ISSN: 0975-3583,0976-2833 VOL15, ISSUE 11, 2024

Original Research Article

A Study of Chronic Inflammation in Chronic Kidney Disease and its Correlation With Systemic Organ Dysfunction

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Received: 08-08-2024 / Revised: 17-08-2024 / Accepted: 27-09-2024

ABSTRACT

Background
A cross sectional study to know the chronic inflammation in CKD and its correlation with systemic organ dysfunction.
Methods
This cross sectional study included 62 patients admitted with chronic kidney disease in K R Hospital, Mysore medical college and research institute from October 2022- September 2023. Systemic manifestations including anaemia, pulmonary hypertension, Ischemic heart disease, Bone mineral disease, protein energy malnutrition, cerebro vascular accident. Inflammatory (ESR, CRP, LDH, FERRITIN and ALBUMIN) were measured. statistical analysis were performed to evaluate the association between these parameters and systemic organ dysfunction in CKD.
Objectives
To study chronic inflammation in chronic kidney disease.
To correlate the chronic inflammation in chronic kidney disease with that of systemic organ dysfunction
Results
In present study it was found that 27 individuals (43.5%) are having anemia and 25 individuals (40.3%) are having pulmonary hypertension ,23 individuals (37.1%) are having IHD, 15 individuals (24.2%) are having CVA ,26 subjects (41.9%) are having PEM, 33 subjects (53.2%) having BMD. The results show that individuals with anemia, IHD, PEM, BMD, CVA, pulmonary HTN have significantly higher mean levels for ESR, CRP, LDH, AND Ferritin and lower levels of s albumin which is significant and a p- value of 0.001.
Conclusion
This study proves that there is a definite association between chronic inflammation with that of systemic organ dysfunction in CKD patients. So this study recommends that appropriate measures like early renal replacement therapy and controlling of inter current infections should be taken to reduce the inflammation associated with CKD to prevent further organ damage.
Keywords: Chronic CKD, Systemic Organ Dysfunction, Inflammation.

ISSN: 0975-3583,0976-2833 VOL15, ISSUE 11, 2024

INTRODUCTION

Kidney Disease is defined as abnormalities of the kidney structure or function, present for more than 3 months with implications for health. Chronic kidney disease encompasses a spectrum of pathophysiologic processess associated with abnormal kidney function. Chronic kidney disease affects 10-12% of population.Diabetic nephropathy being the leading cause of CKD followed by glomerulonephritis,htn associated ckd, ADPKD, alports syndrome, other cystic and tubulointerstitial nephritis. In Chronic kidney disease the inflammatory markers like ESR, CRP, Fibrinogen, Ferritin, Sr LDH, IL-6, TNF-alpha are inverserly associated with kidney function and positively with albuminuria. The serum albumin, CRP, IL-6, Ferritin are predictors of malnutrition, cardiovascular disease and mortality in patients with advanced chronic kidney disease. Chronic inflammation is a consequence of chronic kidney disease so that I would like to see the correlation between chronic inflammation and systemic organ dysfunction in chronic kidney disease patients.

MATERIALS AND METHODS

The current Cross sectional study was conducted on 62 patients in OPD/ IPD of Medicine Department, KR Hospital, Mysore medical college and research institute from October 2022 to September 2023.

Inclusion Criteria

- Chronic kidney disease patients.
- Age more than 18 years.

Exclusion Criteria:

- Autoimmune diseases
- Malignancy
- Infectious diseases
- Patients on steroids
- Patients on antimetabolites
- patients who are in pre existing cardiac and liver disease before the onset of chronic kidney disease.

Sample size calculation

Sample size: 62; $S=Z^2pq/d^2$S=1.96x1.96x0.042x0.958/0.05x0.05; S=62; Z=1.96 Confidence interval =0.05;P=proportion of prevalence =4.2%=0.4;q=1-p=0.958.
d=margin of error 5%=0.05.

Study Procedure

Patients with chronic kidney disease and passing selection criteria was taken into study, clinical examination was done in all of the study subjects. Blood sample was taken from each of theses individuals and following investigations were done: complete blood count(CBC). Renal function test (RFT). Liver function test(LFT), electrocardiogram (ECG), NCCT Head, serum elctrolytes, 2 D Echocardigraphy, serum calcium, phosphorus, chest x ray, urine routine, USG abdomen Iflammatiry markers ESR, CRP, FERRITIN LDH AND ALBUMUN were measured. The information was tallied and examination using the relevant statistical approach.

