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Original Article

Impact Of Type 2 Diabetes Mellitus On Platelet Indices In Non-dialysis Chronic Kidney Disease Patients

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ABSTRACT

Background:diabetic platelets anomalies, which cause enhanced adhesiveness and exaggerated aggregation and thrombus formation, diabetes mellitus is linked to an increased risk of problems. Few studies have shown how diabetes affects platelet indices in non-dialysis chronic kidney disease patients . These patients experience both bleeding and thrombotic problems as a result of a disturbed balance between pro- and anti-hemostatic variables, including changes in platelet function.

Aim of the work: To investigate impact of type 2 DM on Platelet indices in Non-dialysis CKD patients.

Patients and methods: 150 patients classified into 3 groups each group included 50 patients, group with DM only patients, group with CKD only patients and group with CKD and DM patients , demographic data, complete blood count including platelet indices , HbA1c, eGFR and Abdominal Ultrasound were done for all patients .

Results: DM when combined with CKD significantly increased number of platelets (P= 0.02), increased MPV value (P= 0.02), increased PDW value (P <0.0001) and increased PCT value (P = 0.007) and platelet indices were positively correlated with HbA1c (P <0.0001), MPV and PDW were negatively correlated with eGFR (r= -0.03 , P<0.0001) and (r= -0.05, P<0.0001) respectively .

Conclusion: DM had a big impact. In non-dialysis CKD patients, platelet indices played a significant part in the pathological processes of vascular thrombosis; therefore, to reduce the risk of thrombosis in the future, it is important to monitor the patients' glycemic status and platelet indices .

Keywords: Type 2 diabetes mellitus; platelet indices; Non-dialysis chronic kidney disease

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Introduction

Individuals with diabetes mellitus (DM) who have metabolic abnormalities that throw off the natural equilibrium between fibrinolysis and coagulation, resulting in a prothrombotic state marked by hypo-fibrinolysis, coagulation disorders, and platelet hypersensitivity alterations in platelet activation and quantity are brought on by insulin resistance and hyperglycemia, and these alterations are essential for pro-thrombotic events. [(1-3)]

Larger platelets have a stronger thrombogenic potential than small platelets because they contain denser granules and are more metabolically and enzymatically active.

Mean platelet volume (MPV), a measure of platelet size, is a predictor of athero-thrombotic events such unstable angina, myocardial infarction, and stroke as well as a sign of platelet function

The imbalance between pro- and anti-hemostatic factors is the primary cause of both bleeding and thrombotic problems in chronic kidney disease (CKD), which results in high rates of morbidity and mortality. [(4-6)]

In patients with chronic kidney disease (CKD), mean platelet volume is a common assessment

performed by complete blood count (CBC) testing. It is a reality that clinicians often overlook this straightforward laboratory test. Although MPV is rarely examined in kidney illnesses, it has been studied in various circumstances as an inflammatory/atherosclerotic biomarker.

A small number of international studies that examined the effects of diabetes mellitus (DM) on platelets and the coagulation system in people with chronic kidney disease (CKD) and found that DM is a major risk factor for CV complications and patient death

Patients and methods

We performed a cross sectional study on 150 Patients who were aged 18 to 75 years old and we classified study participants into 3 groups:

a) 50 Non-dialysis CKD patients without diabetes mellitus
b) 50 Diabetic patients without detectable CKD
c) 50 Non-dialysis CKD Patients with diabetes mellitus

Exclusion criteria :

- Chronic liver illness;
- History of known inherited bleeding disorders
- Malignancy history
- Infectious illnesses, including hepatitis B, hepatitis C, and human immunodeficiency virus.
- Alcoholics, habitual tobacco chewers, and smokers
- Using oral contraceptives and anticoagulant or antiplatelet medications; pregnancy or lactation
- Those with CKD receiving hemodialysis

Patients were subjected to :

