Serum Ferritin Level in Patients of Chronic Diseases Presenting with Anemia: A Cross-Sectional Observational Study

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Abstract

Background: Anemia is a common complication in patients with chronic diseases and may result from iron deficiency, chronic inflammation, or combined etiologies. Serum ferritin, a marker of iron stores and inflammation, provides valuable insight into anemia pathophysiology. This study aimed to evaluate serum ferritin levels in patients with chronic diseases presenting with anemia. **Material and Methods:** A cross-sectional observational study was conducted in the Department of General Medicine, Sir T Hospital, Bhavnagar, over nine months, with six months of data collection. Adult patients (>18 years) with chronic diseases and anemia were enrolled after obtaining informed consent. Exclusion criteria included recent infection, blood transfusion, iron therapy, or pregnancy. Clinical details and laboratory parameters were recorded in a pre-validated Case Record Form, including complete blood count and iron studies (serum iron, ferritin, total iron-binding capacity, and transferrin saturation). Data were analyzed using standard statistical methods. **Results:** 288 participants were included, with a slight male predominance (55%). Most participants were aged 20–40 (50%), followed by 41–60 (40%). CKD (32%) and CLD (25%) were the most common chronic diseases. Mean hemoglobin was 8 ± 2 g/dl, with red cell indices showing low-normal values. Mean serum ferritin was 322 ± 138.9 ng/ml, serum iron 33 ± 21 µg/dl, TIBC 224 ± 57 µg/dl, and transferrin saturation $16 \pm 3\%$. Anemia was classified as mild (16%), moderate (45%), and severe (39%). Serum ferritin levels were low in 8%, normal in 47%, and high in 45% of participants. High ferritin was particularly observed in CKD, thalassemia, and malignancy, while low ferritin was more frequent in CKD and CLD. Ferritin distribution was comparable across age and gender groups. **Conclusion:** Serum ferritin levels in chronic disease-associated anemia vary according to the underlying disease and the severity of the anemia. Assessment of ferritin alongside hematological indices is essential for accurate diagnosis and management of anemia in this population.

Keywords: Serum ferritin, Chronic disease, Anemia, Iron status, Cross-sectional study.

INTRODUCTION

Anemia is a prevalent complication in individuals with chronic diseases, encompassing conditions such as chronic kidney disease (CKD), chronic liver disease (CLD), malignancies, and inflammatory disorders.[1,2] These conditions can lead to anemia through impaired erythropoiesis, increased red blood cell destruction, and chronic inflammation.[3] Serum ferritin, an acute-phase reactant, serves as a key biomarker in differentiating between iron deficiency anemia (IDA) and anemia of chronic disease (ACD).[4]

In CKD, anemia often results from erythropoietin deficiency and iron dysregulation. Studies have indicated that iron deficiency is common in non-dialysis CKD patients, with a significant proportion exhibiting low serum ferritin levels.[5] Conversely, in inflammatory conditions like ulcerative colitis, elevated ferritin levels may reflect the acute-phase response rather than iron overload.[6]

The interpretation of serum ferritin in the context of chronic diseases requires careful consideration of both inflammatory status and iron parameters. Recent guidelines suggest that a serum ferritin level <100 ng/mL and low transferrin saturation indicate iron deficiency, whereas higher ferritin levels may suggest ACD or iron overload.[7]

Given the complex interplay between chronic diseases, inflammation, and iron metabolism, this study aims to evaluate serum ferritin levels in patients with chronic diseases presenting with anemia. Understanding these dynamics is crucial for accurate diagnosis and effective anemia management in this patient population.

MATERIALS AND METHODS

Study Design and Setting: This cross-sectional observational study evaluated serum ferritin levels in patients with chronic diseases presenting with anemia. The study was carried out over nine months in the Department of General Medicine at Sir T

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Hospital, Bhavnagar, with data collection spanning six months.

Ethical Considerations: Approval was obtained from the Institutional Ethics Committee (Annexure I) before commencement. Written informed consent was obtained from all participants willing to partake in the study (Annexure II), per ethical guidelines for human research.

Study Population: Patients aged over 18 years presenting with anemia and underlying chronic diseases, either visiting the medicine outpatient department or admitted to the general medicine wards of Sir T Hospital, were considered for inclusion.

Inclusion Criteria:
- Age >18 years.
- Diagnosis of chronic disease with anemia.
- Willingness to participate, confirmed by written informed consent.

Exclusion Criteria:
- History of acute infection within the preceding six weeks.
- Blood transfusion or iron therapy within the previous three months.
- Pregnant females.

