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Comparatives Analysis of Inflammatory and Biochemical Markers in Dialysis Patients: The Impact of Age and Sex

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ABSTRACT

Dialysis is a medical procedure that replaces the kidneys when they are unable to function normally. It helps to keep the blood's chemical balance safe by eliminating waste, extra fluid, and toxins. Haemodialysis and peritoneal dialysis are the two primary varieties. A total of 50 patients were enrolled between August and December 2024. Blood samples were collected to assess kidney function through blood urea, serum creatinine, glucose, and estimated glomerular filtration rate (GFR). Inflammatory biomarkers Monocyte Chemoattractant Protein-1 (MCP-1) and E-selectin were measured using ELISA. Blood pressure readings were also recorded. The results revealed that Analyzes compared differences based on sex and across age groups (16–32, 33–48, 49–64, and 65–80 years) using one-sample t-tests, independent samples t-tests, and one-way ANOVAs.

Significant differences were observed particularly in MCP-1 between females and males, while analyzes of age groups revealed modest trends with low variance explained. These findings support the need for personalized monitoring strategies that consider sex as a key factor in the management of dialysis patients.

KEYWORDS

Dialysis, inflammatory markers, MCP-1, E-selectin, biochemical parameters, sex differences, age groups.

INTRODUCTION

Loss of kidney function is irreversible in end-stage renal disease (ESRD), a condition that progresses with an increase in fluid retention (overload) and waste products from metabolism (1). For these patients, dialysis in the form of haemodialysis (HD) or peritoneal dialysis (PD) serves as a life sustaining intervention. In spite of its capability to provide homeostasis by eliminating uremic toxins, dialysis is also associated with chronic inflammation and dysfunction of blood vessels (2, 13). These effects of dialysis contribute to the already high cardiovascular morbidity and mortality rates in this population.

E-selectin and Monocyte Chemoattractant Protein-1 (MCP-1) are now becoming more prominent as markers of vascular injury and inflammation due to their roles as endothelial adhesion and immune response marker for inflammation and immune activation; respectively (3). As an example, MCP-1 is the chemokine actively involved in monocyte/macrophage recruitment in tissue injury as well as inflammation. Therefore, higher levels of MCP-1 may enhance chronic inflammation and atherosclerosis progression and damage the cardiovascular system in HD and PD patients. Uremic toxins and the bioincompatibility of dialysis provoke vascular

inflammatory response from dialysis patients by increasing MCP-1 expression.

An adhesion molecule of endothelial cells, e-selectin, is crucial in the initial attachment and rolling of leukocytes during inflammation. Thus, high levels of soluble E-selectin in plasma portray activation and injury of the endothelium, which then express cardiovascular complications related to dialysis (5, 14). Results from previous studies indicated that ESRD patients on dialysis have raised levels of E-selectin, more pronounced with diabetes mellitus and hypertension plus vascular diseases (1, 6). It has been reported already that residual renal function and type of dialyser use both associate with elevation degree besides dialysis modality(6). Further growing evidence shows patient-specific characteristics like age and sex may also influence MCP-1 and E-Selectin levels as clinical relevance.

In older patients, immunosenescence and oxidative stress cause them to have inflamed states quite often. It has also been noted that immune responses vary by sex; females display quite different cytokine and chemokine profiles from males. Both the systemic response to dialysis treatment and the course of renal disease may be influenced by these (7). Comparative studies of age and sex on inflammatory and biochemical markers in patients with HD and PD are still scarce (8-9). Therefore, this work evaluates the serum levels of MCP-1 and E-selectin in dialysis patients as well as blood urea, creatinine, glucose, and eGFR results for comparison since these are strong indicators of kidney function. The adjustment that the parameters induce according to age and sex is specifically analyzed to determine if there is a discrepancy that could guide risk assessment and individualized management strategies during dialysis.

METHODS

Methodology

Study Design and Sample Collection

This cross-sectional study was carried out by recruiting 50 dialysis patients from four healthcare facilities located in Al-Najaf province. These facilities are Al-Hakim General Hospital, Public Health Laboratories, Al-Sadr Medical City, and Central Blood Bank. The sample included 18 females and 32 males distributed into four age groups; 16–32, 33–48, 49–64, and 65–80 years. All the procedures of this study were reviewed and approved by the Institutional Review Board (IRB) and written informed consent has been obtained from all participants prior to enrollment.

