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A Comparative Study of Lipid Profile in Pre-Dialysis and Post-Dialysis End-Stage Renal Disease Patients

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Abstract

Background: *Chronic kidney disease (CKD) represents a major public health concern in India, with its prevalence increasing at an alarming rate. Individuals with CKD are at a substantially higher risk of developing cardiovascular disease (CVD), which remains the leading cause of mortality in this population. Dyslipidemia is particularly pronounced among patients with end-stage renal disease (ESRD); however, limited data are available regarding the impact of hemodialysis on lipid profile alterations. Therefore, the present study was undertaken to evaluate the effect of hemodialysis on lipid parameters in patients with CKD.* ***Materials and Methods:*** *A cross-sectional study involving 131 CKD patients receiving hemodialysis Between November 2023 and October 2024, at Government Medical College and Associated Hospitals Kota in Rajasthan, India, was carried out. Using an autoanalyzer, the serum lipid profile was examined both before and after the hemodialysis session. Before and after hemodialysis, the mean values of various lipid parameters were calculated and the difference between the two was compared using a paired t-test. Statistical significance was defined as a p-value < 0.05.* ***Results:*** *Low-density lipoprotein (LDL) levels considerably dropped after hemodialysis in this study. The levels of Triglycerides (TG), Very low-density lipoprotein (VLDL), and Total cholesterol (TC) were all significantly decreased. The only lipoprotein to rise following dialysis was High-density lipoprotein (HDL).* ***Conclusion:*** *CKD patients can benefit from adequate dialysis and time-bound monitoring of specific lipid profile components by lowering their risks for cardiovascular problems.*

Keywords: Chronic kidney disease, dyslipidemia, end-stage renal disease, hemodialysis, lipid profile

INTRODUCTION

Chronic kidney disease (CKD) encompasses a spectrum of pathophysiological processes arising from diverse etiologies, characterized by a progressive and irreversible decline in nephron number and renal function, often culminating in end-stage renal disease (ESRD). ESRD denotes a clinical condition marked by the permanent loss of intrinsic renal function to an extent that necessitates lifelong dependence on renal replacement therapies, such as dialysis or kidney transplantation, to avert life-threatening complications associated with uremia [1, 2].

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Chronic renal failure develops gradually over weeks, months, or years when the kidneys gradually stop functioning, resulting in end-stage renal disease (ESRD), as compared to acute renal failure, which occurs fast and suddenly.

Chronic kidney disease (CKD) constitutes a significant health burden in India, with its prevalence rising at a rapid pace. Patients with CKD are at an

increased risk of developing cardiovascular disease (CVD), which remains the leading cause of mortality in this population. Dyslipidemia, impaired liver function, and renal dysfunction are common in CKD patients and are associated with an increased risk of CVD [3, 4].

Due to the lack of a national registry, the incidence of CKD in India is not clearly known. However, it has been anticipated that up to 785 persons per million people in India may have CKD.

More than half of CKD patients pass away from CVD rather than develop ESRD, according to many studies. Dyslipidemia is the primary cause of CVD, associated with an increase in both conventional and unconventional risk factors. Elevated levels of triglycerides (TG), very low-density lipoproteins (VLDL), and intermediate-density lipoproteins (IDL) represent the most prominent lipid abnormalities in these patients, primarily due to impaired clearance of triglyceride-rich lipoproteins and reduced high-density lipoprotein cholesterol (HDL-C) concentrations. Although low-density lipoprotein cholesterol (LDL-C) levels may remain quantitatively normal, qualitative modifications are frequently observed. Enhanced oxidative stress, hyperhomocysteinemia, and disturbances in lipid metabolism in hemodialysis patients may further promote LDL-C oxidation. These lipid abnormalities significantly increase the risk of atherosclerosis and cardiovascular disease (CVD) and contribute substantially to the initiation and progression of glomerular and tubulointerstitial damage [5–10].

AIM AND OBJECTIVES

Aim

A comparative analysis of lipid profiles in chronic renal failure patients before and after hemodialysis.

Objectives

To analyze changes in lipid profile among chronic renal failure patients undergoing hemodialysis.

