Original Research Article

The overbearing physiological changes marring iron indices interpretation in response to iron therapy during pregnancy

Chandrika N

Associate Professor, Department of Biochemistry, CIMS, Chamarajanagar, INDIA.
Email: dr.chandrikar@gmail.com

Abstract

Background: Iron deficiency anemia (IDA) is most common cause of anemia in pregnancy. In order to prevent this iron supplementation is routinely practiced as a prophylactic measure in pregnant women all over. The biochemical parameters assessed in IDA comprise an iron profile evaluation which consists of estimation of serum ferritin, serum iron, total iron binding capacity(TIBC), serum transferrin levels and calculation of transferrin saturation. These biochemical parameters are subjected to variations due to maternal adaption phenomenon. **Aim:** In the current study we have chosen three iron indices, serum iron, serum TIBC and transferrin saturation percent to note their performance in diagnosing and monitoring the response to iron therapy in pregnant women. **Methodology:** The study population are thirty- six pregnant women in their early second trimester, who are diagnosed with mild iron deficiency anemia (Hemoglobin between 9 and 11 g %). Iron parameters, serum iron, serum TIBC and transferrin saturation levels were analyzed in these women. They are then given oral iron preparation in the form of Ferrous sulphate for a period of twelve weeks. After this the Hemoglobin level, serum iron, TIBC and transferrin saturation levels are re-analyzed in these women. **Results:** The hemoglobin levels increased (p= 0.002). as expected after oral iron intake. Serum iron levels improved from 58.19±39.07 to 64.78±34.96 µg/dl. Serum TIBC value before supplementation 234.22±134.49 increased to 437.33±94.95 after, which contradicts the expected pattern seen in response to therapy in general population. Similarly absurdity prevails in transferrin saturation index levels which dropped from 36.8 ± 31.8 to 16.3 ± 10.6. **Conclusion:** The iron status during pregnancy is highly influenced by the maternal changes. And a blind interpretation of the report can lead to erroneous diagnosis. The interpretation of values should be based on the trimester specific reference ranges during pregnancy.

Key words: Serum iron, Total iron binding capacity, Transferrin saturation, Pregnancy.

*Address for Correspondence:
Dr Chandrika N, No.7, 'Santushti'. Survey no. 79/1, Sri Krishna Layout, Srirampura Mysore-570008.INDIA.
Email: dr.chandrikar@gmail.com

Received Date: 02/02/2021 Revised Date: 12/03/2021 Accepted Date: 21/04/2021
DOI: https://doi.org/10.26611/10021833

Access this article online	
Quick Response Code:	Website: www.medpulse.in
	Accessed Date: 15 June 2021

INTRODUCTION

Anemia is one of the commonly prevailing hematological disorder in women across the world. According to World Health Organization (WHO), globally, one third of the reproductive age group women population suffer from anemia and 40 % of the pregnant women are anemic.[1] The prevalence of anemia in pregnant women between age 15 and 49 years in India according to recent WHO data is 50.1 %.[2] Iron deficiency anemia is frequently encountered type of anemia in women of reproductive age and in children. Anemia is one of the leading causes of maternal deaths. India contributes to about 80% of the maternal deaths due to anaemia in South Asia.[3] National Iron Plus Initiative for Anemia Control by Government of India is an initiative to bring down prevalence rate of anemia among the vulnerable children and women population of the country.[4] As a result of such initiation, we have observed a considerable 38 % decline in Maternal mortality rate, a key

How to cite this article: Chandrika N. The overbearing physiological changes marring iron indices interpretation in response to iron therapy during pregnancy. *MedPulse International Journal of Biochemistry.* June 2021; 18(3): 39-42. https://www.medpulse.in/Biochemistry/

health index, in the past two decades in our country.[5] Iron deficiency anemia (IDA) is most common cause of anemia in pregnancy. A lot of physiological changes during pregnancy make women easily susceptible to IDA. These include expansion in maternal blood and plasma volume and a decrease in hematocrit, as well as an increase in the levels of some plasma proteins.[6] Also the fetal requirements for iron are met despite maternal deficiency. Maternal iron deficiency has a number of adverse consequences, including preterm delivery and low-birth-weight infants.[7] In view of this impending fall in iron status that occurs due to physiological changes in pregnancy as well increased demand by the growing fetus, iron supplementation is routinely practiced as a prophylactic measure in pregnant women all over.[8] The routine laboratory investigations to diagnose and monitor IDA are Hemoglobin concentration, red blood cell indices and peripheral smear. The biochemical parameters assessed in IDA comprise an iron profile evaluation which consists of estimation of serum ferritin, serum iron, total iron binding capacity, serum transferrin levels and calculation of transferrin saturation. The reference range of hemoglobin is 11 grams per deciliter in the first and third trimester of the pregnancy and 10.5 grams per deciliter in the second trimester.[9]The microcytic hypochromic blood picture is classic for IDA. There is no ambiguity in interpreting the results of these hematological indices in diagnosing IDA. However, the same does not apply when it comes to analyzing an iron profile parameters during pregnancy. These biochemical parameters are to subjected to variations due to maternal adaption phenomenon. In the current study we have chosen three iron indices, serum iron, serum TIBC and transferrin saturation percent to note their performance in diagnosing and monitoring the response to iron therapy in pregnant women.

