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Study of Comparative Effect of Hemodialysis and Peritoneal Dialysis on Lipid Profile of Patients of Chronic Kidney Disease

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Abstract

Chronic kidney disease (CKD) patients are at increased risk of cardiovascular disease (CVD) like coronary heart disease, cerebrovascular disease, peripheral vascular disease and heart failure. Strong association is present between renal disease progression & dyslipidemia. The present study was undertaken to study the comparative effect of hemodialysis and peritoneal dialysis on lipid profile in these patients. 100 diagnosed CKD patients i.e. cases (50 undergoing hemodialysis HD and 50 undergoing peritoneal dialysis PD) were enrolled for the study after institutional ethical committee's clearance was obtained. In this study, we measured serum levels of lipid profile comprising of total cholesterol (TC), triglyceride (TG), high density lipoprotein cholesterol (HDL-C), low density lipoprotein cholesterol (LDL-C), very low density lipoprotein cholesterol (VLDL-C) and atherogenic ratios (LDL-C/HDL-C, TC/HDL-C).

In our study, we found that the mean values of TC, LDL-C and atherogenic ratios (LDL-C/HDL-C, TC/HDL-C) were significantly higher and HDL-C was significantly lower in cases of peritoneal dialysis group as compared to cases of hemodialysis group. Out of both dialysis modalities, peritoneal dialysis (PD) patients develop a somewhat different and probably more atherogenic lipoprotein profile than do hemodialysis (HD) patients. So, among patients with cardiovascular disease, the risk for death was higher in peritoneal dialysis (PD) patients than in hemodialysis (HD) patients.

Keywords: Chronic kidney disease, lipid profile, hemodialysis, peritoneal dialysis.

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INTRODUCTION

Chronic kidney disease is defined as either kidney damage or GFR < 60ml/min/1.73 m^2 for ≥ 3 months with or without evidence of kidney damage, irrespective of the cause. Kidney damage is defined as pathological abnormality or marker of damage, including abnormalities of blood or urine test or imaging studies.[1]

The Greek word "dialysis" means "dissolution". The word "dia" means "through" and the word "lysis" means "loosening or splitting". Dialysis is the process for removing waste and excess water from blood, and is used primarily to provide an artificial replacement for the lost kidney function in people with renal failure.[2] Dialysis works on the principles of diffusion (waste removal) and ultrafiltration (fluid removal) across a semipermeable membrane.

Hemodialysis (HD):

Removes waste and excess water by circulating blood outside the body through an external filter, called a dialyzer that contains a semipermeable membrane.[3]

Peritoneal dialysis (PD):

Removes waste and excess water from the blood inside the body into a special dialysis solution called dialysate using peritoneal membrane as the natural semipermeable membrane.[4]

Peritoneal dialysis is of two main types:

1) CAPD: Continuous ambulatory peritoneal dialysis. It is done without a machine.

2) CCPD: Continuous cycler-assisted peritoneal dialysis.

It uses a machine (cycler) to fill and drain the dialysate.

In order to contribute to the better understanding of the effect of dialysis on lipid profile of the patients of chronic kidney disease, the present study was undertaken to study the comparative effect of hemodialysis and peritoneal dialysis on lipid profile in these patients.

AIMS AND OBJECTIVES

To compare the effect of hemodialysis and peritoneal dialysis on lipid profile of patients of chronic kidney disease.

MATERIALS AND METHODS

The present study was undertaken in the department of Biochemistry, in the tertiary institute. Period of study was from January 2011 to July 2012.

Study design: Prospective hospital based comparative study.

Study Population: 100 diagnosed CKD patients i.e. cases (50 undergoing HD hemodialysis and 50 undergoing PD peritoneal dialysis) were enrolled for the study after institutional ethical committee's clearance was obtained.

Inclusion criteria: Criteria for cases of Chronic Kidney Disease (CKD) undergoing Hemodialysis (HD): Adequate hemodialysis for 3 hours / 3 times weekly.

Criteria for cases of Chronic Kidney Disease (CKD) undergoing peritoneal dialysis (PD): Adequate continuous ambulatory peritoneal dialysis (CAPD) usually four or five times daily.

Exclusion criteria:

Ischemic heart disease, nephrotic syndrome, hypertension, diabetes mellitus, hepatic diseases, hypothyroidism, familial hypercholesterolemia, recurrent myocardial infarction, unstable angina.

Study duration: 18 months.

Sample collection:

5 ml of blood was collected in clean plain bulb after an overnight fast. (i.e. after 12 hours of intake of meals). Blood was allowed to clot. Serum was then separated by centrifugation.