To compare lipid profile parameters in patients with chronic renal failure before and after hemodialysis.

MATERIALS AND METHODS

The present study is an observational cross-sectional study comprised of n = 131 subjects having chronic renal failure pre-dialysis and post-dialysis. The subjects were selected amongst those attending outpatient departments and those admitted to Medical College and Associated Hospital, Kota, Rajasthan, India, from November 2023 to October 2024. Informed written consent was obtained from all the participating subjects.

Based on hospital records, 131 such patients admitted were included in this study. Super specialty block of Kota Medical College was enrolled for the study. The study comprised 131 individuals of all ages and genders. A total of 131 patients (68 male and 63 female) with CKD on maintenance hemodialysis after applying exclusion criteria were included. The study excluded individuals with liver illness, diabetes mellitus, a history of alcohol and tobacco use, obesity (BMI > 25 kg/m^2), patients on a particular prescribed diet, and patients receiving hypolipidemic medication because these conditions may influence lipid profiles and the results of our investigation.

During each session, patients underwent hemodialysis for at least three to four hours. Prior to and following hemodialysis, a plain bulb was used to collect a 5-ml blood sample from each patient while taking all necessary aseptic measures. After sample collection, the specimens were centrifuged, and serum was separated for lipid profile estimation. Serum total cholesterol (TC), triglycerides (TG), high-density lipoprotein (HDL), low-density lipoprotein (LDL), and very low-density lipoprotein (VLDL) levels were measured using an XL 640 Erba autoanalyzer based on the enzymatic colorimetric method.

RESULTS

The study included 131 patients with chronic kidney disease undergoing dialysis. The age and sex distribution of the study population is presented in Table 1. The mean age of the participants was 46.9 ± 7.66 years, with ages ranging from 31 to 60 years. Among the 131 subjects, 68 were male and 63 were female. A higher proportion of dialysis-dependent CKD patients belonged to the 41–60-year age group. No statistically significant association was observed between age or gender and the occurrence of end-stage renal disease (ESRD).

Table 1. Age and sex distribution of end stage renal disease patients.

Age in years	Male	Female	Total	Chi-square value	P-value
30–40	13	14	27	0.0752	0.9402
41–50	33	26	59		
51–60	22	23	45		
Total	68	63	131		

Table 2 presents the levels of total cholesterol (TC), triglycerides (TG), high-density lipoprotein (HDL), low-density lipoprotein (LDL), and very low-density lipoprotein (VLDL) in patients with end-stage renal disease (ESRD) before and after hemodialysis. Post-dialysis, an increase in HDL levels was observed, whereas TC, TG, LDL, and VLDL levels showed a reduction. Statistical comparison of lipid profile parameters between the pre- and post-dialysis groups was performed using p-value analysis, with a p-value < 0.05 considered statistically significant. Prior to dialysis, the mean concentrations of TC, TG, LDL, and VLDL were 180.8 ± 21.14 mg/dL, 111.5 ± 13.29 mg/dL, 129.4 ± 19.32 mg/dL, and 22.3 ± 2.66 mg/dL, respectively. Following dialysis, these values decreased to 166.5 ± 11.83 mg/dL, 105.7 ± 6.72 mg/dL, 115.7 ± 35.12 mg/dL, and 21.1 ± 1.34 mg/dL, respectively. The observed reductions were found to be statistically highly significant ($P < 0.001$).

Table 2. Comparison of pattern of lipid profile in pre-dialysis and post-dialysis end stage renal disease patients.

Parameters serum lipids (mg/dl)	Pre-hemodialysis (N = 131) (mean ± SD)	Post-hemodialysis (N = 131) (mean ± SD)	P-value (t-test)
Total Cholesterol	180.8 ± 21.14	166.5 ± 11.83	<0.001
Triglyceride	111.5 ± 13.29	105.7 ± 6.72	0.0227
High-Density Lipoprotein	42.9 ± 4.7	44.1 ± 4.03	<0.001
Low Density Lipoprotein	129.4 ± 19.32	115.7 ± 35.12	<0.001
Very low-density lipoproteins	22.3 ± 2.66	21.1 ± 1.34	<0.0001

In the present study, high-density lipoprotein (HDL) was the only lipoprotein fraction that showed an increase following hemodialysis. The mean HDL concentration increased from 42.9 ± 4.7 mg/dL before dialysis to 44.1 ± 4.03 mg/dL after dialysis; however, this rise was not statistically significant (Figures 1 and 2).

