

A comparative study of cord blood haemoglobin and ferritin in normotensive versus preeclamptic patients

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Abstract:

Background: During pregnancy, newborn development is directly affected by mother's well being. In India pregnancy induced hypertension incidence corresponds to be around 15%. The babies born to hypertensive mother have higher incidence of haematological changes. Due to uteroplacental vascular insufficiency or due to chronic foetal hypoxia there is increased iron utilization during enhanced erythropoiesis. **Objectives:** The aim is to compare the cord blood haemoglobin and ferritin level in newborns of normotensive versus preeclamptic patients. **Materials and methods:** It is a hospital based prospective case control study conducted from June 1st 2019 to 31st May 2020 for a period of one year. Over the study period, total 200 patients are included in the study and analysis of cord blood haemoglobin and ferritin level of 100 preeclamptic (case) and 100 normotensive (control) mothers was done. All data were analysed using SPSS version 21. A p - value <0.05 is considered as statistically significant at 5% level of significance. **Results:** Out of 100 preeclamptic patients 96% were booked cases and their mean age was 24.34±3.77 years and out of 100 normotensives patients 99% were booked and their mean age was 23.71±3.72 years. Haemoglobin level were found to be significantly higher in the preeclamptic group (case) as compared to normal group (control) with p value of <0.004 and mean value of 16.91 and 17.39 in control and cases respectively. In case of ferritin, the level were found to be significantly lower in the preeclamptic group as compared to normal group with p value <0.0001 and mean value of 158.94 and 76.98 in control and cases respectively. **Conclusion:** The chronic intrauterine hypoxia caused by preeclampsia causes significant changes in the haematological values in these babies.

Keywords: Preeclampsia, cord blood haemoglobin, cord blood ferritin, normotensive.

Hypertensive disorders are the most common cause of maternal and foetal mortality and morbidity¹⁻³. In India pregnancy induced hypertension incidence corresponds to be around 15%¹. Pre eclampsia is a multisystem disorder of the mother in which foetus is affected because of uteroplacental insufficiency⁴ as due to insufficient invasion and ingrowth of the trophoblasts that inhibit vessel dilation, thus reducing maternal blood supply to the intervillous space, and thus reducing perfusion and causing hypoxia, therefore releasing some toxic causing vascular endothelial dysfunction and damage leading to preeclampsia. The babies born to hypertensive mother have higher incidence of somatic growth retardation, low Apgar scores, and have a spectrum of haematological changes^{4, 5} and the haematological changes include polycythemia, thrombocytopenia, leukopenia, neutropenia.

Iron is an essential micronutrient that is vital for early brain growth and function since it supports neuronal and glial metabolism, neurotransmitter synthesis and myelination⁶. Newborn infants with the lowest quartile of cord ferritin concentrations (<76ug/l) have impaired mental and psychomotor function at school age⁷. The major form of iron storage is ferritin. Factors that influence neonatal ferritin concentration at birth include gestational age and conditions altering maternal-foetal iron exchange. Due to uteroplacental vascular insufficiency or due to chronic foetal hypoxia there is increased iron utilization during enhanced erythropoiesis⁸. According to some studies the haemoglobin level was found to be higher in cases and also lower in other studies^{4,5,9}.

Keeping in mind the various changes that have been occurring in foetus born to preeclamptic mothers like haemoglobin and ferritin level, a comparative study has been proposed regarding the effect of pre eclampsia in the levels of haemoglobin and ferritin in neonates by taking samples from umbilical cord of foetus born to preeclamptic and normotensive pregnant women admitted in department of obstetrics and gynaecology, Gauhati Medical College and Hospital in a 1 year study period. The aim is to compare the cord blood haemoglobin and ferritin of babies born to normotensive patients versus preeclamptic patients.

Methodology

A hospital based prospective case-control study, conducted in department of obstetrics and gynaecology, Gauhati medical college and hospital, Guwahati, Assam from June 1st 2019 to 31st May 2020 for a period of one year. Permission for the study was obtained from the ethical committee. It was carried out on 200 patients meeting the inclusion and exclusion criteria, who were admitted to department of obstetrics and gynaecology. Out of these, 100 patients had preeclampsia (case) and 100 were normotensive (control) patients. Pregnant female with preeclampsia with other comorbid conditions like essential hypertension, diabetes, renal disease, liver disease, anemia and also pregnant females below 18years and more than 35years were excluded from the study.

Data of the patients were collected in a proforma from time to time. Results obtained from the study of cord blood were recorded. Detailed history was recorded including complete demographic details, dietary history, past medical history, previous obstetric history, and antenatal history including details of any antenatal complications.

The case group included 100 pregnant women whose systolic blood pressure was > 140 mmHg and diastolic pressure > 90 mmHg or both in a woman known to be normotensive prior to pregnancy. The diagnosis was made if two such abnormal blood pressure measurements were recorded at least 6 hours apart. The first and fifth Korotkoff sounds were used to determine the systolic and diastolic components respectively. Preeclampsia was diagnosed when along with gestational hypertension there was presence of proteinuria and / or presence of features suggestive of end organ damage like thrombocytopenia, oliguria, epigastric or upper quadrant abdominal pain, elevated liver enzymes, headache and visual disturbances.

