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STUDY OF SERUM IRON AND SERUM TOTAL IRON BINDING CAPACITY IN PREECLAMPSIA

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ABSTRACT

Aims: 1 To study and compare the serum levels of iron and TIBC in women with normal pregnancy and preeclampsia.2.To study the correlation of serum levels of iron with TIBC women with preeclampsia. Materials and Methods: Hospital based study of 30 preeclamptic cases and 30 age matched controls without having preeclampsia in the age group of 20-45years. Results: Mean serum Iron levels were significantly higher in cases (198.0 ± 6 mcg/dl) as compared to controls (125.2 ± 32.5 mcg/dl) (P<0.001) and serum TIBC levels were significantly lower in cases (200.0 ± 56.5mcg/dl) as compared to controls (272.2±38mcg/dl).Conclusion: Increased serum Iron level is strongly associated with Preeclampsia.

KEY WORDS

Iron, oxidative stress, preeclampsia, TIBC

INTRODUCTION

Pregnancy is a physiological state associated with many alterations in metabolic, biochemical, physiological, hematological and immunological processes. If these changes are exaggerated, they can lead to complications during pregnancy. [1]

Globally, an estimated 2,87,000 women died during pregnancy and childbirth in 2010, of which India accounted for approximately 19% (56,000) deaths.[2] Preeclampsia is one of the major causes of maternal and perinatal mortality and morbidity. It is one of the commonest medical disorder diagnosed by obstetricians in clinical practice.[3]

Although the pathophysiology of preeclampsia remains undefined, placental ischemia or hypoxia is widely regarded as a key factor. [4,5] Inadequate trophoblast invasion leading to incomplete remodeling of the uterine spiral arteries considered to be a primary cause of placental ischemia.[6]

When tissues become ischemic, reactive oxygen species such as superoxide and hydrogen peroxide are produced, but neither of these is reactive enough to initiate cellular damage directly.[7,8] However, in the presence of catalytic amounts of transition metal ions, particularly iron, which may arise in the ischemic placenta by destruction of red blood cells from thrombotic, necrotic and hemorrhagic areas these species can generate the highly reactive hydroxyl radical by Fenton chemistry.[9] This radical can initiate the process of lipid peroxidation which, if uncontrolled, may result in endothelial-cell damage.[10,11]

The purpose of this study is to determine the increase in the Iron and decreased Total Iron Binding Capacity (TIBC) in women with preeclampsia when compared to normal pregnant women.

MATERIAL AND METHODS

The study subjects were selected based on inclusion and exclusion criteria a total number of 60 subjects. 30 women with preeclampsia were selected as cases and 30 women with normal pregnancy were selected as controls for the present study. A proforma was

used to record relevant information and study subjects.

Control group-30 Age matched healthy pregnant women of ≥20 weeks of gestation with BP ≤140/90 mm of Hg and without proteinuria were included.

Case group - 30 Women with hypertensive disorders of pregnancy were selected as per the guidelines given by National High Blood Pressure Education Programme (NHBPEP 2000). This group included 30 diagnosed cases of preeclampsia in age group of 20-45 years.

Inclusion criteria: Pregnant female of ≥20 weeks of gestation with blood pressure ≥140/90 mmHg noted first time during pregnancy on ≥2 occasions at least 6 hours apart with proteinuria of ≥1+ (≥30mg/dl) by dipstick method in a random urine sample were considered as having preeclampsia.

The pregnant women were excluded from the study with the H/O chronic hypertension, diabetes mellitus and/or who are on insulin therapy or hypoglycaemic drugs and diagnosed liver, cardiac or renal diseases or any other major illness.

Collection of blood samples for the study:

About 3ml of venous blood will be collected under aseptic precaution in a sterile bulb from selected subjects. Then the serum is separated by centrifugation which is used for estimation of Iron and TIBC.

In all the subjects serum concentrations of iron and TIBC were estimated using ferrozine method [12, 13] using Roche 400 auto analyser.

