J.Biol. Today's World 2019; 8(8): 208.

Journal of
Biology and Today's World

Research

The Relation between Hyperparathyroidism and Premature Atherosclerosis in Haemodialysis Patients at Minia University Hospital

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Received: 05 October 2019 • Accepted: 15 October 2019

ABSTRACT

Secondary hyperparathyroidism and elevated blood levels of parathyroid hormone (PTH) may play an important role in the pathogenesis of the triglyceridemia of chronic renal failure. A cross-sectional study was carried out at El Minia university hospital dialysis unit. In our study, 189 patients on dialysis and 50 healthy individuals have been included in our study, all of them subjected to full history taking, clinical examination, lipid profile analysis, bone mineral parameters analysis (Ca^{+2}, ph $^{+4}$, PTH, Alp). They were classified into three groups: Group I: Includes 105 patients on dialysis their parathyroid hormone level less than 300 pg/ml, Group II: Includes 84 patients on dialysis their parathyroid hormone level more than 300 pg/ml, Group III: Includes 50 healthy individuals, as a control group. We found that there is highly significant statistical difference between triglycerides level of patients on dialysis and control group ($p<0.001$) and highly significant statistical difference between both groups as regard total cholesterol level($p<0.001$), while comparison of LDL and HDL levels between control group and patient on dialysis showed no significant statistical difference There is significant positive correlation between parathyroid hormone level and triglyceride level in patients of group I ($r=0.438$, $p=0.029$), and between parathyroid hormone level and triglyceride level in patients of group II ($r=0.719$, $p<0.001$). The hyperparathyroidism in haemodialysis patients has an essential role in pathogenesis of premature atherosclerosis in these patients.

Keywords: Parathyroid hormone, Dialysis, Triglycerides, Haemodialysis, Hyperthyroidism.

INTRODUCTION

Background/rationale

CKD disturbs calcium and phosphate homeostasis. The pathogenesis of this disturbance due to decreased renal excretion of phosphate and diminished renal hydroxylation of 25-hydroxyvitamin D to calcitriol [1,2].

Circulating calcitriol levels begin to decrease when the GFR is less than 40 ml/min and are severely reduced in subjects with end-stage kidney disease. Progressive kidney dysfunction results in hyperphosphatemia and calcitriol deficiency. These result in hypocalcaemia. These abnormalities directly increase PTH levels.

Patients with chronic renal failure have a type IV lipoproteinemia [3,4]. They have elevated serum levels of very-low-density, intermediate-density, and low-density lipoprotein. Serum cholesterol levels are usually reasonable, and those of high-density lipoprotein are low [5].

Excess PTH suppresses insulin release from pancreatic islets and the insulin deficiency results in carbohydrate intolerance. Insulin deficiency also causes the decreased synthesis of lipoprotein lipase and hence, abnormal lipid metabolism. Thus, the hyperparathyroidism of chronic renal failure may play a paramount role in the genesis of the abnormal metabolism of both carbohydrates and lipids [6].

Objectives

Study the relation between the hyperparathyroidism in haemodialysis patients and dialysis dyslipidemia in these patients.

METHODS

Study design

A cross-sectional study.

Setting

This study was carried out at El Minia university hospital dialysis unit.

Participants

One hundred eighty-nine patients of ESRD on maintenance haemodialysis treatment were studied. They were 79 males and 110 females. Their mean duration of haemodialysis treatment was 4.455 ± 2.565 years with frequency of three times per week, and each session for haemodialysis treatment lasting for four hours with polysulfone hollow fibre dialyser (F6HPS, Fx5) against a dialysis path containing 32-36 mmol/l of bicarbonate, 0.85 mmol/l of magnesium, 1.50 mmol/l of calcium and 2 mmol/l of potassium. Additionally, ten healthy individuals had no history of chronic illness included in the study.

Exclusion criteria of this study

HCV positive patients, Diabetic patients, Patients known to have dyslipidemia 4-Patients on lipid-lowering drugs, 5-Patients on CCB6-Patients with chronic liver disease.

After they were informed about the study, written consent was obtained. All patients in the study were subjected to the following.

Full history taking with special attention on Age, Gender, History of comorbid conditions, History of drug intake.

Clinical examination

Vital signs, pulse, blood pressure, temperature, respiratory rate; General examination (height, body weight, head and neck examination); Systemic examination (cardiac, chest, abdominal).

Laboratory investigations

Complete blood count. Renal function tests, including blood urea and serum creatinine.

