Hb) concentration more than 11 gm/dl and blood pressure (systolic range = 100–139 mmHg; diastolic range = 60–89 mmHg). Group II (anemic) included subjects ( $n = 50$ ) with Hb concentration <11 gm/dl and blood pressure (systolic range = 100–139 mmHg; diastolic range = 60–89 mmHg). Group III (hypertensive) included Hb concentration of more than 11 gm/dl and blood pressure  $\geq 140/90$  mmHg. Hematological parameters (Hb concentration, total red blood cell (RBC) count, blood indices, total platelets count, total white blood cells count, and differential leukocyte count in maternal blood and cord blood) were duly studied. **Results:** Hb concentration, RBC count, mean cell volume of red blood, mean corpuscular Hb (MCH), and MCH concentration were observed significantly lower in anemic mothers, but there were no statistically significant differences noted between mother's and her cord blood investigations. Absolute neutrophil count ( $1000/\text{mm}^3$ ), absolute lymphocyte count ( $1000/\text{mm}^3$ ), and platelets count ( $\text{lacs}/\text{mm}^3$ ) were significantly decreased in cord blood of hypertensive mothers (Group III). **Conclusion:** Conditions such as anemia and hypertension in pregnancy influence hematological changes in cord blood which, in turn, adversely affect the perinatal outcome.

**KEY WORDS:** Anemia; Placenta; Cord Blood; Hypertension; Third Trimester

## INTRODUCTION

The hemoglobin (Hb) concentration in umbilical cord blood is important and can be an essential hematological parameter

in newborns at birth. Hb concentration and hematocrit (Hct) values have been used many times in the diagnosis and follow-up of the conditions like neonatal anemia.<sup>[15]</sup> Other hematological parameters such as white blood cell count (WBC count) and platelet count are also helpful in the assessment of newborn's sepsis and hemostatic status of the infant.<sup>[15]</sup> The hematological values of newborns depend on several factors such as ethnic group, maternal health, nutritional status of mother, and antenatal complications such as anemia, hypertension, growth retardation, and fetal infections.<sup>[15]</sup> On the other hand, intrapartum factors including asphyxia also play an important role on newborn's health.

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Anemia in pregnancy is very common, but severe anemia during pregnancy may have serious effects on pregnancy, delivery and neonates outcome, and their health.<sup>[10]</sup> Anemia is the nutritional deficiency disorder and maximum number of women living in developing countries are anemic (World Health Organization [WHO]).<sup>[11]</sup> Anemia is the most common hematological disorder during pregnancy. The occurrence of anemia in South Asian countries is among the highest in the world and India is the country which has the highest prevalence of anemia.<sup>[2]</sup>

According to the WHO, an Hb level below 11 g/dl is considered as anemia during pregnancy. The centers for disease control and prevention has defined anemia as Hb concentration <11 g/dl in the first and third or final trimester and <10.5 g/dl in the second trimester. Indian Council of Medical Research has classified anemia in pregnancy as mild: 10.1–10.9 g/dl, moderate: 7.1–10.0 g/dl, severe: 4.1–7.0 g/dl, and very severe: 4.0 g/dl and below.<sup>[4]</sup>

On the other side, hypertensive disorders of pregnancy are also somewhat responsible for maternal deaths.<sup>[14]</sup> The basic classification for hypertension describes hypertension as the first, i.e., gestational hypertension, second pre-eclampsia and eclampsia syndrome, third chronic hypertension of any etiology, and fourth pre-eclampsia or chronic hypertension.<sup>[16]</sup> Among all four types, gestational hypertension is defined as new hypertension presenting after 20 weeks of gestation without any significant proteinuria, and this diagnosis is made in women whose blood pressure reaches 140/90 mmHg or greater for the 1<sup>st</sup> time after 20 weeks of gestation, but in whom proteinuria is not identified significantly.<sup>[16]</sup>

Hence, in this study, we tried to study the hematological parameters such as Hb conc., total red blood cell (RBC) count, Hct, blood indices, total WBC count, total platelets count, absolute neutrophil count (ANC), and absolute lymphocyte count (ALC) in maternal and cord blood of anemic and hypertensive mothers, which may be supposed to affect the health status of the mothers and their fetus.<sup>[9,13]</sup> Thus, an early diagnosis may allow prompt treatment or facilitate proper planning to improve quality of life in these mothers and their newborns.

## MATERIALS AND METHODS

This study was undertaken in the Department of Physiology in association with the Department of Pathology and Department of Obstetrics and Gynaecology in Govt. Medical College, Kannauj. Before starting the research work, permission has taken from the Institutional Ethics Committee.

### Inclusion and Exclusion Criteria

#### *Inclusion criteria*

- Pregnant women aged 20–40 years.
- Pregnant women in the third trimester from the outpatient

door (OPD) or on the day of delivery admitted in labor room or operation theater.