- History taking and physical examination
- A structured using questionnaire were collected to detect Socio-demographic characteristics and clinical information of study participants
- Kidney Disease Improving Global Outcomes (KDIGO) defines chronic kidney disease (CKD) as "Abnormalities of kidney structure or function, present for >3 months, with implications for health" is the definition of chronic kidney disease (CKD). One of two requirements must be met, either by means of documentation or inference, for >3 months to be considered: either GFR <60 ml/min/1.73 m2 or kidney damage markers, such as albuminuria. [7]
- The Epidemiology Collaboration equation (eGFR) was utilized to compute the glomerular filtration rate (GFR). [8]
- In accordance with Kidney Disease Outcomes Quality Initiative (KDOQI) recommendations, the CKD patients were divided into 4 groups based on GFR. [7]
- GFR >90 mL/min/1.73 m2+ proteinuria is the definition of stage 1.
- GFR 89–60 mL/min/1.73 m2 is the definition of Stage 2; GFR 59–30 mL/min/1.73 m2 is the definition of Stage 3; and GFR 29–15 mL/min/1.73 m2 is the definition of Stage 4.
- If one or more of the following conditions are satisfied, DM will be diagnosed through laboratory testing:
- A random glucose level > 11.1 mmol/l (200 mg/dl) or a fasting plasma glucose level ≥7.0 mmol/l (126 mg/dl) or a two-hour plasma glucose level ≥11.1 mmol/l (200 mg/dl) after a 75 g oral glucose load, or a HbA1c ≥ 48 mmol/l (equal to 6.5%) .[9]
- We classified diabetic patients into 2 groups according the type of anti-diabetic treatment received
- Patient group receiving insulin therapy
- Patient group receiving oral hypoglycemics

- Complete blood count including platelet indices was done in clincal pathology department
- A normal spot urine albumin-creatinine ratio was determined to be less than 20 mg/g for men and less than 30 mg/g for women. When the spot urine albumin–creatinine ratio is 20–200 mg/g in men and 30–300 mg/g in women, it is referred to as microalbuminuria. [7]
- Patients with a HbA1c test result of less than 5.7% were categorized as normal, or in the non-diabetic range; those with a result of 5.7% to 6.4% were classified as prediabetics; and those with a result of 6.5% or above were labeled as diabetic patients. [9]
- Imaging : Abdominal Ultrasound study was done for all studied patients
- The study protocol was approved by scientific and ethical committees at Sohag Faculty of Medicine and an informed written consent was obtained from all participants.

Statistical analysis

STATA version 17.0 (Stata Statistical Software: Release 17.0 College Station, TX: Stata Corp LP.) was used to analyze the data. The distribution of the various variables was ascertained using the Shapiro-Wilk normality test. The measures used to express quantitative data were mean, standard deviation, median, and range. ANOVA was used to compare the means of three groups or more for analyzing the data, and the student t-test was used to compare the means of two groups. The Mann-Whitney test was used to compare two groups and the Kruskal Wallis test was used to compare three or more groups when the data were not normally distributed.

The Chi square test or Fisher exact test were used to compare the numerical and percentage forms of the qualitative data. The Spearman correlation test was used for correlation analysis. The identification of variables influencing platelet indices and coagulation profile was also accomplished by multivariate linear regression analyses. If the P value was less than 0.05, it was deemed significant.

Results

Table (1): Demographic and clinical feature of studied population

Variable	CKD N=50	DM N=50	CKD with DM N=50	P value
Age/years				
Mean ± SD	49.74±15.92	51.7±8.25	52±6.60	0.43
Median (range)	48 (18:80)	49.5 (39:70)	53.5 (38:67)	
P1=0.36, P2=0.26, P3=0.47				
Gender				
Female	25 (50.00%)	28 (56.00%)	17 (34.00%)	0.07
Male	25 (50.00%)	22 (44.00%)	33 (66.00%)	
P1=0.55, P2=0.11, P3=0.03				
BMI				
Mean ± SD	27.74±3.74	32.64±3.76	31.56±3.24	<0.0001
Median (range)	28 (22:37)	33 (23:40)	32 (25:38)	
P1<0.0001, P2<0.0001, P3=0.40				
Hypertension				
No	20 (40.00%)	29 (58.00%)	18 (36.00%)	0.06
Yes	30 (60.00%)	21 (42.00%)	32 (64.00%)	
P1=0.07, P2=0.68, P3=0.03				
Dyslipidemia				
No	34 (68.00%)	28 (56.00%)	28 (56.00%)	0.37
Yes	16 (32.00%)	22 (44.00%)	22 (44.00%)	
P1=0.22, P2=0.22, P3=1.00				

CKD= chronic kidney disease, DM= diabetes mellitus, BMI= body mass index

P value compared the three groups. P1 compared CKD & DM, P2 compared CKD & CKD with DM and P3 compared DM & CKD with DM.