2ml of cord blood anticoagulated with EDTA and in a clot vial were collected from these babies and haemoglobin and ferritin level were estimated. For haemoglobin estimation, cyanmeth method was used and for ferritin estimation, chemiluminescence immunoassay was used.

Chi square or Fishers exact test is used to evaluate difference between categorical variables. Data were checked for normality using Kolmogorov - Smirnova and Shapiro - Wilk test. Independent t-test is used depending on fulfilment of normality assumption for mean difference or Man Whitney test is used for normal data. All data were analysed using SPSS version 21. A p - value <0.05 is considered as statistically significant at 5% level of significance.

Results

During the study period, 100 preeclamptic and 100 normotensive patients with maternal age between 18-35 years and gestational age between 36-42 weeks were included in the study group and control group respectively. The important factors relating to pregnancy of hypertensive and normotensive mothers are given in table 1.

Parameters	Cases (n=100)	Control (n=100)
Maternal age in years	24.34 ± 3.77	23.71 ± 3.72
Booked cases	96%	99%
Mean systolic BP in mmHg	158 ± 11.27	113.98 ± 8.52
Mean diastolic BP in mmHg	102.3 ± 9.2	73.18 ± 7.23
Gestational age in weeks	38.94 ± 1.46	39.16 ± 1.39

A haemoglobin value of less than 13.5g/dl was considered anaemic and a level more than 22g/dl was considered polycythemic. Comparisons of cord blood haemoglobin among the newborns of normotensive versus preeclamptic patients are shown in table 2. Haemoglobin level were found to be significantly higher in the study group as compared to control group ($p < 0.004$).

Parameter	Control (n=100)	Cases (n=100)	Mean difference	P-value
	Mean ± SD	Mean ± SD		
Cord blood Hb%	16.91 ± 1.07	17.39 ± 1.25	-0.480	0.004

In the present study, when comparing umbilical cord blood data from normal and pre-eclamptic pregnancies (table 3), we found that ferritin level were found to be significantly lower in the study group as compared to control group ($p < 0.0001$).

Parameter	Control (n=100)	Cases (n=100)	Mean difference	Lower	Upper	P-value
	Mean ± SD	Mean ± SD				
Cord blood ferritin	158.94 ± 57.18	76.98 ± 64.48	81.96	64.96	98.95	<0.0001

When preeclampsia was distributed on the basis of severity it was seen that around 17 preeclamptic mothers had mild preeclampsia and 83 had severe preeclampsia. It was seen that cord blood haemoglobin when compared with the severity of preeclampsia, there was no statistical significance seen with p-value being 0.579. Similarly when cord blood ferritin level was compared with the severity of preeclampsia, there was no statistical significance seen with p-value being 0.559 (table 4).

Parameters	Mean distribution	P - value
Cord blood haemoglobin	Mild	0.579
	Severe	
Cord blood ferritin	Mild	0.559
	Severe	

Discussion

Hypertensive disorders, one of the most common complications in obstetrical field. Hypertensive disorders especially preeclampsia is a major cause of maternal and perinatal morbidity and mortality worldwide. In our study, the haemoglobin level in cord blood of the study group was found to be significantly higher than the control group with p-value being <0.004. Some studies showing the similar result are: Kurlat et al (1992)¹⁰ - The risk of polycythemia was shown to be 12.6 fold higher in babies of hypertensive mothers compared to the general population similar to Huang SC, Chang FM et al (1994)¹¹ which also shows elevated haemoglobin ($p < 0.05$) in preeclamptic pregnancies. Bolat A et al⁹ and Evalyn Singnarpi et al² also shows that risk of polycythemia was higher in babies of hypertensive mothers compared to the general population with significance value <0.05. But

according to Sivakumar et al⁴ and Prekshya et al⁵ there was no significant differences in haemoglobin values which was similar to Mosayebi Z et al¹², Naim Eman et al¹ and Catarino et al¹³ who found similar values for Hb values.

Our study demonstrates that babies born to pre-eclamptic patients who were at risk of for impaired uteroplacental blood flow had depressed ferritin levels. The AGA infants of mothers with preeclampsia also had increased serum transferrin levels with low serum ferritin values. According to Brunner et al¹⁴, Dewolf F et al¹⁵, in preeclampsia vasospasm, endothelial deposition and lipid deposition in the uteroplacental arterioles leads to compromised transport of iron to the foetus. In the present study, when comparing umbilical cord blood data from normal and pre-eclamptic pregnancies, we found that ferritin level were found to be significantly lower in the study group as compared to control group ($p < 0.0001$). Chockalingam et al¹⁶ and Siddappa et al¹⁷ shows the similar result that infants of pre-eclamptic mothers had significantly lower ferritin levels than did asymptomatic gestational age matched control infants without these conditions. Some studies shows the contradictory result like Bolat A et al⁹ who found Ferritin levels to be higher in the newborns of hypertensive mothers compared to control group. While Evalyn Singnarpi et al² found no difference in ferritin levels between the two groups.

Conclusion

We conclude that the cord blood haemoglobin of newborn of preeclamptic are higher and ferritin levels are lower as compared to newborns of normotensive patients. This parameters can be used for the screening purpose to detect the haematological changes in newborns in order to attempt to provide these babies with decreased morbidity and improved growth, development and survival.

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