VER
Vascular & Endovascular Review

Role Of Pentraxin 3 And Doppler Ultrasound in Assessing the Severity of Endothelial Dysfunction in Patients on Regular Hemodialysis in Comparison with Chronic Kidney Disease Patients Stage 5 Not on Renal Replacement Therapy

Heba M. Ibrahim[*1], Mohamed M. Elkhatib[2], Amr Shaker[3], Basma Abd El-Aziem Zaghloul[4], Tarek R. Abd El-Aziem[5], Karim K. Thabt[6]

1. Internal Medicine Department, Vascular Medicine Subdivision, Faculty of Medicine, Cairo University, Egypt.
2. Internal Medicine Department, Nephrology Subdivision, Faculty of Medicine, Cairo University, Egypt.
3. Internal Medicine Department, Nephrology Subdivision, Faculty of Medicine, Cairo University, Egypt.
4. Internal Medicine Department, Nephrology Subdivision, Faculty of Medicine, Cairo University, Egypt.
5. Clinical And Chemical Pathology Department, Faculty of Medicine, Cairo University, Egypt.
6. Internal Medicine Department, Nephrology Subdivision, Faculty of Medicine, Cairo University, Egypt.

***Corresponding Author: Heba M. Ibrahim**
E-mail: drbebo88@gmail.com

ABSTRACT

Background: One of the main causes of the pro-inflammatory condition is endothelial dysfunction (ED), causing subclinical atherosclerosis and cardiovascular disease, which is the most common reason of death for those with end-stage renal illness. Pentraxin3 (PTX3) is an interesting indicator of vascular inflammation in addition to measuring Flow mediated dilatation (FMD)of brachial artery %, its flow volume as novel measurement of FMD and carotid intima media thickness (CIMT) are noninvasive techniques in assessing endothelial dysfunction.

Methods: cross-sectional study with 150 individuals overall, classified into 3 groups: 50 individuals for each group: i) Control group ii) chronic kidney disease CKD group (stage 5 not on renal replacement therapy); and iii) Dialysis group. All of them were subjected to clinical assessment, laboratory measurements of lipid profile, calcium, phosphorus, PTH and serum PTX3. Using Doppler ultrasonography, CIMT, FMD%, and volume flow were evaluated.

Results: PTX3 level and CIMT was substantially greater in CKD and dialysis cases in contrast to controls; its level is higher in CKD in contrast to dialysis cases with p <0.001.while The FMD% was significantly lower; ROC curve and its area under curve showed that PTX3, FMD% had a high sensitivity (82% and 80% respectively) and high specificity (75%, and 85%respectively)

Conclusion: High levels of PTX3, low FMD%, and increased CIMT have a crucial function in assessing endothelial dysfunction in CKD and dialysis cases. Furthermore, we hypothesized that dialysis may improve the endothelial dysfunction, which is confirmed by higher PTX3 and lower FMD% in CKD compared to dialysis patients.

KEYWORDS: Endothelial dysfunction, CKD, Hemodialysis patients, PTX3, FMD, and CIMT.

How to Cite: Heba M. Ibrahim, Mohamed M. Elkhatib, Amr Shaker, Basma Abd El-Aziem Zaghloul, Tarek R. Abd El-Aziem, Karim K. Thabt, (2025). Role of Pentraxin 3 And Doppler Ultrasound in Assessing the Severity of Endothelial Dysfunction in Patients on Regular Hemodialysis in Comparison with Chronic Kidney Disease Patients Stage 5 Not on Renal Replacement Therapy, Vascular and Endovascular Review, Vol.8, No.13s, 71-80.

INTRODUCTION

One of the earliest main causes of atherosclerosis is endothelial dysfunction (ED) and its assessment has a crucial role and predictor in assessing cardiovascular risk, particularly in the CKD population. [1]

Reduced endothelium-dependent vasodilatation as a result of decreased NO synthesis or insufficient NO role in the vascular tissue are the hallmarks of endothelial dysfunction. [2]. ED is evaluated by multiple noninvasive procedures include: FMD assessment by doppler ultrasonography in the brachial artery [1] laser Doppler flowmetry to evaluate blood flow oscillations linked to vasomotion and digital volume plethysmography also used to assess the volume flow [3-4]. Doppler ultrasonography assess blood flow volume in the brachial artery as the same technique of FMD. Prior research employed brachial artery flow volume as a major predictor of AV fistula maturation. [5]

In reaction to cytokine stimuli (interleukin-1, TNF-α), neutrophils and vascular wall cells release pentraxin-3 (PTX3), an acute phase protein. It is regarded as a new predictive indicator for endothelial dysfunction in ESRD cases as well as a developing biomarker of both acute and chronic inflammation; additionally, it predicts their negative consequences. [6-7]

PTX3 could be involved in the innate immunity. [8] and it is suggested that both the innate and acquired immune systems contribute to atherosclerosis and, consequently, cardiovascular risk. [9]

A substituting marker for subclinical atherosclerosis was CIMT. Indicators of cardiovascular diseases in everyone include elevated CIMT in the carotid arteries. [10]

The study's objective was to compare people on hemodialysis to those with stage 5 chronic kidney disease who are not receiving renal replacement treatment in order to assess the importance of serum PTX 3, FMD%, and CIMT in detecting endothelial dysfunction.

