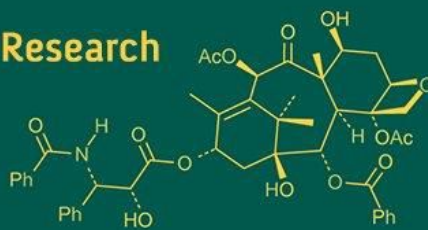


International Journal of Advanced Biochemistry Research



ISSN Print: 2617-4693

ISSN Online: 2617-4707

IJABR 2019; 3(2): 84-87

www.biochemjournal.com

Received: 06-11-2019

Accepted: 22-11-2019

Dr. Syed Ghouse Ali Hatim

Associate Professor,
Department of Biochemistry,
Sri Lakshmi Narayana
Institute of Medical Sciences,
Agaram Village, Villianur
Commune, Kudupakkam Post,
Puducherry, India

Dr. Manjoor Ilahi

Assistant Professor,
Department of General
Medicine, Sri Lakshmi
Narayana Institute of Medical
Sciences, Agaram Village,
Villianur Commune,
Kudupakkam Post,
Puducherry, India

Preliminary evaluation of serum iron and TIBC as screening markers in suspected tuberculosis

Syed Ghouse Ali Hatim and Manjoor Ilahi

DOI: <https://www.doi.org/10.33545/26174693.2019.v3.i2a.7239>

Abstract

Background and Objectives: In order to effectively control tuberculosis (TB), early identification is essential, and the illness continues to be a big public health concern in developing nations. Chronic inflammatory diseases, such as tuberculosis, have been found to alter iron metabolism, namely serum iron and total iron-binding capacity (TIBC). The purpose of this research was to determine whether serum iron and TIBC may be used as diagnostic tools for those who may have tuberculosis.

Methods: This prospective observational study involved 40 individuals exhibiting clinical and radiological indications of tuberculosis at a tertiary care institution. Patients completed standard diagnostic assessments for tuberculosis, including the measurement of serum iron and total iron-binding capacity (TIBC) levels. Patients were classified into confirmed TB (n = 22) and non-TB (n = 18) groups based on microbiological and/or radiological validation. We looked at the serum iron and TIBC levels in both groups. The independent t-test was used to do the statistical analysis, and a p-value of less than 0.05 was thought to be statistically significant.

Results: The non-TB group had an average serum iron level of 76.2 ± 12.1 $\mu\text{g/dL}$, while the confirmed TB group had a considerably lower average level of 38.6 ± 9.4 $\mu\text{g/dL}$ ($p < 0.001$). Also, compared to non-TB patients (286.9 ± 34.5 $\mu\text{g/dL}$), TB patients had considerably lower mean TIBC levels (212.4 ± 28.7 $\mu\text{g/dL}$) ($p < 0.001$). In 81.8% of confirmed tuberculosis patients, a decrease in serum iron and total iron binding capacity (TIBC) was noted, indicating a robust correlation with active disease.

Conclusion: The levels of serum iron and total iron binding capacity (TIBC) were considerably lower in tuberculosis patients as compared to non-TB individuals. This study adds to the growing body of evidence that serum iron and TIBC can be cost-effective and valuable supplemental screening markers for tuberculosis, particularly in areas where resources are scarce. To confirm their diagnostic value, additional large-scale trials are suggested.

Keywords: Tuberculosis, Serum iron, Total iron-binding capacity, Screening markers, Inflammation

Introduction

Infectious diseases like tuberculosis (TB) continue to be a major health problem around the world, especially in less developed regions. Early identification of tuberculosis remains challenging in resource-constrained settings owing to vague clinical presentation and limited access to advanced diagnostic facilities. This is despite the availability of efficient diagnostic instruments and treatment regimens. Transmission, disease progression, and fatality rates are all worsened when diagnoses are delayed [1, 2].

As a chronic inflammatory disease, tuberculosis drastically changes the way the host body uses iron. Mycobacterium development and host immunological defense both rely on iron. The reticuloendothelial system sequesters iron during persistent illnesses like tuberculosis, resulting in low serum iron levels circulating in the blood. The process by which inflammatory cytokines and elevated hepcidin synthesis hinder iron absorption in the intestines and iron release from macrophages is what causes this syndrome, which is often called anemia of chronic illness [3-5].