Data Collection: Eligible patients were enrolled consecutively according to the selection criteria. Clinical and laboratory data were recorded using a pre-validated Case Record Form (CRF) (Annexure IV), capturing the following information:
- Demographics: Age, sex, and weight.
- Clinical History: Primary reason for admission, past medical and drug history, and relevant personal history.
- Clinical Examination: Vital signs and detailed general and systemic examination.
- Laboratory Investigations:
  o Complete blood count: Hemoglobin (Hb%), red blood cell count (RBC), white blood cell count (WBC), platelet count, red cell distribution width (RDW), mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH), and mean corpuscular hemoglobin concentration (MCHC).
  o Iron profile: Serum iron, serum ferritin, total iron-binding capacity (TIBC), and transferrin saturation.

Data Management and Statistical Analysis: All collected data were entered into a Microsoft Excel spreadsheet for organization and analysis. Statistical evaluation was performed using appropriate tests to determine the distribution, central tendencies, and correlations among study variables. Results were expressed as mean ± standard deviation for continuous variables and percentages for categorical variables.

RESULTS

A total of 288 participants were enrolled in the study. The gender distribution showed a slight predominance of males (n=159, 55%) compared to females (n=129, 45%). The majority of participants were aged between 20 and 40 years (n=145, 50%), followed by 41–60 years (n=116, 40%), and those above 60 years accounted for 10% of the cohort (n=27) [Table 1].

Chronic kidney disease (CKD) was the most prevalent comorbidity, affecting 32% of participants (n=93), followed by chronic liver disease (CLD) in 25% (n=72). Other chronic conditions included ischemic heart disease (IHD) in 10% (n=29), malignancy in 8% (n=23), and rheumatoid arthritis in 7% (n=20). Chronic obstructive pulmonary disease (COPD) and osteoarthritis were each present in 5% of participants, while thalassemia accounted for 4%. Tuberculosis (TB) and sickle cell anemia were the least common, comprising 2% each [Table 2].

The hematological profile of the study population revealed a mean hemoglobin of 8 ± 2 g/dl, with a mean red blood cell count of 4 ± 1 million/cm³. Other red cell indices included a mean corpuscular volume (MCV) of 77 ± 6 fl, mean corpuscular hemoglobin (MCH) of 22 ± 2 pg, and mean corpuscular hemoglobin concentration (MCHC) of 28 ± 1 g/dl. Hematocrit averaged $27 \pm 4\%$, and red cell distribution width (RDW) was $24 \pm 1\%$. The mean white blood cell and platelet counts were $8,305 \pm 3,863$ cells/µl and $291,226 \pm 131,758$ cells/µl, respectively. Iron studies showed a mean serum iron of 33 ± 21 µg/dl, total iron-binding capacity (TIBC) of 224 ± 57 µg/dl, transferrin saturation (TS) of $16 \pm 3\%$, and serum ferritin of 322 ± 138.9 ng/ml [Table 3].

Anemia was classified as mild in 16% (n=45), moderate in 45% (n=131), and severe in 39% (n=112) of participants. Serum ferritin levels were low in 8% (n=22), normal in 47% (n=136), and high in 45% (n=130) of cases [Table 4].

Correlation analysis indicated high serum ferritin levels were observed across all age groups, with the majority in the 25–40 years and >40 years categories. Males and females had comparable distributions of ferritin levels. Among disease groups, high ferritin was particularly notable in thalassemia, CKD, and malignancy, whereas low ferritin was more frequent in CKD and CLD. Regarding anemia severity, high ferritin levels were predominantly seen in moderate and severe anemia, while low ferritin was most common among participants with mild to moderate anemia [Table 5].

Table 1: Age and Gender distribution among study participants

Variable	Category	Number (n=288)	Percentage (%)
Gender	Male	159	55
	Female	129	45
Age	20–40 years	145	50
	41–60 years	116	40
	>60 years	27	10

Table 2: Distribution of Chronic Disease in Study Participants (n=288)

Chronic Disease	Number of Patients	Percentage (%)
Chronic Kidney Disease	93	32

Chronic Liver Disease	72	25
Ischemic Heart Disease (IHD)	29	10
Malignancy	23	8
Rheumatoid Arthritis	20	7
Chronic Obstructive Pulmonary Disease (COPD)	15	5
Osteoarthritis	14	5
Thalassemia	11	4
Tuberculosis (TB)	6	2
Sickle Cell Anemia	5	2
Total	288	100

Table 3: Laboratory Investigations in the Study Patients (n=288)

