Assessment of serum ferritin and transferrin saturation in thalassaemia major patients

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ABSTRACT

BACKGROUND: The objective of this study is to shed light on the level of serum ferritin and serum transferrin saturation in thalassaemia patients. The level of serum ferritin and serum transferrin saturation in thalassaemia patients were determined and compared to that of normal healthy controls. MATERIALS AND METHODS: Serum samples of fifty thalassaemia patients and fifty normal healthy controls were taken. Serum ferritin was estimated in Abbott 1000sr by CMIA (chemiluminescent micro particle immunoassay) method. Serum transferrin saturation was calculated from serum iron and serum TIBC. Serum iron and serum TIBC estimated by colorimeter method in Fully automated Erba XL-640 Analyser. RESULTS: The results showed that serum ferritin level and serum transferrin saturation level of thalassaemia patients were significantly high as compared to normal healthy controls. (p value<0.05). CONCLUSIONS: Serum ferritin and Transferrin saturation increased in thalassemia patients significantly as compared to control. Serum ferritin and Transferrin saturation may be the best way to utilize the information about iron overload & development of complications like oxidative stress due to non-bound iron form. So serum ferritin and serum transferrin saturation measurement is useful for thalassaemia patients to know about level of iron overload.

Key words: Thalassaemia major, Serum iron, Serum transferrin saturation.

INTRODUCTION

Thalassaemia is a genetic disease associated with hemoglobin, defect in β-globin chain synthesis. The beta thalassaemia carrier rate in India is around 3-7% with higher frequency in certain ethnic groups. It is associated with increase in iron overload which becomes one of the major causes of morbidity & mortality. When serum iron and serum TIBC are used to diagnose iron overload, the measurements are usually combined in the calculation of serum transferrin saturation. Thalassaemia major is the severe transfusion dependent form and major cause of morbidity & mortality is iron overload. The progressive iron overload observed in β thalassaemia major patients is the side effect of ineffective erythropoiesis, increased gastrointestinal absorption of iron, lack of physiological mechanism for excreting excess iron & multiple blood transfusions, which results in Hemochromatosis. Even elevated body iron load is observed in milder form of thalassemia. Although the survival of thalassemic is steadily increasing, the prevalence of complications due to iron over load remains high. Thus Iron overload complication in β thalassemia is the major focus of management today. Repeated laboratory assessment of iron status is necessary for monitoring iron overload in thalassaemia. Routinely Serum Iron concentration and Total iron binding capacity (TIBC) reflects the iron status of the body, however several additional factors influence their value in serum. TIBC indirectly measures transferrin a specific carrier protein, which increase as serum iron concentration (and stored iron) decreases. Unfortunately, result of this parameter is also affected by factors like malnutrition, inflammation, chronic infection, and cancer. Ferritin is a storage compound for iron, and serum ferritin levels normally correlate well with total iron stores. However, due to limited availability and high cost factor and being an acute-phase reactant which can be elevated in the setting of inflammation, chronic infection, or other diseases, measurement of ferritin levels remain limited. Thus single test may not be able to evaluate the correct status of actual iron overload of an individual as many factors not concern influence on them. Transferrin

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Serum transferrin saturation (the percent iron saturation of transferrin) is calculated from the following formula.\textsuperscript{9} Transferrin saturation (%) = 100 × serum iron / TIBC and results were analysed with Graphpad Instat software by using student’s t-test for statistical significance of 0.05.

RESULTS

Table (1) showed the results of serum ferritin and serum transferrin saturation expressed as mean±standard deviation. Serum ferritin level of thalassaemia major patients are significantly higher (p<0.05) than the level in healthy control. And also serum transferrin saturation level of thalassaemia major patients are significantly higher (p<0.05) than the level in healthy control.