PATIENT AND METHODS

This work was carried out between December 2022 to September 2024 in Kasr AlAiny Hospitals at Cairo University that included 150 participants; they clasified into 3 groups: -50 patients for each group. Group 1 healthy control participant. Group 2 stage 5 chronic kidney disease not on renal replacement therapy and Group 3 on regular hemodialysis

A written informed consent obtained from all subjects. - Full history taking (duration and cause of chronic kidney disease, duration of hemodialysis, associated diseases, any regular medication). - Clinical examination and assessment of Body mass index (BMI) The study Included patients on regular hemodialysis for at least one year (3 times per week with high flux dialyzer) and patients of chronic kidney disease not on renal replacement therapy, stage 5 (estimated GFR less than 15 ml /min, and was calculated by CKD EPI) of both sex within age 30-60 years, but excluded diabetic patients , heart failure , liver cell failure and septic patients , patients with history autoimmune diseases or Malignancy.

Biochemical analyses:

Laboratory work up including creatinine, calcium, phosphorus, PTH and lipid profile (triglycerides, total cholesterol, and LDL-C) were obtained. Estimated GFR less than 15 ml /min and was calculated by CKD EPI. The Kt/V is (K is the dialyzer's urea clearance rate (usually in mL/min or L/hour), it is the duration of the dialysis treatment (usually in minutes or hours), and V is the urea distribution volume in the body (usually in mL or L)). The formula $KtV = In (R - 0.008 \times t) + (4 - 3.5 \times R) \times 0.55$ UF/V can be used to compute it from the predialysis to postdialysis urea nitrogen ratio (R), weight loss (UF), session length in hours (t), and anthropometric or modeled volume (V). [14] The fractional decrease in urea concentration during the course of one hemodialysis session is known as the urea reduction ratio (URR): URR is equal to (Predialysis BUN minus Postdialysis BUN)/Predialysis BUN.[15] Moreover, serum level of PTX3 was measured by ELISA. The sample was taken prior to dialysis session.

Measurement of Flow mediated dilatation:

Detection of the brachial artery using Philips ultrasonography with a linear transducer of (frequency L9-12MHz). It was performed by single operator. The measurements performed prior to the dialysis session because blood volume can affect FMD and volume flow measurements after dialysissession.

Test precautions:

The patient should refrain from exercising for more than 24 hours prior to the study, cease smoking for at least 6 hours, and stop taking any vasoactive medications at least 12 hours earlier. The measurements were performed before the patients took their antihypertensive medications, especially calcium channel blockers.

Technique:

The participant is positioned supine in a quiet room with a consistent temperature after fasting for at least six hours. His hand is placed in a comfortable posture and should stay there for at least one minute. At rest, the brachial artery's diameter was first evaluated. The pulse wave Doppler was used to automatically determine the average blood volume flow cc/min. Following the measurement of the brachial artery's base diameter, a cuff balloon was inflated at a pressure 50 mmHg greater than the systolic blood pressure in order to obstruct the brachial artery and create an ischemia environment. When the tourniquet was removed after three minutes, the endothelium's produced nitric oxide caused the brachial artery to dilate, increasing the volume of blood flow to the forearm. By examining the pulse Doppler signal inside the artery immediately following cuff release, one minute later, and two minutes later—the peak hyperemia flow—the maximum diameter of the brachial artery and its maximum blood flow rate were found. FMD%=Peak diameter- Basline diameter/Basline diameter. Moreover, blood volume flow percentage variation from the the baseline to the peak volume flow calculated= Peak volume flow - Basline volume flow /Basline volume flow. [1]

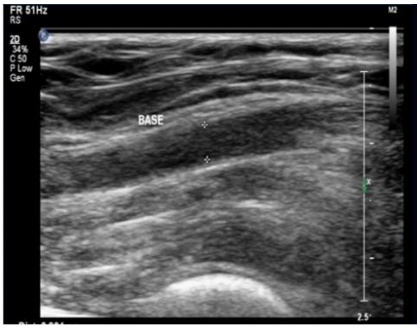

Fig 1 Brachial artery diameter

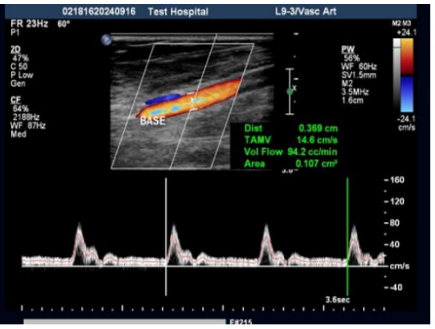

Fig 2 Brachial artery volume flow

Measurement of carotid intima media thickness (CIMT):