Table (2): Platelet indices in studied population

Variable	CKD N=50	DM N=50	CKD with DM N=50	P value
Platelets count				
Mean ± SD	224.56±43.46	305.3±71.85	282±73.38	0.0001
Median (range)	219.5 (160:295)	292 (173:433)	284 (157:422)	
P1=0.0001, P2=0.0001, P3=0.13				
MPV				
Mean ± SD	9.36±1.06	11.18±0.96	11.24±0.86	<0.0001
Median (range)	9 (7.8:11)	11 (9:13)	11.15 (8.8:14)	
P1<0.0001, P2<0.0001, P3=1.00				
PDW				
Mean ± SD	10.18±1.38	12.77±1.27	13.55±1.14	<0.0001
Median (range)	10 (7.9:14)	12.8 (10.5:16)	13.55 (10.7:16.8)	
P1<0.0001, P2<0.0001, P3=0.008				
PCT				
Mean ± SD	0.25±0.06	0.44±0.15	0.44±0.12	0.0001
Median (range)	0.25 (0.12:0.37)	0.38 (0.27:0.79)	0.43 (0.24:0.77)	
P1=0.0001, P2=0.0001, P3=0.14				

CKD= chronic kidney disease, DM= diabetes mellitus, MPV= mean platelet volume, PDW= platelet distribution width, PCT= plateletcrit

P value compared the three groups. P1 compared CKD & DM, P2 compared CKD & CKD with DM and P3 compared DM & CKD with DM.

Table (3) Relation between type of DM treatment with platelet indices

Variable	Insulin N=27	Oral N=73	P value
Platelets count			
Mean ± SD	290.19±64.30	294.93±76.60	0.93
Median (range)	286 (158:422)	286 (157:433)	
MPV			
Mean ± SD	10.48±0.59	11.48±0.86	**<0.0001**
Median (range)	10.6 (8.8:11.3)	11.5 (9:14)	
PDW			
Mean ± SD	12.30±1.05	13.48±1.19	**<0.0001**
Median (range)	12.7 (10.5:14)	13 (10.9:16.8)	

MPV= mean platelet volume, PDW= platelet distribution width, PCT= plateletcrit,

Table (4): Relation between stages of CKD with platelet indices

Variable	Group	Stage 2	Stage 3	Stage 4	P value for trend
Platelet count	**CKD**	220.88±34.25 220.5 (176:273)	210.33±45.10 186 (160:294)	236.46±43.03 234 (177:295)	0.16
	CKD with DM	229.6±53.93 237 (158:284)	293.88±64.27 291 (194:385)	284.14±79.31 284.5 (157:422)	0.35
	Both groups	224.23±40.90 231 (158:284)	250.91±68.97 259 (160:385)	262.13±68.86 267.5 (157:422)	0.07
P value compared 2 group		0.66	0.0002	0.05	
MPV	**CKD**	8.18±0.29 8.1 (7.9:8.7)	8.92±0.76 8.8 (7.8:11)	10.08±0.88 10.5 (8.5:11)	<0.0001
	CKD with DM	10.2±0.29 10.3 (9.7:10.4)	10.67±0.63 10.7 (8.8:11.8)	11.77±0.63 11.8 (11:14)	<0.0001
	Both groups	8.95±1.06 8.5 (7.9:10.4)	9.77±1.12 9.8 (7.8:11.8)	10.99±1.13 11 (8.5:14)	<0.0001
P value compared 2 group		<0.0001	<0.0001	<0.0001	
PDW	**CKD**	8.8±0.37 8.7 (8.3:9.3)	9.56±0.77 9.4 (8.5:11.5)	11.13±1.27 11 (7.9:14)	<0.0001
	CKD with DM	12.18±0.55 12.4 (11.3:12.7)	12.81±0.76 12.8 (10.7:14)	14.24±0.89 14 (13:16.8)	<0.0001
	Both groups	10.08±1.78 9.2 (8.3:12.7)	11.14±1.82 10.7 (8.5:14)	12.8±1.90 13 (7.9:16.8)	<0.0001
P value compared 2 group		<0.0001	<0.0001	<0.0001	
PCT	**CKD**	0.19±0.03 0.19 (0.12:0.23)	0.23±0.04 0.24 (0.15:0.29)	0.29±0.06 0.29 (0.16:0.37)	<0.0001
	CKD with DM	0.31±0.05 0.31 (0.24:0.37)	0.38±0.05 0.38 (0.27:0.46)	0.51±0.12 0.47 (0.35:0.77)	<0.0001
	Both groups	0.23±0.07 0.22 (0.12:0.37)	0.30±0.08 0.29 (0.15:0.46)	0.41±0.14 0.38 (0.16:0.77)	<0.0001
P value compared 2 group		0.003	0.0001	0.0001	