SPSS (Statistical Package For Social Sciences) version 21. (IBM SPASS statistics [IBM corporation: NY, USA]) was used to perform the statistical analysis. Data was entered in the excel spread sheet. Descriptive statistics of the explanatory and outcome variables were

ISSN: 0975-3583,0976-2833 VOL15, ISSUE 11, 2024

calculated by mean, standard deviation for quantitative variables, frequency and proportions for qualitative variables. Inferential statistics like Chi-square test was applied for qualitative variables to find the association. Independent sample t test was applied to compare the quantitative parameters between the groups. The level of significance is set at 5%.

RESULTS

	N	Minimum	Maximum	Mean	S.D.
Age	62	23.0	68.0	49.02	12.21

Table 1: Mean age distribution of subjects

Table 1 presents the age distribution of 62 subjects, ranging from 23 to 68 years old, with a mean age of 49.02 years and a standard deviation of 12.21 years.

Age Group	Frequency	Percent
20-30 Yrs.	5	8.1
31-40 Yrs.	15	24.2
41-50 Yrs.	12	19.4
51-60 Yrs.	17	27.4
61-70 Yrs.	13	21.0
Total	62	100.0

Table 2: distribution of the subjects based on age group

Table 2 illustrates the distribution of 62 subjects across different age groups. The largest age group was 51 to 60 years, comprising 27.4% of the sample, followed closely by the 31 to 40 years group at 24.2%. The least represented groups were those aged 20 to 30 years, constituting 8.1% of the sample, and those aged 61 to 70 years, making up 21.0%.

		Frequency	Percent
Anaemia	Absent	35	56.5
	Present	27	43.5
Pulmonary HTN	Absent	37	59.7
	Present	25	40.3
IHD	Absent	39	62.9
	Present	23	37.1
CVA	Absent	47	75.8
	Present	15	24.2
PEM	Absent	36	58.1
	Present	26	41.9
BMD	Absent	29	46.8
	Present	33	53.2

Table 3 : Distribution based on conditions

The data presented in Table 3 shows the distribution of various medical conditions among the participants. Anaemia was absent in 35 individuals, making up 56.5% of the sample, while 27 individuals (43.5%) were affected by anaemia. Pulmonary hypertension was absent in 37 participants (59.7%) and present in 25 participants (40.3%). Ischaemic heart disease (IHD) was absent in 39 individuals (62.9%), with 23 individuals (37.1%) diagnosed with the condition. Cerebrovascular accident (CVA) had the highest rate of absence, with 47 individuals (75.8%) unaffected, and 15 individuals (24.2%) experiencing CVA. Protein-energy malnutrition (PEM) was absent in 36 participants (58.1%) and present in 26 participants (41.9%). Finally, body mass deficiency (BMD) was present in a majority of the sample, with 33 individuals (53.2%)

ISSN: 0975-3583,0976-2833 VOL15, ISSUE 11, 2024

affected, while it was absent in 29 individuals (46.8%)

Parameters	Anemia	N	Minimum	Maximum	Mean	S.D.	Mean diff.	P value
ESR	Absent	35	11.0	130.0	42.03	26.43	-59.74	0.001*
	Present	27	66.0	170.0	101.78	25.37		
CRP	Absent	35	3.00	109.00	23.90	26.55	-77.95	0.001*
	Present	27	56.00	294.00	101.85	45.25		
LDH	Absent	35	13.9	546.0	267.37	126.68	-407.2	0.001*
	Present	27	300.0	2153.0	674.56	393.42		
Feritin	Absent	35	61.7	1173.0	414.22	254.08	-669.3	0.001*
	Present	27	439.0	2000.0	1083.59	449.80		
Serum Albumin	Absent	35	2.60	4.70	3.65	0.52	0.868	0.001*
	Present	27	2.03	3.70	2.79	0.47		

Table 4: Comparison of the lab parameters based on anaemia using independent sample t test