Inflammatory conditions also impact total iron-binding capacity (TIBC), which is an indirect indicator of transferrin levels. Reduced hepatic production of transferrin is one reason why TB patients typically have lower TIBC levels, which in turn affect iron homeostasis. The inflammatory load and disease activity are reflected in these variations in serum iron and TIBC [6, 7].

While sputum microscopy, cultures, and nucleic acid amplification tests are widely recognized as the gold standard for tuberculosis diagnosis, these technologies aren't always accessible or provide fast findings. Thus, there is a great deal of clinical interest in

Corresponding Author:

Dr. Manjoor Ilahi

Assistant Professor,
Department of General
Medicine, Sri Lakshmi
Narayana Institute of Medical
Sciences, Agaram Village,
Villianur Commune,
Kudupakkam Post,
Puducherry, India

developing simple and cost-effective laboratory criteria to aid in early screening. The current study was conducted to assess the potential screening markers of serum iron and TIBC in patients suspected of having tuberculosis [8-10].

Materials and Methods

This was a prospective observational study carried out in the Department of Medicine in conjunction with the Department of General Medicine, Sri Lakshmi Narayana Institute of Medical sciences, Agaram Village, Villianur Commune, Kudupakkam Post, Puducherry, between September 2018 to August 2019. During the trial period, 40 individuals with a clinical suspicion of tuberculosis were included after providing informed consent. Patients exhibiting symptoms indicative of tuberculosis, including chronic cough, fever, weight loss, night sweats, and radiological abnormalities consistent with TB, were assessed. The Institutional Ethics Committee gave its approval for the study.

Inclusion Criteria

- Patients aged 18 years and above
- Clinical and/or radiological suspicion of tuberculosis
- Patients not previously treated for tuberculosis
- Willingness to provide written informed consent

Exclusion Criteria

- Known cases of iron deficiency anemia
- Patients on iron supplementation or recent blood transfusion
- Chronic liver disease or renal failure
- Malignancy or other chronic inflammatory diseases
- Pregnant or lactating women

Statistical Analysis

Application software known as Statistical Package for the Social Sciences (SPSS) was used for data entry and analysis. The mean plus or minus the standard deviation (SD) was used to represent continuous variables. The levels of serum iron and TIBC were compared between the groups with and without proven tuberculosis using an independent t-test. A statistically significant result was defined as a p-value less than 0.05.

Results

The study comprised 40 participants who were clinically suspected of having tuberculosis. Based on microbiological and/or radiological confirmation, 22 patients (55%) were diagnosed with tuberculosis, while 18 patients (45%) were categorized as non-tuberculosis cases. Every subject had the necessary tests and was incorporated into the final analysis.

Table 1: Demographic Profile of the Study Population

Parameter	TB Group (n=22)	Non-TB Group (n=18)	p-value
Mean age (years)	41.3 ± 12.6	39.8 ± 11.4	0.68
Male	14 (63.6%)	11 (61.1%)	0.87
Female	8 (36.4%)	7 (38.9%)	

Appropriate group matching was shown by Table 1, which reveals that both groups were equivalent with respect to gender distribution and age. No statistically significant difference was found.

Table 2: Clinical Presentation of Patients with Suspected Tuberculosis

Symptom	TB Group (n=22)	Non-TB Group (n=18)
Chronic cough	20 (90.9%)	13 (72.2%)
Fever	18 (81.8%)	10 (55.6%)
Weight loss	16 (72.7%)	6 (33.3%)
Night sweats	14 (63.6%)	5 (27.8%)
Loss of appetite	15 (68.2%)	7 (38.9%)

In comparison to patients without tuberculosis, those with confirmed cases were more likely to have constitutional symptoms such as persistent coughing, fever, and decreased weight.

Table 3: Comparison of Serum Iron Levels between TB and Non-TB Groups

Group	Serum Iron (µg/dL)	p-value
TB Group (n=22)	38.6 ± 9.4	<0.001
Non-TB Group (n=18)	76.2 ± 12.1	

There appears to be a change in iron metabolism in active tuberculosis, since the tuberculosis group had substantially lower mean serum iron levels than the non-TB group.