RESULTS

A total of 30 cases and 30 controls were studied. Table a showsThe mean age and mean POG of controls and cases were similar which was statistically not significant. Table b shows mean concentrations of serum levels of Iron and TIBC of controls are 125.2 ± 32.5 mcg/dl, 272.2 ± 38.0mcg/dl and in the cases 198.0 ± 52.6mcg/dl, 200.1 ± 56.5mcg/dl respectively(Graph a and b).

The statistical analysis by unpaired student's t-test showed that mean concentration of serum level of Iron is significantly increased in subjects with preeclampsia when compared to healthy controls ($p< 0.001$). The mean concentration of serum level of TIBC significantly decreased in subjects with preeclampsia when compared with controls ($p<0.001$). Pearson's correlation study shows serum TIBC negatively correlated with serum iron. (Table c)

Table a) Shows comparison of age and period of gestation (POG) of women with normal pregnancy and preeclampsia.

Variables		Controls (n=50)	Cases (n=50)	Significance
Age (Yrs)	Mean ± SD	24.7 ± 3.8	25.2 ± 3.9	t* = 0.65, p = 0.52, NS
POG (Wks)	Mean ± SD	31.4 ± 2.9	30.7 ± 2.4	t* = 1.31, p = 0.19, NS

* Unpaired student's t-test; p>0.05: Non-significant;
p<0.01 & p<0.05: significant; p<0.001: Highly significant.

Table b) Shows serum levels of iron and TIBC in women with normal pregnancy and in preeclampsia.

Groups		Serum Iron (mcg/dl)	Serum TIBC (mcg/dl)
Controls	**Mean ±S.D**	125.2 ± 32.5	272.2 ± 38.0
Cases	**Mean ±S.D**	198.0 ± 52.6	200.1 ± 56.5
	p	0.00 **	0.00 **

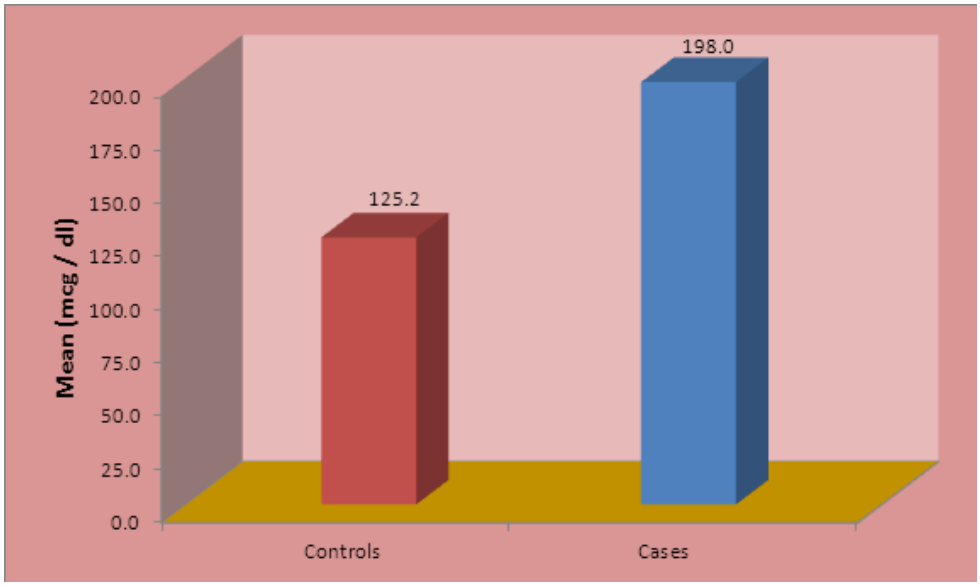
* Unpaired student's t-test; p>0.05: Non-significant;
p<0.01 & p<0.05: significant; p<0.001: Highly significant.