The common carotid artery (CCA) longitudinal slice was used for the evaluation. IMT identified at a point about 10 mm below the carotid bifurcation and the distal end of the CCA. In order to draw a line from the intima to the media interface, the patient was lying down with their neck extended and their head slightly tilted in the opposite direction of the carotid artery. This was done at the anterior wall, along an axis perpendicular to the artery. The following formula will be used to determine the averaged CIMT of the maximum value on both sides: CIMT is equal to (left CIMT + right CIMT)/2. Taking into account that CIMT values in the normal range fall between 0.5 and 0.8 mm. According to the European Society of Cardiology (ESC) guidelines, a cutoff value of 0.9 mm is used. [16]

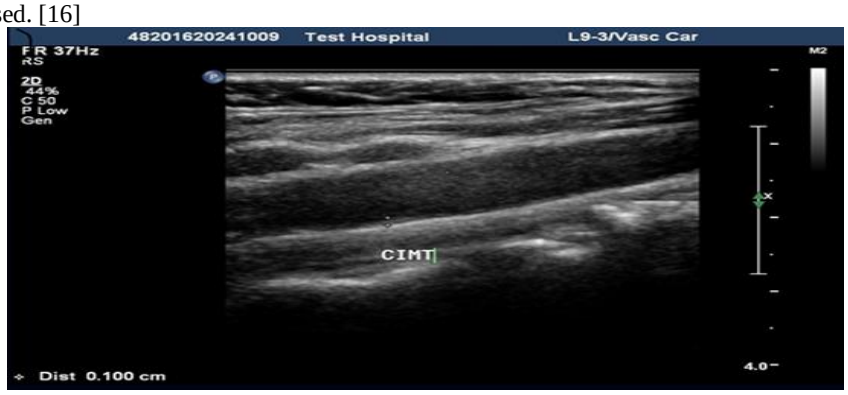

Fig 3. carotid intima media thickness (CIMT)

Statistical analysis:

All statistical computations were performed using the SPSS (Statistical Package for the Social Sciences, version 26.0) program. The findings are presented as medians (range), means, standard deviations (SD), frequencies, and percentages. The distribution properties of continuous variables were ascertained using the Kolmogorov-Smirnov test. ANOVA and the post-hoc Tukey test (for a normal distribution), the Kruskal Wallis test and the Mann Whitney U test (for parameters that deviate from the norm), and Pearson Chi-Square (for qualitative data) were used to examine group differences. The correlation between parameters determined by Pearson correlation and expressed by line charts. To ascertain their capacity to distinguish between the three groups, the receiver operating characteristic (ROC) curve and its area under the ROC curve (AUC) were also evaluated for PTX3, CIMT, FMD, and rising volume flow percentage. A P value of less than 0.005 was considered to be statistically significant.

RESULTS:

Table 1 presents the demographic, clinical data and biochemical parameters of our patients

		Group I Control (50)	Group II CKD (50)	Group III Dialysis (50)	P-value
Sex N (%)	Male	25 (50%)	24 (48.0%)	27 (54.0%)	0.830*
	Female	25 (50%)	26 (52.0%)	23 (46.0%)	
Age	Mean ±SD	44.28±12.72	43.40±14.16	43.86±13.19	0.938**
	Median (range)	42.5 (19.0-64.0)	43.0 (19.0-65.0)	45.5 (19.0-64.0)	
Duration (months)	Mean ±SD	--	26.90± 25.86	**76.02±49.74**	<0.001**
	Median (range)	--	13.0 (4.0-120.0)	60.0 (12.0-240.0)	
BMI (kg/m^2)	Mean ±SD	23.55±3.20	23.89± 3.26	23.92±3.55	0.860**
	Median (range)	23.7 (19.1-29.5)	23.2 (18.9-29.1)	23.9 (18.2-29.5)	
Calcium (mg/dl)	Mean ±SD	9.30±0.58	7.56± 1.14 #(P<0.001)	8.31± 0.88 #(P<0.001) @(P=0.001)	<0.001**
	Median (range)	9.3 (8.5-10.4)	7.5 (5.5-10.0)	8.3 (6.6-10.3)	
Phosphorus (mg/dl)	Mean ±SD	3.55±0.65	5.10±1.08 #(P<0.001)	4.14±1.40 #(p=0.05) @(P<0.001)	<0.001**
	Median (range)	3.7 (2.5-4.6)	5.1 (3.0-6.9)	4.0 (1.5-7.6)	
PTH (pg/dl)	Mean ±SD	36.63±12.07	347.70±126.31 #(P<0.001)	343.54±124.55 #(P<0.001)	<0.001**
	Median (range)	36.6 (16.7-61.0)	335.5 (126.0-591.0)	330.8 (157.0-588.3)	
Cholesterol (mg/dl)	Mean ±SD	120.58±36.96	160.50±41.88 #(P<0.001)	147.84±44.37 #(P=0.001)	<0.001**
	Median (range)	103.5 (83.0-200.0)	161.5 (93.0-247.0)	146.5 (87.0-245.0)	
TGs (mg/dl)	Mean ±SD	100.02±27.45	119.10±25.35 #(P<0.001)	126.60±31.90 #(P<0.001)	<0.001**
	Median (range)	94.5 (14.0-146.0)	115.5 (66.0-173.0)	126.5 (79.0-203.0)	

