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Serum Lipid Profiles in Chronic Kidney Disease Patients on Haemodialysis at Parkview Renal Unit

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Abstract

Chronic kidney disease is a condition where there is loss of kidney function over time. Sometimes acute kidney injury develops into chronic kidney disease. In such situations, renal replacement therapy may be prescribed which includes kidney transplant, peritoneal dialysis, hemodialysis and hemodiafiltration. Haemodialysis is a process that uses diffusion principles to remove metabolites from the blood using a dialyzer. Chronic kidney disease patients are known to be at risk for cardiovascular diseases and the lipid profile and cardiovascular indices may be used to assess this. This cross-sectional study was used to assess lipid dysfunction in 55 chronic kidney disease patients, on haemodialysis, attending Parkview Renal Unit in Harare, Zimbabwe. Total cholesterol (TC) levels of all patients were in the normal ranges as recommended by the National Cholesterol Education Program (NCEP) and The Kidney Dialysis Outcome Quality Initiative. Approximately 82% of the population had decreased high density lipoprotein (HDLc), 7% had elevated low density lipoprotein (LDLc), and 2% had a high LDLc/HDLc ratio while 4% had a high TC/HDLc ratio. Of the chronic kidney disease patients on haemodialysis at Parkview Renal Unit, at most 82% are at a risk of developing cardiovascular disease when determined using reduced HDLc levels as an index but risk is low when using CVD indeces.

Keywords

Chronic Kidney Disease, Haemodialysis, Lipid Profile, HDLc, LDLc, TC

1. Introduction

When the kidneys are damaged or injured they fail to perform some of their important functions such as: removal of metabolites, regulating fluid and electrolyte balance and control of blood pressure [1]. Renal failure can be acute or chronic [2]. Acute kidney injury causes sudden reduction in renal filtration function [1, 3]. Causes include acute tubular necrosis, autoimmune kidney disease, cholesterol emboli, decreased blood flow, surgery, clotting disorders, urinary tract blockage, septicaemia and pregnancy complications [1, 3]. These may be treated by correcting high potassium levels, fluid overload with furosemide or haemodialysis for a short time [4].

Chronic kidney disease is a condition where there is loss of kidney function over time and also defined as less than 60ml/min/1.73m^3 for at least three months [1, 5]. Diabetes and hypertension are the main causes [1, 3, 5]. In such cases renal replacement therapy is prescribed- peritoneal dialysis, haemodialysis, haemodiafiltration and transplantation being options. Haemodialysis is the most common [1, 3, 6].

Cardiovascular disease is the leading cause of death in people with kidney disease on dialysis [7]. Cardiovascular disease comprises a group of ailments caused by problems in the heart and blood vessels. These consist of congenital heart disease, coronary heart disease, peripheral arterial disease, rheumatic heart disease (caused by rheumatic fever), cerebrovascular disease, deep vein thrombosis and pulmonary embolism [8].

The causes of cardiovascular diseases are several; hypertension and atherosclerosis being the most common in renal patients on haemodialysis. Approximately 80 to 85 percent of patients with chronic kidney disease are hypertensive [9]. Hypertension is a well-established risk factor for several cardiovascular diseases and for sudden cardiac death [9, 10]. Hypertension causes blood to flow

through the veins at a high pressure which puts the blood vessels under stress [10, 11]. This stress in the long run may kill or weaken the muscles, and the blood pressure damages the endothelial cells [10]. Both situations may elicit an inflammatory response, which if chronic causes further damage to the endothelium [10]. This leads to lipid deposition along the blood vessels an early step in atherogenesis. When the smooth muscles of the blood vessels are damaged, they calcify leading to ischemia [12]. The aorta and peripheral arteries are also affected thereby increasing cardiac work, increasing cardiovascular risk [10].

Renal patients are known to have lipoprotein abnormalities comprising elevated total cholesterol (TC), elevated very low density lipoprotein cholesterol (VLDLc), elevated low density lipoprotein cholesterol (LDLc) and reduced high density lipoprotein cholesterol (HDLc) [13, 14]. Hypoparathyroidism common in renal patients is known to affect lipoprotein metabolism [11, 15, 17]. Insulin resistance that comes with chronic kidney disease (CKD) promotes hepatic VLDLc production [12, 16, 17]. Patients with CKD have a decreased HDLc due to decrease in levels of apolipoproteins AI and AII. Deficiency in lecithin-cholesterol acyltransferase (LCAT) and cholesterol ester transfer protein (CETP) reduces serum concentration of HDLc [12, 18]. Hence the current study was carried out to assess lipid dysfunction in CKD patients at Parkview Renal Unit in Harare, Zimbabwe.

2. Materials and Methods

2.1. Ethical Considerations

This study was approved by the Joint Research Ethics Committee of the University of Zimbabwe College of Health Sciences and Parirenyatwa Group of Hospitals (JREC/252/13). Samples and data were given numerical codes to protect patients' privacy.