Table 4 presents a comparison of various lab parameters based on the presence of anaemia using an independent sample t-test. The results show that individuals with anaemia have significantly higher mean values for ESR, CRP, LDH, and Ferritin compared to those without anaemia. Specifically, the mean ESR for anaemic individuals is 101.78 (SD = 25.37) compared to 42.03 (SD = 26.43) in non-anaemic individuals, with a mean difference of -59.74 and a p-value of 0.001, indicating statistical significance. Similarly, the mean CRP level is significantly higher in anaemic individuals (101.85, SD = 45.25) compared to non-anaemic individuals (23.90, SD = 26.55), with a mean difference of -77.95 and a p-value of 0.001. The LDH levels also show a marked increase in anaemic individuals (mean= 674.56, SD = 393.42) compared to non-anaemic individuals (mean = 267.34, SD = 126.68), with a mean difference of -407.2 and a p-value of 0.001. Ferritin levels follow the same pattern, being significantly higher in anaemic individuals (mean = 1083.59, SD = 449.80) compared to non-anaemic individuals (mean 414.22, SD = 254.08), with a mean difference of -669.3 and a p-value of 0.001. Conversely, serum albumin levels are significantly lower in anaemic individuals (mean = 2.79, SD = 0.47) compared to non-anaemic individuals (mean = 3.65, SD = 0.52), with a mean difference of 0.868 and a p-value of 0.001.

Parameters	Pulmonary HTN	N	Minimum	Maximum	Mean	S.D.	Mean diff.	P value
ESR	Absent	37	11.0	130.0	44.70	28.30	-57.89	0.001*
	Present	25	66.0	170.0	102.60	26.18		
CRP	Absent	37	3.00	109.00	26.98	29.17	-76.54	0.001*
	Present	25	56.00	294.00	103.53	46.45		
LDH	Absent	37	13.9	1183.0	299.62	198.83	-359.74	0.001*
	Present	25	300.0	2153.0	659.36	394.94		
Ferritin	Absent	37	61.7	2000.0	464.97	361.31	-597.07	0.001*
	Present	25	439.0	2000.0	1062.04	421.62		
Serum Albumin	Absent	37	2.30	4.70	3.60	0.56	0.813	0.001*
	Present	25	2.03	3.70	2.79	0.47		

Table 5: Comparison of the lab parameters based on pulmonary hypertension using independent sample t test

ISSN: 0975-3583,0976-2833 VOL15, ISSUE 11, 2024

Table 5 compares various lab parameters based on the presence of pulmonary hypertension (HTN) using an independent sample t-test. The results indicate that individuals with pulmonary HTN have significantly higher mean values for ESR, CRP, LDH, and Ferritin compared to those without pulmonary HTN. Specifically, the mean ESR for individuals with pulmonary HTN is 102.60 (SD = 26.18) compared to 44.70 (SD = 28.10) in those without, with a mean difference of -57.89 and a p-value of 0.001, indicating statistical significance. CRP levels are also significantly higher in those with pulmonary HTN (mean = 103.53, SD = 46.45) compared to those without (mean = 26.98, SD = 29.17), with a mean difference of -76.54 and a p-value of 0.001. LDH levels show a notable increase in individuals with pulmonary HTN (mean = 659.36, SD = 394.94) compared to those without (mean = 299.62, SD = 198.83), with a mean difference of -359.74 and a p-value of 0.001. Ferritin levels are significantly higher in individuals with pulmonary HTN (mean = 1062.04, SD = 421.62) compared to those without (mean = 464.97, SD = 361.31), with a mean difference of -597.07 and a p-valueof0.001. Conversely, serum albumin levels are significantly lower in individuals with pulmonary HTN (mean = 2.79, SD = 0.47) compared to those without (mean= 3.60, SD = 0.56), with a mean difference of 0.813 and a p-value of 0.001.

Parameters	IHD	N	Minimum	Maximum	Mean	S.D.	Mean diff.	P value
ESR	Absent	39	11.0	130.0	45.97	27.92	-59.50	0.001*
	Present	23	67.0	170.0	105.48	25.27		
CRP	Absent	39	3.00	109.00	29.88	31.10	-75.38	0.001*
	Present	23	56.00	294.00	105.27	48.07		
LDH	Absent	39	13.9	1183.0	309.79	202.29	-363.5	0.001*
	Present	23	300.0	2153.0	673.39	406.19		
Ferritin	Absent	39	61.7	2000.0	487.56	372.11	-588.09	0.001*
	Present	23	439.0	2000.0	1075.65	427.41		
Serum Albumin	Absent	39	2.30	4.70	3.59	0.55	0.848	0.001*
	Present	23	2.03	3.59	2.74	0.45		

Table 6: Comparison of the lab parameters based on ihd using independent sample t test