CKD= chronic kidney disease, DM= diabetes mellitus, MPV= mean platelet volume, PDW= platelet distribution width, PCT= plateletcrit

Table (5): Correlation between HbA1C with platelet indices

Variable	CKD		DM		CKD with DM		All patients	
	R	**p**	**r**	**p**	**R**	**P**	**r**	**P**
Platelets count	0.35	**0.01**	0.08	0.60	-0.04	0.79	0.39	**<0.0001**
MPV	0.82	**<0.0001**	0.86	**<0.0001**	0.83	**<0.0001**	0.89	**<0.0001**
PDW	0.88	**<0.0001**	0.84	**<0.0001**	0.81	**<0.0001**	0.90	**<0.0001**
PCT	0.56	**<0.0001**	0.86	**<0.0001**	0.84	**<0.0001**	0.90	**<0.0001**

r -- Spearman's correlation co-efficient, P – Value

CKD= chronic kidney disease, DM= diabetes mellitus, MPV= mean platelet volume, PDW= platelet distribution width, PCT= plateletcrit

Table (6): Correlation between eGFR with platelet indices

Variable	CKD		DM		CKD with DM		All patients	
	r	P	R	p	r	P	r	P
Platelet count	-0.27	0.06	-0.20	0.16	-0.09	0.55	0.18	**0.03**
MPV	-0.76	**<0.0001**	-0.22	0.12	-0.77	**<0.0001**	-0.03	**0.001**
PDW	-0.79	**<0.0001**	-0.43	**0.002**	-0.75	**<0.0001**	-0.10	**0.001**
PCT	-0.62	**<0.0001**	-0.29	**0.04**	-0.71	**<0.0001**	0.004	0.97

r -- Spearman's correlation co-efficient, P – Value

CKD= chronic kidney disease, DM= diabetes mellitus, MPV= mean platelet volume, PDW= platelet distribution width, PCT= plateletcrit

Table (7): Multivariate regression analysis of parameters affecting platelets count.

Variable	Regression co-efficient (95% CI)	P value
Age	0.71 (-0.53:1.96)	0.26
Male gender	-2.09 (-25.03:20.85)	0.86
Hypertension	-4.26 (-30.55:22.02)	0.75
Dyslipidemia	8.34 (-17.06:33.73)	0.52
BMI	1.81 (-1.78:5.40)	0.32
HbA1C	-0.71 (-9.94:8.52)	0.88
eGFR	-0.46 (-1.66:0.73)	0.45
DM vs. CKD	101.81 (-1.32:204.94)	**0.05**
CKD with DM vs. CKD	50.33 (9.00:91.65)	**0.02**

CKD= chronic kidney disease, DM= diabetes mellitus, eGFR= glomerular filtration rate, BMI= body mass index

Table (8): Multivariate regression analysis of parameters affecting MPV.

Variable	Regression co-efficient (95% CI)	P value
Age	0.02 (0.006:0.03)	**0.003**
Male gender	0.09 (-0.11:0.28)	0.38
Hypertension	-0.13 (-0.35:0.10)	0.26
Dyslipidemia	0.13 (-0.08:0.35)	0.22
BMI	0.05 (0.02:0.09)	**<0.0001**
HbA1C	0.30 (0.22:0.37)	**<0.0001**
eGFR	-0.03 (-0.04:-0.02)	**<0.0001**
DM vs. CKD	2.42 (1.54:3.29)	**<0.0001**
CKD with DM vs. CKD	0.40 (0.05:0.76)	**0.02**

CKD= chronic kidney disease, DM= diabetes mellitus, eGFR= glomerular filtration rate, BMI= body mass index

Table (9): Multivariate regression analysis of parameters affecting PDW.

