

A Study of Transferrin Saturation and Serum Ferritin Concentration in Patients with Anaemia in Chronic Kidney Disease

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Abstract

Background: Chronic kidney disease (CKD) is an important, chronic, non-communicable epidemic disease that affects world including, India and anemia is one of the common complication seen in CKD. Study aimed to assess the transferrin saturation and serum ferritin concentration among the patients with CKD.

Methodology: The present Prospective Observational study is conducted on patients with diagnosed chronic kidney disease. The study was performed on the out patients and also inpatients admitted in General Medicine Department, Basaveshwara Teaching and General Hospital attached to Mahadevappa Rampure Medical College Kalaburagi. Total of 100 patients aged more than 18yrs of either gender with diagnosed CKD were included in the present study.

Result: Total of 100 patients fulfilling inclusion criteria were included in present study after obtaining the informed consent from all the patients. The mean age of the patients was found to be 51.98 ± 15.79 yrs of age. In present study, 66% of the patients had serum ferritin concentration lower than $100 \mu\text{g/dl}$, followed with 32% of patients had between $101-200 \mu\text{g/dl}$. The mean level of serum ferritin was found to be $98.86 \pm 28.45 \mu\text{g/dl}$. 80% of patients had the transferrin saturation level lower than $20 \mu\text{g/dl}$, followed by 14% with $> 20 \mu\text{g/dl}$ and only 2 patient it was $> 50 \mu\text{g/dl}$. The mean level of transferrin saturation in the patients was found to be $16.63 \pm 6.14 \mu\text{g/dl}$. On correlation of serum level of creatinine with the serum ferritin and transferrin saturation, we found a significant negative relation between them.

Conclusion: The key techniques for measuring iron status and therapy in CKD patients with anemia are serum ferritin and transferrin saturation. These biochemical markers aid in the diagnosis and management of iron insufficiency in patients with chronic kidney disease.

Keyword: Anemia, Chronic kidney disease, Ferritin, Transferrin saturation.

Date of Submission: 29-01-2022

Date of Acceptance: 10-02-2022

I. Introduction

Chronic kidney disease (CKD) is an important, chronic, non-communicable epidemic disease that affects world including, India.^{1,2} It is characterized by irreversible deterioration of renal function, which results from diminished effective functioning of renal tissue. Ensuing impairment of excretory, metabolic and endocrine functions of the kidney leads to development of clinical syndrome of uremia.³

Anaemia is common complication of chronic kidney disease. The prevalence of anaemia varies with the degree of renal impairment in predialysis patient with CKD, but once end-stage kidney failure occurs, all patients are eventually affected.^{4,5} Anaemia develops once renal function decreases to 50% because of a deficiency in endogenous erythropoietin production by the kidney, decreased red cell survival, blood losses, and increased red blood cell destruction once the patient begins dialysis treatment, particularly haemodialysis.⁶

Anaemia reduces physical capacity, well being, neurocognitive function, and energy level and worsens quality of life both on predialysis and dialysis patient. Absolute or functional iron deficiency is present in 25 – 38% of patients with anaemia of CKD. Serum ferritin concentration and transferrin saturation are most commonly done test for diagnosing iron deficiency anaemia. So the present study was undertaken to understand the pathology and better management of Anaemia in CKD patients.

II. Material & Method

The present study is conducted on patients with diagnosed chronic kidney disease. The study was performed on the out patients and also inpatients admitted in General Medicine Department, Basaveshwara Teaching and General Hospital attached to Mahadevappa Rampure Medical College Kalaburagi.

Study design: Prospective Observational study.

Duration of study: 1st October 2019 to 31st March 2021 (18 months)

Sample size: 100 cases

Sample procedure: Simple random sampling technique.

Subjects: Study subjects were selected after applying inclusion-exclusion criteria. Information is collected through prepared performa from each patient.

Method of collection of data: Patients will be selected for study according to all inclusion and exclusion criteria. A detailed history will be obtained from qualifying patients using a pre-designed, structured proforma. Further, a detailed systemic examination, followed by relevant investigations was conducted and the results were noted.

Inclusion Criteria

1. CKD patients diagnosed with anaemia.
2. Patients age more than 18 years of either sex

Exclusion Criteria.

- Cases of Anemia not due to chronic kidney disease.