Table c) Shows correlation between serum levels of iron with serum levels of TIBC:

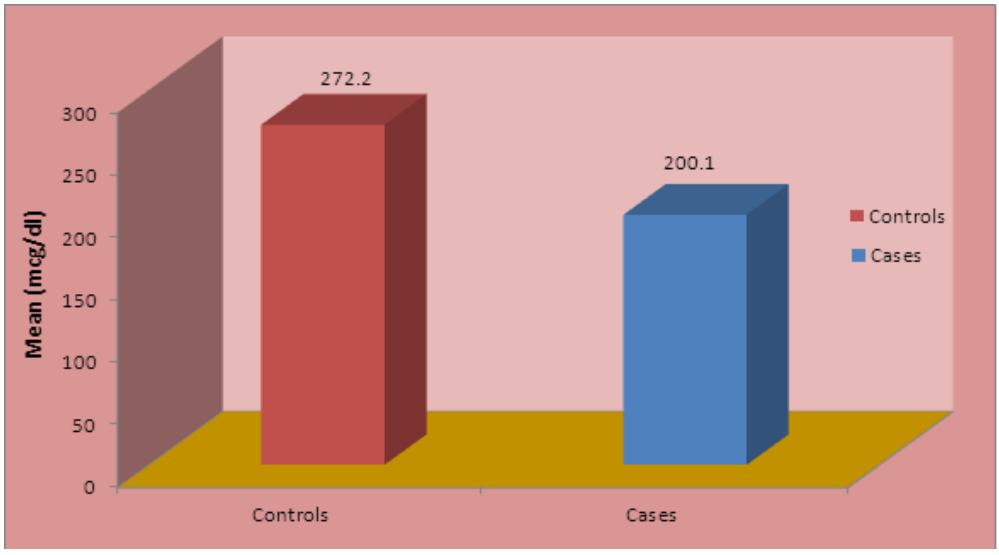
Relationship between Iron and TIBC	Pearson's Correlation coefficient (r)	'p' value
	-0.66**	< 0.001

** Highly significant; * Significant.
+ sign: Positive correlation; - sign: Negative (inverse) correlation

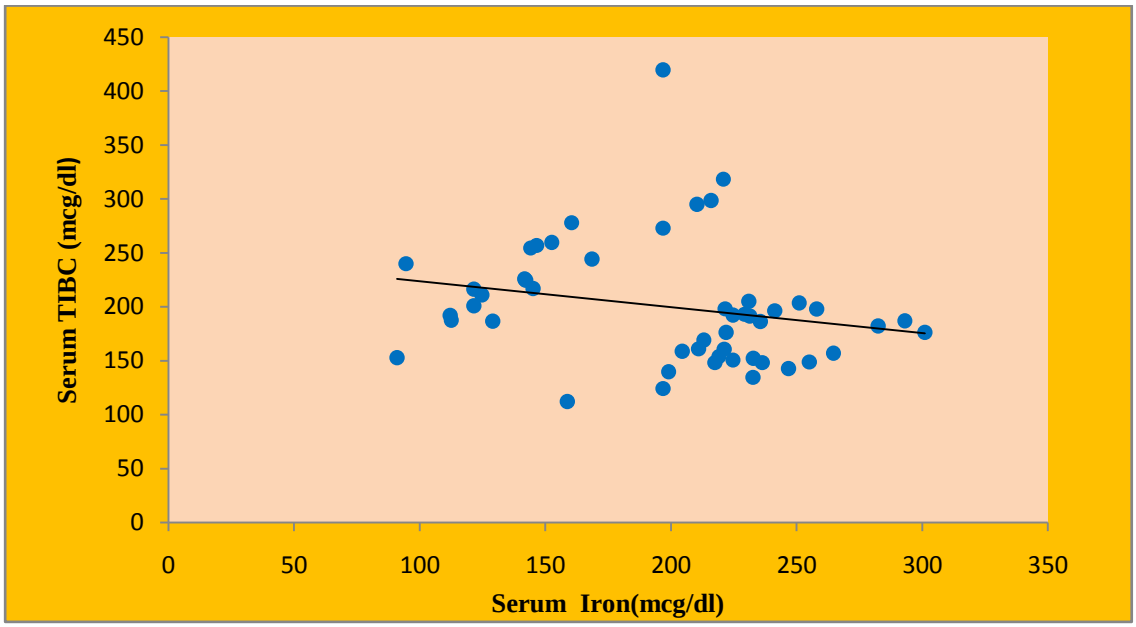
Graph a) Comparison of serum Iron levels among study groups.



