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ORIGINAL ARTICLE

Prevalence of Dyslipidemia in Children and Adolescents on Regular Hemodialysis

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ABSTRACT

Background: Children who have chronic kidney disease (CKD) or end-stage renal disease (ESRD) often present with a range of concurrent medical conditions, one of which is dyslipidemia. This work aimed to detect the frequency of dyslipidemia among children with ESRD at Zagazig university hospitals. **Methods:** This cross-sectional observational study included (61 children patients) aged from 4 to 17 years old, who had ESRD (CKD grade V) with estimated glomerular filtration rate less than 15 ml/min/1.73m^2 by modified Schwartz equation and on regular hemodialysis. A comprehensive history taking, thorough physical examination, and laboratory tests, including regular labs and the lipid profile, were conducted for all patients.
Results: High percentage of examined children had high lipid profile (29.5 %) of the populations, The prevalence of abnormally high levels of total serum cholesterol, triglycerides, and low-density were found to be 29.5%, 75.4% and 16.4% respectively. Triglycerides, VLDL-C, and HDL levels were found to be higher during maintenance hemodialysis. No significant correlation was found between duration of hemodialysis, urea, and creatinine, with Cholesterol, triglyceride, high density lipoprotein (HDL), low density lipoprotein, and very low-density lipoprotein, except for a significant positive correlation between phosphate (Po4) and high density lipoprotein (HDL) (P =0.022). **Conclusion:** The prevalence of dyslipidemia was found to be high among HD patients in Zagazig university hospitals. Comparisons of lipid parameters with CVD risk stratifications need further studies to prove the benefits of these scores in CVD prediction among the dialysis population.
Keywords: Prevalence, Dyslipidemia, Hemodialysis, Morbidity, Mortality

INTRODUCTION

Chronic kidney disease is linked to a significantly elevated prevalence of atherosclerotic cardiovascular diseases (CVD). As to the pediatric consensus recommendations of the American Heart Association, dyslipidemia develops in over 50% of patients with children CKD [1]. CKD patients often experience a multitude of cardiovascular risk factors. However, dyslipidemia has significant importance in clinical CKD research because of its high prevalence and potential for modifiable exposure [2].

The condition known as dyslipidemia is characterized by the existence of at least one of the subsequent: According to the recommendations for cardiovascular health and risk reduction in children and adolescents, If a person's fasting triglycerides concentration is 20 mg/dL in their first decade of life and 27 mg/dL in their second decade, hypertriglyceridemia is defined according to the 95th centile. On the other hand, low HDL cholesterol is defined as having a less than 35 mg/dL which puts the teen at higher risk for heart disease [3].

Hypertriglyceridemia is widely recognized as a characteristic feature of uremic dyslipidemia. It arises from the buildup of triglycerides (TG) and triglyceride rich lipoproteins (TRL) in CKD as a result of heightened triglyceride production, impaired catabolism, and elevated levels of

apolipoprotein C-III, leading to an elevation in triglyceride levels [4].

Elevated serum lipid levels exhibit variability in relation to age, puberty, and gender. Girls have a somewhat reduced risk of CVD mortality compared to boys, but young people with CKD have a risk that is at least ten times greater than the overall population. The type of dyslipidemia in both adult and pediatric patients with chronic kidney disease (CKD) is affected by the severity as well as the duration of proteinuria [5].

The management of dyslipidemia in pediatric patients remains a subject of debate, with little evidence indicating a decrease in death rates after treatment. Nevertheless, statins have shown a noteworthy decrease in cardiovascular morbidity among adult patients with CKD, making them the preferred therapeutic options for pediatric cases as they mature [6].

This work aimed to detect the frequency of dyslipidemia in patients with end stage renal disease (ESRD) at Zagazig university hospital which could aid in early prediction of complications and management of dyslipidemia in patients on regular hemodialysis to decrease morbidity and mortality.

PATIENTS AND METHODS

The present cross-sectional observational study included a cohort of 61 individuals ranging in age from 4 to 17 years. These patients were diagnosed with end stage renal disease (CKD grade V), characterized by an estimated glomerular filtration rate below 15 ml/min/1.73m2 as determined by the modified Schwartz equation. Additionally, all participants were on regular hemodialysis.

The study was conducted between December 2022 and December 2023 (one year duration), in the Pediatric Nephrology ward, of Zagazig University Children's Hospital after clearance from the Ethical Committee of Zagazig University Hospitals in Egypt, as indicated by the Institutional Review Board (IRB) number 97398-318. The family of the patients provided informed written permission.

The exclusion criteria were individuals having a history of malignancy, prior transplantation, dialysis within a 90-day period, and an age beyond 18 years.