Table 6 compares various lab parameters based on the presence of ischaemic heart disease (IHD) using an independent sample t-test. The data reveals that individuals with IHD have significantly higher mean values for ESR, CRP, LDH, and Ferritin compared to those without IHD. The mean ESR for individuals with IHD is 105.48 (SD = 25.27), significantly higher than the mean ESR of 45.97 (SD= 27.92) in those without IHD, with a mean difference of -59.50 and a p-value of 0.001. Similarly, the mean CRP level is significantly elevated in individuals with IHD (105.27, SD = 48.07) compared to those without (29.88, SD = 31.10), with a mean difference of -75.38 and a p-value of 0.001. LDH levels are also notably higher in individuals with IHD (mean = 673.39, SD = 406.19) compared to those without (mean = 309.79, SD = 202.29), with a mean difference of -363.5 and a p- value of 0.001. Ferritin levels follow the same trend, being significantly higher in individuals with IHD (mean = 1075.65, SD = 427.41) compared to those without IHD (mean = 487.56, SD = 372.11), with a mean difference of -588.09 and a p- value of 0.001. Conversely, serum albumin levels are significantly lower in individuals with IHD (mean = 2.74, SD = 0.45) compared to those without (mean = 3.59, SD = 0.55), with a mean difference of 0.848 and a p-value of 0.001.

Parameters	PEM	N	Minimum	Maximum	Mean	S.D.	Mean diff.	P value

ISSN: 0975-3583,0976-2833 VOL15, ISSUE 11, 2024

ESR	Absent	36	11.0	130.0	43.25	27.06	-59.13	0.001*
	Present	26	66.0	170.0	102.38	25.68		
CRP	Absent	36	3.00	109.00	25.93	28.86	-76.1	0.001*
	Present	26	56.00	294.00	102.04	46.13		
LDH	Absent	36	13.9	546.0	275.08	133.22	-404.4	0.001*
	Present	26	300.0	2153.0	679.50	400.36		
Ferritin	Absent	36	61.7	1173.0	422.33	255.10	-675.7	0.001*
	Present	26	439.0	2000.0	1098.12	452.20		
Serum Albumin	Absent	36	2.60	4.70	3.64	0.52	0.868	0.001*
	Present	26	2.03	3.70	2.77	0.47		

Table 7: Comparison of the lab parameters based on pem using independent sampe t test

Table 7 presents a comparison of various lab parameters based on the presence of protein-energy malnutrition (PEM) using an independent sample t-test. The results show that individuals with PEM have significantly higher mean values for ESR, CRP, LDH, and Ferritin compared to those without PEM. Specifically, individuals with PEM have a mean ESR of 102.38 (SD = 25.68), significantly higher than the mean ESR of 43.25 (SD = 27.06) in those without PEM, with a mean difference of -59.13 and a p-value of 0.001. Similarly, CRP levels are significantly elevated in individuals with PEM (mean = 102.04, SD = 46.13) compared to those without PEM (mean = 25.93, SD = 28.86), with a mean difference of -76.1 and a p-value of 0.001. LDH levels also show a notable increase in individuals with PEM (mean= 679.50, SD = 400.36) compared to those without PEM (mean = 275.08, SD = 133.22), with a mean difference of -404.4 and a p-value of 0.001. Ferritin levels are significantly higher in individuals with PEM (mean = 1098.12, SD = 452.20) compared to those without PEM (mean = 422.33, SD = 255.10), with a mean difference of -675.7 and a p-value of 0.001. Conversely, serum albumin levels are not significantly different between individuals with PEM (mean = 2.77, SD = 0.47) and those without PEM (mean = 3.64, SD = 0.52), with a mean difference of 0.868 and a p-value of 0.868.

Parameters	**BMD**	**N**	**Minimum**	**Maximum**	**Mean**	**S.D.**	**Mean diff.**	**P value**
ESR	Absent	29	12.0	130.0	44.93	27.01	-43.43	0.001*
	Present	33	11.0	170.0	88.36	37.65		
CRP	Absent	29	3.00	109.00	26.42	28.40	-59.03	0.001*
	Present	33	3.00	294.00	85.46	54.04		
LDH	Absent	29	13.9	546.0	260.38	125.50	-346.5	0.001*
	Present	33	114.0	2153.0	606.64	387.53		
Ferritin	Absent	29	61.7	1173.0	397.62	238.74	-578.7	0.001*
	Present	33	229.0	2000.0	976.42	484.74		
Serum Albumin	Absent	29	2.60	4.70	3.62	0.53	0.653	0.001*
	Present	33	2.03	4.50	2.97	0.61		

Table 8: Comparison of the lab parameters based on bmd using independent sample t test