Graph b) Comparison of serum Total Iron Binding Capacity (TIBC) levels among study groups



Graph c) Correlation of serum Total Iron Binding Capacity (TIBC) levels with serum iron levels in cases.



DISCUSSION

Preeclampsia is a multisystem disorder of unknown etiology and is unique to pregnant women after twenty weeks of gestation. It is progressive disease with a variable mode of presentation and rate of progression. Hypertension, proteinuria, excessive weight gain and edema are the classic clinical manifestation. [14, 15]

It is stated that increased oxidative stress play a role in the development of preeclampsia. An imbalance between pro-oxidants and antioxidants results in oxidative stress which would increase the potential for development of preeclampsia.[16]

In the present it was found that the mean concentrations of serum iron levels are significantly increased in subjects with preeclampsia when compared to healthy controls ($p < 0.001$). These findings are in accordance with the studies of Tasneem Zafar et al, Philip Samuels et al they stated that the elevated serum iron derived from hemolysis. Hemolysis may be caused by physical destruction of red blood cells as a result of intense vasospasm or abnormal endothelial cell-erythrocyte interactions. [17, 18] Excess iron is postulated as causal factor in the oxidative stress i.e in its radical form, which might be involved in pathogenesis of preeclampsia. [19, 15]

HulyaAksoy et al and N.Vitoratos et al they stated that the ability of transferrin to bind with free iron in the circulation is decreased. Therefore low serum iron binding capacity seems to contribute to the harmful effect of oxygen free radicals on the tissues.[20,21] A decreased Transferrin level would have led to iron-dependent $OH^{\bullet}$ formation from H_2O_2 in these patients. This may be a cause of the increase in lipid peroxidation in the plasma of the patients with mild and severe preeclampsia.[22,23,24] Carl A Hubel et al and N.Vitoratos et al they quoted that ceruloplasmin and transferrin act in concert to effectively eliminate iron catalysed free radical activity in the normal circumstances.[25]

The present study shows that increased Iron species and decreased TIBC are important finding in women with preeclampsia. Estimation of serum Iron can be helpful to assess the progression of the disease.

CONCLUSION

The findings of this study suggests that increase in serum levels of Iron and decrease in serum levels of Total Iron Binding Capacity (TIBC) is present in women with preeclampsia and they may have a role in pathogenesis of this disease. Therefore iron status of pregnant women could be assessed before giving iron supplement as these may cause more harm than benefit.