Liver function tests including ALT, AST, Albumin and Bilirubin. Serum Calcium, Phosphorus, Alkaline phosphatase. PTH level, Serum cholesterol, triglyceride, HDL, and LDL.

The variables of Diagnostic criteria are listed in **Table 1**.

Table 1: Diagnostic Criteria

Total cholesterol (mg/dL)	LDL cholesterol (mg/dL)	HDL cholesterol (mg/dL)	Triglyceride (mg/dL)
<200=Desirable	<100=Optimal	<40=Low	<150=Normal
200-239=Borderline high	100-129=Near optimal/above optimal	>60=High	150-199=Borderline high
>240=High	130-159=Borderline high		200-499=High
	160-189=High		>500=Very high
	>190=Very high		

DATA SOURCES/MEASUREMENT

Parathyroid hormone

***Principles of the method*:** The serum levels of Intact parathyroid hormone (iPTH) were measured with two-site sandwich immunoradiometric assay (IRMA) utilizing a polyclonal 1-84 PTH antibody with a tendency to bind in the N terminal region of 1-84 PTH (Label Antibody), and a polyclonal 1-84 PTH antibody with a tendency to bind in the C terminal region of 1-84 PTH (Capture Antibody). The use of these antibodies guarantees that Whole PTH (1-84 PTH) and truncated PTH fragments are detected. The Label Antibody is labelled with ^{125}I. The Capture Antibody is fixed to the tubes. The Total Intact PTH in patient samples is bound both to the tubes and the Label Antibody. After incubation free ^{125}I antibodies and bound ^{125}I antibody, fractions are separated by discarding the supernatant. Simple wash steps reduce the non-specific binding (NSB) to a minimum for increased precision at the low end of the calibration curve. The concentration of Total Intact PTH is directly proportional to the radioactivity bound to the tubes after separation. The concentration of PTH in unknown patient samples and controls is determined by interpolation using a calibration curve. The sensitivity of this test was 2 ng/L and meant inter and intra- assay coefficients of variation (CV) were 7.1% and 1.1% respectively [7].

Specimen collection and preparation

Blood samples should be promptly separated from the blood cells.

Serum and plasma must be kept at 2°C-8°C.

If the test is not run within 8 hours, storage in aliquots at -20°C is recommended. Avoid subsequent freeze-thaw cycles.

Prior to use, all samples should be at room temperature. It is recommended to vortex the samples before use.

It is advisable to assay serum samples.

Do not use haemolysed samples [8].

Assay procedure

Pipette 0.2 mL of calibrators, samples, and controls into the corresponding tubes.

Pipette 0.1 ml of Total Intact PTH Tracer into each tube.

Gently vortex all tubes.

Seal the tubes and incubate them for 18-24 h at room temperature (18°C-25°C).

Aspirate the supernatant from each tube except for the total count tubes. Wash the tubes three times with 2 ml of diluted wash solution. After each addition of a diluted wash solution aspirate all of the wash solution.

Count each tube for at least 1 minute in a gamma counter calibrated to detect ^{125}I [9].

Bias

We tried to avoid bias with. Qualitative data analysis, by using multiple people to code the data, and we reviewed findings with peers.

Study size

In our study, 189 patients on dialysis and 50 healthy individuals were included. They were classified into three groups.

***Group I*:** Includes 105 patients on dialysis their parathyroid hormone level<300 pg/ml.

***Group II*:** Includes 84 patients on dialysis their parathyroid hormone level>300 pg/ml.

***Group III*:** Includes 50 healthy individuals, as a control group.

Quantitative variables

Description of quantitative variables as mean, SD.

Description of qualitative variables as number and percentage.

Statistical methods

Analysis of data was done by IBM computer using SPSS v16.

Independent sample t-test was used to compare quantitative variables in parametric data (SD<50% mean).

Chi-square test was used to compare two groups as regard qualitative variables.

Analysis of variance test (ANOVA) was used to compare the multinomial parameter as regard quantitative data.

Multivariate linear regression analysis was done.

p value>0.05 insignificant

p<0.05 significant

p<0.01 highly significant

RESULTS

Participants

In our study, 189 patients on dialysis and 50 healthy individuals were included. They were classified into three groups.