LDL (mg/dl)	Mean ±SD	70.42±24.05	95.61±36.83 #(P<0.001)	89.88±36.25 #(P<0.014)	0.002**
	Median (range)	60.0 (43.0-113.0)	94.5 (14.0-165.0)	91.0 (40.0-159.0)	
PTX3 (pg/ml)	Mean ±SD	9.54±2.51	37.49±18.93 #(P<0.001)	23.01±11.55 #(P<0.001) @(P<0.001)	<0.001**
	Median (range)	9.2 (6.2-14.9)	31.9 (10.6-80.8)	19.2 (7.5-52.1)	
CIMT (mm)	Mean ±SD	0.61±0.06	0.81±0.21 #(P<0.001)	0.80±0.16 #(P<0.001)	<0.001**
	Median (range)	0.6 (0.5-0.7)	0.8 (0.5-1.2)	0.8 (0.5-1.2)	
FMD %	Mean ±SD	16.41±3.03	7.97±3.53 #(P<0.001)	12.02±3.89 #(P<0.001) @(P<0.001)	<0.001**
	Median (range)	16.4 (10.3-22.9)	8.5 (1.4-14.6)	12.6 (3.5-18.0)	
volume flow%	Mean ±SD	90.54±6.59	33.91±20.80 #(P<0.001)	52.72±21.52 #(P<0.001) @(P<0.001)	<0.001**
	Median (range)	91.4 (80.1-104.2)	31.7 (3.3-79.6)	52.4 (14.6-96.3)	

SD: standard deviation
* Pearson Chi-Square **Kruskal Wallis Test

statistically significant difference in contrast to the corresponding results of control group (P<0.05).
Table 1 presents the demographic, clinical data and biochemical parameters of our cases. LDL, cholesterol, and triglyceride show a statistically substantial variation between the two groups of cases in contrast to the control group. It additionally shows that calcium was significantly lower, phosphorus and PTH were significantly greater in two groups of cases in contrast to the control. Serum PTX3 levels were substantially greater in both groups of patients in contrast to controls so it highlights the role of PTX3 as crucial proinflammatory marker. Moreover, its levels were substantially greater in CKD than in dialysis group with. FMD% and volume flow percentage (%) were significantly lower in the two groups of cases in contrast to controls, indicating their role as a non-invasive approach for assessment of the endothelial role in our groups of patients. Furthermore, they were lower in CKD cases in contrast to dialysis group. CIMT substantially elevated in the two case groups in contrast to control group with p value <0.001.

Table 2. The correlations between serum PTX3 levels, FMD% , volume flow % , CIMT and all demographic

Correlations	PTX3 (pg/ml)		FMD %		flow volume %		CIMT (mm)	
	R Pearson Correlation	p-value	R Pearson Correlation	p-value	R Pearson Correlation	p-value	R Pearson Correlation	p-value
Age	-0.041	.622	0.044	0.589	-0.028	0.736	0.007	0.935
BMI (kg/m2)	-0.033	.688	0.027	0.745	-0.061	0.459	0.064	0.436
Calcium (mg/dl)	-0.360	<0.001	0.398	<0.001	0.465	<0.001	-0.355	<0.001
Phosphorus (mg/dl)	0.377	<0.001	-0.360	<0.001	-0.380	<0.001	0.320	<0.001
PTH (pg/dl)	0.370	<0.001	-0.444	<0.001	-0.558	<0.001	0.325	<0.001
Cholesterol (mg/dl)	0.263	0.001	-0.320	<0.001	-0.325	<0.001	0.244	0.003
TGs (mg/dl)	0.173	0.034	-0.273	0.001	-0.257	0.002	0.115	0.162
LDL (mg/dl)	0.235	0.004	-0.295	<0.001	-0.281	0.001	0.233	0.004
CIMT (mm)	0.534	<0.001	-0.596	<0.001	-0.574	<0.001	0.534	<0.001
FMD %	-0.786	<0.001			0.776	<0.001	-0.596	<0.001
increase in volumeflow%	-0.879	<0.001	0.776	<0.001			-0.574	<0.001
PTX3 (pg/ml)			-0.786	<0.001	-0.879	<0.001		