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REFERENCES

1. Maternal physiology. In : Cunningham F, Lenevo K, Bloom S, Hauth J, Rouse D, Spong C (Edts). Williams Obstetrics, 23rd ed. USA: The McGraw-Hill companies. 2010; 107-131.
2. Preventative medicine in obstetrics, pediatrics & geriatrics. In: Park K. (Edt). Park's textbook of preventive and social medicine, 21st ed. Jabalpur: M/s BanarasidasBhanot publishers. 2011: 514-517.
3. PIH: The challenge. In: Shah M (Edt). Hypertensive disorders in pregnancy. New Delhi: Jaypee brothers. 2007; 1-9.
4. Camille EP, Richard J. Levine, S. AnanthKarumanchi. Preeclampsia, a Disease of the Maternal Endothelium: The Role of Antiangiogenic Factors and Implications for Later Cardiovascular Disease. Circulation 2011; 123:2856-2869.
5. Jeffrey S. Gilbert et al. Pathophysiology of hypertension during preeclampsia: linking placental ischemia with endothelial dysfunction. American Journal of Physiology Heart Circulation 2008; 294:H541-H550.
6. Margaret PR, John B, Robert WE, Christopher WG. Redman, Laurence JK. Abnormal iron parameters in the pregnancy syndrome pre-eclampsia. American Journal of obstetrics and Gynaecology 2002; 187:412-418.
7. Meculure N, Thompson W. Pre-Eclampsia and eclampsia. In: Sengupta B, Chattopadhyay S, Thornton J, Sengupta P (Edts). Obstetrics for postgraduate and practitioners. New Delhi: Churchill Livingstone Publications. 1999; 40-47.
8. Deka D. Hypertensive disorders in pregnancy. In: Desai P, Patel P (Edts). Medical disorders in pregnancy. New Delhi: Jaypee brothers. 2001; 276-283.
9. Pregnancy hypertension. In : Cunningham F, Lenevo K, Bloom S, Hauth J, Rouse D, Spong C (Edts). Williams Obstetrics, 23rd ed. USA: The McGraw-Hill companies. 2010; 706-728.
10. Lockwood C, Paidas M. Preeclampsia and hypertensive disorders. In: Cohen W (Edt). Cherry and Merkatz's Complications of pregnancy, 5th ed. USA: Lippincott Williams & Wilkins. 2000; 207-232.
11. Duckitt K, Harrington D. Risk factors for pre-eclampsia at antenatal booking: systematic review of controlled studies.British Journal of Obstetrics and Gynecology. 2005; 1-7.
12. Yamanishi H, Kimura S, Iyama S, Yamaguchi y, and Yanagihara T. Fully automated measurement of total iron binding capacity in serum. Clinical Chemistry 1997; 43(12):2413-2417.
13. Higgins T, Bentler E, Doumas B. Haemoglobin, Iron and Bilirubin.In:Burtis CA, Ashwood ER and Bruns DE, editors. Tietz Textbook of clinical chemistry and molecular diagnostics. 4thedn. New Delhi:Elsevier co.2006;1190-1192.
14. Lei Q, Zhang B, Wen J, Liu G, Lin X, Niu J. Ante-partum and post-partum markers of metabolic syndrome in pre-eclampsia. Journal of Human Hypertension 2011; 25: 11–17.
15. Mohanty S, Nayak N, Nanda N, Rao P. Serum lipids and malondialdehyde levels in primiparous patients with pregnancy induced hypertension. Indian Journal of Clinical Biochemistry. 2006; 21(1): 189-192.
16. Dr.TasneemZafar, Dr.ZafarIqbal. Iron Status in Preeclampsia. Journal of Proffessional Medicine 2008;15(1):74-80.
17. CA Hubel, AV Kozlov, VE Kagan. Decreased transferrin and increased transferrin saturation in sera of women with preeclampsia: Implications for oxidative stress. American Journal of obstetrics Gynecology 1996; 175:692-700.
18. Shalini Gupta, Smiti Nanda, Uma Singh, SadhnaBansal and HarbansLal. Evaluation of the changes in serum iron levels in preeclampsia. Indian Journal of Clinical Biochemistry 1997;12(1):91-94.
19. N Vitoratos, E Salamalekis, N Dalamaga, D Kassanos, G Creatsas.Defective antioxidant mechanisms via changes in serum ceruloplasmin and total iron binding capacity of serum in women with pre-eclampsia. European Journal of Obstetrics & Gynecology and Reproductive Biology 1999; 84(1):63-67.
20. Hulya A, Seyithan T, Konca A, Ebubekir B, Nuri B, YakupK. Antioxidant Potential and Transferrin, Ceruloplasmin, and Lipid Peroxidation Levels in Women with Preeclampsia. Journal Of Investigative Medicine 2003; 51(5):284-287.
21. Tinatin K, Tamar S, Rusudan K. Alterations of oxidative metabolism at the pregnancy attended with Preeclampsia. Tbilisi State Medical University 2004; 4(1):34-36.
22. Ganiyu A, Ayo A, Ayodele B, Adijat A , Adebayo A.Serum concentrations of immunoglobulins and acute phase proteins in Nigerian women with preeclampsia. Reproductive Biology 2006; 6(3): 265-274.
23. Z. Nejim, A. Jwad. Comparative study of total iron binding capacity, serum iron, transferrin saturation

percent, and oxidative stress for two groups of pregnants. Scientific journal of veterinary medicine 2007; 6(1):2975-2981.

24. SS Entman, LD Richardson, AP Killam. Elivated serum ferritin in the altered ferrokinetics of toxaemia of pregnancy. American Journal of obstetrics Gynecology 1982; 144:418-422.
25. Hubel C A. Dyslipidemia, iron and oxidative stress in preeclampsia: assessment of maternal and feto-placental interactions. Seminar Reproduction Endocrinology 1998; 16: 75-92.

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