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RESEARCH

ANALYSIS OF MEAN PLATELET VOLUME IN TYPE II DIABETIC PATIENTS WITH VASCULAR COMPLICATION

(Analisis Mean Platelet Volume Pasien Diabetes Melitus Tipe II dengan Komplikasi Vaskuler)

Mustakin, Liong Boy Kurniawan, Nurahmi, Ruland DN Pakasi

ABSTRAK

Penyakit Diabetes Melitus (DM) merupakan kelainan yang tersebar luas di seluruh dunia. Penyakit DM tipe 2 dengan komplikasi lama berkaitan dengan gangguan pembuluh darah yang timbul mencakup yang terkait mikrovaskuler seperti: retinopati, nefropati dan neuropati, serta komplikasi makrovaskuler seperti: penyakit jantung koroner dan penyakit pembuluh darah besar. Trombosit yang berukuran besar bersifat trombogenik dan menjadi faktor kebahayaan komplikasi mikro dan makrovaskuler. Penelitian ini untuk mengetahui nilai Mean Platelet Volume (MPV) di pasien DM tipe 2 dengan komplikasi makro dan mikrovaskuler dan tanpa komplikasi vaskuler; serta pembanding sehat dari yang tidak berpenyakit diabetik dengan cara membandingkan. Penelitian ini bersifat potong lintang dengan menggunakan data rekam medis pasien di rumah sakit Dr.Wahidin Sudirohusodo Makassar selama masa waktu antara bulan Januari 2011—Desember 2013 terhadap 314 pasien DM tipe 2 (136 dengan komplikasi makrovaskuler dan 49 komplikasi mikrovaskuler) dan 129 yang tanpa komplikasi) serta 150 pembanding sehat yang bukan DM. Rerata nilai MPV di pembanding yang normal, DM tipe 2 tanpa komplikasi, DM tipe 2 dengan komplikasi, berturut-turut adalah: 8,77±0,52fl, 8,93±1,07fl, 10,28±1,95fl. Uji Kruskal-Wallis menunjukkan perbedaan bermakna nilai MPV antara pembanding yang normal DM tipe 2 disertai komplikasi serta DM tipe 2 tanpa komplikasi vaskuler (p=0,000). Uji Mann Whitney menunjukkan perbedaan bermakna nilai MPV antara pembanding nonDM dengan DM tipe 2 yang disertai komplikasi (p=0,000), DM tipe 2 tanpa komplikasi dengan yang disertai komplikasi (p=0,000). Tidak ditemukan perbedaan nilai MPV yang bermakna antara pembanding normal dengan pasien DM tipe 2 tanpa komplikasi (p=0,401) dan yang disertai komplikasi makrovaskuler dan mikrovaskuler (p=0,522). Nilai MPV di kelompok DM tipe 2 dengan komplikasi lebih tinggi dibandingkan dengan DM tipe 2 tanpa komplikasi dan pembanding yang bukan DM.

Kata kunci: *Mean platelet volume, diabetes melitus, vaskuler*

ABSTRACT

Diabetes Mellitus (DM) is a metabolic disorder found all over the world. Long term complications are related to the vascular diseases and classified into micro vascular disease such as: retinopathy, nephropathy and neuropathy. The macrovascular disease concerns the heart and vascular. Large platelets are more thrombogenic and put the patient at a higher risk. Mean Platelet Volume (MPV) is a determinant of platelet function and increased MPV is associated with high risk for vascular complication. The objective of this study is to know the MPV in DM patients with macro, micro vascular complications, without vascular complication and healthy controls by comparison. This study was performed from medical records type 2 DM including 314 patients type 2 DM (136 with macrovascular complications, 49 with microvascular complications, 129 without vascular complications) and 150 healthy controls. The MPV value was found in normal healthy controls, DM type 2 without complication and with complication, 8.77±0.52fl, 8.93±1.07fl, 10.28±1.95fl, respectively. Kruskal-Wallis test showed difference of MPV value between normal controls, with DM type 2 without and with vascular complications (p=0.000). Mann Whitney test showed significant differences of MPV value between healthy controls and type 2 DM with complications (p=0.000) and between type 2 DM with and without complications (p=0.000). There was no significant difference between healthy controls and type 2 DM without complications (p=0.401) and between those with macro and microvascular complications (p=0.522). Mean platelet volume values in type 2 DM patients with vascular complications were higher then in those without complications and healthy controls.