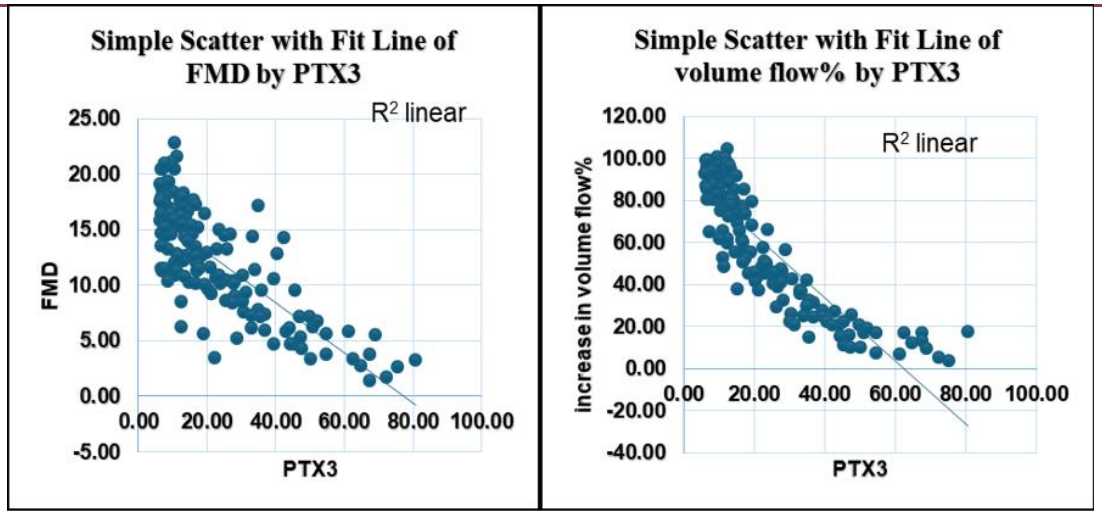

Figure (4) correlations between serum PTX3 levels, FMD% and volume flow %, all demographic

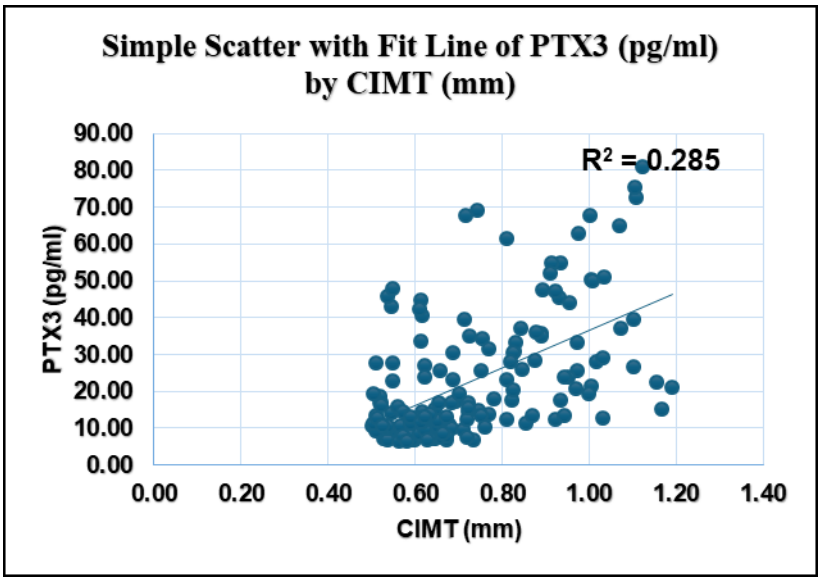

Figure (5) Correlation between PTX3 and CIMT

Table 2 shows the correlations between serum PTX3 levels, FMD%, volume flow %, CIMT and all demographic, laboratory parameters and imaging studies. Significant positive correlations were observed between PTX3 and phosphorus, PTH, cholesterol, triglycerides, LDL, and negative correlation with calcium levels. Moreover, it had significant negative correlation with FMD%, and volume flow % variation Figure 4 and CIMT Figure 5

There was substantial positive association between FMD%, volume flow % and calcium level. Furthermore, there was a substantial negative correlation between them and phosphorus, cholesterol, triglycerides, LDL, PTH and PTX3 level. Furthermore, the correlations between imaging studies both had a substantial moderate negative association with CIMT and a significant moderate positive association with each other with a P value<0.001.

There were substantial negative correlations between CIMT and calcium level. Moreover, there was a substantial positive association between CIMT and phosphorus, cholesterol, a LDL and PTX3 level.

Table 3 Correlation between PTX3, FMD%, flow volume% and Kt/v, URR in dialysis group:

		PTX3	FMD%	Flow volume%
Kt/v	**r**	-0.995-	0.997	0.996
	P value	<0.001**	<0.001**	<0.001**
URR %	**r**	-0.940-	0.938	0.937
	P value	<0.001**	<0.001**	<0.001**

Table 3 it emphasizes the impact of adequate hemodialysis sessions which assessed by Kt/V and URR in improving FMD% and

flow volume% and hence the endothelial dysfunction as Kt/v and URR shows a substantial negative association with PTX3 levels and a significant positive association with FMD% and flow volume%.