Statistical Analysis

All the patients data was collected in proforma and entered in excel sheet. The statistical data was analysed using SPSS software version 20 operating on windows 10. Data was tabulated and summarized as mean, standard deviations, frequency and percentage. The summarised data was represented using tables, figures, pie chart and

bar diagram. The strength of association between the variables was analysed using Pearson's correlation. a $p < 0.05$ was considered statistically significant.

III. Results

Total of 100 patients fulfilling inclusion criteria were included in present study after obtaining the informed consent from all the patients. The mean age of the patients was found to be 51.98 ± 15.79 yrs of age.

In this study majority of them were males 72% and 28% were female, with male preponderance of male to female ratio of 2.5:1.

In present study, the history of hypertension was seen in 76% patients, diabetes mellitus was present in 38% and IHD was seen in 26% of patients.

Among the 100 patients, the facial puffiness was seen in 92% of patients, 90% with pedal edema, 90% with early fatigability and 94% were with presence of pallor.

In present study, among the 100 CKD patients, majority of the patients had mild to moderate grade of anemia in them. 46% of patients had hemoglobin of 8.1-9gm%, followed with 34% patients with 9.1-10gm%. 2 patients had severe grade of anemia in them. The mean hemoglobin among the patients was 8.89 ± 0.67 gm%.

Table 1: Distribution of patients according to serum creatinine level

Serum creatinine	Frequency	Percent
1-4.9	4	4
5-9.9	52	52
10-14.9	40	40
15-19.9	4	4

Among the included 100 CKD patients, majority of the patients were with creatinine level in the range of 5-9.9mg/dl (52%), followed with 40% with 10-14.9mg/dl of creatinine. The mean creatinine among the included patients was found to be 9.48 ± 2.73 mg/dl.

Table 2 : Showing the mean level of iron profile among the CKD patients

	N	Minimum	Maximum	Mean	SD
Sr Iron $\mu\text{g/dL}$	100	28	91	49.72	14.34
Sr Ferritin $\mu\text{g/dL}$	100	26.63	236.00	98.86	28.45
TSAT	100	9.42	51.12	16.63	6.14
TIBC $\mu\text{g/dL}$	100	28	414	297.68	55.04

Table 3 : Showing the distribution of patients according to serum ferritin level

Serum ferritin	Frequency	Percent
0-100	66	66
101-200	32	32
201-300	2	2

In present study, 66% of the patients had serum ferritin concentration lower than 100µg/dl, followed with 32% of patients had between 101-200µg/dl. The mean level of serum ferritin was found to be 98.86±28.45µg/dl.

Table 4: Showing the distribution of patients according to the transferrin saturation level

TSAT %	Frequency	Percent
0.1-10	4	4
10.1-20	80	80
20.1-30	14	14
30.1-40	0	0
40.1-50	0	0
50.1-60	2	2
Total	100	100

In present study, among the 100 CKD patients 80% of patients had the transferrin saturation level lower than 20µg/dl, followed by 14% with > 20µg/dl and only 2 patient it was >50µg/dl. The mean level of transferrin saturation in the patients was found to be 16.63±6.14µg/dl.

Table 5 : Pearson's correlation of serum ferritin and transferrin saturation with serum creatinine level

Sr Ferritin	r	Creatinine
		-.881
	Sig	.042*
TSAT%	r	
		-.383
	Sig	.049*
	N	100

*p<0.05 was considered statistically significant

In present study, on correlation of serum level of creatinine with the serum ferritin and transferrin saturation, we found a significant negative relation between them.

IV. Discussion

Total of 100 patients fulfilling inclusion criteria were included in present study after obtaining the informed consent from all the patients. The mean age of the patients was found to be 51.98±15.79yrs of age. The maximum incidence of CKD was seen in patients of age group 51-60yrs followed with 61-70yrs of age. In similar to present study Kumar R et al., documented maximum incidence of 26 (43.3%) patients were seen in age group of 51-60years. The increasing age is a risk factor for the CKD and decreased GFR. The CKD is common among the elderly than compared to young patients with underlying hypertension and diabetes mellitus.⁴⁰

Majority of patients included were males (72%) and 28% were female, with male preponderance of male to female ratio of 2.5:1. Previously, Kumar R et al., also documented the male preponderance with 76.7% male and 23.3% female in their study with male to female ratio of 3.29:1. The men suffering with CKD more than female could be due to the fact that the men seek the medical attention more than female.¹⁴ Previous researchers also demonstrated similar findings like Rajashekar S et al., Mondal et al., Basha A et al^{12,15,16}