METHODOLOGY

The study was conducted for a period of one and half years starting from February 2008 to August 2009 on pregnant women in their second trimester (between 14-20 weeks of gestation) attending antenatal clinic at M.S. Ramaiah Medical Teaching Hospital, Bengaluru. The Ethical clearance was obtained from the Ethical Review Board of the Institution prior to commencement of the study. An informed consent was taken from the pregnant women who were inducted in this study.

Thirty six Pregnant women of more than 14 weeks of gestation with Hemoglobin concentration between 9 and 11 g % were included in this study. Pregnant women with other medical illness or any intercurrent infection were excluded from our study.

Blood samples were collected from pregnant women between 14-20 weeks of gestation and following laboratory tests were done:

- Hemoglobin Concentration:
- Peripheral smear
- Serum iron-By automated direct iron assays using chromophore Ferene.
- Serum TIBC- By fully automated method using chromophore Ferene
- Transferrin saturation was calculated as Serum iron/serum TIBC x 100

All the thirty-six pregnant women with mild iron deficiency anemia (hemoglobin concentration between 9-11g/dl) were given oral iron supplementation in the form of ferrous sulphate tablets for a period of twelve weeks.

Re-estimation of the following laboratory tests after a period of twelve weeks of supplementation therapy was done,

- Hemoglobin Concentration
- Serum iron
- Serum TIBC.
- Transferrin saturation was calculated

Statistical analysis: The mean value and Standard deviation for all the biochemical parameters was calculated. The Mean ± SD between the cases and controls were compared using student 't' test. All statistical analysis was done at 5% level of significance.

RESULTS

Table 1 is compilation and comparison of Biochemical parameters analyzed before and after oral iron supplementation in thirty six pregnant women of the study.

Table 1: Comparison of study parameters prior and after supplementation with ferrous sulphate

Biochemical investigation	I sample (B/n 14-20 weeks) (mean ±SD)	II sample (B/n 26-32 weeks) (mean±SD)	'p' value
Hb%	10.24±0.86	11.08±1.46	0.002
Sr.iron(µg/dl)	58.19±39.07	64.78±34.96	0.441
Sr.TIBC(µg/dl)	234.22±134.49	437.33±94.95	0.000
Transferrin saturation (%)	36.8 ± 31.8	16.3 ± 10.6	0.0005

DISCUSSION

There are lot of physiological changes that occur during pregnancy to accommodate the growing fetus and prepare the pregnant woman for parturition. These changes alters the normal Biochemical values.[10] Such alterations have inspired researchers to investigate and establish reference ranges of various biochemical analytes in all the three trimesters of pregnancy. The typical presentation of iron profile analysis in IDA reveals decreased levels of serum iron, ferritin and transferrin saturation but TIBC increases. In circulation serum iron is carried bound to transferrin. The TIBC is the amount of iron that can be bound by transferrin if it were 100% saturated. The transferrin saturation is the amount of iron that is bound to transferrin, expressed as a percentage of the TIBC.[11] Following therapy, which can be either oral iron supplementation or parenteral, the improvement in iron status in a patient of IDA manifests in the form of improved serum iron, transferrin saturation and decreased TIBC levels. In the present study, we have noticed significant increase in the mean ± Standard deviation values of Hemoglobin from 10.24±0.86 to 11.08±1.46 (p = 0.002) after the women took ferrous sulphate preparation for 12 weeks. This in accordance to findings mentioned in study by Okam MM *et al.*[12] Serum iron levels also shows upward trend following supplementation from 58.19±39.07 to 64.78±34.96 µg/dl However the increase in the levels was not statistically significant. The next iron status approver we have analyzed in the population of the present study is Total iron binding capacity (TIBC). This particular parameter has not emerged in an expected pattern in this situation of mild IDA of pregnancy. The Mean ± SD values of TIBC is 234.22±134.49 before supplementation and it has increased to 437.33±94.95 after. This is contrary to the natural behaviour of TIBC in IDA and to iron therapy intervention. The TIBC reference ranges for the three trimesters of pregnancy are 235 – 408 µg/dl, 302 – 519 µg/dl, 380 - 597 µg/dl respectively.[13] One of the physiological changes that occurs during pregnancy in order to meet the increase iron demand is increased synthesis of β globulin transferrin, in the maternal liver cells.[14] Thus TIBC ranges also vary accordingly in pregnancy. When we look into the TIBC results of the present study, the values are within the ranges for the corresponding trimesters. So there was no derangement in TIBC value to start with, as it is a mild IDA condition and it has remained within range when the pregnancy has progressed to second trimester. However when the values are interpreted without referring the trimester specific reference ranges the TIBC behavior appears paradoxical. Tranferrin saturation index which is derived from serum iron and TIBC, also becomes fallible in this scenario.

