Original Research Article

A study on platelet indices in Diabetes Mellitus subjects

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Abstract

Background : Diabetes Mellitus (DM), a clinical syndrome characterised by an increase in blood glucose concentration. Hyperglycemia induces changes in the platelet function in Diabetes Mellitus subjects. Platelet Indices include parameters such as mean platelet volume (MPV), platelet distribution width (PDW) and plateletcrit (PCT). **Aim:** To study the platelet indices in Diabetic Mellitus subjects, to compare the platelet indices in controlled with uncontrolled Diabetes Mellitus, to compare the platelet indices in Diabetes Mellitus with normal subjects. **Materials and methods :** A cross – sectional study was conducted in (100 – Diabetes Mellitus & 100 Control(normal) subjects. Written Informed consent was obtained from the subjects. Each subject was asked to fill up the questionnaire on history of Diabetes Mellitus and general information. Blood parameters like Platelet Count, Mean Platelet Volume, Platelet Distribution Width, Plateletcrit, Fasting Blood Sugar, Post-Prandial Blood Sugar, HbA1c were estimated. **Results :** Among the Diabetic group, the FBS, PPBS and HbA1c was higher in uncontrolled DM than in DM subject under glycemic control, which was statistically significant. Platelet indices showed statistically significant difference between controlled and uncontrolled DM. MPV and PDW showed statistically significant difference between Diabetic and control group. Plateletcrit was not different between Diabetic and control group. **Conclusion :** Our study found that hyperglycemia leads to platelet hyperactivity. Thecontrol of glycemic status in each and everyDiabetic individual can prevent the development of micro vascular and macro vascular complications.

Keywords: Diabetes Mellitus, Mean Platelet Volume, Platelet Distribution Width, Plateletcrit

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Introduction

Platelets are non – nucleated, colourless, disc shaped and smallest blood cells of diameter(2 – 4 µm) derived from megakaryocytes and found in bone marrow.[1] The normal range of platelet count is 1,50,000 to 3,00,000 lakh / microliter.[2] Platelet Indices includes parameters such as plateletcrit, mean platelet volume and platelet distribution width. The mean platelet volume (MPV) is an index of the average size of platelets in blood and a marker for assessing platelet function and activation.[3] Platelet distribution width (PDW) reflects uniformity of the platelet size. PDW is a simple and specific marker of platelet activation. Plateletcrit (PCT) measures the total platelet mass. PCT is related to the platelet count and size of the platelets.MPV and PDW shows the reflection in the variation of size in the circulating platelets.[4] PDW and PCT is important in assessing tendency for atherosclerosis and thrombosis.[5]

Diabetes Mellitus (DM) is a clinical syndrome characterised by hyperglycemia, polyuria, polydipsia, polyphagia, weight loss and tiredness. Diabetes Mellitus is associated with microvascular and macrovascular complications. These complications are the major cause of morbidity, mortality and decrease in quality of life.[6]

In 2010, prevalence of Diabetes was 6.4% and by 2030, it is expected to rise to 7.7% worldwide. In India, the prevalence of Diabetes is slightly higher than the world average (9.1%vs.8.3% worldwide). In India, the number of Diabetes Mellitus cases in 2030 is expected to increase from 50.8 million to 87 million.[7] Diabetes Mellitus is considered as a prothrombotic state with increased activation of platelet.[8] The development of chronic complication has a close relationship to platelet dysfunction. Hyperglycemia, insulin deficiency, insulin resistance, metabolic condition, and cellular abnormalities in Diabetic patients.[9]

Aim To study the platelet indices in Diabetic Mellitus subjects.

Objectives

- To compare the platelet indices in controlled with uncontrolled Diabetes Mellitus
- To compare the platelet indices in Diabetes Mellitus with normal subjects.

Materials and methods

A cross – sectional study was conducted among 100 Diabetes Mellitus and 100 normal (control) subjects who were attending the Endocrinology and General Medicine Department in Sree Balaji Medical College & Hospital, Chromepet. Subjects of both genders was recruited for this study. The study was approved by the Institutional Ethical Committee for human research The procedure and purpose of the study was clearly explained in detail to the subjects. Written Informed consent was obtained from the subjects in their own language. History regarding duration of the disease, treatment regimen, presenting complaint, past history, socioeconomic status and family history of Diabetes Mellitus were collected.

