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RELATIONSHIP BETWEEN HbA1C AND eGFR IN DIABETES MELLITUS (DM) PATIENTS FOLLOWING PROLANIS AT ULTRA MEDICA TULUNGAGUNG CLINIC LABORATORY

Taufik Salis Syaifudin[1], Fatimah[1], Mutia Hariani Nurjanah[1], Nurul Chamidah Kumalasari[2], Wimbuh Tri Widodo[3]
[1,2,3]Program Studi Analis Kesehatan, STIKes Karya Putra Bangsa Tulungagung

*[1]e-mail : mutiahariani994@gmail.com
*[2]e-mail : taufiksaliss@gmail.com

Abstrak

Diabetes melitus adalah suatu kondisi metabolisme glukosa darah yang tidak normal yang ditandai dengan hiperglikemia yang berkepanjangan dan peningkatan kadar HbA1c sebagai pemeriksaan standar untuk diabetes melitus. HbA1c menggambarkan kadar gula dalam darah selama 3 bulan terakhir. Salah satu komplikasi diabetes melitus adalah kerusakan ginjal. Keadaan fungsi ginjal dapat digambarkan dari pemeriksaan GFR (Glomerular Filtration Rate) sebagai pemeriksaan standar kelainan pada penyakit ginjal. Tujuan dari penelitian ini adalah untuk mengetahui hubungan kadar HbA1c dengan nilai eGFR pada penderita diabetes melitus. Rancangan penelitian ini adalah pendekatan cross-sectional terhadap 30 sampel pasien DM yang mengonsumsi Prolanis di Laboratorium Klinik Ultra Medica Tulungagung. Hasil penelitian menunjukkan bahwa rata-rata kadar HbA1c pada seluruh sampel adalah 6,2% dan rata-rata nilai eGFR adalah 88,7 ml/menit/1,73m2. Uji korelasi Pearson diperoleh nilai ρ = 0,000 sehingga dapat disimpulkan bahwa ada hubungan kadar HbA1c dengan nilai eGFR pada penderita diabetes melitus yang mengonsumsi Prolanis di Laboratorium Klinik Ultra Medica Tulungagung.

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Kata kunci: HbA1c, Diabetes Mellitus, eGFR

Abstrak

Diabetes mellitus is a condition of abnormal blood glucose metabolism characterized by prolonged hyperglycemia and elevated HbA1c levels as a standard test for diabetes mellitus. HbA1c describes the level of sugar in the blood for the last 3 months. One of the complications of diabetes mellitus is kidney damage. The state of kidney function can be described from the GFR (Glomerular Filtration Rate) examination as a standard examination for abnormalities in kidney disease. The purpose of this study was to determine the relationship between HbA1c levels and eGFR values in people with diabetes mellitus. The design of this study was a cross-sectional approach to 30 samples of DM patients who took Prolanis at the Ultra Medica Tulungagung Clinical Laboratory. The results showed that the average HbA1c level in all samples was 6.2% and the average eGFR value was 88.7 ml/min/1, 73m2. The Pearson correlation test obtained a ρ value = 0.000 so that it can be concluded that there is a relationship between HbA1c levels and eGFR values in people with diabetes mellitus who take Prolanis at the Ultra Medica Clinical Laboratory Tulungagung

Kata Kunci: HbA1c, Diabetes Mellitus, eGFR

1. INTRODUCTION

Diabetes Mellitus (DM) is a metabolic disease characterized by chronic hyperglycemia, as well as abnormalities in carbohydrates, proteins and fats caused by abnormal insulin secretion, insulin performance or both (American Diabetes Association, 2010). The number of DM sufferers globally continues to increase (Sukohar et al., 2017). The World Health Organization (WHO) estimates that the global prevalence of

DM sufferers will increase from 171 million people in 2000 to 366 million in 2030. The prevalence of DM in Indonesia ranges from 1.5-2.1% (WHO, 2016).

The East Java Provincial Health Office reported that in 2012 there were 102,399 cases of diabetes mellitus, which is the second most common disease after hypertension. While the data recorded at the Tulungagung District Health Office itself, the number of Diabetes Mellitus sufferers was 10,572 cases in 2015, with the highest number of DM cases being treated at RSUD (Masruroh, 2018)

Diabetes mellitus is called the silent killer because it can interfere with all organs of the body and can cause various diseases, including impaired vision, cataracts, heart disease, kidney disease, sexual impotence, difficulty healing wounds and can rot/gangrene, stroke, and so on. (Ministry of Health, 2005). The complication that often occurs in all type 1 DM and type 2 DM patients is kidney disease with a presentation of 40%, characterized by the presence of microalbuminuria (30mg/day), as well as increased blood pressure, resulting in decreased glomerular filtration, and ends in kidney failure (Schonder, 2008 in Rivandi et al., 2015)

The diagnosis of diabetes mellitus can be determined from several criteria, namely: fasting blood glucose level ≥126 mg/dL, blood glucose concentration 2 hours after the oral glucose tolerance test (OGTT) ≥200 mg/dL, and the percentage of hemoglobin A1c (HbA1c) ≥6,5% (Perkeni, 2015).