Laboratory Investigation	Values (Mean ± SD)
Hemoglobin (g/dl)	8 ± 2
White Blood Cell Count (cells/μl)	8,305 ± 3,863
Platelet Count (cells/μl)	291,226 ± 131,758
Red Blood Cell Count (million/cumm)	4 ± 1
Mean Corpuscular Volume (MCV) (fl)	77 ± 6
Mean Corpuscular Hemoglobin (MCH) (pg)	22 ± 2
Mean Corpuscular Hemoglobin Concentration (MCHC) (g/dl)	28 ± 1
Hematocrit (%)	27 ± 4
Red Cell Distribution Width (RDW) (%)	24 ± 1
Serum Iron (μg/dl)	33 ± 21
Serum Ferritin (ng/ml)	322 ± 138.9
Total Iron Binding Capacity (TIBC) (μg/dl)	224 ± 57
Transferrin Saturation (TS) (%)	16 ± 3

Table 4: Classification of Anemia and Serum Ferritin Levels in Study Participants (n=288)

Parameter	Category	Number of Patients	Percentage (%)
Anemia	Mild	45	16
	Moderate	131	45
	Severe	112	39
	Total	288	100
Serum Ferritin Levels	Low	22	8
	Normal	136	47
	High	130	45
	Total	288	100

Table 5: Correlation of Variables with Serum Ferritin Levels in Study Participants (n=288)

Variable	Category	Ferritin Low	Ferritin Normal	Ferritin High	Total
Age	<25 years	2	0	10	12
	25–40 years	10	65	58	133
	>40 years	10	71	62	143
Gender	Male	12	80	67	159
	Female	10	56	63	129
Disease	Chronic Kidney Disease	7	49	37	93
	Chronic Liver Disease	7	33	32	72
	IHD	3	16	10	29
	Malignancy	1	10	12	23
	Rheumatoid Arthritis	1	10	9	20
	COPD	2	5	8	15
	Osteoarthritis	1	6	7	14
	Thalassemia	0	0	11	11
	TB	0	4	2	6
	Sickle Cell Anemia	0	3	2	5
Anemia	Mild	4	23	18	45
	Moderate	9	65	57	131
	Severe	9	48	55	112

Discussion

Our study aimed to evaluate serum ferritin levels in patients with chronic diseases presenting with anemia. The findings revealed a high prevalence of anemia among these patients, with varying serum ferritin levels. These results underscore the complexity of diagnosing and managing anemia in the context of chronic diseases.

Anemia in chronic diseases can be attributed to multiple factors, including iron deficiency and anemia of chronic disease (ACD). Iron deficiency is commonly observed in patients with chronic kidney disease (CKD), with studies reporting a prevalence of iron deficiency ranging from 24% to 85% in this population.[8] Conversely, ACD is characterized by elevated serum ferritin levels, reflecting an acute-phase response rather than iron overload.[9]

The interpretation of serum ferritin levels in patients with

chronic diseases requires careful consideration of the inflammatory status. While ferritin is a marker of iron stores, it is also an acute-phase reactant that can be elevated in the presence of inflammation, potentially masking underlying iron deficiency.[10] Therefore, additional markers such as transferrin saturation (TSAT) are essential for accurate assessment.

In our study, most patients exhibited high serum ferritin levels, particularly those with chronic kidney disease, thalassemia, and malignancy. This finding aligns with previous research indicating that elevated ferritin levels are common in these conditions due to chronic inflammation.[11] Furthermore, the study highlighted the importance of comprehensive iron studies, including serum iron, total iron-binding capacity (TIBC), and TSAT, in evaluating anemia in chronic diseases. These parameters provide a more nuanced understanding of iron status and can guide appropriate therapeutic interventions.[12-14]

This study has certain limitations that should be acknowledged. Being a single-center, cross-sectional observational study, the findings may not be fully generalizable to broader populations. Though adequate for preliminary assessment, the sample size may limit the power to detect subtle associations between serum ferritin levels and specific chronic diseases. Additionally, inflammatory markers such as C-reactive protein (CRP) or interleukin-6 were not routinely measured, which could have provided a clearer distinction between anemia of chronic disease and true iron deficiency. Longitudinal studies incorporating a larger and more diverse patient cohort and comprehensive inflammatory and iron parameters are warranted. Future research should also explore the clinical impact of targeted iron supplementation or anti-inflammatory interventions on anemia outcomes in patients with chronic diseases and the predictive value of serum ferritin concerning morbidity and mortality.

Conclusion

In this cross-sectional observational study, serum ferritin levels varied widely among patients with chronic diseases presenting with anemia. While a substantial proportion of participants exhibited elevated ferritin, reflecting chronic inflammation or disease-related iron dysregulation, a smaller subset demonstrated low ferritin levels, suggesting absolute iron deficiency. Chronic kidney disease, thalassemia, and malignancy were associated with higher ferritin levels, whereas chronic liver disease frequently corresponded with lower levels. These findings highlight the importance of assessing serum ferritin alongside other hematological parameters for accurate evaluation and management of anemia in patients with chronic illnesses.

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Conflicts of interest
There are no conflicts of interest.

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