- Women with primary and multiple pregnancies.
- Pregnant women with normal Hb conc., i.e., >11 gm/dl and blood pressure, i.e., Systolic = 100–139 mmHg; diastolic = 60–89 mmHg in Group I and Hb concentration (<11 gm/dl) and blood pressure (systolic = 100–139 mmHg; diastolic = 60–89 mmHg) in Group II, and Hb concentration (>11 gm/dl) and blood pressure  $\geq$  140/90 mmHg in Group III were included.
- Non-smokers, non-alcoholic, and non-diabetic mothers having perfect sense of physical, mental, and psychological well-being.

#### *Exclusion criteria*

- Elderly women aged more than 40 years.
- Pregnant women in the first and second trimester.
- Pregnant women with a known case of coronary artery disease/ischemic heart disease or congenital heart disease.
- Subjects having a history of neurological disorder, diabetes, with the features of hypothyroidism or hyperthyroidism, the patients on any drug that alters the sinus node impulse generation and atrioventricular conduction, patients with fever and features suggestive of infections, and patients with chronic obstructive pulmonary disease and other chronic lung disorders were excluded.

#### *Sample Size*

The sample size included in the study was 150 pregnant women aged 20–40 years.

Patients were divided into three groups.

The subjects that satisfied the inclusion and exclusion criteria were divided into:

1. Group I – Normal healthy ( $n = 50$ )
2. Group II – Anemic ( $n = 50$ )
3. Group III – Hypertensive ( $n = 50$ ).

Pregnant women were recruited from Gynaec. outpatient door (OPD) and labor room in the third trimester based on the described inclusion and exclusion criteria. The demographic information [Table 1] of the mothers such as any chronic disease, drug usage, parity, blood group, gestational week, history of past illness, history of previous childbirth, problems during pregnancy, mode of delivery, administration of anesthesia, presence of meconium, fetal declaration, and presence of a nuchal cord, birth weight of the newborn, length of the newborn, gender, heart rate, body temperature, and maturity of the newborn were recorded, Apgar scores at the 1<sup>st</sup> and 5<sup>th</sup> min were recorded. The blood samples from mother and her cord blood were collected and sent to central laboratory of institute for investigations.

**Table 1:** Basal parameters in pregnant women

Parameter	Control Group I (n=50)	Anemic Group II (n=50)	Hypertensive Group III (n=50)
Maternal age (years)	27±4.7	29±4.5	28±4.6
BMI (Kg/m <sup>2</sup> )	22±1.7	21±1.2	22±0.7
Blood pressure (mmHg)	SBP – 118±4.3 DBP – 81±5.0	SBP – 119±4.5 DBP – 81±4.2	SBP – 149±2.9** DBP – 94±2.9**
Parity	Primi – 12 Multi – 38	Primi – 10 Multi – 40	Primi – 12 Multi – 38
Diet	Veg – 41 Non-veg – 9	Veg – 42 Non-veg – 8	Veg – 40 Non-veg – 10
Education	Edu – 35 Unedu – 15	Edu – 37 Unedu – 13	Edu – 30 Unedu – 20

Variables are represented as mean±standard deviation; \* *P*<0.05; \*\* *P*<0.01, SBP: Systolic blood pressure, DBP: Diastolic blood pressure, BMI: Body mass index

**Table 2:** Hematological parameters in maternal blood

Parameter	Control Group I (n=50)	Anemic Group II (n=50)	Hypertensive Group III (n=50)
Hb (g%)	12.7±0.7	8.2±1.2**	13.1±0.4
Total RBC count (million/mm <sup>3</sup> )	4.1±0.3	3.2±0.6**	4±0.2
Hct (%)	37.2±1.6	37.1±1.2	36.4±0.9
MCV (fl)	97.2±2.4	96.9±5.5	97.3±5.3
MCH (pg)	29.2±2.3	30.0±5.0	30.2±2.4
MCHC (%)	33.2±1.9	32.9±3.46	33.1±1.3
Total WBC count (1000/mm <sup>3</sup> )	7506±1127.5	6220±1232.8	6613±863.9
ANC (1000/mm <sup>3</sup> )	4422±719.0	4425±4902.0	4098±277.4
ALC (1000/mm <sup>3</sup> )	2833±502.8	2955±456.2	2732±165.9
Platelets count (lacs/cc)	3.1±0.3	3.3±0.5	3.0±0.1

Variables are represented as mean±standard deviation; \**P*<0.05; \*\**P*<0.01. RBC: Red blood cell, WBC: White blood cell, MCV: Mean cell volume of red blood, MCH: Mean corpuscular Hb, MCHC: MCH concentration, Hct: Hematocrit, Hb: Hemoglobin

**RESULTS**

In the above study, Hb concentration (8 ± 1.2), RBC count (3 ± 0.5), were significantly lower in anaemic group [Table 2], but no significant differences were noted between mother’s and her cord blood investigations. The Absolute Neutrophil Count (ANC), Absolute Lymphocyte Count (ALC), platelets count were observed significantly lower in hypertensive mother’s cord blood when compared with maternal blood (*P* < 0.05) [Table3].