A comprehensive history taking, thorough physical examination, and laboratory tests, including regular labs and the lipid profile, were conducted for all patients.

Vital signs were examined including blood pressure management (by Sphygmomanometer), heart rate, respiratory rate, temperature measurements, The cardiac examination included inspection, palpation, and auscultation.

Concomitant collection of nonlaboratory data was conducted via the use of standardized forms and physical examination. The data included in the present research encompasses variables such as age, gender, race, ethnicity, height, weight, and main diagnosis of CKD. The BMI was determined by dividing the weight by the height, expressed as kg/m2. The BMI percentiles for different age groups and genders were determined by using the 2000 Centers for Disease Control and Prevention standard growth charts specifically designed for children in the United States. The term "overweight" was operationally defined as a body mass index (BMI) falling among the 85th and 95th percentiles, while "obesity" was defined as a BMI above the 95th percentile. The categorization of CKD diagnosis into glomerular or non-glomerular categories is provided in a published document, which offers a more comprehensive discussion of this classification for individual illnesses.

The analysis was limited to participants who had a known age, sex, race, peak flow rate (GFR), and CKD diagnosis, along with comprehensive lipid measurements. Children who were using lipid-lowering medication and those who were known to have been non-fasting at the time the blood sample was taken were not included in the study.

To analyze different kinds of blood lipid levels, patients were instructed to follow an overnight fast for a minimum duration of 12 hours. Measurements were taken for the levels of total blood cholesterol, serum triglycerides (TG), high density lipoprotein (HDL), low density lipoprotein (LDL), and very low-density lipoprotein (VLDL). The blood lipid levels were categorized into several groupings. The enzymatic colorimetric tests were conducted using the Cobas 8000 instrument manufactured by Roche Diagnostics in Germany.

The laboratory investigations:

A blood sample was collected and transferred into a serum separator tube. It was then left to coagulate at room temperature for 30 minutes before being subjected to centrifugation and separated into serum. The serum was sent to the laboratories at Zagazig University Hospitals by next-day mail or, in the event that the next day was not a working laboratory day, stored in a refrigerator at a temperature of 4 °C and then transported on the subsequent available day. The lipid measurements were conducted using an automated system (Cobas

8000, Chemistry c702 unit) by an enzymatic and colorimetric approach.

The assessment of serum TG and TC was conducted using standard enzymatic techniques, whereas the analysis of HDL-C was performed using the Cobas 8000 chemistry c702 unit by an enzymatic and colorimetric approach.

The existence of dyslipidemia was defined using the following cut points: TG levels over 130 mg/dl, HDL–C levels below 40 mg/dl, and non-HDL–C levels beyond 160 mg/dl. The determination of these cut points was derived from three sources: (a) the normative NHANES data for children aged 12 years and older, (b) the normative data from the Lipid Research Clinic data set, and (c) the values often regarded as atherogenic in adults.

The plasma disappearance of iohexol (iGFR) technique was used to directly quantify glomerular filtration rate (GFR) for most research participants, as previously described. If iGFR was not accessible, the estimation of GFR was conducted using a published estimating equation that was created specifically for this research cohort.

STATISTICAL ANALYSIS

SPSS v26 (IBM Inc., Chicago, IL, USA) was used for conducting the statistical analysis. The mean and standard deviation (SD) were used to show the quantitative variables. The two groups were compared using an unpaired Student's t-test, while the three groups were compared using an ANOVA (F) test with a post hoc test (Tukey). The study used quantitative non-parametric data, namely the median and interquartile range (IQR), to examine the data. The data was then compared across groups using the Kruskal-Wallis test and the Mann Whitney-test. The frequency and percentage (%) of qualitative variables were reported and evaluated using the Chi-square test or Fisher's exact test, as deemed suitable. A statistically significant result was defined as a two-tailed P value less than 0.05. The correlation analysis included the use of the Pearson moment correlation equation to examine the linear relationship between normally distributed data, and the Spearman rank correlation equation to analyze non-normal variables or non-linear monotonic relationships.

RESULTS

Sociodemographic data is shown in Table 1. Table 2 shows that Cholesterol was high (>=200) in 18 (29.5 %) patients, was borderline (170 - 199) in 12 (19.7%) patients and was acceptable (<170) in 31 (50.8%) patients, high plasma total cholesterol levels were associated with increased mortality, as observed in the general population. A total of 29.5%, 75.4%, and 16.4% of the participants had abnormally high levels of total serum cholesterol, triglycerides, and low-density lipoprotein, respectively. Cholesterol/HDL ratio ranged from 2.64 to 9.03 with a mean value (± SD) of 4.8 (±1.28). 7(11.5 %) patients were desirable (<3.4), 29 (47.5%) patients were borderline (3.4 - 5) and 25 (41%) patients were high (>5).