Key words: Mean platelet volume, diabetes mellitus, vascular

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INTRODUCTION

Diabetes mellitus is a metabolic disorder with hyperglycemia caused by insuline secretion disorder, insuline use disorder by cells or both. Chronic hyperglycemia in diabetes is related to the long-term damage which involves body organ malfunction, especially eyes, nerve, heart and vascular.

According to American Diabetic Association (ADA) in 2014, DM was categorized into four (4) clinical groups such as DM type 1 and 2, another type of DM and gestational diabetes.[1–3]

The microvascular complications (retinopathy, nephropathy and neuropathy) increase the number of DM patients. Retinopathy and nephropathy diseases are the main causes for blindness and chronic renal disease while macrovascular (vascular disease, coronary heart and lower extremities) is the main cause of diabetic patient's disease and mortality. More than 75% of diabetic patients passed away because of cardiovascular disease. *The Diabetes Control and Complication Trial* (DCCT) and *The UK Prospective Diabetes Study* (UKPPDS) showed a strong relation between hyperglycemia and chronic vascular complication occurance in diabetic patients.[4–6]

The chronic vascular complication is related to hyperactivity of platelets in DM type 2. Hyperactivity of platelets has an important role on atherosclerosis and the increase of artery platelets in DM patients.[7,8]

One of the indicators used to evaluate the hyperactivity of platelets in DM type 2 patients is *Mean Platelet Volume* (MPV). *Mean platelet volume* is the average measurement and volume of platelets with a normal range between 6.6-11 fl. *Mean platelet volume* links to the amount of glycoprotein molecules in membrane, the ability of producing thromboxane and the content of granules.

The platelet hyperactivity in DM type 2 patients causes the increase of platelet agregation, fibrin bound and thromboxane production. The *Mean platelet volume* in DM patients is higher than non-DM patients. *Mean platelet volume* in DM type 2 patients is meaningfully higher than in non-DM patients, but the relation between MPV in DM with complication and non-complication is not significant.[8–12]

From the explanation above, MPV needs to be examined more in DM type 2 patients with vascular and non-vascular complications. The *Mean platelet volume* examination is easy, quick and relatively cheap. The *Mean platelet volume* indicators are expected to be additional signs to periodically monitor DM type 2 patients.

METHODS

This research was a cross-sectional study conducted from July to August 2014 in Dr. Wahidin Sudirohusodo Hospital Makassar by taking the medical record data of DM type 2 patients between January 2011-December 2013. The population of this research was all data of DM type 2 patients with non-vascular complications and vascular complications (macro and microvascular).

The Benchmark participants were all patients older than 30 years and who were diagnosed by Internal Medicine Doctor and who suffered from DM type 2 with and without vascular complications. The routine blood used was the first blood test by the hematological *Sysmex XT 2000i* analyzer when the patients were hospitalized. The patient data were not included if the patients were suffering from an infection like leukocytosis, thrombocytopenia, thrombocytosis, anemia and if they had a history of malignant disease. The statistical test was done using SPSS 17.0 software to know the MPV grade of DM type 2 patient with and without complications. Normality test with Kolmogorov-Smirnov showed all the benchmark that had normally been studied.

RESULTS AND DISCUSSION

About 314 patients with DM type 2 (the samples of this research) consisted of 206 males (65.6%) and 108 female patients (34.4 %). The examined DM type 2 patients consisted of 129 people without vascular complications and 185 people with it. The highest number of patients' age 51-60 was 70 patients (37.8%) consisting 139 males (75.1%) and 46 females (24.9%). The MPV in DM type 2 patients was compared with MPV in 150 healthy people. Further data are shown in table 1.