**DISCUSSION**

Total RBC count, Hct, MCV, MCH, and MCHC were observed lower in anemic mother’s blood, but their cord blood investigations statistically were not significantly different

**Table 3:** Hematological parameters in cord blood

Parameter	Control Group I (n=50)	Anemic Group II (n=50)	Hypertensive Group III (n=50)
Hb (gm%)	12.6±0.7	8±1.2**	13±0.4
Total RBC count (million/mm <sup>3</sup> )	4±0.3	3.4±0.6**	4±0.2
Hct (%)	37±1.6	36±1.2	35±0.9
MCV (fl)	97±6.6	96±5.5	97±5.3
MCH (pg)	29±2.3	30±5.0	30±2.4
MCHC (%)	33±1.9	32±3.46	33±1.3
Total WBC count (1000/mm <sup>3</sup> )	7556±1127.5	6230±1232.0	6653±863.9
ANC (1000/mm <sup>3</sup> )	4421±719.0	4429±490.0	1998±277.4**
ALC (1000/mm <sup>3</sup> )	2833±502.8	2955±456.2	1232±165.9**
Platelets count (lacs/cc)	3±0.3	3.1±0.5	1±0.1**

Variables are represented as mean±standard deviation; \**P*<0.05; \*\**P*<0.01. RBC: Red blood cell, WBC: White blood cell, MCV: Mean cell volume of red blood, MCH: Mean corpuscular Hb, MCHC: MCH concentration, Hct: Hematocrit, Hb: Hemoglobin

from mother’s investigations. ANC, ALC, and platelets count were observed significantly lower in hypertensive mother’s cord blood when compared with maternal blood.

Our study is in support with Koenig and Christensen, who also found neutropenia in his study. They suggested that decrease in neutrophil count might be either due to decrease in growth factor which increases neutrophil production or decrease in response of progenitor cells to growth factors or the presence of any inhibitor substance which inhibit neutrophil production. Their investigations showed that the activity of colony-stimulating factor (CSF) may be decreased in the placenta of hypertensive mothers. The investigators observed an inhibitor substance for inhibiting neutrophil production in the placenta of hypertensive mothers. In some studies, the principal mechanism postulated was that pre-eclampsia and the resultant fetal hypoxia have a direct depressant effect on megakaryocytes and platelet production and this combined effect of decreased megakaryocytes and decreased platelet activation is mediated through cytokines, thrombopoietin, and interleukin-6.<sup>[16]</sup> Some other authors such as Xiong *et al.* and Brazy *et al.* also reported thrombocytopenia in cord blood of hypertensive mothers.

On the other hand, Burrows *et al.* did not notice any significant difference in cord blood of hypertensive mothers.<sup>[18]</sup> In fact, Moellem and Koenig and Backes *et al.* showed decrease in neutrophil count in newborns of hypertensive mothers in their study.<sup>[16]</sup> In some previous researches, it has been observed that newborns of hypertensive mothers have reduced number of myeloid precursors and this reduced number of myeloid precursors resulted from uteroplacental insufficiency and hypoxia that inhibits their production.<sup>[12]</sup> In addition, some researches have also suggested that decreased levels of the granulocyte CSF may also be responsible for neutropenia

in neonates of hypertensive mothers and the hypoxia in newborns that may be induced due to hypertension is likely to have a direct depressant effect on megakaryocyte proliferation.<sup>[14]</sup>

The growth of placenta and its functions are precisely regulated and coordinated to allow the exchange of nutrients and waste products between maternal and fetal circulatory systems. It can be said that the placenta shares the same level of stress and strain as fetus is exposed.<sup>[3]</sup> Therefore, any condition or disease affecting mother and fetus also has a great impact on the placenta.<sup>[3]</sup> If we talk about anemia during pregnancy, it leads to maternal hypoxia so it might be produced changes on the maternal circulatory system and affects both mother and fetus.<sup>[5]</sup>

In hypertensive group, neutropenia and lymphocytopenia suggest that there may be some uteroplacental failure.<sup>[6]</sup> Decrease in neutrophil count suggests that this might be occurring due to a decrease in growth factor which is supposed to increase neutrophil production.<sup>[6]</sup> Decrease in response of progenitor cells to growth factors and the presence of some inhibitor substance may also inhibit neutrophil production.<sup>[6]</sup>

Decreased platelets count in pregnancy-induced hypertension is mostly supposed to be caused due to increase consumption of platelets which may be resulted from adherence of platelets at the site of damaged vascular endothelium.<sup>[6]</sup> Severity of pregnancy-induced hypertension and thrombocytopenia is closely correlated with each other which indicates that thrombocytopenia is directly proportional to the severity of pregnancy-induced hypertension.<sup>[7,8]</sup>

## CONCLUSION

Hence, the observed neutropenia might be thought due to inhibitor of neutrophil production. Neutropenia and lymphocytopenia suggest that there may be some uteroplacental failure due to hypoxia. Therefore, in response to hypoxia and inhibitory factors for both the condition, i.e., erythropoiesis and leukopoiesis produced during hypertensive disorders of pregnancy may lead to changes in ANC, ALC, and platelets count.<sup>[17]</sup>

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