There was no correlation between (age, weight, duration of hemodialysis, SBP, DBP, Hb, platelets, WBCs, albumin, urea, creatinine, PTH, Ca, po4, iron, ferritin, Na, K, CRP, ejection fraction, and fractional shortening) and Cholesterol, and cholesterol/HDL ratio. There was significant positive correlation between Po_4 and HDL (P =0.022) and no correlation between (age, weight, duration of hemodialysis, SBP, DBP, Hb, platelets, WBCs, albumin, urea, creatinine, PTH, Ca, iron, ferritin, Na, K, CRP, ejection fraction and fractional shortening) and HDL (Table 3).

There was no correlation between (age, weight, duration of hemodialysis, SBP, DBP, Hb, platelets, WBCs, albumin, urea, creatinine, PTH, Ca, po4, iron, ferritin, Na, K, CRP, ejection fraction and fractional shortening) and TG, LDL and VLDL (Table 4). Lipid profile in studied group according to underlying etiology shown in Table 5.

Table 1: Sociodemographic data and present history of illness of the studied group.

		Mean or N	SD or %	Median (IQR)	Range
Age (in years)		9.79	3.35	8 (8 - 12)	(4 - 17)
Weight (Kg)		26.66	9.82	22 (20 - 35)	(12 - 54)
Duration of hemodialysis (years)		3.19	2.66	2.1 (1.9 - 2.3)	(0.4 - 12)
Sex	Male	34	55.7%		
	Female	27	44.3%		
Causes of CKD	Unknown	11	18.0%		
	Obstructive uropathy	22	36.0%		

	a. Undetermined b. Hydronephrosis c. Reflux d. Neurogenic bladder	10	16.4%		
		4	6.6%		
		5	8.2%		
		3	4.9%		
	SLE	8	13.1%		
	UTI	5	8.2%		
	Nephrotic syndrome	11	18.0%		
	RPGN	2	3.3%		
	HUS	1	1.6%		
	Solitary kidney	1	1.6%		
Blood pressure	SBP	125.05	7.19		
	DBP	81.70	7.87		
No. of HTN drugs	No	15	24.6%		
	One drug	37	60.7%		
	Two drugs	9	14.8%		
Cardiac complications (HF-Infective endocarditis-Arrhythmia-pericardial effusion - Cardiomegaly)	No	23	37.7%		
	Yes	38	62.3%		

HUS:Hemolytic uremic syndrome, RPGN:Rapidly progressive glomerulonephritis, SLE:Systemic lupus erythematosus, UTI: Urinary tract infection, HTN: Hypertension.

Table 2: laboratory investigations of the studied group.

		Mean or N	SD or %	Median (IQR)	Range
Hb		9.70	1.07	9.6 (9.1 - 10.2)	(7.6 - 12.9)
PLT		245.71	116.92	216 (187 - 277)	(50.2 - 886)
WbCs		6.66	2.02	6.7 (5.2 - 7.4)	(3.2 - 14.5)
Cholesterol		173.59	38.65	159.1 (144.6 - 201.1)	(113.4 - 252.1)
Cholesterol	**Acceptable (<170)**	31	50.8%		
	Borderline (170 - 199)	12	19.7%		
	High (>=200)	18	29.5%		
TG		187.69	79.95	186.4 (121.2 - 249.5)	(56.8 - 450.5)
TG	**Acceptable**	3	4.9%		
	Borderline	12	19.7%		
	High	46	75.4%		
HDL		37.59	8.68	37.4 (32.7 - 41.2)	(14.9 - 62.9)
HDL	**Acceptable (>45)**	10	16.4%		
	Borderline (40 - 45)	11	18.0%		
	Low (<40)	40	65.6%		
LDL		99.61	29.66	92.3 (78.5 - 117)	(54.8 - 166.7)
LDL	**Acceptable (<110)**	39	63.9%		
	Borderline (110 - 129)	12	19.7%		