Variable	Regression co-efficient (95% CI)	P value
Age	0.003 (-0.01:0.02)	0.64
Male gender	0.09 (-0.17:0.35)	0.51
Hypertension	-0.02(-0.32:0.28)	0.89
Dyslipidemia	0.26 (-0.03:0.54)	0.08
BMI	0.04 (-0.004:0.08)	0.09
HbA1C	0.41 (0.31:0.52)	**<0.0001**
eGFR	-0.05 (-0.06:-0.04)	**<0.0001**
DM vs. CKD	3.90 (2.73:5.07)	**<0.0001**
CKD with DM vs. CKD	1.49 (1.02:1.96)	**<0.0001**

CKD= chronic kidney disease, DM= diabetes mellitus, eGFR= glomerular filtration rate, BMI= body mass index

Table (10): Multivariate regression analysis of parameters affecting PCT.

Variable	Regression co-efficient (95% CI)	P value
Age	0.001 (-0.001:0.002)	0.39
Male gender	0.0002 (-0.02:0.02)	0.99
Hypertension	-0.007 (-0.03:0.02)	0.57
Dyslipidemia	-0.0001 (-0.02:0.02)	0.99
BMI	0.0009 (-0.003:0.004)	0.60
HbA1C	0.06 (0.05:0.07)	**<0.0001**
eGFR	0.002 (0.001:0.003)	**0.002**
DM vs. CKD	0.04 (-0.06:0.14)	**0.01**
CKD with DM vs. CKD	0.05 (0.01:0.09)	**0.007**

CKD= chronic kidney disease, DM= diabetes mellitus, eGFR= glomerular filtration rate, BMI= body mass index

DISCUSSION

There were few researches that studied the impact of DM on platelet parameters and coagulation profile in CKD patients not on Hemodialysis and We reported that platelet parameters, mean platelet volume (MPV) was significantly higher in diabetic patients with chronic kidney disease in comparison to chronic kidney disease patients without diabetes mellitus (P <0.001) and This was consistent with other studies like Russel TA et al.[10] who carried out a study and demonstrated that MPV was considerably higher in diabetic patients with CKD than in controls.

As such, platelets could play a key role in assessing the vascular risk associated with type 2 diabetes. Also in agreement with Demirtunc R et al.[11] which discovered that MPV is significantly higher in patients with T2DM who have vascular complications compared to those without vascular complications. Additionally**,** Buch et al [12] found that MPV was significantly increased in diabetic patients with complications (diabetic nephropathy and diabetic retinopathy) as compared to diabetics without complications and nondiabetic group. Moreover Jindal et al [13] discovered that MPV and PDW were all considerably greater in diabetes patients relative to the control group and were higher in patients experiencing complications relative to those not experiencing complications.

we found slight reduction in platelet count in patients with CKD only compared to patients with CKD and DM in stage 3 and 4 , also we found significant increase in values of platelets indices (MPV, PDW and PCT) when DM is combined with CKD compared with CKD only patients and from stage 2-4 CKD, platelets indices is higher as CKD stage rise even in CKD only patients, this is similar to a study. [14] They discovered that among CKD patients, DM patients had higher MPV levels than non-DM patients, and that in male patients with diabetes, there was a significant association between CKD stage and MPV.

Data regarding the relationship between MPV and CKD are few and conflicting and we found that there were inverse relationships between platelet indices and eGFR as they were increasing as eGFR was declining , this was similar with Tamadon et al [15] that showed that the changes in MPV had a negative relationship with changes in eGFR levels especially in patients with underlying hypertension or diabetes mellitus.

Zdrojewski et al [16] demonstrated that MPV could predict the course of non-diabetic glomerular disease when the condition was evaluated .

This finding aligns with Turgutalp K et al [17], which examined MPV in individuals with diabetes at various stages of the disease (noncomplicated, cases with microalbuminuria or overt nephropathy, and stage 2- 4 CKD). The study found that the highest MPV values were observed in the latter group, and the researchers concluded that MPV had an inverse relationship with GFR and that MPV values increased with the degree of nephropathy.

Moreover, this aligns with Ju HY et al [18], which revealed that as the stage of CKD advanced, the MPV values also increased dramatically and showed a negative correlation with estimated GFR. Based on these findings, the authors conjectured that MPV could be a predictor of the severity of the disease.