***Group I*:** Includes 105 patients on dialysis their parathyroid hormone level less than 300 pg/ml.

***Group II*:** Includes 84 patients on dialysis their parathyroid hormone level more than 300 pg/ml.

***Group III*:** Includes 50 healthy individuals, as a control group.°C

Descriptive data

They were 37(36%) males and 68(64%) females in group I, 42(50%) males and 42(50%) females in group II, and 30(60%) males and 20(40%) females in control group with no statistically significant difference between all groups **(Table 2).**

Their mean age was 45.64 years for the group I, and 48.75 years for group II, and 40.9 years for the control group with no statistically significant difference between all groups **(Table 2).**

Table 2: Demographic characteristics of patients on dialysis with PTH<300 (group i), patients on dialysis with PTH>300 (group ii), and control group (group iii).

	Group I	Group II	Group III	p value		
	PTH<300	PTH>300	Control			
	N=105	N=84	N=50			
Age:	(20-67) 45.64 ± 14.08	(28-70) 48.75 ± 14.11	(36-45) 40.9 ± 3.14	0.296		
(rang) M ± SD				I vs. II	I vs. III	II vs. III
				0.425	0.33	0.122
Sex:				0.374		
Male.	9 (36%)	10 (50%)	6 (60%)	I vs. II	I vs. III	II vs. III
Female	16 (64%)	10 (50%)	4 (40%)	0.379	0.266	0.709

The mean BMI of group I was 25.1 ± 2.973, while 23.45 ± 1.31 for group II with a highly significant statistical difference (p=0.016) **(Table 3).**

Table 3: Comparative study of body mass index between patients on dialysis with PTH<300 (group i), patients on dialysis with PTH>300 (group ii)

	Group I PTH<300 N=105	Group II PTH>300 N=84	
BMI: (Kg/m2) **(rang)** **M ± SD**	(17.94-32.39) 25.13 ± 2.97	(21.35-25.25) 23.45 ± 1.31	0.016*

Outcome data

There was a highly significant statistical difference as regard duration of dialysis, between patients of group I and group II (p<0.001) as the mean duration was 2.76 ± 1.96 years for the group I and 6.25 ± 3.17 years for group II **(Table 4).**

Table 4: Comparative study of duration of dialysis between patients on dialysis with PTH<300 (group i), patients on dialysis with PTH>300 (group ii).

	Group I PTH<300 N=105	Group II PTH>300 N=84	p value
Duration of dialysis: **(rang)**	(1-8)	(2-15)	<0.001*
M ± SD	2.76 ± 1.96	6.25 ± 3.17	

The three groups were compared as regard bone mineral parameters: PTH level, alkaline phosphatase level, serum calcium, and phosphorus levels, and revealed that;

- The PTH level was 186.76 ± 43.87 for group I, 512.1 ± 241 for group II, and 34.8 ± 6.1 for group III with a highly significant statistical difference in PTH level between group I and II (p<0.001) and between-group II and III (p<0.001) and between group I and III (p<0.001), also significant statistical difference between the three groups (p<0.001) **(Table 5).**

-Alkaline phosphatase level was 122.04 ± 17.57 in group I, 165.95 ± 23.59 for group II, and 69.3 ± 8.78 for group III with a highly significant statistical difference between group I and II (p<0.001) and between-group II and III (p<0.001) and between-group I and III (p<0.001), also a highly significant statistical difference between the three groups (p<0.001)**.**

Serum calcium level was 8.33 ± 0.17 in group I, 7.99 ± 0.55 in group II and 9.9 ± 0.33 in group III with a highly significant statistical difference between group I and II (p<0.001) and between group I and III (p<0.001) and significant statistical difference between group II and III (p=0.005), also a highly significant statistical difference between the three groups (p<0.001).

No significant statistical difference was found when comparing serum phosphorus between patients of group I and group II (p=0.974), group I and group III (p=0.052), group II and group-III (p=0.057), and between the three groups (p=0.111) **(Table 5).**

Lipid profile parameters were compared between patients on dialysis and control group (group III) and revealed that:

Table 5: Comparative study of parathyroid hormone level (PTH), alkaline phosphatase level (alp), serum calcium level, and serum phosphorus level between patients on dialysis with PTH<300 (group i), patients on dialysis with PTH>300 (group ii), and control group.