	High (>=130)	10	16.4%		
VLDL		37.50	15.99	37.2 (24.2 - 49.9)	(11.3 - 90.1)
VLDL (2 - 30)	**Normal**	21	34.4%		
	Abnormal	40	65.6%		
Cholesterol/HDL ratio		4.8	1.28	4.56 (3.86 – 5.45)	(2.64 – 9.03)
Cholesterol /HDL ratio	**Desirable (<3.4)**	7	11.5%		
	Borderline (3.4 - 5)	29	47.5%		
	High (>5)	25	41.0%		
Alb		4.21	0.43	4.17 (4.07 - 4.41)	(2.91 - 5.5)
Urea		48.47	15.92	49.7 (40.5 - 55.95)	(4.06 - 92.2)
Creat		7.45	6.73	6.92 (5.47 - 8.87)	(0.93 - 55.4)
PTH		388.56	1155.86	216 (186.5 - 277)	(10.1 - 9212)
Ca		8.78	0.92	8.8 (8.07 - 9.4)	(5.77 - 10.5)
PO4		4.97	1.42	4.99 (4.05 - 5.6)	(2.17 - 9.81)
Iron		93.53	40.27	82.1 (59.1 - 112.3)	(32.3 - 198.7)
Ferritin		727.74	809.08	457.2 (204.2 - 963.2)	(9.16 - 4281)
Na		135.70	2.71	136 (134 - 137)	(125 - 141)
K		5.41	0.86	5.3 (4.8 - 5.8)	(3.6 - 8.6)
CRP		6.86	9.75	4.13 (1.25 - 6.85)	(0.52 - 46.1)

Hb:Hemoglobin,PLT: Platelets,WbCs: White blood cells,TG:Triglycerides,HDL:High density lipoprotein,LDL: Low- density lipoprotein,VLDL:Very low-density lipoprotein,Alb: Albumin,Create: Creatinine,PTH:Parathyroid hormone,CRP:C-reactive protein.

Table 3: Correlation between the parameters of ESRD and dyslipidemia

	Cholesterol		**HDL**		**Cholesterol/HDL ratio**	
	r	**p-Value**	**r**	**p-Value**	**r**	**p-Value**
Age	-0.127$^{(P)}$	0.328	-0.001$^{(P)}$	0.995	-0.088$^{(P)}$	0.499
Weight (Kg)	-0.190$^{(P)}$	0.143	0.012$^{(P)}$	0.925	-0.144$^{(P)}$	0.267
Duration of hemodialysis (years)	-0.015$^{(S)}$	0.909	0.020$^{(S)}$	0.879	-0.056$^{(S)}$	0.669
SBP	-0.187$^{(P)}$	0.150	-0.073$^{(P)}$	0.574	-0.081$^{(P)}$	0.537
DBP	-0.218$^{(P)}$	0.092	-0.076$^{(P)}$	0.560	-0.092$^{(P)}$	0.480
Hb (g/dl)	0.056$^{(P)}$	0.668	0.222$^{(P)}$	0.086	-0.122$^{(P)}$	0.350
PLT(x10^3/cmm)	0.085$^{(S)}$	0.513	0.070$^{(S)}$	0.594	0.032$^{(S)}$	0.808
WbCs(x10^3/cmm)	0.084$^{(P)}$	0.521	0.186$^{(P)}$	0.151	-0.117$^{(P)}$	0.370
Alb(g/dl)	-0.130$^{(P)}$	0.319	-0.047$^{(P)}$	0.721	-0.085$^{(P)}$	0.515
Urea(mg/dl)	0.151$^{(P)}$	0.249	0.067$^{(P)}$	0.611	0.021$^{(P)}$	0.874
Creat(mg/dl)	0.063$^{(S)}$	0.630	-0.127$^{(S)}$	0.331	0.200$^{(S)}$	0.123
PTH(pg/ml)	0.034$^{(S)}$	0.797	0.104$^{(S)}$	0.423	-0.055$^{(S)}$	0.672
Ca (mg/dl)	0.222$^{(P)}$	0.085	0.230$^{(P)}$	0.075	-0.012$^{(P)}$	0.926
PO4 (mg/dl)	-0.047$^{(P)}$	0.720	0.294$^{(P)}$	0.022	-0.250$^{(P)}$	0.052
Iron (mcg/dl)	-0.013$^{(P)}$	0.919	-0.020$^{(P)}$	0.880	-0.024$^{(P)}$	0.856
Ferritin(ng/ml)	0.024$^{(S)}$	0.857	-0.117$^{(S)}$	0.369	0.049$^{(S)}$	0.706
Na (mmol/l)	-0.116$^{(P)}$	0.372	0.066$^{(P)}$	0.615	-0.138$^{(P)}$	0.290
K (mmol/l)	-0.124$^{(P)}$	0.340	-0.034$^{(P)}$	0.797	-0.111$^{(P)}$	0.393
CRP (mg/l)	0.100$^{(S)}$	0.446	-0.014$^{(S)}$	0.913	0.121$^{(S)}$	0.357
Ejection fraction (%)	-0.020$^{(P)}$	0.880	-0.088$^{(P)}$	0.500	0.124$^{(P)}$	0.339
Fractional shortening (%)	0.156$^{(P)}$	0.229	0.226$^{(P)}$	0.080	-0.138$^{(P)}$	0.288

(P) Pearson's method for correlation. (S) Spearman's rho method for correlation. HDL: high density lipoprotein. Hb: Hemoglobin. PLT: Platelets. WbCs: White blood cells. Alb: Albumin. Create: Creatinine. PTH: Parathyroid hormone. CRP: C-reactive protein. SBP: systolic blood pressure. DBP: diastolic blood pressure.

