



*Difference of Red Blood Cell Count (RBC) Levels in Diabetes Mellitus Type II  
with Ulcers and without Ulcers*

Perbedaan Jumlah Sel Darah Merah (RBC) pada Diabetes Mellitus Tipe II  
dengan Ulkus dan tanpa Ulkus

Miftahul Mushlih

Fakultas Ilmu Kesehatan, Universitas Muhamadiyah Sidoarjo

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**Abstract**

Type II diabetes mellitus (T2DM) is a metabolic disorder that has potential causing ulcer complications. Ulcers occur due to peripheral vascular abnormalities and trauma. The occurrence of ulcers allows differences in the hematology characteristics in sufferers. This study aimed to determine the comparison of the blood picture between T2DM with ulcers and T2DM without ulcers. This was an analytical descriptive research using 29 samples (10 T2DM samples with ulcers and 19 T2DM samples without ulcers). A complete blood test was performed using Sysmex Kx-21N hematology analyzer. Data were analyzed using Independent T-test and Mann-Whitney U depends on the normality. Normality was done using Shapiro Wilk (Confident Level: 95%). The results of this study indicated that Red blood cell count (RBC) and Hemoglobin Count (HGB) differ significantly between T2DM with ulcers and T2DM without ulcers ( $p$ : 0.012 and 0.006). Identification of HGB levels was highly recommended to get proper treatment in T2DM.

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**Abstrak**

Diabetes mellitus tipe II (DMT2) merupakan kelainan metabolik yang berpotensi mengakibatkan komplikasi ulkus. Ulkus terjadi akibat adanya kelainan pembuluh darah perifer dan trauma. Kejadian ulkus menyebabkan perbedaan karakter hematologi pada penderitanya. Penelitian ini bertujuan untuk membandingkan gambaran darah antara DMT2 dengan ulkus dan DMT2 tanpa ulkus. Penelitian ini merupakan penelitian deskriptif analitik dengan menggunakan sampel sebanyak 29 (10 sampel DMT2 dengan ulkus dan 19 sampel DMT2 tanpa ulkus). Pemeriksaan darah lengkap dilakukan menggunakan Sysmex Kx-21N hematology analyzer. Analisis data dilakukan dengan Independent T test dan uji Mann-Whitney U tergantung pada normalitas data. Normalitas dianalisis menggunakan uji Shapiro Wilk (Confident Level: 95%). Hasil Penelitian ini menunjukkan Red blood cell count (RBC) dan Hitung Hemaglobin (HGB) berbeda secara nyata antara DMT2 dengan ulkus dan DMT2 tanpa ulkus ( $p$ : 0.012 dan 0.006). Identifikasi HGB sangat direkomendasikan untuk mendapatkan pengobatan pada DMT2.

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 \*Corresponding Author:

Jln. Raya Lebo No 4 Rame Pilang, Kecamatan Wonoayu, Sidoarjo  
E-mail: mif.mushlih@umsida.ac.id

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## INTRODUCTION

Diabetes Mellitus is a metabolic disorder caused by unproductive, not optimal insulin performance or both (Suneja et al., 2018). Diabetes can be categorized into Type I Diabetes Mellitus (T1DM), Type 2 Diabetes Mellitus (T2DM), Gestational Diabetes Mellitus and Diabetes Mellitus which causes are unknown (Ekoe et al., 2018). Currently, T2DM abnormalities in the sixth rank cause of death in the world. In 2030 the prevalence of DM in Indonesia was predicted will increase within 366 million people. The prevalence of Diabetes Mellitus in the world tends to increase and reach 4.4% (WHO, 2004). It is caused the disorder not only comes from genetic factors but also environmental factors (Hu, 2011). Understanding of T2DM is more difficult caused it is a multi-genomics disorder (Tsaih et al., 2014).