	Group I PTH<300 N=105	Group II PTH>300 N=84	Group III Control N=50	p value		
PTH: **(rang)** **M ± SD**	(117-271) 186.76 ± 43.87	(304-1131) 512.1 ± 241.3	(26-44) 34.8 ± 6.1	<0.001*		
				I vs. II	I vs. III	II vs. III
				<0.001*	<0.001*	<0.001*
ALP: **(rang)** **M ± SD**	(82-148) 122.04 ± 17.57	(118-198) 165.95 ± 23.59	(55-86) 69.30 ± 8.78	<0.001*		
				I vs. II	I vs. III	II vs. III
				<0.001*	<0.001*	<0.001*
Ca2+:	(8.1-8.6)	(7-8.6)	(9.3-10.3)	<0.001*		

(rang)				I vs. II	I vs. III	II vs. III
M ± SD	8.33 ± 0.17	7.99 ± 0.55	9.9 ± 0.33	<0.001*	<0.001*	<0.001*
				0.111		
Ph:				I vs. II	I vs.III	II vs. III
(rang)	(5-6.8)	(5-6.8)	(4.1-5.9)			
M ± SD	5.62 ± 0.44	5.63 ± 0.56	5.24 ± 0.55	0.974	0.052	0.057

Main results

There is highly significant statistical difference between triglyceride level of both groups (p<0.001) as the mean value of triglyceride was 177.29 ± 56.49 for patients on dialysis and 122.2 ± 6.77 in control group, and a highly significant statistical difference between both groups as regard total cholesterol level which was 231.33 ± 21.89 for patients on dialysis and 177.7 ± 4.92 for control group, while comparison of LDL level between control group and patients on dialysis showed no significant statistical difference(p=0.324), and no significant statistical difference between HDL level of both groups (p=0.516) **(Table 6).**

Table 6: Comparative study of lipid profile parameters between patients on dialysis and control group.

	Patients on dialysis N=105	**Control group N=50**	**p value**
TG :			
(rang)	(110-315)	(112-132)	
M ± SD	177.29 ± 56.49	122.2 ± 6.77	<0.001*
TC:			
(rang)	(193-295)	(172-186)	
M ± SD	231.33 ± 21.89	177.7 ± 4.92	<0.001*
LDL :			
(rang)	(95-175)	(42-64)	
M ± SD	86.42 ± 5.55	84.6 ± 3.31	0.324
HDL:			
(rang)	(32-50)	(65-80)	
M ± SD	50.27 ± 3.42	49.5 ± 3.03	0.516

Other analysis

Comparison of lipid profile parameters between group I and group II showed that the mean value of triglyceride level was 152.6 ± 42.56 for group I and 208.15 ± 57.41 for group II with a highly significant statistical difference between both groups (p=0.001) **(Table 6)**, and the mean value of total cholesterol was 225.24 ± 19.20 for patients of group I and 238.95 ± 23.11 for patients of group II with significant statistical difference between both groups (p=0.035), while no significant statistical difference was found between LDL(p=0.321) and HDL levels (p=0.312) of both groups **(Table 7).**

Table 7: Comparative study of lipid profile parameters between patients on dialysis with PTH<300 (group i), patients on dialysis with PTH>300 (group ii).

	Group I PTH<300 N=105	**Group II PTH>300 N=84**	**p value**
TG :			
(rang)	(118-235)	(110-315)	0.001*
M ± SD	152.6 ± 42.56	208.15 ± 57.41	
TC:			
(rang)	(193-251)	(198-295)	0.035*
M ± SD	225.24 ± 19.20	238.95 ± 23.11	
LDL:	(75-95)	(80-95)	
(rang)	85.68 ± 6.06	87.35 ± 4.82	0.321

M ± SD			
HDL: **(rang)** **M ± SD**	(45-55) 49.8 ± 3.57	(45-56) 50.85 ± 3.22	0.312

The correlation between Parathyroid Hormone level and other parameters are listed in **Tables 8 and 9.**

Table 8: Correlation between parathyroid hormone level and triglyceride level, total cholesterol level, low-density lipoprotein level, high-density lipoprotein level, alkaline phosphatase level, serum calcium level, body mass index and duration of dialysis with PTH<300.

PTH with	**Group I** **PTH<300** **N=105**	
	R	P
TG	0.438	0.029*
TC	0.497	0.011*
LDL	-0.038	0.855
HDL	0.001	0.996
ALP	0.553	0.004*
Ca2+	-0.443	0.027*
BMI	-0.416	0.039*
Dialysis duration	0.754	<0.001*

Table 9: Correlation between parathyroid hormone level and triglyceride level, total cholesterol level, low-density lipoprotein level, high-density lipoprotein level, alkaline phosphatase level, serum calcium level, body mass index and duration of dialysis in on dialysis with PTH>300 (group ii).