Table 4: Correlation between the laboratory, and cardiac parameters of ESRD patients and dyslipidemia

	TG		LDL		VLDL	
	r	p-Value	r	p-Value	r	p-Value
Age	-0.245(P)	0.057	-0.096(P)	0.462	-0.244(P)	0.058
Weight (Kg)	-0.143(P)	0.273	-0.231(P)	0.074	-0.142(P)	0.273
Duration of hemodialysis (years)	-0.039(S)	0.768	-0.059(S)	0.654	-0.037(S)	0.777
SBP	-0.016(P)	0.901	-0.187(P)	0.149	-0.016(P)	0.903
DBP	-0.133(P)	0.306	-0.239(P)	0.063	-0.133(P)	0.306
Hb (g/dl)	-0.107(P)	0.410	0.050(P)	0.702	-0.107(P)	0.411
PLT(x10^3/cmm)	0.068(S)	0.604	0.060(S)	0.648	0.065(S)	0.616
WbCs(x10^3/cmm)	-0.052(P)	0.690	0.097(P)	0.455	-0.052(P)	0.691
Alb(g/dl)	-0.011(P)	0.934	-0.099(P)	0.446	-0.011(P)	0.934
Urea(mg/dl)	0.055(P)	0.678	0.122(P)	0.355	0.055(P)	0.676
Creat(mg/dl)	0.146(S)	0.261	0.046(S)	0.724	0.146(S)	0.261
PTH(pg/ml)	0.070(S)	0.590	0.004(S)	0.973	0.068(S)	0.602
Ca (mg/dl)	0.022(P)	0.868	0.181(P)	0.162	0.022(P)	0.868
PO4 (mg/dl)	-0.183(P)	0.157	-0.058(P)	0.658	-0.183(P)	0.157
Iron (mcg/dl)	-0.074(P)	0.573	-0.058(P)	0.659	-0.073(P)	0.574
Ferritin(ng/ml)	0.157(S)	0.227	-0.004(S)	0.977	0.157(S)	0.227
Na (mmol/l)	-0.202(P)	0.119	-0.086(P)	0.509	-0.202(P)	0.119
K (mmol/l)	-0.038(P)	0.773	-0.152(P)	0.241	-0.038(P)	0.773
CRP (mg/l)	0.109(S)	0.407	0.055(S)	0.675	0.110(S)	0.403
Ejection fraction (%)	-0.076(P)	0.562	0.029(P)	0.824	-0.076(P)	0.562
Fractional shortening (%)	0.082(P)	0.530	0.087(P)	0.506	0.082(P)	0.529

Hb:Hemoglobin,PLT: Platelets,WbCs: White blood cells,TG:Triglycerides,HDL:High density lipoprotein,LDL: Low- density lipoprotein,VLDL:Very low-density lipoprotein,Alb: Albumin,Create: Creatinine,PTH:Parathyroid hormone,CRP:C-reactive protein.