DISCUSSION

Declining renal function has been recognized as a significant risk factor for cardiovascular events and related hospitalizations, largely due to the high prevalence of dyslipidemia, which contributes to increased mortality among patients with chronic kidney disease. If the disease worsens to end-stage renal disease (ESRD), the risk of death increases even further. Health care institutions worldwide are under tremendous strain due to the rising frequency of ESRD.

In the present study, hypertension, chronic urinary tract obstruction, and renal disorders like glomerulonephritis were identified as the primary etiological factors contributing to chronic kidney disease, while other conditions known to influence lipid profiles were excluded. The study population consisted of dialysis-dependent CKD patients aged between 30 and 60 years, with a mean age of 46.9

± 7.66 years. Most of the participants were in the 40–60-year age group, a distribution that is consistent with findings reported in similar studies conducted in Lucknow, India, which documented a mean patient age of 49.17 ± 11.45 years. This could reflect the fact that the economically productive age group is affected by ESRD. However, this stands in contrast to the Western population survey, which indicated that the mean age was over 65. The cause may be due to the differences in the prevalence of diabetes and hypertension, two conditions that are common risk factors for CKD, as well as other elements like genetic and sociocultural factors, the therapeutic process, and the disease pattern that results in CKD [11].

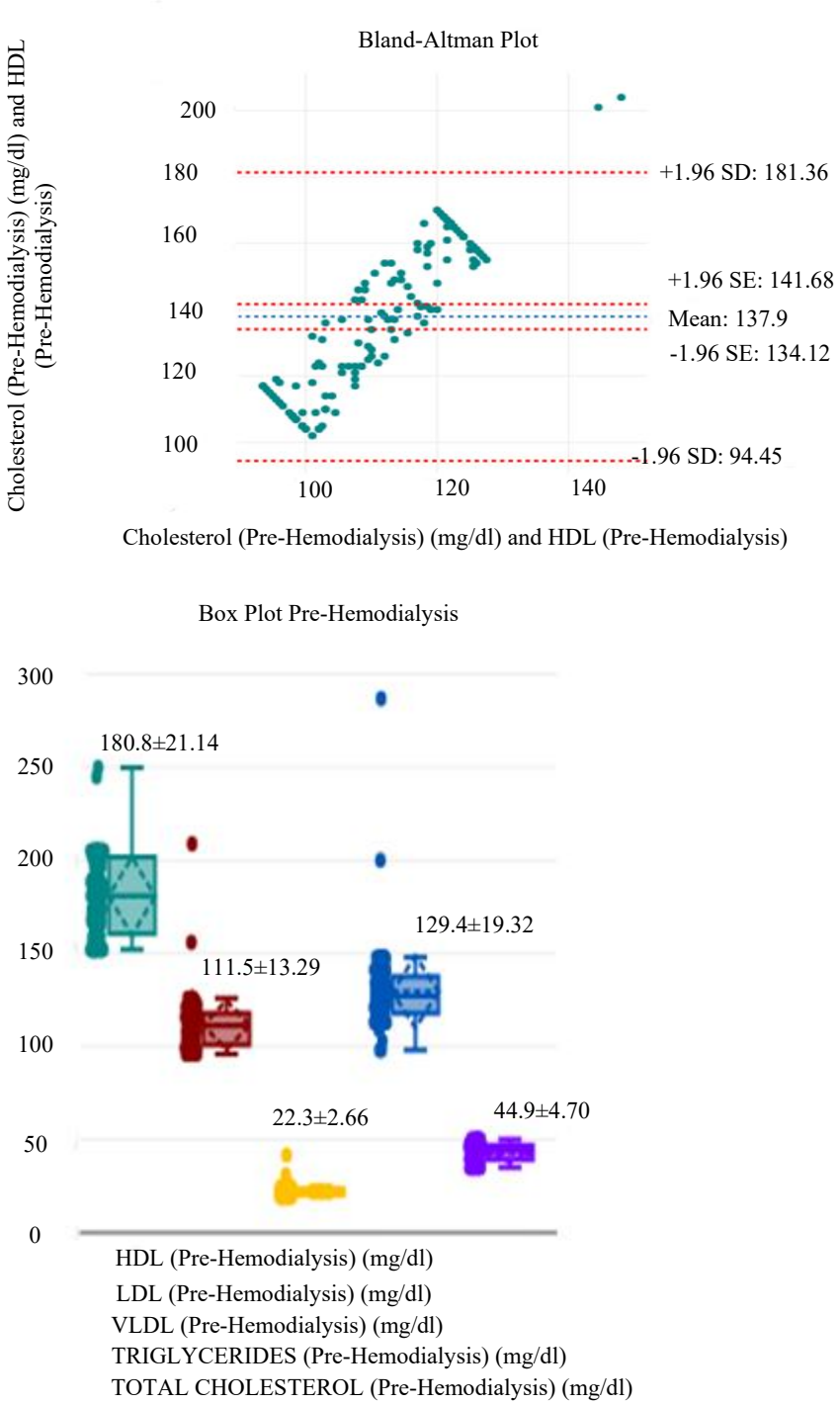
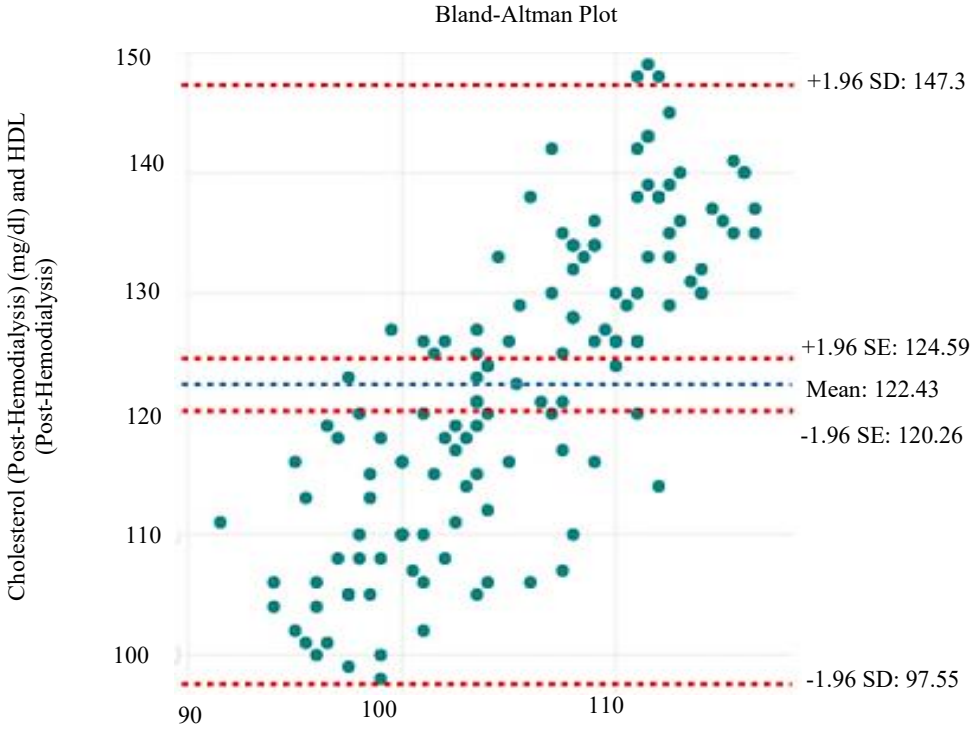


Figure 1. Pre-hemodialysis.