Table 8 compares various lab parameters based on the presence of BMD using an independent sample t-test. The data indicates that individuals with BMD have significantly higher mean values for ESR, CRP, LDH, and Ferritin compared to those without BMD. Specifically, the mean ESR for individuals with BMD is 88.36 (SD = 37.65), significantly higher than the mean ESR of 44.93 (SD = 27.01) in those without BMD, with a mean difference of -43.43 and a p-value of 0.001. Similarly, CRP levels are significantly elevated in individuals with BMD (mean

ISSN: 0975-3583,0976-2833 VOL15, ISSUE 11, 2024

= 85.46, SD = 54.04) compared to those without BMD (mean = 26.42, SD = 28.40), with a mean difference of -59.03 and a p-value of 0.001. LDH levels show a notable increase in individuals with BMD (mean = 606.64, SD = 387.53) compared to those without BMD (mean = 260.38, SD = 125.50), with a mean difference of -346.2 and a p-value of 0.001. Ferritin levels are significantly higher in individuals with BMD (mean = 976.42, SD = 484.74) compared to those without BMD (mean = 397.68, SD = 238.71), with a mean difference of -578.7 and a p-value of 0.001. Conversely, serum albumin levels are significantly lower in individuals with BMD (mean = 2.97, SD = 0.61) compared to those without BMD (mean = 3.62, SD = 0.53), with a mean difference of 0.653 and a p-value of 0.001.

DISCUSSION

This study was conducted to know the association between chronic inflammation in chronic kidney disease with that of systemic organ dysfunction and we found that, there is a definite association between chronic inflammation with systemic organ abnormalities in chronic kidney disease.

In this study, majority were male (75%, n=47) it was correlated with the study conducted by vandana menon et al , which showed majority were male i.e 65%.[1] We found majority of patients were in the age group of 51-60 years which was correlating with the study conducted by oluseyi A adejumo et al, which showed mean age for ckd was 50±16.8 years.[2]

A Study conducted by Alfano G et al, showed that majority of the subjects are in the age group of 60 -65 yrs which is similar with this study.[3] It was found that 43% of subjects (n=27) had higher CRP levels among anemia in CKD subjects which was similar to study conducted by Faheem usma sulehre et al which had 27%(n=21) patients had higher CRP levels among CKD.[4] The ferritin levels of 43% of the participants (n=27) with CKD anemia were found to be higher, which was consistent with a research by Meghana K. Padwal et al.[5] It was found that 40% (n=25) subjects had higher CRP levels among pulmonary Hypertension in CKD subjects which was similar similar to study conducted by shankar prasad nagaraju et al.[6]

Among CKD patients with pulmonary hypertension, 40% of participants (n=25) had low serum albumin, which was comparable to a research by David Sinpelisky et al.[7] It was discovered that 37% (n=23) of IHD in CKD participants had low serum albumin, which was comparable to a study done by Fengming Huang et al.[8]

In our study, found 37%(n=23) subjects had higher CRP levels among IHD in CKD subjects which was similar to study conducted by Vandana menon et al.[9] It was discovered that 37% of participants (n=23) with IHD in CKD subjects had higher ESR levels, which was comparable to a study done by Anna Bucken Mayer et al.[10] It was found 24% (n=15) subjects had higher CRP levels among Cerebrovascular accident in CKD subjects which was similar to study conducted by olang zhao et al.[11] It was found 24% (n=15) subjects had lower albumin levels among Cerebrovascular accident in CKD subjects which was similar to study conducted by T Raakrishna et al.[12]

Among those with protein energy deficiency in chronic kidney disease (CKD), it was discovered that 41% (n=26) had reduced serum albumin levels, elevated ferritin, and increased CRP, which was consistent with a research by Franca M. Lorember et al.[13] It was discovered that among patients with chronic kidney disease (CKD), 53% (n=33) had increased CRP levels, which was consistent with a research by Cewen Liver et al.[14] Among patients with chronic kidney disease (CKD), it was discovered that 53% (n=33) had low blood albumin levels, which was consistent with a study by Seong Woochy et al.[15]

ISSN: 0975-3583,0976-2833 VOL15, ISSUE 11, 2024

CONCLUSION

This study proves that there is a definite association between chronic inflammation with that of systemic organ dysfunction in CKD patients. So this study recommends that appropriate measures like early renal replacement therapy and controlling of intercurrent infections should be taken to reduce the inflammation associated with CKD to prevent further organ damage.

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