Table 5: Lipid profile in studied group according to underlying etiology

	Cholesterol			TG			HDL			LDL			VLDL	
	Acceptable (<170)	Borderline (170 - 199)	High (>=200)	Acceptable	Borderline	High	Acceptable (>45)	Borderline (40-45)	Low(<40)	Acceptable (<110)	Borderline (110-129)	High (>=130)	normal	Abnormal
Unknown (10)	2 (20%)	2 (20%)	6 (60%)	1 (10%)	1 (10%)	8 (80%)	2(20%)	2(20%)	6 (60%)	2(20%)	4 (40%)	4 (40%)	3 (30%)	7(70%)
Atrophic kidney (1)	0 (0%)	1 (100%)	0 (0%)	0 (0%)	0 (0%)	1 (100%)	0 (0%)	0 (0%)	I (100%)	0(0%)	I (100%)	0(0%)	o (0%)	I (100%)
Autoimmune (5)	3 (60%)	1 (20%)	1 (20%)	0 (0%)	1 (20%)	4 (80%)	I (20%)	(40%)	2 (40%)	(100%)	0 (0%)	0 (0%)	I (20%)	4 (80%)
HUS (1)	0 (0%)	0 (0%)	1 (100%)	0 (0%)	0 (0%)	1 (100%)	0 (0%)	0 (0%)	1 (100%)	0(0%)	0 (0%)	(100%)	o (0%)	I (100%)
Hydronephrosis (4)	2 (50%)	1 (25%)	1 (25%)	1 (25%)	0 (0%)	3 (75%)	0 (0%)	(25%)	(75%)	2(50%)	I (25%)	I (25%)	2(50%)	2 (50%)
Nephrotic syndrome (11)	8 (72.7%)	1 (9.1%)	2 (18.2%)	0 (0%)	2 (18.2%)	9 (81.8%)	0 (0%)	2 (18.2%)	9 (81.8%)	(72.7%)	3 (27.3%)	0 (0%)	3 (27.3%)	8 (72.7%)
neurogenic bladder (3)	1 (33.3%)	1 (33.3%)	1 (33.3%)	0 (0%)	0 (0%)	3 (100%)	0 (0%)	I (33.3%)	2 (66.7%)	2(66.7%)	0(0%)	I (33.3%)	I (33.3%)	2 (66.7%)
obstructive uropathy (10)	6 (60%)	1 (10%)	3 (30%)	1 (10%)	1 (10%)	8 (80%)	1(10%)	I (10%)	8(80%)	7(70%)	I (10%)	2(20%)	2 (20%)	8 (80%)
Pyelonephritis	2 (50%)	2 (50%)	0 (0%)	0 (0%)	2 (50%)	2 (50%)	3(75%)	I (25%)	0(0%)	4(100%)	0(0%)	0(0%)	2(50%)	2(50%)

(4)														
Reflux (5)	2 (40%)	0 (0%)	3 (60%)	0 (0%)	1 (20%)	4 (80%)	2(40%)	0 (0%)	3(60%)	2(40%)	(40%)	I (20%)	I (20%)	4 (80%)
RPGN (2)	2 (100%)	0 (0%)	0 (0%)	0 (0%)	1 (50%)	1 (50%)	0 (0%)	0 (0%)	2(100%)	2 (100%)	0(0%)	0(0%)	2(100%)	0 (0%)
SLE (3)	3 (100%)	0 (0%)	0 (0%)	0 (0%)	2 (66.7%)	1 (33.3%)	0(0%)	0 (0%)	3(100%)	3(100%)	0 (0%)	0(0%)	3(100%)	0 (0%)
Solitary kidney (1)	0 (0%)	1 (100%)	0 (0%)	0 (0%)	0 (0%)	1 (100%)	0(0%)	(100%)	0(0%)	I (100%)	0 (0%)	0(0%)	0 (0%)	(100%)
UTI (1)	0 (0%)	1 (100%)	0 (0%)	0 (0%)	1 (100%)	0 (0%)	(100%)	0 (0%)	0(0%)	I (100%)	0 (0%)	0(0%)	(100%)	0 (0%)

Data is presented as frequency (%). TG: Triglyceride. HDL: high density lipoprotein. LDL: Low density lipoprotein. V LDL: Very low density lipoprotein. HUS: Hemolytic uremic syndrome, RPGN: Rapidly progressive glomerulonephritis, SLE: Systemic lupus erythematosus, UTI: Urinary tract infection

DISCUSSION

In this research, we aim to assess the prevalence and characteristics of dyslipidemia among juvenile patients diagnosed with end-stage renal disease. The study included a sample of 1.2:1. The prevalence of elevated levels of total blood cholesterol, triglycerides (TG), and low-density lipoprotein (LDL) was determined to be 29.5%, 75.4%, and 16.4% correspondingly.

CKD is a chronic medical illness that is linked to significant morbidity and early mortality because of problems arising from a gradual decline in renal function. The global incidence and prevalence of all phases of CKD in children are steadily rising [7].

This research revealed that 18 patients (29.5%) had high cholesterol levels (>=200), 12 patients (19.7%) had borderline cholesterol levels (170 - 199), and 31 patients (50.8%) had acceptable cholesterol levels (<170). These findings indicate that elevated plasma total cholesterol levels are linked to higher death rates, as documented in the general population.

However, Kwan et al. [8] shown that individuals with low plasma albumin levels also had low plasma total cholesterol levels, which were linked to higher rates of death from any cause. The dichotomous relationship between cardiovascular mortality and plasma total and non-HDL cholesterol levels was validated in the Choices for Healthy Outcomes in Caring for ESRD (CHOICE) study. The study revealed a nonsignificant negative correlation between cardiovascular mortality and these levels in the presence of inflammation and/or malnutrition. Conversely, in the absence of inflammation or malnutrition, a positive correlation was observed between total and non-HDL cholesterol and mortality . Also, in our study, TG had a mean value (± SD) of 187.69 (±79.95) mg/dL., 46 (75.4 %) patients were high 12 (19.7%) patients were borderline, and 3(4.9 %) patients were acceptable .