T2DM complications cause sufferers to experience prolonged pain (Lathifah, 2017). These complications may as macrovascular and microvascular complications. Macrovascular complications include coronary artery disease, peripheral arteries, and stroke. While, microvascular complications include diabetic nephropathy, neuropathy, and retinopathy (Yuhelma et al., 2015). In the long period, T2DM sufferers can cause several problems such as decreased quality of vision, the emergence of ulcers or gangrene, kidney damage, high blood pressure, liver damage and even stroke (Tsaih et al., 2014).

An ulcer is one of the complications that are often experienced by people with T2DM. As many as 15% of T2DM sufferers have ulcers (Aumiller & Dollahite, 2015). The dominant risk factors causing ulcers are Peripheral Artery Disease (PAD) and trauma (Loviana et al., 2015). Ulcers with extreme conditions will result in amputations to prevent wider complications (Aumiller & Dollahite, 2015). The occurrence of ulcers can also be more dangerous if accompanied by a serious infection (Fitria et al., 2017). Early treatment of ulcers is one of the keys to avoiding broader complications (Mirtha et al., 2018). The factors that influence ulcer occurrence are the duration of DM, neuropathy, PAD, history of trauma, and foot care are risk factors for diabetic ulcers (Loviana et al., 2015). Social support is needed for DMT2 to keep trying to heal and improve the awareness of treatment (Ramkisson et al., 2017).

Hematology character influences someone with DM condition (Biadgo, 2016). Several studies have shown differences in the character of hemoglobin in

people with T2DM with ulcers and without ulcers. However, information about the characteristics of hematology in patients with DM is still limited (Thomas et al., 2005). This study aimed to determine differences in the characteristics of hematology in T2DM with ulcers and without ulcers.

## MATERIAL AND METHODS

This research was cross-sectional. The ethical study was approved by the ethics commission of Airlangga University, Indonesia with no. 195 / HRECC.FODM / V / 2019. A total of 29 samples were taken from various places in Sidoarjo. 10 T2DM samples were taken at Rumah Luka Sidoarjo Branch. Whereas T2DM samples without ulcers were taken from several places (health centers) in Sidoarjo. Whole Blood was taken by macro sampling in 3 cc venous blood into an EDTA anticoagulant tube. Furthermore, T2DM blood samples were labeled and immediately stored in a cooling cupboard 4°C. Complete blood count was conducted using hematology Analyzer Sysmex Kx-21N with analyzed parameters analyzed were White blood cell count (WBC); Red blood cell count (RBC); Calculate Hemoglobin (HGB); Hematocrit (Ht or HCT); Average red blood cells (Mean Corpuscular Volume / MCV); Mean corpuscular hemoglobin or MCH; Mean corpuscular hemoglobin concentration or MCHC; Platelet (PLT). Calculation of different tests was conducted by using independent T-test and Mann-Whitney U test depending on the normality test. Normality Test used was Shapiro-Wilk. The Confident Level used was 95%.

## RESULT AND DISCUSSION

Based on the research results, it was found that Diabetes Mellitus Type II was obtained; with a composition of 60% being male and 40% were female. The sample was obtained from Rumah Luka Sidoarjo. The results of this study can be described according to the observed parameters ie WBC on T2DM obtained at  $7210 \pm 3839.11$  /ul (Sign. 0.327) with a lower value compared to T2DM without ulcers  $8663.15 \pm 3668.81$  ul; whereas the parameters of HCT in T2 DM with ulcers have an average of  $33.74 \pm 11.41$  lower when compared to T2 DM without ulcers  $37.25 \pm 5.27$  (Sign. 0.264). The MCV value in T2DM with ulcers has a lower value compared to T2DM with ulcers  $88.97 \pm 12.77$  fl while in T2DM it is  $81.35 \pm 5.76$  fl. MCH and MCHC values respectively in T2DM with ulcers

28.26 ± 9.03 pg and 32.11 ± 9.84 g/dl whereas in T2DM without ulcers 27.60 ± 3.44 & 33.66 ± 2.69 g/dl respectively were not significantly different, namely 0.148 and 0.748. The value of PLT with ulcers was 387.8 ± 200.32 x 10<sup>3</sup>/μL and in T2DM without ulcers was 336.68 ± 124.27 x 10<sup>3</sup>/μL (Sign. 0.206) (Table 1).