Table 4 Area under curve (AUC), for PTX3, FMD%, volume flow%, and CIMT

Diagnostic tool	AUC	CUT-OFF point	Sensitivity (%)	Specificity (%)	Overall accuracy (95% confidence interval)
FMD %	0.876 (87.6%)	10.6000	80%	85% (1-0.15)	82.2- 93.0%
CIMT mm	0.681 (68.1%)	0.6845	76%	62% (1-0.38)	59.5- 76.6%
volume flow%	0.872 (87.2%)	47.7%	82%	82% (1-0.18)	81.8- 92. 7%
PTX3 pg/ml	0.864 (86.4%)	19.1	82%	75% (1-0.25)	80.6- 92.1%

Table 4 shows the ideal cutoff point at which endothelial dysfunction is present, along with its specificity, sensitivity and area under curve (AUC), for PTX3, FMD%, volume flow%, and CIMT. PTX3 cutoff point was 19.1 pg/mL with 82% and 75% sensitivity and specificity, respectively figure (6). FMD% and volume flow % cut off point if they were increased at or below 10.6% and 47.7% respectively with sensitivity 80%, 82% respectively and specificity 85%, 82% respectively Fig 7,8 The cutoff point for CIMT was 0.68 mm, with 76% and 62% sensitivity and specificity, respectively Fig 9

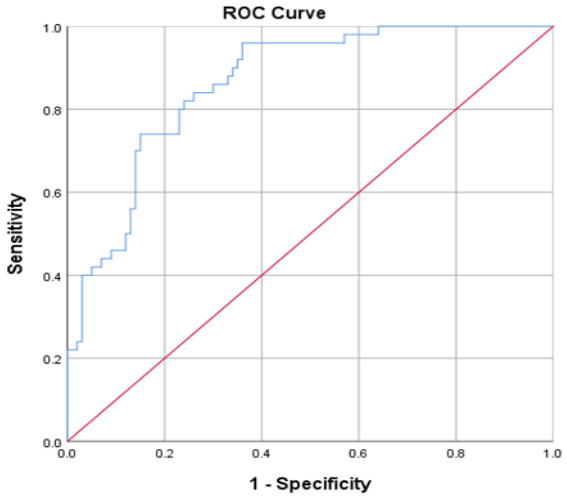

Figure 6. ROC curve of PTX3

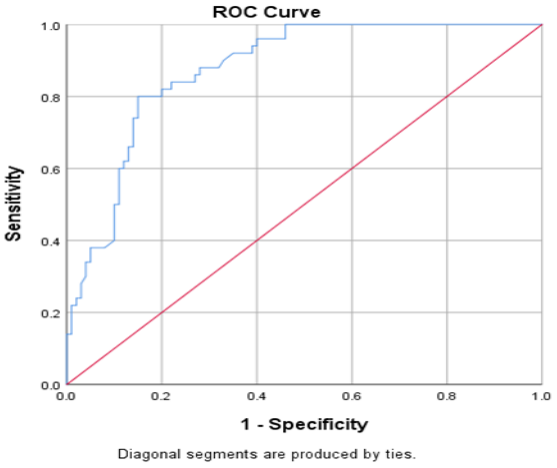

Figure 7. ROC curve of FMD%

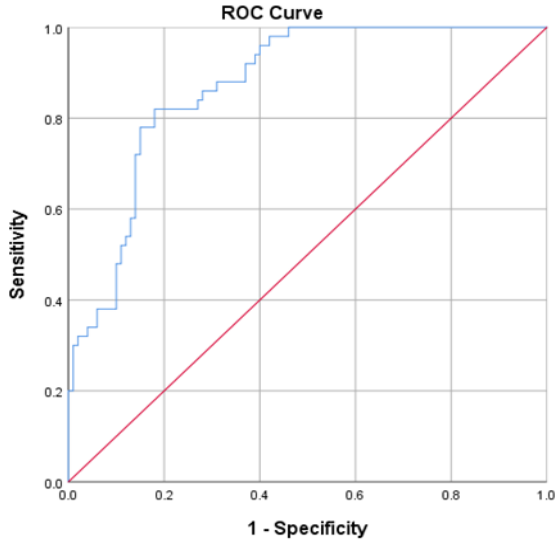

Figure 8. ROC curve of volume flow%

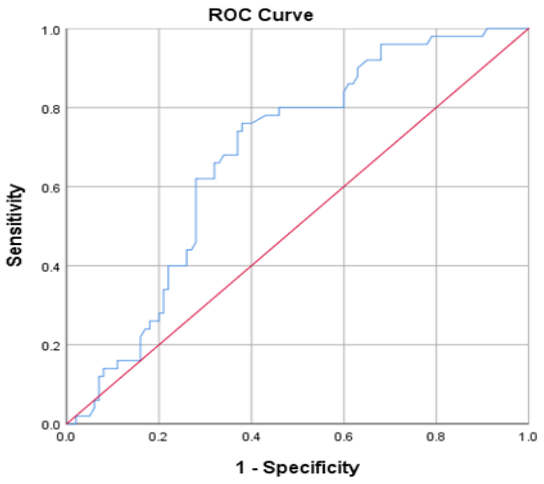

Figure 9. ROC curve of CIMT

DISCUSSION:

Our findings showed that the two patient groups' pentraxin 3 levels were noticeably greater than the control group's. Furthermore, the pentraxin 3 level was noticeably greater in the CKD group than in the dialysis group.