Inclusion criteria

- Age group - 25 to 70 years
- Both male and female gender
- Healthy volunteers with no medical illness (control group).

- All known cases and newly diagnosed Type 1 and 2 Diabetes Mellitus.
- The subject on oral hypoglycemic drugs were included.

Exclusion criteria

- Smokers
- Subjects with Congenital or acquired platelet disease,
- Subjects on antiplatelet and anticoagulant therapy.
- Individuals with hypertension, renal failure, heart disease, stroke, liver disease and other systemic illness are excluded from the study.

After an overnight fasting, around 5 ml venous blood was collected from all the subjects.Blood parameters like Platelet Count (PLT CT), Mean Platelet Volume (MPV), Platelet Distribution Width(PDW), Plateletcrit (PCT), Fasting Blood Sugar (FBS), Post - Prandial Blood Sugar (PPBS), HbA1c were estimated. Data was collected, entered in Microsoft Excel, expressed as mean ± SD (standard deviation) and analysed by using independent samples test in SPSS version 20.

Results

100 subjects with Diabetes Mellitus (DM) and 100 normal (control) were enrolled for this study. There were 62 males and 38 females in Diabetic subjects group. The Diabetic group was divided into controlled and uncontrolled DM. In a controlled group of 50 Diabetic patients, 32 subjects were males and 18 subjects were females. In Uncontrolled group of 50 Diabetic patients, 30 subjects were males and 20 subjects were females.

Discussion :

Platelet plays an important role in maintaining the normal haemostasis. Changes in platelet morphology and its functions have been reported in Diabetes Mellitus. Altered platelets morphology in Diabetes Mellitus is associated with an increase in risk of developing vascular complications.

In our study, there is no statistical significance in mean age and sex of controlled Diabetes Mellitus and uncontrolled Diabetes Mellitus. This means our findings were not influenced by age and sex. Similar to our study, there were no significant difference of age and sex of the Diabetic and non- Diabetic subjects in these studies.[10-12] The Body mass index is higher in Diabetic group than the non – Diabetic group. This result is similar to Biswal et al study.[11]

Therefore, in our study, the sample chosen were matched with respect to the anthropometric data between the two Diabetic groups. In our study, the mean FBS, PPBS and HbA1c of uncontrolled Diabetes was higher when compared to the controlled Diabetes group. There is a statistically significant difference between the two Diabetic groups. Similar to the study done by Yenigün et al.[12]

The mean value of HbA1c in my study is 7.47 ± 1.74%. The glycemic status of uncontrolled Diabetes was higher (8.85 ± 1.42%) when compared to the controlled Diabetes group.[13] When compared with normal subjects, the Diabetes Mellitus subject had values that were significantly higher. Similar findings were found in other studies.[14-17] The platelet count in controlled DM group (2.69 ± 0.60lakh/cu.mm) was lower than that of uncontrolled DM group

(2.97±0.81lakh/cu.mm), but was not statistically significant (p=0.058). When compared to the controls (2.49 ± 0.74lakh/cu.mm), the platelet count was higher in Diabetes. This result was compatible to the results of Swaminathan et al., Demirtunc et al., Alhadas et al.[18-20]

The average MPV value is 8.69 ± 1.43 fL in Diabetic group, and 7.44 ±0.68 fL in non - Diabetic (normal) group. MPV is significantly high in our study. The results of our study were similar to Kodiatte et al., Sharpe and Trinick et al, Hekimsoy et al, and Papanas et al. MPV is an indicator of average platelet size and its function.

Platelets become hyperreactive in Diabetes subjects that causes increase in activation, adhesion, and aggregation. Studies reported that larger platelets are younger, more active and more adhesive than smaller ones .They contain dense granules that secretes the prothromotic factors such as serotonin, β-thromboglobulin, platelet factor 4, and platelet-derived growth factor, that produces more thromboxane A2 and possess greater aggregability in response to ADP.[19,20] Jones et al study reported that association of increased platelet volume and reduced platelet survival in Diabetic subjects.[23] Therefore, larger platelets circulating in blood are mainly by increase in MPV, that predispose to thrombotic vascular complication in Diabetes patients.