2.2. Study Design and Setting

A cross sectional study was carried out at Parkview Laboratory which services Parkview Renal Unit. Parkview Renal Unit is a private facility run by Premier Service Medical Investments, Zimbabwe.

2.3. Inclusion Criteria

Both male and female CKD patients from Parkview Hospital Renal Unit, who were undergoing haemodialysis

2.4. Sample Collection

Samples collected from patients for routine assays were transported on ice to the University of Zimbabwe, College of Health Sciences, Department of Medical Laboratory Science where they were stored at -20°C.

2.5. Sample Analysis

Serum samples were first thawed at room temperature before being assayed on the Mindray BS 120 chemistry analyzer (Shenzhen city, Guangdong province, China).

2.6. Reference Ranges

Table 1 shows reference ranges used in this study as recommended by the National Cholesterol Education Program (NCEP) (2011) based on Adult Treatment Panel classifications. The Kidney Dialysis Outcome Quality Initiative suggests that patients with and LDLc value greater than 2.59mmol/l should be treated to reduce cardiovascular complications [19]. However 2.59mmol/l is the lower limit of the normal range (2.59 to 3.34mmol/l) provided by the NECP so some values above 2.59mmol/l may be considered normal. In this study, 2.59mmol/l was used as the upper limit as recommended by the Kidney Dialysis Outcome Quality Initiative.

Table 1. *Reference ranges.*

Parameter	Normal range in mg/dl	Normal range in mmol/l
Total Cholesterol	200-239	5.17-6.18
HDL-C	≥60	1.55
LDL-C	100-129	2.59-3.34
LDL-C/HDL-C ratio	3-4 (>6 for CVD high risk)	N/A
TC/HDL-C ratio	4-5 (>6 for CVD high risk)	N/A

3. Results

Mean ±SD age of the whole population was 52±13.5 years. Females in this study had a minimum age of 25 years and maximum age of 77 years, with mean age of 48±14.4 years. The male patients had a minimum age of 26 years, a maximum age of 77 years with a mean± SD age of 53±12.9 years. A large proportion of female patients (≈31%) were in the age groups 40-49 and 60-69 years respectively, whilst a third of male patients were aged 40-49 years (Table 2).

Table 2. *Age and sex distribution of the participants.*

Age group (years)	Males	Percentage	Females	percentage
<30	1	2.6	2	12.5
30-39	4	10.3	2	12.5
40-49	13	33.3	5	31.2
50-59	7	17.9	2	12.5
60-69	9	23.1	5	31.3
70-79	5	12.8	0	0
Total	39	100	16	100

Table 3. *Summary of results.*

Variable N=55	Mean (mmol/l)	SD	Minimum (mmol/l)	Maximum (mmol/l)
TC	3.94	0.92	1.80	5.58
HDLc	1.21	0.37	0.59	2.23
LDLc	1.64	0.72	0.20	3.04
VLDLc	1.09	0.59	0.11	3.96
TC/HDLc ratio	3.53	1.24	1.52	6.47
LDLc/HDLc ratio	1.51	0.89	0.20	5.02

TC, Total Cholesterol; HDLc, high density lipoprotein cholesterol; LDLc, low density lipoprotein cholesterol; VLDLc, very low density lipoprotein cholesterol; SD, Standard deviation

Table 3 shows mean lipid values for all the patients to be within normal range. A two tailed student t test was done to find if there is a significant difference between males and females, for total cholesterol, at 95% confidence interval with 53 degrees of freedom, Table 4. The same table (Table 4) also shows mean values for each sex. The females on haemodialysis at Parkview Renal Unit have a higher total cholesterol mean than males (p=0.01).

Table 4. *Comparison of total cholesterol levels of males and females.*

Sex	Number	Mean Total Cholesterol	Standard Deviation	95% Confidence interval	
Female	16	4.42	0.84	3.97	4.87
Male	39	3.74	0.88	3.46	4.03
Combined	55	3.94	0.92	3.69	4.19
Difference		0.68	0.16	p= 0.011	

Table 5. *Patients with low HDLc (<1.55).*

	HDLc category		
Sex	**Normal, n (%)**	**Low, n (%)**	**Total, n (%)**
Female number	1(6.3)	15(93.8)	16(100)
Male number	9(23.1)	30(76.9)	39(100)
Total number	10(18.18)	45(81.82)	55(100)
*p value	0.25		

Fisher's exact was used to calculate the p value because of low sample size, p=0.25

Approximately 82% (both males and females) of the population have a low HDLc (Table 5). Though females alone appeared to have a higher proportion, the difference between males and females was found to be insignificant, p=0.25 (Table 5). Over 92% of patients had normal LDLc levels (Table 6).