CONCLUSION

The current study findings emphasizes the importance of acknowledging the physiological changes that occurs during pregnancy and the need to have the awareness of trimester specific reference ranges when interpreting any Biochemical analyte in a pregnant lady.

REFERENCES

1. Anaemia Global Mao.Pdf.
2. Ukibe S, Ikeako Lawrence C2, Mbanugo James I3, Obi- Okaro Alphonsus C4 and UNR. Prevalence of anaemia in pregnant women aged 15-49 years (%) [Internet]. Vol. 1, International Journal of Advanced Research. 2016. p. 65–9. Available from: https://www.who.int/data/maternal-newborn-child-adolescent-ageing/indicator-explorer-new/mca/prevalence-of-anaemia-in-pregnant-women-aged-15-49-years-(-)
3. NHP.GOV. Anaemia during pregnancy (Maternal anemia) | National Health Portal Of India [Internet]. Nhp.Gov. 2018. Available from: https://www.nhp.gov.in/disease/gynaecology-and-obstetrics/anaemia-during-pregnancy-maternal-anemia
4. NHP. National Iron Plus Initiative for Anemia Control | National Health Portal Of India [Internet]. Goi. Available from: https://www.nhp.gov.in/national-iron-plus-initiative-for-anemia-control_pg
5. UNICEF. Maternal health | UNICEF India [Internet]. 2018. Available from: https://www.unicef.org/india/what-we-do/maternal-health
6. Bauer K. Maternal Adaptations to Pregnancy: Hematologic Changes. UpToDate. 2020. p. 45–45.
7. De Sá SA, Willner E, Pereira TAD, De Souza VR, Boaventura GT, De Azeredo VB. Anemia in pregnancy: Impact on weight and in the development of anemia in newborn. Nutr Hosp. 2015;32(5):2071–9.
8. Gomes F, Bergeron G, Bourassa MW, Dallmann D, Golan J, Hurley KM, et al. Interventions to increase adherence to micronutrient supplementation during pregnancy: a protocol for a systematic review. Ann N Y Acad Sci. 2020;1470(1):25–30.
9. Khoigani MG, Goli S, Hasanzadeh A. The relationship of hemoglobin and hematocrit in the first and second half of pregnancy with pregnancy outcome. [Internet]. Vol. 17, Iranian journal of nursing and midwifery research. 2012. p. S165-70. Available from: http://www.ncbi.nlm.nih.gov/pubmed/23833600%0Ahttp://www.pubmedcentral.nih.gov/articlerender.fcgi?artid=PMC3696966
10. Soma-Pillay P, Nelson-Piercy C, Tolppanen H, Mebazaa A. Physiological changes in pregnancy. Cardiovasc J Afr. 2016;27(2):89–94.

11. Bouri S, Martin J. Investigation of iron defi ciency anaemia. Clin Med J R Coll Physicians London. 2018;18(3):242–4.
12. Okam MM, Koch TA, Tran MH. Iron Supplementation, Response in Iron-Deficiency Anemia: Analysis of Five Trials. Am J Med [Internet]. 2017;130(8):991.e1-991.e8. Available from: http://dx.doi.org/10.1016/j.amjmed.2017.03.045
13. Alagappan R. Laboratory Reference Values. Man Pract Med. 2011;823–6.
14. Joseph JC, Baker C, Sprang ML, Bermes EW. Changes in plasma proteins during pregnancy. Ann Clin Lab Sci. 1978;8(2):130–41.

Source of Support: None Declared
Conflict of Interest: None Declared