Tabel 1. The characteristic of research subject in health comparison and DM type 2

Variable	n (%)
A health comparison (n=150)	
Age	
Between 30–40 years old	52 (34.7)
Between 3 41–50 years old	78 (52.0)
Between 3 51–60 years old	18 (12.0)
Between 3 61–70 years old	2 (1.3)
Gender	
Male	70 (46.7)
Female	80 (53.3)

Table 2. The subjects characteristic of DM type 2, without complications and with macro complications and microvascular

Characteristics	n (%)
DM without complications (n=129)	
Age	
30–40 years old	11 (8.5)
41–50 years old	21 (16.3)
51–60 years old	45 (34.9)
61–70 years old	38 (29.5)
>70 years old	14 (10.9)
Gender	
Male	13 (10.1)
Female	116 (89.9)
DM with complications (n=185)	
Age	
30–40 years old	12 (6.5)
41–50 years old	25 (13.5)
51–60 years old	70 (37.8)
61–70 years old	57 (30.8)
>70 years old	21 (11.4)
Gender	
Male	139 (75.1)
Female	46 (24.9)
Microvascular complications (n=136)	
Age	
30–40 years old	1 (0.7)
41–50 years old	7 (5.1)
51–60 years old	62 (45.6)
61–70 years old	47 (34.6)
>70 years old	19 (14.0)
Gender	
Male	121 (89.0)
Female	15 (11.0)
Microvascular complications (n=49)	
Age	
30–40 years old	10 (20.4)
41–50 years old	18 (36.7)
51–60 years old	9 (18.4)
61–70 years old	10 (20.4)
	2 (4.1)
Gender	
Male	18 (36,7)
Female	31 (63,3)

Table 3. The characteristics of DM type 2 with macro and microvascular complications

Macrovascular and microvascular complications (n=185)	n (%)
Coronary heart disease	110 (59.5)
Diabetic foot	26 (14.1)
Diabetic retinopathy	3 (1.6)
Diabetic nephropathy	46 (24.9)

Feature samples for DM type 2 with and without macro complications and microvascular are shown in table 2.

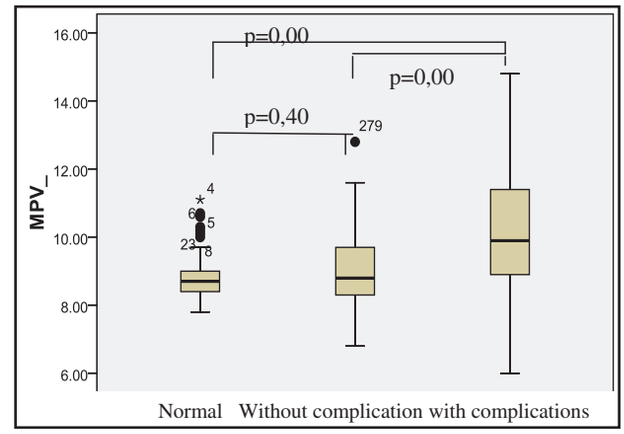
DM type 2 patients with vascular complications consisted of: those with macrovascular complications in the precentage of; CHD 110 (59.5%), diabetic foot 26 (14.1%) and microvascular complication in the total of: diabetic retinopathy 3 (1.6%) and diabetic nephropathy 46 (24.9%). Further complete data can be seen in Table 3.

The different results of blood and chemical routine examination on a comparative group with non-DM and DM type 2 without complication; group of type 2 DM with macrovascular complications and microvascular complications are shown in Table 4 and Table 5.

The *post hoc* test using Mann Whitney with MPV value from DM type 2 patients in comparison to healthy people showed significant differences not only in comparison of DM type 2 without complications (p=0.000) and DM type 2 without complications, but also in DM type 2 with vascular complications (p=0.000).