Table 4: Comparison of Total Iron-Binding Capacity (TIBC) Between Groups

Group	TIBC (µg/dL)	p-value
TB Group (n=22)	212.4 ± 28.7	<0.001
Non-TB Group (n=18)	286.9 ± 34.5	

This suggests that inflammation-related reduction of transferrin synthesis is at work in tuberculosis patients, as their TIBC levels are markedly lower than those of non-TB patients.

Table 5: Combined Alteration of Serum Iron and TIBC in the Study Population

Parameter	TB Group (n=22)	Non-TB Group (n=18)
Reduced serum iron alone	3 (13.6%)	2 (11.1%)
Reduced TIBC alone	1 (4.5%)	1 (5.6%)
Reduced serum iron + TIBC	18 (81.8%)	4 (22.2%)

A significant number of tuberculosis patients (81.8%) had lower serum iron and total iron binding capacity (TIBC) than non-TB patients, indicating that these markers could be useful as additional screening tools for suspected tuberculosis.

Discussion

Changes in iron homeostasis are among the many metabolic and immunological changes brought about by tuberculosis, a long-term infectious disease. This study looked at serum iron and total iron-binding capacity (TIBC) as possible screening markers for tuberculosis in patients who might have the disease. It found that low levels of both parameters were associated with active tuberculosis [11, 12].

Serum iron levels were found to be considerably lower in people with proven tuberculosis compared to those without the disease. In the well-known anemia of chronic disease, inflammatory cytokines cause an increase in hepcidin synthesis, which in turn causes iron to be sequestered inside macrophages and less available in the bloodstream. This data is in line with that theory. As a host defensive

mechanism, iron redistribution is thought to reduce the availability of iron to *Mycobacterium tuberculosis* [13-15]. Patients with tuberculosis also had substantially lower TIBC values. When inflammation persists over an extended period of time, the liver produces less transferrin, which shows in a lower TIBC. This study's findings that most TB patients had decreased blood iron and total iron binding capacity (TIBC) provide credence to the idea that these parameters might be used as indirect indicators of disease activity, drawing attention to the inflammatory nature of tuberculosis [16-18]. There is strong evidence to support the use of serum iron and TIBC as supplementary screening techniques, as more than 80% of confirmed tuberculosis cases showed a simultaneous drop in both. In resource-limited situations, where access to advanced diagnostic modalities may be restricted, these parameters can be especially beneficial due to their widespread availability, low cost, and simplicity of evaluation; nevertheless, they are not disease-specific [19, 20]. It is important to consider the study's limitations before interpreting its results, though. It is difficult to draw firm conclusions about cause and effect because of the study's observational approach and the tiny sample size. We also did not evaluate inflammatory indicators like C-reactive protein or hepcidin levels, and we excluded additional inflammatory disorders that may impact iron metabolism based on clinical criteria alone. To further understand iron metabolism in tuberculosis, future research should use bigger cohorts and more biomarkers [21, 22]. This preliminary study's findings, taken as a whole, provide more evidence that serum iron and TIBC levels are indicators of disease-related inflammatory alterations in tuberculosis and could be valuable additions to the initial screening of suspected cases [23, 24].

Conclusion

Serum iron and total iron-binding capacity (TIBC) levels are considerably lower in tuberculosis patients compared to non-TB individuals, according to this study. These parameters were found to be reduced in most tuberculosis cases, which is consistent with the iron metabolism changes seen in chronic inflammatory conditions. Initial evaluation of patients with suspected tuberculosis, especially in resource-limited settings, may benefit from the use of serum iron and TIBC as additional screening markers. These laboratory procedures are straightforward, affordable, and widely available. Clinical findings and conventional diagnostic tests should be considered with these characteristics because they are not disease-specific. These findings need to be validated and their use in illness monitoring and treatment response investigated in further large-scale trials.

Funding

None.

Conflict of Interest

None.