In our study Table -3 shows that all platelet indices were increased in uncontrolled Diabetic patients when compared to the controlled Diabetic patients. This finding was similar to Kodiatte et al., and Zuberi et al., study. A high MPV is an important predictor for an increased risk for thrombosis and complications.

Several mechanisms have been proposed for an increased platelet activity in Diabetes due to hyperglycemia. The membrane proteins of platelet undergo a non – enzymatic glycation that reduces membrane fluidity and increase the platelet adhesion.[10,25] An increase in calcium mobilisation from the storage pools and high level of intracellular calcium has been reported in Diabetes Mellitus patients. Intracellular free calcium is correlated with the reduction in membrane fluidity. Platelet activation is mediated by protein kinase C activation. Furthermore, due to hyperglycemia, osmotic swelling occurs that increase the platelet reactivity by glucose metabolites.[26]

Platelet distribution width level in our study was increased in Diabetes when compared to non – Diabetic group. PDW was also significantly increased with poor glycemic control. Our findings were as similar as Jindal et al.,and Dalamaga et al study.[25,27] Platelet activation causes changes in the morphology and pseudopodia formation. This difference in size and shape (discoid to spherical) leads to change in platelet distribution width.

In our study, plateletcrit (PCT) showed statistically significant difference ($p<0.0001$) between the two Diabetic group. Plateletcrit is higher in Diabetic groups than the normal group. Since the larger platelets are more reactive in Diabetic subjects, the platelet mass increases, thereby increasing PCT. Swaminathan et al study, found that PCT is high in the type 2 Diabetes Mellitus subjects (18). In khan et al study, PCT was higher in patients with hyperglycemia than the normoglycemia. [28]

Table1:Comparison of Physical Characteristics Between Controlled And Uncontrolled Diabetes Mellitus group :

Characteristics	Diabetes mellitus group		T-test	P-value
	Controlled DM (n=50) Mean ± SD	Uncontrolled DM (n=50) Mean ± SD		
Age (years)	55.42±7.25	54.5±10.98	-0.494	0.622
BMI(kg/m^2)	28.08±3.61	27.09±3.99	1.301	0.196
Duration (years)	5.70±2.17	6.78±2.49	2.31	0.02

DM - Diabetes Mellitus, SD - Standard Deviation, BMI - Body Mass Index.

Table 2:Comparison of Blood Parameters Between Controlled and Uncontrolled Diabetes Mellitus group

Blood parameters	Diabetes mellitus group		T-Test	P-Value
	Controlled DM(n=50) Mean ± SD	Uncontrolled DM (n=50) Mean ± SD		
FBS (mg/dl)	105.8±10.44	185.2±76.92	7.221	<0.0001*
PPBS(mg/dl)	133.8±15.01	288.9±108.5	10.005	<0.0001*
HbA1c (%)	6.03±0.43	8.85±1.42	12.89	<0.0001*
PLT CT (lakh/cu.mm)	2.69±0.60	2.97±0.81	1.920	0.058

*Statistically significant.

[Table -2]Among the Diabetic group, the FBS, PPBS and Hb A1c washigher in uncontrolled DM than thecontrolledDM subjects, which is statistically significant. The analysis shows that there was no significance between the platelet count of the two Diabeticgroups.

Table 3: Platelet Indices in Diabetic Mellitus Subjects.

Platelet Indices	Diabetes Mellitus group n =100		T-test	P-value
	Controlled DM (n=50) Mean ± SD	Uncontrolled DM (n=50) Mean ± SD		
MPV (fL)	7.7±0.90	9.7±1.08	10.312	<0.0001*
PDW(fL)	9.8±0.82	11.8±1.67	7.061	<0.0001*
PCT(%)	0.11±0.005	0.20±0.05	12.52	<0.0001*

*Statistically significant. MPV: Mean platelet volume, PDW: Platelet distribution width, PCT: Plateletcrit

Figure:1 Comparison Of Mean Platelet Volume between Controlled And Uncontrolled DiabetesMellitus Group