Among the 100 patients, the facial puffiness was seen in 92% of patients, 90% with pedal edema, 90% with early fatigability and 94% were with presence of pallor. History of hypertension was seen in 76% patients, diabetes mellitus was present in 38% and IHD was seen in 26% of patients. Similar to present study, Kumar R et al., documented the presence of facial puffiness in 88.3%, pedal edema in 81.7%, easy fatiguability in 68.3% and breathlessness in 35%. Similarly they documented the presence of hypertension in 71.7%, diabetes mellitus in 65%, IHD in 31.7% and dyslipidemia in 16.7% of the patients.¹⁴

In present study, among the 100 CKD patients, majority of the patients had mild to moderate grade of anemia in them. 46% of patients had hemoglobin of 8.1-9gm%, followed with 34% patients with 9.1-10gm%. 2 patients had severe grade of anemia in them. The mean hemoglobin among the patients was 8.89±0.67gm%. In concordance to present study, Kumar R et al., documented 48.3% of patients had haemoglobin percentage of 8.1-9gm%, followed by 31.7% of patients in the range of 9.1-10gm%¹⁷. Haemoglobin percentage is ranged from 6.1- 11gm%¹⁴ which is comparable with other studies.^{15,16} On peripheral blood smear, 82% of the patients reported the Normocytic normochromic anemia in them, followed with 10% patients with microcytic hypochromic anemia in them and 8% had the presence of Normocytic hypochromic anemia. Similar to present

study, Rajashekar et al documented the presence of majority of patients in the mean Hb of 8.1-9 in 46%, followed with 34% patients with 9.1-10gm%.³⁸ However in study by Talwar et al., it was found that Sixty percent of the patients had microcytic hypochromic anaemia, five percent had macrocytic anaemia while 30% had normocytic normochromic anaemia.¹⁷

In present study, 66% of the patients had serum ferritin concentration lower than 100µg/dl, followed with 32% of patients had between 101-200µg/dl. The mean level of serum ferritin was found to be 98.86±28.45µg/dl. 80% of patients had the transferrin saturation level lower than 20µg/dl, followed by 14% with > 20µg/dl and only 2 patient it was >50µg/dl. The mean level of transferrin saturation in the patients was found to be 16.63±6.14µg/dl. In study by Kumar R et al., documented Mean S. ferritin is 179.3±31.03 and transferrin saturation is 17.1±5.9 respectively. When renal function falls below 50%, anemia occurs due to a lack of endogenous erythropoietin synthesis by the kidney, decreased red cell survival, blood losses, and accelerated red blood cell destruction after the patient begins dialysis treatment, particularly hemodialysis.¹⁸ In study by Rajashekar et al., the 13(26%) patients had S. ferritin less than 100ug % followed by 10(20%) patients had between 101-200ug and 21(42%) patients above 200ug. Mean S ferritin of total patients is 185.5 and standard deviation is 28.58. Same study documented 22 (44%) patients had transferrin saturation level <20 ug% followed by 7(14%) patients>20ug% and 1(2%) patients is above 50ug%. Mean transferrin saturation is 16.6% and standard deviation is 6.2.¹²

In present study, on correlation of serum level of creatinine with the serum ferritin and transferrin saturation, we found a significant negative relation between them. Similar to present study Ogawa et al., documented the relation of the serum ferritin with the hemoglobin and the creatinine.¹¹

We hypothesized that not only were iron deficit and renal insufficiency both independent risk factors for anemia, but there may also be an interaction, based on the finding that individuals with end-stage renal illness appear to have a "functional iron deficiency." The same degree of iron deficiency might be associated with a greater drop in hemoglobin in patients with reduced renal function than in patients with preserved renal function

V. Conclusion

The key techniques for measuring iron status and therapy in CKD patients with anemia are serum ferritin and transferrin saturation. These biochemical markers aid in the diagnosis and management of iron insufficiency in patients with chronic kidney disease. Also this will aid to guide treatment with iron supplementation and erythropoiesis stimulating agents.

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Dr Suresh Harsoor, et. al. “A Study of Transferrin Saturation and Serum Ferritin Concentration in Patients with Anaemia in Chronic Kidney Disease.” *IOSR Journal of Dental and Medical Sciences (IOSR-JDMS)*, 21(02), 2022, pp. 08-12.