Table 1: Level of Serum Iron and Serum Transferrin Saturation(%) in cases & controls

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Biological reference interval</th>
<th>Cases (Thalassaemia Major) n=50</th>
<th>Control (Normal Control) n=50</th>
<th>significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Serum ferritin</td>
<td>5-204ng/ml</td>
<td>585.38 ± 47.34</td>
<td>89.54 ± 12.59</td>
<td>&lt;0.05</td>
</tr>
<tr>
<td>Serum transferrin saturation</td>
<td>20 % - 45%</td>
<td>56.92 ± 21.26</td>
<td>22.18 ± 9.54</td>
<td>&lt;0.05</td>
</tr>
</tbody>
</table>

Venous blood samples were collected from patients of thalassemic patients and normal healthy controls and supernatant blood serum was used for the analysis of serum ferritin and transferrin saturation. Serum ferritin was estimated in Abbott 1000sr by CMIA (chemiluminescent micro particle immunoassay) method.\textsuperscript{10} Serum transferrin saturation was calculated from serum iron and serum TIBC. Serum iron and serum TIBC estimated by colorimetric method in Erba XL-640 Fully Auto Analyser.\textsuperscript{8}
Statistically significant positive correlation was observed between percentage transferrin saturation & serum ferritin in thalassemia major.

**DISCUSSION**

Transferrin saturation value (normal 20-45%) is more consistently helpful than either value of serum iron or serum TIBC alone. Most times, serum ferritin levels are related to the quantity of iron stored in the body with and without iron overload. Serum ferritin is a useful screening test for the initial diagnosis of thalassemia. However, serum Ferritin protein is an acute phase reactant, rising with any inflammation process from infection through chronic disease like acute or chronic inflammatory processes, autoimmune diseases, neoplasias, chronic renal insufficiency, hepatopathies, and metabolic syndrome. So increase in ferritin concentrations with no excess iron body level can be observed in terms to determine whether a high serum ferritin protein is due to iron overload or inflammation; in these conditions transferrin saturation generally is normal or decreased. On the other hand, when there is an iron overload, the increase in ferritin concentrations is associated with increased saturation of transferrin. It has been also necessary to determine transferrin saturation, as Transferrin has a much longer half life in plasma than iron and shows short term of fluctuation. Transferrin can be measured indirectly as the ability of the plasma protein to bind iron so called TIBC.

The progressive iron overload in β thalassemia major patients is the consequence of ineffective erythropoiesis, increased gastrointestinal absorption of iron, lack of physiologic mechanism for excreting excess iron, and above all multiple blood transfusions. The iron which exceeds the iron binding capacity of transferrin appears in the plasma as non-transferrin bound iron, which is highly toxic to tissues. The accumulation of iron results in progressive dysfunction of the heart, liver and endocrine glands. The iron burden on the body can be assessed by means of elevated levels of serum transferrin saturation, serum ferritin, iron and TIBC levels. As loading continues, the capacity of transferrin, the main transport protein of iron, to bind and detoxify this essential metal may be exceeded. The resulting nontransferrin-bound iron (NTBI) fraction within plasma may promote the generation of reactive oxygen species (ROS), propagators of oxygen-related damage. Iron overload is responsible for the most damaging effects of the thalassemias, making iron chelation a focal point of the management of this diseases.

In nontransfused patients with severe thalassemia, abnormal dietary iron absorption results in an increased body iron burden between 2 and 5 g per year depending on the severity of erythroid expansion. If regular transfusions are required, as in β-thalassemia major patients, this doubles the rate of iron accumulation. In the severe forms of beta-thalassemia, multiple blood transfusions and a deficiency of a potent iron absorption inhibitor, result in iron overload with increased ferritin serum concentration and transferrin saturation.

**CONCLUSION**

In our study we concluded that there is a significant increase in serum ferritin level (585.38 ± 47.34) in thalassaemia patients as compare to serum ferritin level (89.54 ± 12.59) in normal healthy control. Also there is significantly increase in serum transferrin saturation level (56.92 ± 21.26) in thalassaemia patients as compare to serum transferrin saturation level (22.18 ± 9.54) normal healthy control.

Our study correlate well with previous studies by Aparna A Sagare et al 2014, Amna Faruqi et al 2014, Amitkumar Mishra et al 2013, Saraya AK et al 1985, Nadeem Ikram et al 2004. Serum ferritin and transferrin saturation are better indicators of iron status in thalassaemia patients. It is useful to know status of iron overload in thalassaemic patients. Not only for iron overload and diagnosis it also allow adequate management, appropriate family counseling and have important prognostic implication, but it also prevents unnecessary iron therapy at increase risk of iron toxicity. The dose and frequency of desferrioxamine infusion or any other iron chelator therapy is not investigated and it is a limitation of our study.

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REFERENCES


9. Delmar’s Guide to Laboratory and Diagnostic Tests. 2nd Ed. 2010