Increased pentraxin-3 levels in ESRD have been reported in numerous investigations. This result is consistent with a prior investigation by Tong et al. that discovered that PTX3 concentrations were greater in patients with CKD than in control persons. PTX3 was inversely correlated with GFR (with $P < 0.0001$) [12]. Similar to our research, Harun et al. discovered a substantial negative connection between PTX3 and eGFR and noted considerably increased serum levels of PTX3 in CKD individuals in stages 3, 4, and 5.[13]

Wijdan et al, revealed a substantial elevation in serum PTX3 levels in CKD compared with the control group ($P<0.05$). [14]
Yilmaz et al. conducted a study on CKD patients not on dialysis stage 1 to 5 and measuring PTX 3. The study found that PTX3 gradually increased to a higher level in stage 5.[15]

Xu et al.'s study, which included ninety-eight hemodialysis patients, revealed significantly higher plasma PTX3 levels in HD patients when compared to controls. [16]

Our findings are consistent with those of Miljkovic et al., who studied 21 dialysis patients and 19 individuals with CKD with no need for hemodialysis and found that pentraxin-3 was substantially greater in both renal patient groups than in controls ($p<0.001$). PTX3 levels were considerably greater in cases on dialysis than in CKD cases, in contradiction to our findings. [17]

The noticed disparity can be attributed to variations in the study population, given that a significant proportion of cases with diabetic nephropathy and glomerulonephritis were included in these investigations. Additionally, a number of variables associated with hemodialysis patients, such as infection, cardiovascular events, and access to hemodialysis, can alter the levels of PTX3. Furthermore, the abnormal uremic environment, can lead to increased TNF-α and IL-1β release, which in turn triggers the synthesis of PTX3, resulting in persistent systemic low-grade inflammation and this may explain why it's decreased level in our hemodialysis patients as it removes uremic toxins.[15]

Our study revealed a significant positive association between PTX3 with PTH and phosphorus, in addition to a substantial negative association with serum calcium. That agree with Visconti et al, who conducted a study on a patient of osteoporosis (n=32), osteoarthritis (n=19) and healthy controls (n=25). Serum PTX3 levels are positively linked to PTH levels ($p = 0.0203$) in osteoporotic patients.[18]

FMD% was widely utilized in various observational studies to evaluate the endothelial dysfunction in CKD patients. So, in our investigation we highlighted the role of FMD in assessment of endothelial dysfunction, and we found that FMD index was lower in CKD and hemodialysis cases in contrast to healthy control. Moreover, our results show that FMD in the dialysis group was substantially greater than CKD group. We found that volume flow was substantially lower in CKD and hemodialysis cases than control. Furthermore, it was substantially greater in hemodialysis than CKD cases.

CIMT was substantially greater in CKD and hemodialysis groups of cases than the control group. In concordance with many previous studies, in a study by Kopel et al., 70 participants with advanced chronic kidney disease (CKD) were matched 1:1 with controls who had intact renal function. The researchers discovered a trend toward a lower FMD percentage in advanced CKD patients as compared to controls.[19] also, Yilmaz et al, found that FMD% levels gradually decreased with increasing CKD stages, while CIMT values increased.

Alejandro Recio-Mayoral et al. studied thirty-eight predialysis, eighteen hemodialysis, and twenty two kidney transplant patients. FMD % and CIMT were measured. They found decreased FMD and elevated CIMT values in contrast to controls. However, the research showed that hemolysis cases have substantially greater CIMT and lower FMD values in contrary to predialysis and kidney-transplant patients. [20] Moreover, Patel's L cross-sectional study, which included 62 CKD patients ,38 receiving predialysis &24 receiving hemodialysis—its results were consistent with those of Alejandro Recio-Mayoral et al.'s study.[21]
Similar to our results, M. Cross et al conducted a study on hemodialysis and peritoneal dialysis patients. FMD% was done and found that hemodialysis increased FMD% and improved it and this coinciding with our results that FMD in the dialysis group was substantially greater than CKD group. And this implies that endothelial toxins that have a harmful effect may be dialyzable and the endothelial function can be reversible. [22]

From our perspective, we highlight the role of efficient and adequate hemodialysis in improving endothelial dysfunction, as we found a strong negative correlation between PTX3 as a biomarker of inflammation, Kt/V, and URR. Moreover, a strong positive correlation between FMD%, flow volume with Kt/V, and URR was also observed. That can be due to the effect of hemodialysis via reducing pro-inflammatory cytokines and chemokines, which may affect the integrity of the endothelium and secretion of other inflammatory biomarkers.