Each patient underwent clinical history, physical examination and investigations. In this study, we measured serum levels of lipid profile comprising of total cholesterol (TC), triglyceride (TG), high density lipoprotein cholesterol (HDL-C), low density lipoprotein cholesterol (LDL-C), very low density lipoprotein cholesterol (VLDL-C).

Equipment: Transasia Erba Chem Plus Semi-automatic analyzer

Parameters were estimated with methods: (Table 1)

Expected serum cholesterol Values: Cholesterol (mg/dl)

Desirable	< 200
Borderline	200 - 239
High (undesirable)	> 240

Expected value for serum HDL Cholesterol: 30-70 mg%.

Expected value for serum TG: ≤ 170 mg%.

Expected value for serum LDL cholesterol: < 130 mg/dl

No.	Parameter	Method
1.	Total Cholesterol	Enzymatic method - Cholesterol esterase, cholesterol oxidase and peroxidase[5]
2.	HDL-C	Phosphotungstate/Mg2+ precipitation method – End point[6]
3.	Triglycerides	Enzymatic method- Glycerol phosphate oxidase and peroxidase; End point[7]
4.	VLDL-C and LDL-C	Indirect method- Friedewald Equation[8] Serum VLDL-C = Serum TG/ 5 Serum LDL-C = Serum total cholesterol – (Serum VLDL-C +Serum HDL-C)

Table 1: Lipid profile parameters with methods of Estimation

Atherogenic ratios:

i) LDL-C/ HDL-C[9]

ii) TC/HDL-C[9]

Statistical Analysis:

Statistical data was recorded on Microsoft Excel programme.

Data was analysed using prism graphpad software.

The values were quoted in the form of mean ± standard deviation wherever required.

Data between two groups was compared using paired student's t-test.

The p value ($p < 0.05$) is considered as significant and the p value ($p < 0.001$) is considered as highly significant.

Most of the subjects of cases of chronic kidney disease undergoing dialysis were between 41-60 years. (Table 2)

	Hemodialysis	Peritoneal Dialysis
Mean Age	45.92 ± 10.14	43.82 ± 10.75

Table 2: Age wise distribution of cases

TC, LDL-C and atherogenic ratios (LDL-C/HDL-C, TC/HDL-C) were significantly higher and HDL-C was significantly lower in cases of peritoneal dialysis group as compared to cases of hemodialysis group. TG and VLDL-C were comparable between hemodialysis group and peritoneal dialysis group and not found to be significant. (Table 3 & Figure 1)

Serum lipids (mg/dl)	Hemodialysis Cases (n=50) (Mean + SD)	Peritoneal dialysis Cases (n=50) (Mean ± SD)	p value
Total Cholesterol	143.98 ± 25.84	173.76 ± 29.79	0.0000***
Triglycerides	114.22 ± 37.43	117.18 ± 33.75	0.6789
HDL Cholesterol	39.24 ± 12.48	34.10 ± 3.48	0.0061**
LDL Cholesterol	95.80 ± 32.72	115.96 ± 29.64	0.0017**
VLDL Cholesterol	22.84 ± 7.17	24.60 ± 6.89	0.2162
LDL-C/HDL-C	2.67 ± 1.20	3.45 ± 1.00	0.0007***
TC/HDL-C	4.07 ± 1.60	5.14 ± 0.99	0.0001***

Table 3: Serum lipid profile in cases of chronic kidney disease undergoing hemodialysis and cases of chronic kidney disease undergoing peritoneal dialysis

n=number of subjects; * = ($p<0.05$), **= ($p<0.01$), ***= ($p<0.001$)

DISCUSSION:

Dialysis does not correct uremic dyslipoproteinemia completely, but may alter its pattern.

Once dialysis commences, continuous ambulatory peritoneal dialysis (CAPD) patients develop a somewhat different and probably more atherogenic profile than do hemodialysis (HD) patients. High total cholesterol (TC), high triglycerides (TG), high low-density lipoprotein cholesterol (LDL-C) and low high-density lipoprotein cholesterol (HDL-C) was associated with CAPD rather than HD. This was supported by Steele J et al (1989),[10] Avram MM et al (1992),[11] Siamopoulos KC et al (1995),[12] Babazono T et al (1996),[13] Jeong TK et al (1998),[14] Kaysen GA (1999),[15] Solski J et al (2000),[16] Kes P (2001),[17] Kronenberg F et al (2003),[18] Daniel E et al (2004),[19] Grzegorzewska AE (2006),[20] Tsimihodimos V et al (2008),[21] Lacquaniti A et al (2010).[22]