Based on the analysis, RBC and HGB have significantly different values. The RBC and HGB values respectively in T2DM with ulcers were 3.77 ± 1.03 x 100/μL and 10.14 ± 2.33 g/dl whereas in T2DM without Ulcers 4.56 ± 0.55 x 100/μL and 12.67 ± 2.06 g/dl (p: 0. 012 & 0.006). Anemia is often found in diabetic patients (Kothari & Bokariya, 2012; Kizilgul *et al.*, 2018). This study is supported by Wright (2014) study which stated that T2DM accompanied by ulcers was more likely to suffer from anemia. T2DM sufferers accompanied by ulcers are macrovascular complications that occur in about 15% of people with diabetes (Salman *et al.*, 2017). 60-80% of sufferers will recover but 5-24% will lead to amputation (Alexiadou & Doupis, 2012).

The relationship between anemia and T2DM with ulcers is not yet well understood (Salman *et al.*, 2017). However, several supporting factors have been identified. Among these factors are age (Fitria *et al.*, 2017), history of amputation, insulin use, sex, distal neuropathy, foot deformities (Yazdanpanah *et al.*, 2018). The number of reported events was also quite diverse. However, the majority stated that more than 50% of people with T2DM with ulcers had anemia (Kothari & Bokariya, 2012; Salman *et al.*, 2017). Anemia may also occur in other DM complications, namely kidney failure (Abate *et al.*, 2013). Other research on the description of blood components showed that fasting blood glucose

levels were isolated with hemoglobin and hematocrit (Christa, 2014). The incidence of anemia in diabetes allows for more severe complications including ischemic heart disease, hypertension, and kidney failure.

Anemia in DM Ulcers is associated with vascular complications such as nephropathy, retinopathy, and neuropathy which result in slow healing of the wound (Abate *et al.*, 2013). Ulcer incidence reached 15% of total sufferers. Until now, amputation is the final path of complications (Salman *et al.*, 2017). Anemia is reported to be a side effect of DM (Kothari & Bokariya, 2012). Proteins from RBC membranes undergo oxidation through non-enzymatic glycosylation due to increased oxidative stress in diabetes and reduce levels of PCV, HB, RBC which can cause hemolysis and consequently become anemic (Mohammed *et al.*, 2013).

### CONCLUSION

The results of this study showed that red blood cell count (RBC) and Hemoglobin Count (HGB) differed significantly between T2DM with ulcers and T2DM without ulcers. Identification of HGB levels was highly recommended to get proper treatment in T2DM.

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**Table 1.** Character and differences between T2DM ulcer and T2DM without ulcer

Parameters	means + SD DM ulcer	means + SD without Ulcer	Total means + SD	Statistical Test	P- value
WBC (/μl)	7210 ± 3839.11	8663.15±3668.81	8162.06±3726.20	Independent T- test	0.327
RBC ( x 100/μL)	3.77 ±1.03	4.56±0.55	4.28±0.82	Independent T- test	<b>0.012</b>
HGB (g/dl)	10.14 ±2.33	12.67±2.06	11.8±2.44	Independent T- test	<b>0.006</b>
HCT	33.74 ±11.41	37.25±5.27	36.04±7.91	Independent T- test	0.264
MCV (fl)	88.97 ±12.77	81.35±5.76	83.97±9.34	Mann-Whitney U	0.141
MCH (pg)	28.26 ±9.03	27.60±3.44	27.83±5.82	Mann-Whitney U	0.148
MCHC g/dl	32.11 ±9.84	33.66±2.69	33.12±6.03	Mann-Whitney U	0.748
PLT (x 10 <sup>3</sup> / μL)	387.8 ±200.32	336.68±124.27	354.31±153.09	Mann-Whitney U	0.206
Glucose (mg/dl)	239.2 ±752.52	266.63±73.79	257.17±74.23		

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