Ossareh S.et al, conducted a study on hemodialysis patients measuring CIMT. CIMT was higher in hemodialysis cases in contrast to the control group.[23] Another study by Lawal et al revealed that CIMT was greater in CKD population in contrary to controls. [24]

Our findings demonstrate a significant negative asociation between decreased endothelial function as measured by FMD and elevated serum PTH levels and phosphorus; furthermore, they revealed a significant positive correlation with calcium level, all of which are consistent with previous studies that suggest that endothelial dysfunction may be influenced by mineral bone disease.

For instance, Bosworth et al. found that greater serum PTH levels were linked to arterial dysfunction as measured by decreased FMD.[25]

Our study aligned with Bortotolotto et al. illustrated a negative association between FMD and PTH in CKD cases. Furthermore, in contrast with ours, they found that Ca and phosphorus did not influence FMD.[26]

Another study by Baykan et al. evaluated FMD in patients with primary hyperparathyroidism (PHPT) . Patients with PHPT had lower FMD than those without. FMD is also negatively correlated with serum calcium, which is in disagreement with us.[27]

An independent risk factor for atherosclerosis events is dyslipidemia. Our research revealed a strong inverse relationship between LDL cholesterol, CIMT, and FMD. Additionally, TG showed no association with CIMT and a strong negative association with FMD.

O¨ ngen et al performed a case–control study found positive association between LDL-C, TC and CIMT, but a negative correlation with FMD and this agree with our study. [28] 82 individuals with Diabetes Mellitus type 1 were enrolled in Ikeningrum et al.'s cross-sectional study. They discovered that in children with type 1 diabetes, LDL and total cholesterol may be linked to a decline in brachial artery FMD and a rise in intima-media thickness.[29]

A statistical analysis of correlation between the studied indices in all the study participants revealed an inverse correlation between PTX3 and FMD in both CKD and in dialysis group. Furthermore, we found a positive association between PTX3 and CIMT in both the CKD group and the dialysis group. Furthermore, this validates role of both the biomarker, FMD and CIMT in evaluating endothelial dysfunction in our patient population.

Correlation between PTX3 and FMD was analysed in previous studies. In consistence with our results, Yilmaz et al had a study of 257 of non-dialysis CKD patients in different stages, there was a strong negative correlation of PTX3 and FMD and no significant correlation between PTX3 and CIMT. Moreover, Suliman M et al, conducted a study consisted of 207 incident cases who had stage 5 CKD. The study revealed a negative association between PTX3 and FMD and a positive association with CIMT, which is consistent with our findings.[30]

Furthermore, in a trial of individuals with chronic systemic inflammatory distress and sleep apnea, a disease frequently linked to risk factors related to endothelial dysfunction, PTX3 showed a favorable correlation with CIMT. [31] Nevertheless, two extensive population investigations demonstrated that there was no conclusive association between the two measures and denied the usefulness of PTX3 in predicting CIMT progression. [32] After controlling for age, sex, and ethnicity, the connection between PTX3 and CIMT that had previously existed in another large cohort study failed to be statistically significant. [33]

CONCLUSION

PTX3 is a crucial proinflamatory vascular marker that is elevated in ESRD and highly associated with endothelial dysfunction. FMD%, volume flow% is a non-invasive technique for early determining of endothelial dysfunction even before thickening of carotid intima media, which is a marker of subclinical atheroscelerosis. Moreover, dialysis may play a role in improving vascular toxins, which is reflected by a lower level of PTX3 and a higher percentage of FMD and volume flow in dialysis patients than those with CKD stage 5. Finally, volume flow % variation can be used with FMD% as a new and additional procedure of assessment of endothelial dysfunction by the same technique as FMD%.

DECLARATION:

Funding: No entity provided financial assistance to the authors for the work that was submitted.
Conflict of interest: Regarding the subject matter of this essay, the writers have no conflicts of interest to disclose.
Ethics approval and Participant consent: All study methods were carried out in compliance with the 1964 Helsinki Declaration, its subsequent amendments, the institutional and/or national research committee's ethical standards, or similar ethical standards. The ethical committee at Cairo University's Kasr Alainy School of Medicine in Egypt gave its approval to the study's procedure. The number of approval was MD-440-2022. Each participant in the study gave their informed consent.

Consent for publication: “Not applicable”
Data and material availability: Up till the work is published, the datasets created and/or analyzed during this investigation are not publicly accessible; however, they can be obtained from the corresponding author upon reasonable request. This content has never been published before, either in full or in part, and it is not currently being considered for publication anywhere. There are no tables or figures in this work that need permission to be reprinted.

LIST OF ABBREVIATION:

Endothelial dysfunction: ED
Pentraxin3: PTX3
carotid intima media thickness: CIMT
Flow mediated dilatation: FMD
Enzyme Linked Immunosorbent Assay: ELISA.
Chronic kidney disease: CKD
common carotid artery: CCA
European Society of Cardiology: ESC

standard deviation: SD
Area under curve: AUC
receiver operating characteristic curve: ROC
Glomerular filtration rate: GFR
Triglycerides: TGs
Low density lipoprotein" LDL
Parathyroid hormone PTH

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