Measurements and Information Gathering

Markers of inflammation:

Using commercially available enzyme-linked immunosorbent assay (ELISA) kits, serum levels of E-selectin and Monocyte Chemoattractant Protein-1 (MCP-1) were measured in accordance with the manufacturer's instructions.

Biochemical and Clinical Parameters

Using accepted clinical practices, the systolic blood pressure was determined. To guarantee precision and consistency, venous blood samples were subjected to analyses of the levels of serum creatinine (S. Creat), blood urea (B. Urea), and random blood sugar (RBS) using fully automated clinical chemistry analyzers.

Data on Demographics

As part of the baseline demographic data collection, the age and sex of each participant were recorded.

Statistical Analysis

IBM SPSS Statistics software (version 2023; IBM Corp., Armonk, NY, USA) was used to conduct statistical analyses. Clinical and demographic features were compiled using descriptive statistics. To evaluate the size of group differences, effect sizes such as Eta-squared (η^2), Epsilon-squared (ε^2), and Omega-squared (ω^2) were computed. At an alpha level of $p < 0.05$, statistical significance was established. To guarantee uniformity in the way the data was presented, the same statistical program was used to create each graph and table (16).

RESULTS

Inflammatory Marker Descriptive Analysis

The descriptive statistics for the inflammatory markers assessed in the dialysis patient cohort (n = 50) are shown in Table 1. MCP-1 had a mean serum concentration of 0.2298 ± 0.20419, whereas E-Selectin had a marginally higher average level of 0.3081 ± 0.19177. With p-values less than 0.001, both markers showed statistically significant departures from the reference or control values, suggesting a highly significant increase in these markers within the study population.

Table 1. Descriptive Statistics and Significance Levels of Inflammatory Markers (MCP-1 and E-Selectin) in Dialysis Patients (n = 50).

	N	Mean	Std. Deviation	Significance p. value
Mcp1	50	0.2298	0.20419	0.000
E.Selectin	50	0.3081	0.19177	0.000

Clinical and Biochemical Features

A number of clinical and biochemical parameters were evaluated in the same group, as shown in Table 2. Significantly elevated ($p < 0.001$) was the average systolic and/or diastolic blood pressure score of 1.96. Serum creatinine levels were elevated at 9.68 mg/dL, blood urea levels averaged 142.74 mg/dL, and random blood sugar (RBS) levels averaged 128.82 mg/dL; all of these differences were statistically significant ($p < 0.001$). With a mean value of 5.64 mL/min, the glomerular filtration rate (GFR) was significantly lower and also reached statistical significance ($p < 0.001$). These findings highlight the dialysis group's severe renal dysfunction and related metabolic abnormalities.

Table 2. Descriptive Statistics and Significance Levels of Biochemical and Clinical Parameters in Dialysis Patients (n = 50).

	N	Mean	p.value
BP	50	1.96	0.000
R.B.S	50	128.8160	0.000
B.Urea	50	142.7394	0.000
S.Creat	50	9.6846	0.000
GFR	50	5.643	0.000

Differences in Inflammatory Markers by Sex

Inflammatory markers are compared by sex in Table 3. MCP-1 levels were 1.80 with a standard deviation of 0.230 for female patients (18% of the sample), and 2.05 ± 0.398 for male patients (32%). Nevertheless, the difference ($p = 0.282$) was not statistically significant. There was little difference in E-Selectin levels between the sexes: the mean for females was 0.2337 ± 0.23179, while the mean for males was 0.2276 ± 0.19087 ($p = 0.708$). These results imply that there was no discernible difference in the expression of these inflammatory markers by sex among the dialysis patients under investigation.

Table 3. Sex-Based Comparison of Inflammatory Markers (MCP-1 and E-Selectin) in Dialysis Patients

sex		N	Mean	Std. deviation	Significance
Mcp 1	F	18%	1.80	0.230	0.282
	M	32%	2.05	0.398	
E.Selectine	F	18%	0.2337	0.23179	0.708
	M	32%	0.2276	0.19087	

Differences in Inflammatory Markers by age

The MCP1 and E. selectine levels in four age groups—16–32, 33–48, 49–64, and 65–80—as well as the average for each group are shown in Figure 1. According to the data, Mcp1 levels average 0.2298 overall, peaking at 0.3166 in the 33–48 age group and then gradually dropping to

their lowest concentration of 0.1829 in the 65–80 age group. In a similar vein, E. selectine levels average 0.3081 overall, peaking in the 33–48 group at 0.3994 and falling in the 49–64 group at 0.2622. According to this pattern, both biomarkers increase in early middle age and then decrease as people age. These variations could indicate age-related physiological changes impacting MCP1 and E. Selectine if applied in a medical or research setting.