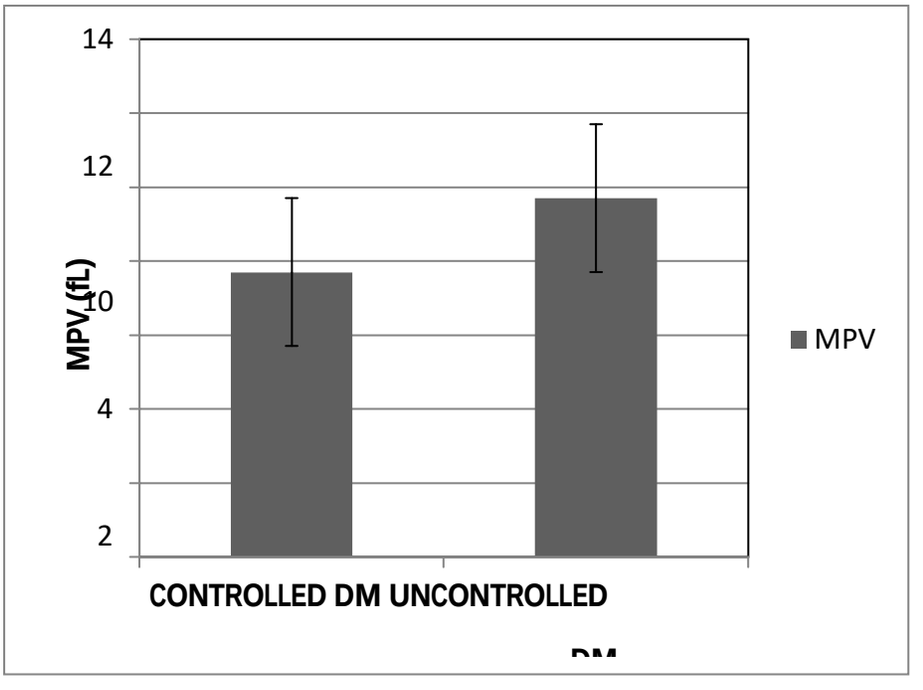

Figure 2: Comparison of Platelet Distribution Width between Controlled and Uncontrolled Diabetes Mellitus group

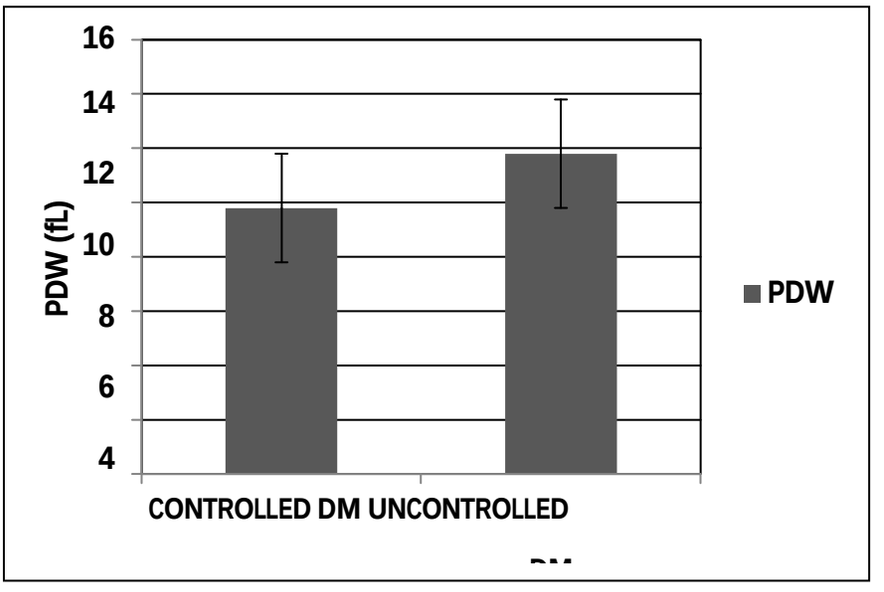

Figure 3: Comparison of Plateletcrit between Controlled and Uncontrolled Diabetes Mellitus group