We found that platelets count is lower in stage 4 CKD in CKD patients with DM and CKD only patients but is more lower in CKD only patients and this is consistent with Ju HY et al [18] who showed that platelet counts were lower in the low

GFR groups and this is also similar to Algythan et al [19] who found platelets count is decreased in CKD patients before hemodialysis compared to normal population and also in accordance with schoorl et al [20] who observed that CKD patients had lower range of platelet count within the reference limits.

Sakalli et al [21] demonstrated that the CKD group had higher MPV levels prior to transplant, and that these levels had dropped by the end of the first post-transplant month when compared to pretransplant levels. The authors suggested that the primary reason for this decline in MPV was the reduction of chronic inflammation following transplantation. The purpose of the aforementioned investigation was to determine whether MPV was a risk factor for the propensity to experience thrombotic problems following transplantation.

In NEFRONA study by Betriu A et al [23], CKD related atherosclerotic risk factors were examined and it was documented that DM was a risk factor in stage 3 and 4 CKD and It is known that MPV is increased in patients with DM by previous studies This is similar to Yenigun et al [14] who looked at MPV at various stages of CKD and showed that there were notable differences between MPV in DM-afflicted CKD patients and non-diabetic individuals, with a positive association identified between CKD stage and MPV in male diabetic patients .

And Yenigun et al [14] came to the conclusion that if DM and CKD coexist, the risk of CVD increases significantly. Based on these findings, they suggested that high MPV values may be a marker in this patient group and may alert doctors. It is also possible to suggest that MPV value may be significant in DM patients with CKD

Additionally, we found that the Platelet distribution width (PDW) of diabetic patients with CKD was considerably greater (P <0.001) than that of patients with CKD alone. [13]

They found that patients with diabetes had significantly higher MPV and PDW than participants in the control group, and that these variables were higher in individuals with issues than in those without them. Furthermore, this is consistent with Dalamaga M et al [24] which discovered that PDW was greater in individuals with diabetic CKD than in individuals with diabetes alone. It also supports research by Buch et al [12] which found that diabetics with and without problems had statistically significant differences in PDW.

Diabetic patients often have larger and more reactive platelets, which leads to an increase in platelet mass and, eventually, a rise in PCT. Our findings showed that PCT was considerably higher in diabetic patients with CKD than in patients without CKD (P<0.001), this is consistent with DerisBesadaa. Martha S., et al [25] where they found that MPV, PDW, and PCT were all significantly higher in diabetic patients compared to the control subjects with (P= 0.001, 0.05, and 0.02 respectively). MPV was greater in those with nephropathy than in those without (P= 0.001).

However, this is not supported by Buch et al [12], who discovered that there was no statistically significant variation in PCT across the research groups and that there was no statistically significant association between PCT and diabetic complications.

and a tiny study by Akinsegun A et al [22] revealed that patients with diabetes had lower MPV.

We think that The reason for the discrepancy in outcomes was that most diabetics had previously received treatment, specifically antiplatelet drugs like aspirin and clopidogrel for different lengths of time.

In our study we found significant impact of type of diabetic treatment on platelets indices where the group who received oral hypoglycemic treatment had higher Platelets indices values compared to the group who received insulin treatment but there were no impact on platelets count in both groups and we demonstrated a statistically significant positive correlation of MPV with HbA1c , These observations were similar to Demirtunc R et al[11] and Kodiatte TA et al [26] who stated that increased HbA1c level was associated with raised MPV.

And alterations in MPV and PDW were reflected by poor glycaemic control which may be due to osmotic effect caused from increased glucose levels and its metabolites in blood, Dalamaga M et al and Hekimsoy Z et al [24,27] that indicate the great role and impact of diabetes mellitus and poor glycemic control on platelet parameters in CKD patients leading to greater risk of thrombosis and other cardiovascular complications.

Thus DM could increase risk of atherosclerosis in CKD patients due to high MPV, PDW and PCT values as stated by **Turker et al** [28] Therefore, MPV has been preferentially explored as marker of platelet reactivity and as a biomarker of the risk and prognosis of CVD and cardiac events.

Conclusion

Diabetic state and poor glycemic control have a great impact on platelet indices in patients with CKD and shows significant increases in MPV and PDW and PCT ,So the assessment of platelet indices is mandatory for all CKD patients with DM to assess the risk of thrombosis and can predict long term complications on cardiovascular system and detect the best preventive measures

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