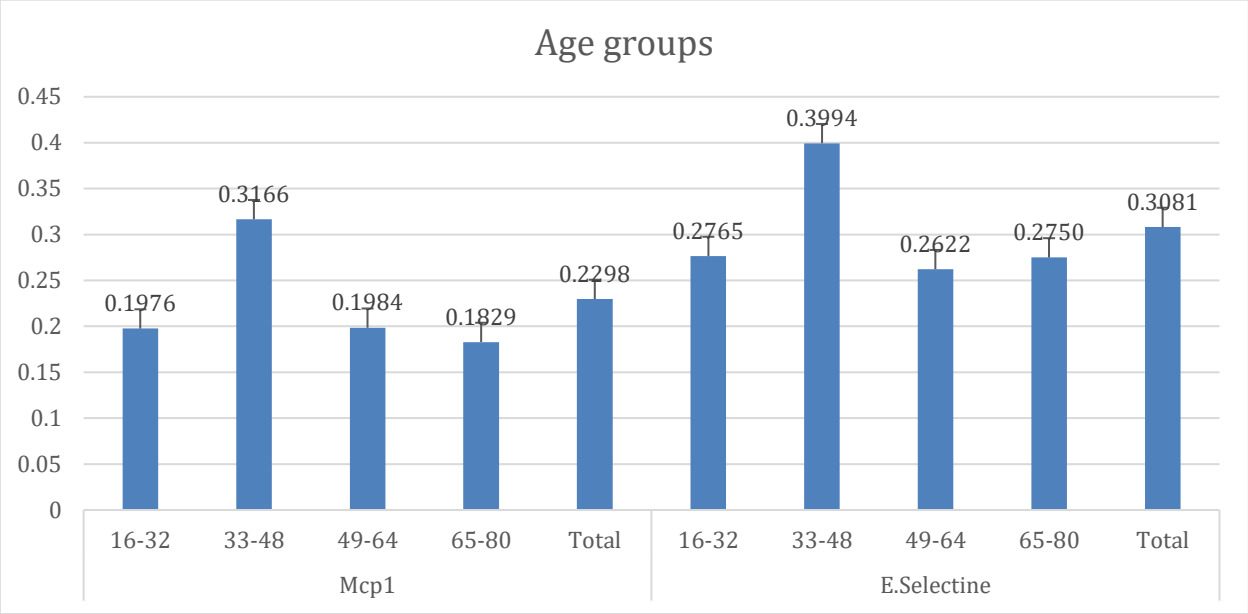

Figure 1. Mean Levels of MCP-1 and E-Selectin Across Different Age Groups in Dialysis Patients

DISCUSSION

In the present study, levels of MCP-1 and E-Selectin were found significantly elevated. Inflammatory and biochemical markers were evaluated in dialysis patients. These results are in line with the increasing amount of data that indicates a persistent inflammatory state is associated with dialysis and chronic kidney disease. Cardiovascular pathology, a common manifestation in dialysis patients, can be linked to monocyte recruitment and endothelial dysfunction. Therefore, it is also to be understood from high levels of MCP-1 and E-Selectin (3). As in the present study, raised levels of MCP-1 were reported previously in haemodialysis patients. It was attributed to oxidative stress and activation of inflammatory pathways in uremia(11). Dialysis patients have also been documented to have higher levels of E-Selectin an adhesion molecule from activated endothelial cells which relates to vascular damage and atherosclerosis risk. These similarities reinforce recent research and emphasis on how important it is to monitor the inflammatory markers in renal patients as part of the clinical evaluation(12).

From a clinical standpoint, the rather dramatic fall in GFR along with the pronounced rises in blood urea and serum creatinine emphasize just how seriously the kidneys of these patients are compromised. Other cohorts with similar clinical states have exhibited these biochemical patterns; thus, it is basically a manifestation of end-stage renal disease. High blood pressure and blood sugar levels may also create a vicious cycle of metabolic and vascular stress worsening kidney function and increasing inflammation (3).