Table 6. *Patients with high LDLc values (>2.59mmol/l).*

	LDLc category		
Sex	**Normal, n (%)**	**High, n (%)**	**Total, n (%)**
Female Number	15(93.8)	1(6.2)	16(100)
Male Number	36(92.3)	3(7.7)	39(100)
Total Number	51(92.7)	4(7.3)	55(100)
*p value	0.067		

*Fisher's exact was also used to calculate the p value because of low sample size p=0.067

Table 7. *Patients with LDLc/HDLc ratio greater than 4 and those at high risk for CVD (>6).*

Category	Number	Percentage
Normal	54	98.18
High (>4)	1	1.82
High risk for CVD (>6)	0	0
Total	55	100

Patients with a LDLc/HDLc ratio of greater than 6 are considered to be at high risk for cardiovascular diseases. Patients with a ratio greater than 4 are also noted because they are not within the normal range as per NECP guidelines. Table 7 shows the results for the current study.

Table 8. *Patients with TC/HDLc >5 and those at high risk for CVD (ratio>6).*

Category	Number	Percentage
Normal	48	87.27
High (>5)	5	9.09
High risk for CVD (>6)	2	3.64
Total	55	100

Though approximately 12.7% of the population had TC/HDLc ratios above 5, only 3.64% of the population is at high risk for cardiovascular diseases according to NCEP guidelines (ratio>6), Table 8.

4. Discussion

The study population has a low mean TC, low mean HDLc, low mean LDLc and low mean cardiovascular indices (Table 3). This is similar to the study done by Altaf A et al. in Pakistan, where means of the above mentioned parameters were also low [15]. The mean TC of the females in this study is significantly higher ($p<0.05$) than that of males, (Table 4) which is similar to the Pakistani study [15]. Usually females have lower TC levels pre-menopause because they produce oestrogen which plays a role in lipid control. During menopause there is a decline in oestrogen production by the ovaries. Of the 16 females in this study, 12 (75%) are over the age of 40, meaning some are approaching menopause while others are already experiencing menopause. During and after menopause, TC together with LDLc levels, both increase whilst HDLc levels decrease [20, 21, 22]. This is because of the decrease in oestrogen production [22].

Of the females, approximately 94% have low HDLc levels (Table 5) which may also be due to low oestrogen. Approximately 82% (both males and females combined) of the population have a low HDLc (Table 5) putting them at risk for cardiovascular diseases, as has been generally reported [9]. There was however no significant difference between the proportion of males and females with decreased HDLc (p=0.25), Table 4. Reduced HDLc in both males and females may be due to the diminished activity of lecithin-cholesterol acyltransferase and cholesterylester transfer protein as well as decreased levels of apolipoproteins AI and AII which are the main apoprotein constituents of HDLc [10].

Only 7.27% of the population have high LDLc levels, which show a low frequency of cardiovascular risk in this population. There was no significant difference between proportion of males and females with increased LDLc. This is similar to results from an earlier study where there were no significant differences in LDLc levels between males and females [21, 23, 24].

Only 1.82% of all the patients had a high LDLc/HDLc ratio (>4) and referring to this ratio only, none are at high risk for cardiovascular disease (none have a ratio >6), according to the NECP guidelines. Approximately 4% have a high TC/HDLc ratio and are at a risk for cardiovascular disease. This is almost similar to another study where many mean cardiovascular indices were normal [15].

5. Conclusion

Results from this study were different from studies done before in France, Iraq and Canada [17, 20, 21] as these studies show relatively high TC, LDLc and high cardiovascular indices. The study showed that a very low percentage (3.64%) of patients is considered to be at risk of cardiovascular diseases using the two cardiovascular indices stated before. However there was a high percentage of patients with decreased HDLc (81.8%). Decreased HDLc is the most significant marker for cardiovascular disease in relation to the lipid profile panel [25, 26]. There are however disputes though against use of HDLc as an independent marker for cardiovascular disease risk assessment [25, 26].

Limitations of the Study

1. The sample size was small, even lower than calculated minimum sample size due to lack of resources, therefore affecting statistical analysis because larger sample sizes increase precision according to the law of large numbers and central limit theorem [27].
2. There was no information on patients' current drug therapy.
3. Several other assays needed to thoroughly assess cardiovascular disease risk for example apolipoproteins and triglycerides were not done.
4. There are still arguments on the use of HDLc as an independent risk factor for cardiovascular risk assessment [23, 24].

Suggestions for Further Research

Further research needs to be done using a larger sample size and including triglycerides and apolipoproteins in the study. Other assays should also be carried out which include microalbumin, C- reactive protein, full blood count, coagulation assays, parathyroid hormone measurement, vitamin D assay and homocysteine levels determination. Future studies should also consider drug therapies the patients are on during data analysis. It would be good if further study could compare patients with healthy individuals.

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