References

1. World Health Organization. Global tuberculosis report 2016. Geneva: World Health Organization; 2016.
2. Lawn SD, Zumla AI. Tuberculosis. *Lancet*. 2011;378(9785):57-72.
3. Cegielski JP, McMurray DN. The relationship between malnutrition and tuberculosis: evidence from studies in humans and experimental animals. *Int J Tuberc Lung Dis*. 2004;8(3):286-298.
4. Schaible UE, Kaufmann SH. Iron and microbial infection. *Nat Rev Microbiol*. 2004;2(12):946-953.
5. Weiss G, Goodnough LT. Anemia of chronic disease. *N Engl J Med*. 2005;352(10):1011-1023.
6. Nemeth E, Ganz T. Regulation of iron metabolism by hepcidin. *Annu Rev Nutr*. 2006;26:323-342.
7. Nemeth E, Rivera S, Gabayan V, Keller C, Taudorf S, Pedersen BK, Ganz T. IL-6 mediates hypoferrremia of inflammation by inducing the synthesis of the iron regulatory hormone hepcidin. *J Clin Invest*. 2004;113(9):1271-1276.
8. Gangaidzo IT, Moyo VM, Mvundura E, Murphree NL, Lhatoo S, Moyo M, *et al*. Association of pulmonary tuberculosis with increased dietary iron intake, iron overload and polymorphisms in the NRAMP1 gene in a high-risk population. *Int J Tuberc Lung Dis*. 2001;5(3):256-263.
9. Cunningham AJ, de Souza JB, Walther M, Tavener S, Fletcher TM, de Menezes LJ, *et al*. Malaria impairs resistance to *Salmonella* through hepcidin-mediated iron restriction. *Nat Med*. 2011;17(6):811-817.
10. Horne DJ, Hubbard A, Narita M, Bate J, Le T, Wang T, *et al*. Correlation of serum ferritin and sputum mycobacterial load in pulmonary tuberculosis. *BMC Infect Dis*. 2011;11:349.
11. Gordeuk VR, Delanghe J, *et al*. Iron status and the risk of tuberculosis: a systematic review. *Int J Tuberc Lung Dis*. 2014;18(1):45-52.
12. Olsson A, Hellberg D, Bentsson M, Johansson I, Blomberg J, Söderström T, *et al*. Low serum iron and transferrin saturation in active tuberculosis. *Scand J Infect Dis*. 2012;44(10):737-744.
13. Lönnroth K, Jaramillo E, Williams BG, Dye C, Raviglione M. Drivers of tuberculosis epidemics: the role of risk factors and social determinants. *Soc Sci Med*. 2009;68(12):2240-2246.
14. Bullen JJ, Rogers HJ, Spalding PB, Ward CG. Natural resistance, iron and infection: a challenge for clinical medicine. *J Med Microbiol*. 2006;55(Pt 3):251-258.
15. Macallan DC. Malnutrition in tuberculosis. *Diagn Microbiol Infect Dis*. 1999;34(2):153-157.
16. Barber MD, Tisdale MJ, McMillan DC. Evidence for anorexia and altered host energy metabolism in patients with pulmonary tuberculosis. *Clin Sci (Lond)*. 1996;91(6):659-663.
17. Murray MJ, Murray AB. The inhibition of tubercle bacilli by transferrin. *J Clin Invest*. 1975;56(4):800-806.
18. Weiss G. Pathogenesis and treatment of anaemia of chronic disease. *Blood Rev*. 2002;16(2):87-96.
19. World Health Organization. Haemoglobin concentrations for the diagnosis of anaemia and assessment of severity. Geneva: World Health Organization; 2011.
20. Thomas C, Mazumder A, Bhattacharya SK, *et al*. Alterations of iron parameters in tuberculosis patients before and after antitubercular therapy. *Indian J Med Res*. 2010;132:127-133.
21. Dargavel J, Jones P, Sinha R. Utility of routine iron studies in patients with suspected infection: a clinical review. *Clin Biochem Rev*. 2013;34(3):173-188.

22. Skjeldestad FE, Andreassen A, Lenvik O, Abrahamsen TG. Serum transferrin and total iron-binding capacity in diagnosis of iron disorders: evaluation and clinical applicability. *Scand J Clin Lab Invest*. 2010;70(6):420-426.
23. Goulart-Filho F, Vieira D, Silva L, *et al*. Iron metabolism biomarkers in active pulmonary tuberculosis: a case-control study. *Tuberculosis (Edinb)*. 2013;93(1):94-97.
24. Chandra RK. Nutrition and immunity: lessons from the past and new insights into the future. *Am J Clin Nutr*. 1991;53(5):1087-1101.