In addition, Chaudhry et al. [3] conducted a study to assess the occurrence and distribution of dyslipidemia in pediatric patients with end-stage renal disease (ESRD). The study revealed that the prevalence of abnormally elevated levels of total blood cholesterol, triglycerides (TG), and low-density lipoprotein (LDL) was 21.7%, 84.8%, and 19.6% respectively. Most juvenile patients with end-stage renal disease (ESRD) have dyslipidemia, particularly elevated levels of blood triglycerides (TG). Furthermore, the lipid profile of individuals undergoing peritoneal dialysis exhibited greater abnormalities compared to those undergoing hemodialysis.

Corresponding to the present study findings, HDL had a mean value (± SD) of 37.59 (±8.68) mg/dL. 10(16.4 %) patients were acceptable (>45), 11 (18%) patients were borderline (40 - 45), and 40 (65.6 %) patients were high (<40). LDL had a mean value (± SD) of 99.61 (±29.66) mg/dL. 39(63.9 %) patients were acceptable (<110), 12 (19.7%) patients were borderline (110 – 129) and 10 (16.4 %) patients were high.*(130=<)*

In CKD, dyslipidemia is often characterized by hypertriglyceridemia (HTG), reduced high-density lipoprotein cholesterol (HDL-C), fluctuating levels of low-density lipoprotein cholesterol (LDL-C), elevated levels of non-HDL-C, and a rise in tiny dense LDL-C, as identified by Chu et al. [9]. Combined dyslipidemia, as described by De Ferranti et al. [10], is characterized by elevated levels of triglycerides (TG) and low levels of high-density lipoprotein (HDL), together with increasing levels of non-HDL cholesterol. It is now the most prevalent type of dyslipidemia in children .

Florens et al. [11] introduced a noteworthy notion whereby they demonstrated that the carbonylation of high-density lipoprotein (HDL) generated by CKD is accountable for compromised platelet aggregation. This finding further contributes to the development of elevated cardiovascular events within the CKD population.

Elevated levels of TG, VLDL-C, and HDL were found throughout the maintenance hemodialysis period. Singh et al. [12] found that patients with end-stage renal disease (ESRD) who undergo continuous hemodialysis had a higher likelihood of developing dyslipidemia. Dyslipidemia is characterized by elevated levels of triglycerides, high levels of very low-density lipoprotein (VLDL), and reduced levels of high-density lipoprotein (HDL), regardless of gender. The results of the present investigation suggest that the use of prescription cholesterol-lowering medicine to patients with chronic renal failure (CRF) and dyslipidemias may have potential benefits in terms of preventing future cardiovascular events and safeguarding renal function.

In the present study cholesterol/HDL ratio had a mean value (± SD) of 4.8 (±1.28). 7(11.5 %) patients were desirable (<3.4), 29 (47.5%) patients were borderline (3.4 - 5) and 25 (41%) patients were high (>5). Hence, Speer et al. [13] stated that the manufacturing and metabolism of lipoproteins undergo significant alterations in CKD. Nevertheless, the applicability of lipid-lowering medications in clinical trials conducted on the general population to patients with CKD is limited owing to the modified metabolism, structure, and function of lipoproteins in the latter group.

In the present study, there was no correlation between (age, weight, duration of hemodialysis, SBP, DBP, Hb, platelets, WBCs, albumin, urea, creatinine, PTH, Ca, po4, iron, ferritin, Na, K, CRP, ejection fraction, and fractional shortening) and Cholesterol, TG, VLDL, LDL and HDL except for significant positive correlation between Po4 and HDL. The disturbance in phosphate metabolism, either a deficiency or excess of phosphate, may represent a key feature of metabolic syndrome (MetS). In the same context, Baek et al. [14] reported that the incidence rate of dyslipidemia was found to be 61.5%. The adjusted odds ratio was considerably elevated by the presence of nephrotic range proteinuria and 25-hydroxyvitamin D insufficiency in individuals with dyslipidemia. In the analysis, it was shown that glomerulonephropathy, which serves as the etiology of CKD, together with nephrotic range proteinuria, had a significant association with elevated levels of total cholesterol and low-density lipoprotein cholesterol.

Several studies have recently reported new lipid-lowering medicines, including evolocumab, alirocumab, evinacumab, and mipomersen. At present, these medications have received approval for individuals diagnosed with severe familial hypercholesterolemia who are 12 years of age or older. Ongoing trials are being conducted in children to expand their recommended use to additional age groups and populations. Pharmaceutical substances, including Lomitapide, Bempedoic acid, and Inclisiram, are now undergoing assessment and lack substantial empirical substantiation for their efficacy in pediatric populations [15].