PTH with	**Group I** **PTH<300** **N=105**	
	R	P
TG	0.438	0.029*
TC	0.497	0.011*
LDL	-0.038	0.855
HDL	0.001	0.996
ALP	0.553	0.004*
Ca2+	-0.443	0.027*
BMI	-0.416	0.039*
Dialysis duration	0.754	<0.001*

DISCUSSION

Key results

Chronic renal failure is associated with premature atherosclerosis and increased incidence of cardiovascular morbidity and mortality [10].

We designed this study to assess the relationship between PTH and dyslipidemia in haemodialysis patients.

For this purpose, 45 patients on dialysis and ten healthy individuals were included; they were classified into three groups. We exclude secondary causes of dyslipidemia as diabetic patients, as diabetes has other effects on the lipid parameters, and this is in agreement with the study of Bricker NS [11].

The classification of the patients into group I and group II based on the level 300 pg/ml of PTH was in agreement with Ahmadi et al. [3] who studied 51 patients on haemodialysis and classify them according to the level 300 pg/ml of into 2

groups and Zanos, et al. who studied 108 non diabetic patients on haemodialysis and classified them according to the level 300 pg/ml of PTH. Also, the level 300 pg/ml was suitable in our study as it provide two comparable groups of nearly equal numbers of patients.

Our patients were 37 (36%) males and 68 (64%) females in group I, and 42 (50%) males and 42 (50%) females in group II, and 30 (60%) males and 20 (40%) females in control group with no statistically significant difference between all groups (p=0.374).

Their mean age was 45.64 years for the group I, 48.75 years for group II, and 40.9 years for the control group with no statistically significant difference between all groups (p=0.296).

The mean BMI of group I was 25.1 ± 2.973, while 23.45 ± 1.31 for group II with highly significant statistical difference (p=0.016), and there was significant negative correlation between PTH level and BMI in patients of group I (r=-0.416, p=0.039), also significant negative correlation was present between PTH level and BMI in patients of group II (r=-0.721, p<0.001). This is in agreement with Ahmadi et al. [3] who reported significant negative correlation between PTH level and BMI (r=-0.362, p=0.009), and in agreement with Canalejo et al. [12] who reported that 48% of patients on haemodialysis had BMI<18.5 kg/m^2; according to WHO guidelines for adults in 1995 this low BMI could be explained by increased prevalence of malnutrition in our haemodialysis patients. As the progression of haemodialysis, malnutrition becomes more evident, and body mass index gets lower, and this conversely correlates with the increase of PTH level.

As regard duration of dialysis, there was highly significant statistical difference between patients of group I and group II (p<0.001) as the mean duration was 2.76 ± 1.96 years for group I and 6.25 ± 3.17 years for group II, and there was high positive significant correlation between parathyroid hormone level and duration of dialysis in group I (r=0.754, p<0.001), also significant positive correlation was present between parathyroid hormone level and duration of dialysis in patients of group II (r=0.675, p=0.001). This is in agreement with Rodriguez et al. [13] who stated that PTH level positively correlated with the duration of dialysis (r=0.53, p<0.05), and with Ahmadi et al. [3] who reported a significant positive correlation between PTH level and duration of dialysis (r=0.408, p=0.003).

As regard comparison of bone mineral parameters between patients of group I, II and III;

The PTH level was 186.76 ± 43.87 for group I, 512.1 ± 241 for group II, and 34.8 ± 6.1 for group III with a highly significant statistical difference in PTH level between group I and II (p<0.001) and between-group II and III (p<0.001) and between group I and III (p<0.001), also significant statistical difference between the three groups (p<0.001), providing valuable comparison between the three groups.

Alkaline phosphatase level was 122.04 ± 17.57 in group I, 165.95 ± 23.59 for group II, and 69.30 ± 8.78 for group III with a highly statistically significant difference between group I and II (p<0.001) and between-group II and III (p<0.001) and between group I and III (p<0.001), also a highly significant statistical difference between the three groups (p<0.001), and there was significant positive correlation between parathyroid hormone level and alkaline phosphatase level (r=0.553, p=0.004) in patients of group I, also there was significant positive correlation between parathyroid hormone level and alkaline phosphatase level (r=0.782, p=<0.001) in patients of group II. This in accordance with the study of Verschoren et al. [14] which showed that there was a significant positive correlation between PTH level and alkaline phosphatase level in haemodialysis patients, and with Ahmadi et al. [3] who reported a significant positive correlation between PTH level and alkaline phosphatase level (r=0.333, p=0.017).

This correlation could be explained by the fact that; In CKD, a high bone turnover condition occurs due to excess PTH which bind to its receptors on osteoblasts and osteocytes stimulating their proliferation and production of several non-collagenous proteins as osteocalcin and alkaline phosphatase (16).