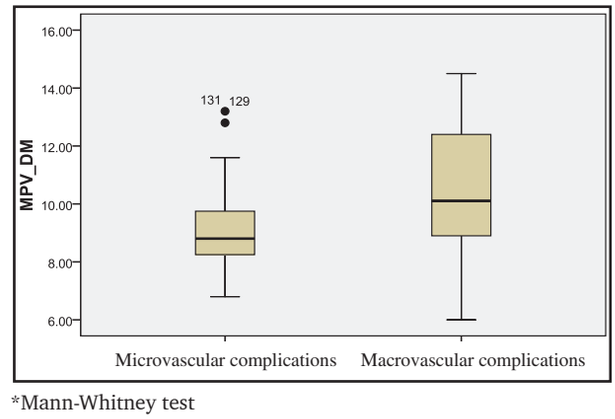
However in this case there was no significant difference in comparison of healthy people and DM without complications (p=0.401) as shown in Figure 1.

The comparison of MPV value between DM type 2 with macrovascular complications and microvascular



*Mann-Whitney test

Figure 1. The DM type 2 patients' average MPV value



*Mann-Whitney test

Figure 2. The average MPV value of DM type 2 patients with vascular complications

Table 4. The different results of blood and chemical routine examination in a comparative group with non-DM and DM without complications

Variable (category)	Comparison of non-DM (n=150)		DM with complications (n=129)		p*
	Mean±SD	Median (min-max)	Mean±SD	Median (min-max)	
RBC($10^6/\mu$L)	4.83±0.49	4.78(3.77-6.57)	4.68±0.65	4.67(1.34-5.82)	0.146
HB(gr/dL)	14.11±1.36	14.10(11.50-17.10)	13.90±1.34	13.60(11.50-17.10)	0.205
WBC($10^3/\mu$L)	666±138	701(402-101)	693±141	701(406-980)	0.229
PLT($10^3/\mu$L)	277±50.14	277(168-436)	275±67.42	268(156-678)	0.340
MPV(fl)	8.77±0.52	8.70(7.80-11.10)	8.93±1.07	8.86(6.80-12.80)	0.401
PDW(%)	9.27±0.85	9.05(7.70-13.60)	9.55±1.68	9.00(7.10-14.40)	0.668
FDP(mg/dL)	91.83±8.73	94(62-108)	203.31±82.22	176(63-497)	0.000
TG(mg/dL)	137.42±83.29	111(35-4310	126.77±75.71	103(35-459)	0.393
LDL(mg/dL)	135.18±38.60	129.50(62-280)	135.58±38.73	137(33-264)	0.648
HDL(mg/dL)	49.39±15.60	47.50(23-152)	51.81±20.67	49(19-152)	0.587
Ureum(mg/dL)	45.59±17.73	41.00(19-152)	29.27±23.81	23.00(9-146)	0.006
Creatinine (mg/dL)	0.78±0.19	0.80(0.10-1.60)	0.99±0.56	0.80(0.10-3.20)	0.077

* Mann Whitney Test

Information:
RBC: *Red Blood Cell*, WBC: *White Blood Cell*, PLT: Platelet, MPV: *Mean Platelet Volume*, PDW: *Platelet D istribution Width*, FBG: *Fasting Blood Glucose*, TG: *Triglyceride*

Table 5. The different result of blood and chemical routine examination on group of DM type 2 patients with macrovascular and microvascular complications

Variable (category)	Macrovascular DM (n=136)		Microvascular DM (n=49)		p*
	Mean±SD	Median (min-max)	Mean±SD	Median (min-max)	
RBC($10^6/\mu$L)	4.15±0.97	4.32(1.86-5.79)	4.48±0.93	4.58(2.04-6.57)	0.092
HB (g/dL)	13.92±1.36	13.73(10.20-17.40)	13.71±1.36	13.30(11.50-16.90)	0.100
WBC($10^3/\mu$L)	787±121	806(470-100)	6975±164	703(306-100)	0.005
PLT($10^3/\mu$L)	242±65.10	233(150-453)	275±57.88	285(157-383)	0.002
MPV(fl)	10.26±1.96	9.90(6.0-14.80)	10.05±1.69	9.70(7.10-14.50)	0.522
PDW (%)	12.18±2.29	11.85(7.90-17.90)	11.44±2.31	11.40(6.90-16.90)	0.055
FDG(mg/dL)	195.08±82.89	170.50(81-497)	212.89±88.57	185(96-456)	0.174
TG (mg/dL)	180.92±117.01	157.50(34-992)	130.10±60.42	117(540-315)	0.001
LDL(mg/dL)	142.20±47.31	141.50(33-270)	138.20±39.32	131(74-244)	0.492
HDL(mg/dL)	40.41±11.80	38(19-126)	47.87±12.55	47(22-76)	0.000
Ureum (mg/dL)	42.58±41.60	34(0.9-326)	26.84±20.57	22(14-125)	0.000
Creatinine (mg/dL)	1.32±2.11	1(0.10-23)	0.99±0.68	0.90(0.50-4.10)	0.000