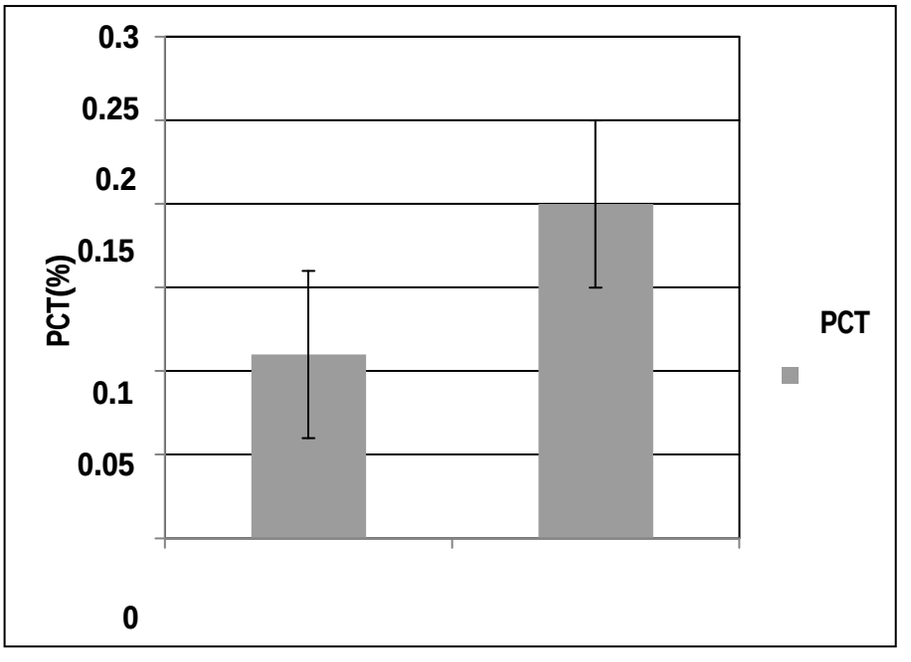

Table -3 and Figure 1,2,3 shows themean and standard deviation of the platelet indices values (MPV, PDW, PCT) of twoDiabeticgroups. Platelet indices between controlled and uncontrolled DM was statistically significant.

Table 4 :Platetet Indices between Diabetic And Control Subjects

Platelet Indices	Diabetes Mellitus group (N=100) Mean ± SD	Control group (N=100) Mean ± SD	T-test	P-value
MPV (fL)	8.69±1.43	7.44±0.68	-7.89	<0.0001*
PDW (fL)	11.7±1.28	10.92±1.17	-4.468	<0.0001*
PCT (%)	0.16±0.05	0.16±0.03	0.000	1.000

Figure 4 Comparison of Mean Platelet Volume between Diabetes Mellitus and Control group

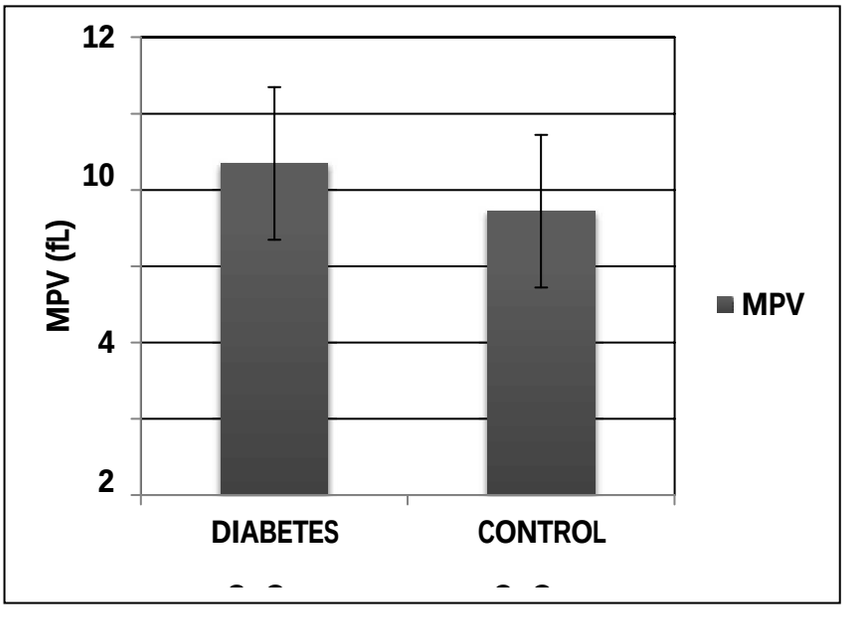

Figure 5: Comparison of Platelet Distribution Width between Diabetes Mellitus and Control group