Serum calcium level was 8.33 ± 0.17 in group I , 7.99 ± 0.55 in group II and 9.9 ± 0.33 in group III with a highly significant statistical difference between group I and II (p<0.001) and between group I and III (p<0.001) and significant statistical difference between group II and III (p=0.005), also a highly significant statistical difference between the three groups(p<0.001), negative significant correlation between PTH level and serum calcium level in patients of group I and group II as (r=-0.443, p=0.027) in group I, and (r =-0.566, p=0.009) for group II. This is in accordance with Ahmadi et al. [3], who reported a significant negative correlation between PTH level and serum calcium level (r=-0.294, p=0.037).

This could be explained that phosphate retention, as a result of reductions in GFR, would cause transient decreases in the levels of ionized calcium, which would, in turn, trigger an increase in PTH secretion and a new steady-state would be achieved [15,16].

No significant statistical difference was found in comparing of serum phosphorus between patients of group I and group II (P=0.974), group I and group III (P=0.052), group II and group-III (P=0.057), and between the three groups (p=0.111) and this is in agreement with the study of Ahmadi, et al. [3] who reported that there was no statistically significant difference between phosphorus levels of both groups (p=0.6).

Lipid profile parameters were compared between patients on dialysis and control group and revealed that:

There is a highly significant statistical difference between the triglyceride level of both groups as the mean value of triglyceride was 177.29 ± 56.49 for patients on dialysis and 122.2 ± 6.77 in the control group. This is in agreement with the study of Brown et al. [15] which reported hypertriglyceridemia in 31% of patients on haemodialysis and with the experimental study of Kurokawa [16] in which the CRF rats had significantly higher TG level compared to control group (99.72 ± 3.57 *vs.* 45.85 ± 18.30, p<0.05).

This significant difference is explained by the fact that LPL activity is reduced as several studies have demonstrated a marked reduction in plasma post heparin lipolytic activity in

ESRD patients [9,10] CRF results in marked down regulation of hepatic lipase expression and activity [11], also VLDL receptor mRNA and protein abundance in adipose tissue, skeletal muscle, and myocardium are severely reduced in CRF animals [16].

LIMITATIONS

Our limitations in this study are the number and the cost of investigating the coronaries of these patients for atheroma.

CONCLUSION

In our study, 189 patients on dialysis treated in El Minia university hospital dialysis unit, and 50 healthy individuals have been included in our study, all of them subjected to full history taking, clinical examination, lipid profile analysis, bone mineral parameters analysis (Ca+2, ph+4, PTH, Alp).

They were classified into three groups:

Group I: Includes 105 patients on dialysis their parathyroid hormone level<300 pg/ml,

Group II: Includes 84 patients on dialysis their parathyroid hormone level>300 pg/ml,

Group III: Includes 50 healthy individuals, as a control group.

We found that there is highly significant statistical difference between triglyceride level of patients on dialysis and control group ($p<0.001$) and highly significant statistical difference between both groups as regard total cholesterol level ($p<0.001$), while comparison of LDL and HDL levels between control group and patient on dialysis showed no significant statistical difference.

There is a significant positive correlation between parathyroid hormone level and triglyceride level in patients of group I ($r=0.438$, $p=0.029$), and between parathyroid hormone level and triglyceride level in patients of group II ($r=0.719$, $p<0.001$).

However, still, there are some limitations as the number of participants and no available fund for investigations of coronary atherosclerosis.

TRANSLATIONAL STATEMENT

This study may help the patients and clinicians of haemodialysis in the future to assess the atherosclerosis and coronary artery disease, when they investigate the routine calcium, phosphorous and PTH.

In the future, I hope for new criteria which depend on PTH and lipid profile for prophylactic therapy for dialysis dyslipidaemia.

GENERALIZABILITY

Our external validity of this study we recommend to investigate the lipid profile of all haemodialysis patients who have abnormal parathyroid hormone and also assess the risk of ischemia and atherosclerosis.

DISCLOSURE

I do not have any kind of financial support (funding, grants and sponsorship).
I do not have any commercial or financial relationship.
I have not signed any agreement with any one that will bias the results of my research in any way.

ACKNOWLEDGMENTS

I would like to express my special thanks of gratitude to my teacher (Sabry Gohr) who gave me the golden opportunity to do this wonderful research on the topic (The relation between hyperparathyroidism and premature atherosclerosis in haemodialysis patients at Minia University).

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