* Mann-Whitney test

Information:
RBC; *Red Blood Cell*, WBC; *White Blood Cell*, PLT: Platelet, MPV: *Mean Platelet Volume,* PDW: *Platelet Distribution Width*, FBG: *Fasting Blood Glucose*, TG: *Triglyceride,* LDL: *Low Density Lipoprotein*, HDL: *High Density Lipoprotein*

Table 6. The comparison of MPV value in a group of DM type 2 without complication, macro and microvascular complications

Type 2 DM	MPV average	*p
Without complications	8.93±1.07	
DM with complications	10.28±1.95	0.000
Macrovascular complications	10.26±1.96	
Microvascular complications	10.03±1.69	

*Kruskall Wallis test

showed non significant differences (p=0.522), as shown in Figure 2.

This study showed that patients with DM type 2 were the most prevalent between the ages of 51-60 years old with the age average of 57.89±11.36 years old.

The same experiment was done by Farah Jabeen *et al*[8] with mean age 51.08±0.7 years old among 93 male patients from 170 samples of DM type 2.[8–10]

Sufferers between comparison of healthy ones with MPV rate (8.77±0.85) and DM type 2 with macro complications (10.26±1.96) and microvascular (10.05±169) complications revealed a significant difference, but they did not show significant differences between healthy MPV value and DM type 2 non-complication (8.93±1.07) even though the MPV mean rate in DM type 2 non-complication patients was higher than the MPV's healthy mean rate. The increasing MVP rate in DM type 2 with complications showed that there was a meaningful relation in thrombogenicity and atherosclerosis in DM type 2 patient's vascular endothel with vascular complications. The increase of platelet activity became the trigger of vascular complications in DM type 2 disease. The experiment done by Kodiatte *et al*[10] showed that MPV rate was higher in DM type 2 patient (with complications or not) than it was in the healthy group, meanwhile in this experiment MPV rate in that group was only different in meaning with MPV rate in DM type 2 with complications. Comparison of MPV rate in DM type 2 patients with vascular complication (10.28±1.95)fl and without vascular complication (8.93±1.07)fl showed that there was a meaningful difference. This showed that the increase of thrombogenicity had a higher mean size of blood platelets volume in DM type 2 with vascular complication than without complication with mean MPV in DM type 2 without such condition 8.93±1.07fl while MPV in DM type 2 with complication 10.28±1.95. The same research was done by Kodiatte *et al*[10] showing different results which MPV in DM type 2 patients with complications (8.35±0.73) was higher than MPV in DM type 2 patients without (8.2±0.74), but did not show a different significance (p=0.145).[9,10]

The MPV value in DM type 2 patients followed by vascular complications and microvascular did not show a big difference (p=0.522) with average (10.26±1.96 vs 10.05±1.69). In this research, the MPV average score in DM type 2 patients with microvascular complications was higher than the average MPV in DM type 2 patients with macrovascular complications. The weakness of this research was platelet aggregation test and the examination of peripheral blood by comparison with MPV value in samples which was not examined. Furthermore, not all the abnormalities and diseases that influence MPV in patients were entirely known.

CONCLUSION AND SUGGESTION

The MPV score of DM type 2 with complications is higher than the DM type 2 without and without the presence of DM.

The researchers are able to accept sugestions about the way next research is expected to be able to examine with cohort method by comparing MPV score with platelet aggregation and disease development.

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