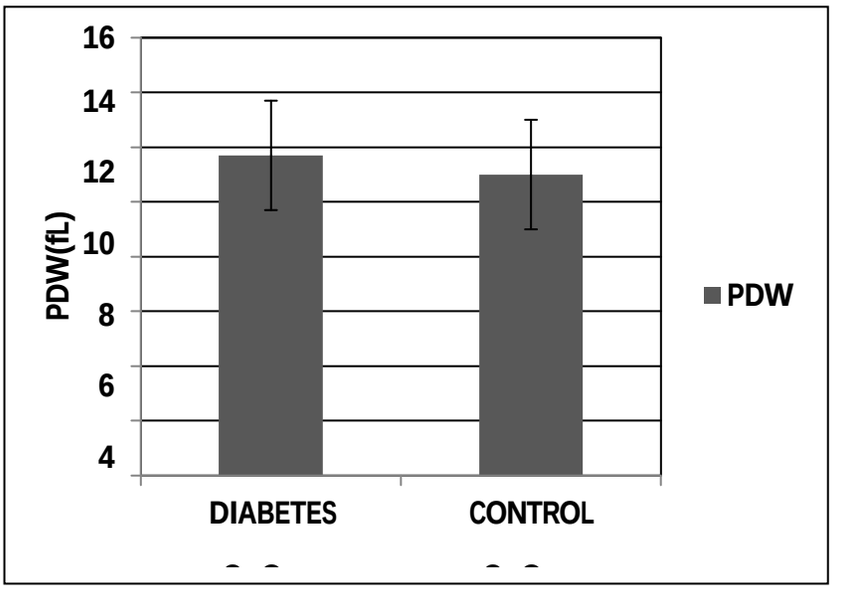

Figure 6 : Comparison of Plateletcrit between Diabetes Mellitus and Control group

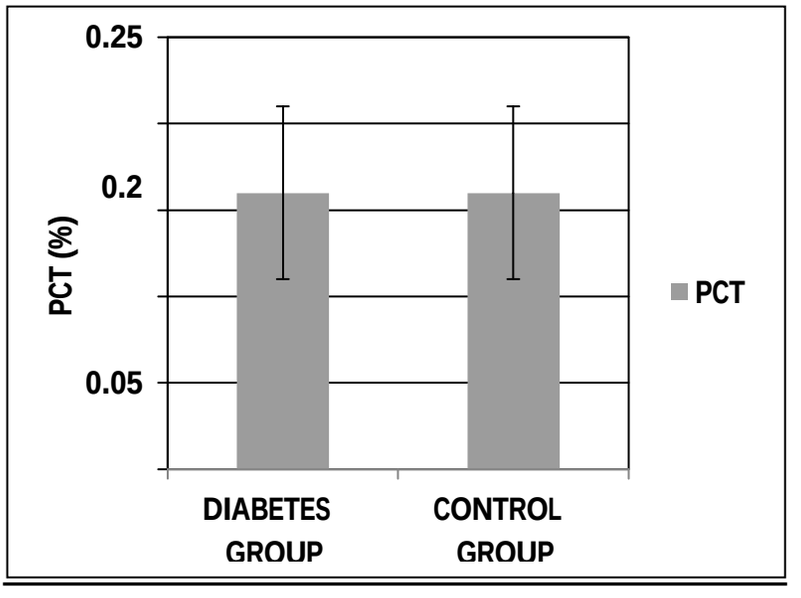

Table 4 and Figure 4,5,6 shows the comparison of the platelet indicesbetween the Diabetic group and control group. MPV and PDW shows statistical significance. The difference in plateletcrit was not significant between Diabetic and control group.

Conclusion

Our study found that hyperglycemia leads to platelet hyperactivity. Subjects with uncontrolled Diabetes Mellitus have an increase in morbidity and mortality. The control of glycemic status in each and every Diabetic individual can prevent the development of micro vascular and macro vascular complications. The regular treatment for Diabetes Mellitus is needed. Therefore, it improves the platelet activity and their functions. So, the platelet indices (MPV, PDW and PCT) could be used as a prognostic marker to monitor the platelet activation and progression of the complications in Diabetes Mellitus.

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Conflict of interest: Nil

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