Also, Mosca et al. [16] stated that Screening for dyslipidemia in children is based on the assumption that early detection and treatment decrease the likelihood of developing cardiovascular issues in maturity. The efficacy of treatment in juvenile patients has been established by research conducted on children diagnosed with familial hypercholesterolemia, wherein the management of the atherosclerotic process has been successfully proved. Nevertheless, elevated cholesterol levels often stem from many factors in most instances, and the specific impact on the risk of CVD is still uncertain. Hence, the diagnosis and treatment of dyslipidemia in children pose a substantial difficulty. Furthermore, De La Torre et al. [17] shown that CKD and nephrotic syndrome often coexist with dyslipidemia, hence exacerbating illness-related morbidity and elevating the likelihood of early CVD. However, due to the absence of randomized controlled studies in children and the limited availability of long-term clinical outcomes, such as cardiovascular disease-related events and death, the most effective approach to care remains uncertain .

Conversely, Saland et al. [18] discovered a link between dyslipidemia and body mass index. Several lipid alterations occurred over time as a result of an elevated body mass index. When looking at the associations between changes in non-HDL

cholesterol and TG levels and changes in body mass index (BMI), glomerular CKD showed stronger and more negative associations. When comparing changes in lipid levels to changes in glomerular filtration rate (GFR) and proteinuria, there were similar but quantitatively smaller differences between the two forms of CKD.

In this study we determined the prevalence as well as the pattern of dyslipidemia in pediatric patients with ESRD, a study on 61 patients with mean age 9.79(± 3.35) years and male to female ratio 1.2:1. Among the participants, 29.5% had abnormally high total serum cholesterol levels, 75.4% had abnormally high triglyceride levels, and 16.4% had abnormally low-density lipoprotein levels.

Moreover, a study was carried out by Chaudhry et al. [3] on 138 patients, with an average age of 11.24 ± 2.37 years and a male to female ratio of 2.5:1, in order to detect the occurrence and distribution of dyslipidemia in juvenile patients with end-stage renal disease (ESRD). A total of 21.7% of patients had abnormally high total serum cholesterol levels, 84.8% had abnormally high triglyceride levels, and 19.6% had abnormally low density. Elevated blood triglycerides and dyslipidemia were the most common symptoms in pediatric patients with end-stage renal disease. Reducing cardiovascular morbidity and mortality in pediatric patients linked with dyslipidemia can be achieved through timely diagnosis of aberrant lipid levels and proper therapy. In addition, compared to hemodialysis patients, those on peritoneal dialysis had a more abnormal lipid profile.

According to Chu et al. [9], the dyslipidemia pattern observed in chronic kidney disease (CKD) is usually defined by hypertriglyceridemia (HTG), reduced HDL-C, fluctuating LDL-C, increased non-HDL-C, and a rise in LDL-C. Moreover, Ikewaki et al. [19] suggested increased levels of both LDL and IDL due to severely impaired catabolism of these particles. They also suggested that increased particle time in circulation leads to further modifications of apoB that will reduce recognition by LDL receptors causing rising level of LDLs. The reduced catabolism is also masked by decreased production.

Cholesterol/HDL ratio ranged from 2.64 to 9.03 with a mean value (± SD) of 4.8 (±1.28). 7(11.5 %) patients were desirable (<3.4), 29 (47.5%) patients were borderline (3.4 - 5) and 25 (41%) patients were high (>5). Hence Speer et al. [13] stated that atherosclerosis, inflammation, oxidative stress, poor lipid transport, dysfunction of the endothelium, and such altered lipoproteins are all promoted by these lipoprotein modifications.

The development of CV problems associated with chronic kidney disease is thus greatly influenced by lipoproteins. Treatment plans for chronic kidney disease (CKD) patients often include lipid-lowering medications. Because lipoprotein metabolism, shape, and function are different in CKD patients compared to the general population, it is only partially possible to extrapolate outcomes from lipid-lowering therapy clinical trials to these patients.

Limitations of the study included the small sample size. The study was in a single center. This was an cross-sectional observational study. Thus, it was not possible to analyze major risk factors in relation to time changes.

CONCLUSION

The prevalence of dyslipidemia was found to be high among HD patients in Zagazig university hospitals. Comparisons of lipid parameters with CVD risk stratifications need further studies to prove the benefits of these scores in CVD prediction among the dialysis population.

CONFLICTS OF TNTERSET

No potential conflict of interest was reported by the authors.

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