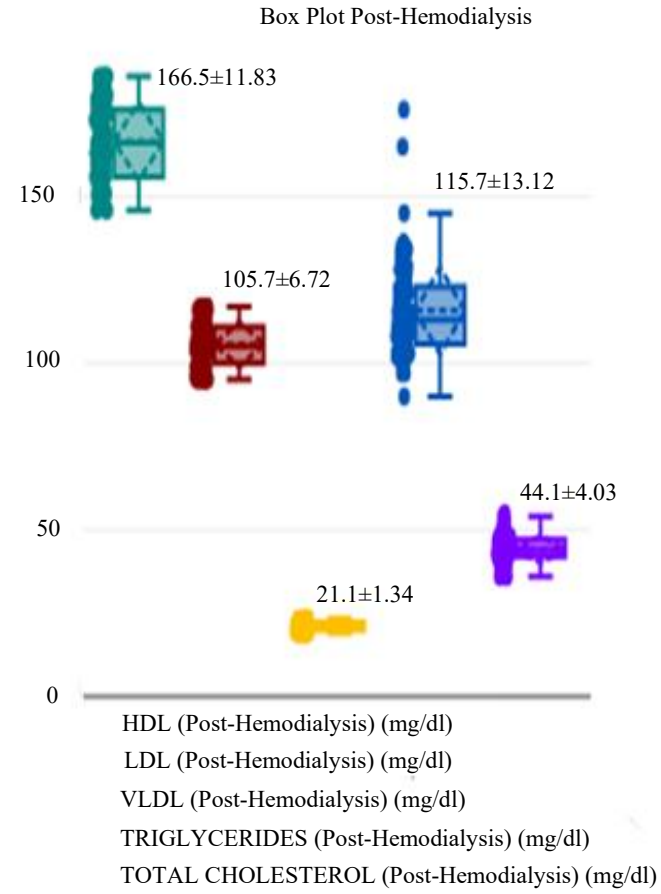


Figure 2. Post-hemodialysis.

In the present study, a significant reduction in mean total cholesterol (TC) levels was observed following hemodialysis when compared with pre-dialysis values. The mean TC concentration in patients with end-stage renal disease was 180.8 ± 21.14 mg/dL prior to dialysis and decreased to 166.5 ± 11.83 mg/dL after dialysis, with this reduction being statistically significant ($P < 0.001$). These findings agree with the observations reported by Nagane and Ganu, who also demonstrated a significantly lower post-dialysis mean TC compared to pre-dialysis levels [12]. In contrast, some studies have reported a modest but statistically significant increase in total cholesterol following a single hemodialysis session [13]. Additionally, the current study revealed a significant post-dialysis decrease in triglyceride levels relative to pre-dialysis values. This finding effectively supports the existing research regarding metabolic shifts during extracorporeal therapy [14] and is consistent with those documented by Nagane and Ganu [12].

The present study demonstrated a significant reduction in both low-density lipoprotein (LDL) and very low-density lipoprotein (VLDL) levels following hemodialysis. Statistical analysis confirmed that the post-dialysis decreases in LDL and VLDL concentrations were significant. These findings are consistent with observations reported in earlier studies. In contrast, some studies have reported no significant change in VLDL levels after dialysis, although a significant reduction in post-dialysis mean LDL levels compared to pre-dialysis values was observed. Conversely, other investigations have reported opposing results, indicating an increase in LDL levels following hemodialysis. In such studies, mean LDL concentrations were noted to be higher before dialysis and showed a significant change after the procedure [13–15].

In the present study, mean high-density lipoprotein (HDL) levels increased following hemodialysis, and this increase was found to be statistically significant. Similar statistically significant post-dialysis elevations in HDL levels have been documented in previous studies. Additionally, earlier research has also shown that mean HDL concentrations in post-hemodialysis samples were markedly higher when compared to pre-hemodialysis values [16].

CONCLUSIONS

The findings of the present study indicate that patients with end-stage renal disease had a higher risk of cardiovascular disease prior to the initiation of hemodialysis, whereas improvement in dyslipidemia was observed following the commencement of hemodialysis. Thus, we reach the conclusion that, in addition to other forms of therapy like a well-recommended diet, lifestyle changes, and lipid-lowering medication, adequate dialysis treatment and prompt lipid profile monitoring should be carried out to significantly and further improve the quality of life for patients with chronic kidney disease and prevent the development of risk factors for CVDs.

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