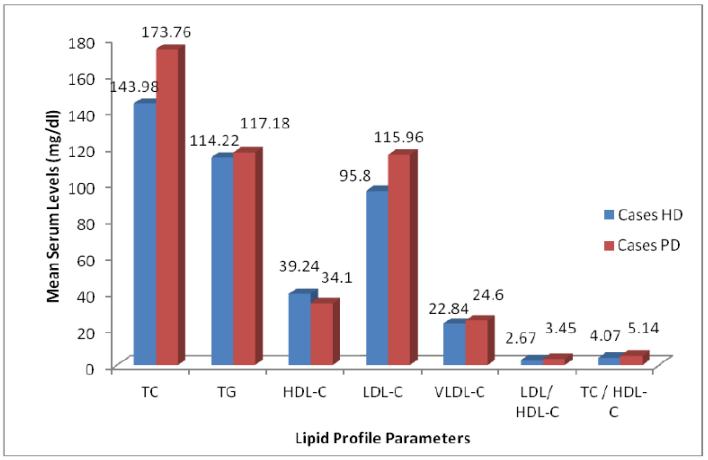

Figure 1: Comparative lipid profile parameters in hemodialysis and peritoneal dialysis cases

A number of factors may be important in producing more atherogenic lipoprotein profile in continuous ambulatory peritoneal dialysis (CAPD) patients compared to hemodialysis (HD) patients. First, continuous ambulatory peritoneal dialysis (CAPD) patients have increased lipoprotein substrate availability through glucose uptake (100-200 g/day) from the peritoneal dialysis fluid, which may contribute to increased hepatic synthesis of apo B containing lipoproteins[23] and increased in insulin levels which enhance the hepatic synthesis of triglyceride. This was supported by Kaysen GA (1999),[15] Lacquaniti A et al (2010)[22] and confirmed by the observation that the lipid profile improves when the overnight dwell is switched from a dextrose based solution to icodextrin.[24,25]

Second, protein loss into the dialysate in continuous ambulatory peritoneal dialysis (CAPD) treated patients occur at the rate of 5-15 g/day, along with all types of lipoproteins. Peritoneal sieving results in preferential loss of smaller molecules such as HDL, which is lost at the rate equivalent to 34% of its daily synthetic rate.[26] This was supported by Steele J et al (1989),[10] Yang X et al (1997),[27] Kaysen GA (1999),[15] Antonio Lacquaniti et al (2010).[22] The daily clearance of apo A-I has been reported to be twofold to fourfold greater than that of apo B.[28] It has been suggested that peritoneal protein

losses upregulate hepatic VLDL production in CAPD treated patients.[29]

Third, it has been reported that the continuous ambulatory peritoneal dialysis (CAPD) patients had significantly higher apo C-III than hemodialysis (HD) patients. Apo C-III inhibits lipoprotein lipase (LPL). LPL hydrolyzes both chylomicron and VLDL on the vascular endothelium and generates precursor of HDL during lipolysis of TG-rich lipoproteins. So removal of TG-rich lipoproteins may be less efficient in the CAPD patients than HD patients.[30] This was supported by Attman PO et al (1999).[31] Thus, decrease in this LPL activity may decrease HDL-C and increase TG in CAPD patients.

Fourth, the extrinsic coagulation pathway [tissue factor (TF), tissue factor pathway inhibitor (TFPI)], impaired fibrinolysis [thrombin-activable fibrinolysis inhibitor (TAFI)] and platelet aggregation are upregulated in uremic patients on continuous ambulatory peritoneal dialysis (CAPD). Increased concentration of fibrinogen, dyslipidemia and impaired fibrinolysis are regarded as important risk factors for cardiovascular diseases.[32] This was supported by Hryszko T et al (2001).[33]

Also, continuous ambulatory peritoneal dialysis (CAPD) patients are seen less frequently by their nephrologists compared to hemodialysis (HD) patients, which may mean that less attention is given to cardiovascular risk factors. It was postulated that hemodialysis (HD) provides better clearance of atherogenic toxins and repeated heparinisation could ameliorate, at least to some extent lipoprotein abnormalities. These factors are important in producing less atherogenic lipoprotein profile in HD patients compared to continuous ambulatory peritoneal dialysis (CAPD) patients.

CONCLUSION

From this study, total cholesterol, LDL-cholesterol and atherogenic ratios (LDL-C/HDL-C, TC/HDL-C) were significantly higher and HDL-C was significantly lower in cases of chronic kidney disease patients undergoing peritoneal dialysis than corresponding values in cases of chronic kidney disease patients undergoing hemodialysis. Out of both dialysis modalities, peritoneal dialysis (PD) patients develop a somewhat different and probably more atherogenic lipoprotein profile than do hemodialysis (HD) patients. So, among patients with cardiovascular disease, the risk for death was higher in peritoneal dialysis (PD) patients than in hemodialysis (HD) patients. However further extensive and long term studies need to be done to prove these findings and understand the basic mechanism involved.

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