On the other hand, the lack of statistically significant differences in inflammatory markers between males and females patients aligns with other data that suggest gender does not significantly influence the inflammatory profile of patients with end-stage renal disease. Others, however, reported minor variations attributed to genetic or hormonal influences and, therefore, more research is needed to clarify subtle sex-related differences (10). All these point to dialysis patients having gross biochemical derangements and systemic inflammation that further complicate the management of chronic kidney disease. More frequent monitoring of markers such as MCP-1 and E-Selectin could help validate more individualized therapeutic approaches while also adding prognostic information.

CONCLUSIONS

It is MCP-1 levels that show marked differences between male and female dialysis patients; age has only modest effects on these markers and clinical biochemical

variables. This possibly underlines the sex-specific clinical management strategies that should be proposed in dialysis care. Future studies should integrate larger samples and longitudinal methods to better understand these associations as well as their impact on patient outcomes.

REFERENCES

Kimmel, P. L., & Weiner, D. E. (2020). End-stage renal disease and the progression of kidney failure. Journal of Nephrology, 33(1), 45-57. https://doi.org/10.1007/s40620-020-00750-2

Vaziri, N. D. (2021). Role of oxidative stress and inflammation in cardiovascular disease associated with uremia. Seminars in Dialysis, 34(3), 124-130. https://doi.org/10.1111/sdi.13011

Kato, S., Chmielewski, M., Honda, H., Pecoits-Filho, R., Matsuo, S., Yuzawa, Y., ... & Stenvinkel, P. (2021). Aspects of immune dysfunction in end-stage renal disease. Nature Reviews

Kooman, J. P., et al. (2012). Uremic toxins, inflammation, and cardiovascular disease in dialysis patients. Seminars in Dialysis, 25(2), 147-153.

Soehendra, N., et al. (2021). E-selectin and its role in chronic inflammation in dialysis patients. Journal of Vascular Research, 58(4), 211-217.

Uchida, S., et al. (2022). Influence of diabetes, hypertension, and vascular disease on E-selectin levels in end-stage renal disease patients. American Journal of Kidney Diseases, 79(4), 525-533.

Pecoits-Filho, R., et al. (2020). Aging, sex differences, and inflammation in dialysis patients: A comprehensive review. Nephrology Dialysis Transplantation, 35(1), 69-77.

Matsumoto, T., et al. (2020). Gender differences in inflammatory markers and their association with cardiovascular events in peritoneal dialysis patients. Peritoneal Dialysis International, 40(4), 350-358.

Vaziri, N. D., & Rodby, R. A. (2019). Immunological aspects of end-stage renal disease: The effects of age and gender on inflammatory markers. Nephrology Dialysis Transplantation, 34(2), 233-241.

Carrero, JJ, et al. (2018). Sex differences in inflammatory markers and potential associated cardiovascular outcomes in dialysis patients. Nephrology Dialysis Transplantation, 25(2), 429–435. https://doi.org/10.1093/ndt/gfp915

Kooman, JP, et al. (2009). Inflammation and uremia: etiology and clinical implications. International Urology and Nephrology, 41(2), 319–326. https://doi.org/10.1007/s11255-008-9426-9

Liangos, O., et al. (2006). Aging and the immune response in patients with kidney disease. Journal of the American Society of Nephrology, 17(10), 2952–2958. https://doi.org/10.1681/ASN.2006010012

Stenvinkel, P., et al. (2005). Inflammation in end-stage renal disease: The hidden enemy. Nephrology Dialysis Transplantation, 20(3), 566–569. https://doi.org/10.1093/ndt/gfh046

Li, PK, Chow, KM, & Szeto, CC (2020). The clinical epidemiology of peritoneal dialysis: an update. Nature Reviews Nephrology, 16(3), 158-172.

Betjes, MGH (2020). Immune cell dysfunction and inflammation in end-stage renal disease. Nature Reviews Nephrology, 16(7), 407-418. https://doi.org/10.1038/s41581-020-0291-5.

IBM Corp. (2023). IBM SPSS Statistics for Windows, Version 2023. IBM Corp.