HbA1C examination is an effective test to monitor long-term blood glucose for people with diabetes mellitus (Indrayanti, 2008). A person can be diagnosed with DM if clinical signs of DM are found in that person, and the HbA1c value exceeds 6.5% in the examination procedure with a standardized method from the National Glycohaemoglobin Standardization Program (NGSP) (Paputungan et al., 2014). This high HbA1c value is used to assess the development of complications of diabetes mellitus (Indrayanti, 2008).

DM sufferers also experience prolonged hyperglycemia, this is closely related to the occurrence of various complications to other organs such as the kidneys (RI Ministry of Health, 2013). The occurrence of these complications, can be through several mechanisms including changes in renal hemodynamics and there is a buildup of substances called AGEs (Advanced Glication End Products), which can trigger structural damage to the kidneys. Decreased GFR is one of the manifestations of structural damage to the kidney (Sukohar dkk., 2018).

Glomerular Filtration Rate (GFR) is the amount of plasma that can be completely cleared by the kidneys in units of time against a particular compound (Dewi, 2015). Determination of the average GFR value is an accurate method for assessing kidney function and provides an overview of the development of kidney disease (Irawan dkk., 2019). The GFR value can be estimated by measuring the serum creatinine value of the patient using the equation use Modification of Diet in Renal Disease (MDRD). Estimates of glomerular filtration rate (eGFR) that have high accuracy play an important role in detecting and determining the severity of impaired kidney function, determining the level of risk of kidney disease, and determining drug dosages. (Dewi, 2015). The advantages of the MDRD formula are that this formula uses a standard unit of average human body area (1.73m2), does not differentiate subjects based on body weight, and is more accurate than other formulas such as the Cockcrof-Gault method, and this formula has been validated to assess GFR in patients with diabetic nephropathy (Verdiansah, 2016; Lydia dkk., 2014)

Based on this explanation, research is needed to find out whether there is a relationship between HbA1c levels and eGFR in people with diabetes mellitus.

2. METHOD

2.1 Research design

The research design used was a cross sectional approach. The cross sectional approach is a study to study the relationship between risk factors and effects, by means of observational or data collection (Notoatmojo, 2010).

2.2 Populasi

The population in this study were prolanis participants at the Ultra Medica Tulungagung Clinical Laboratory who were willing to be respondents, namely 30 people.

2.3 Teknik Sampling

The sampling technique used was purposive sampling technique using inclusion and exclusion criteria

2.4 Research variable

The independent variable in this study was the HbA1c level in DM patients who took prolanis at the Ultra Medica Tulungagung laboratory, while the dependent variable in this study was the eGFR value in DM patients who took prolanis at the Ultra Medica Tulungagung laboratory.

2.5 Research instrument

The tools used in this study were a 3 cc syringe, tourniquet, alcohol cotton, EDTA vacuum tubes (Endo) and without EDTA (Endo), chemistry analyzer (Selectra Pro M), POCT immunoassay analyzer (Hipro), 1.5 ml tube (Opendorf), micropipette, yellow tip

2.5.1 Research material

The materials needed in this study were blood that had been mixed with an anticoagulant for Hb A1c examination, while serum for creatinine examination..

2.6 Research procedure

2.6.1 Sample Preparation

3 ml of blood was taken, then 2 ml of blood was put into a vacutainer tube that had been treated with EDTA, and 1 ml of blood into a vacuum tube without EDTA. Blood mixed with EDTA was used to check HbA1c, while blood that was not mixed with EDTA was used to check serum creatinine..

HbA1c examination uses whole blood, so that the blood that has been obtained directly can be used for HbA1c examination using the POCT immunoassay analyzer (Hipro).

Serum creatinine examination, using a sample in the form of serum. Serum is obtained by rotating the blood sample at high speed using a centrifuge.

2.7 Research procedure

2.7.1 Examination HbA1c

Research procedures include sample preparation, sample collection, and tests. The first procedure is that the test equipment is first equalized to room temperature, then the blood sample is homogenized and then 10 µl is taken with the sampler, then put the sampler into the dilution tube which has been filled with 0.5 ml of pure water, then shaken for 10 seconds until it is completely mixed.

The second procedure is to take 10 µl of sample which has been diluted with the capillary in front of the sample collector, then put the sample collector into the cuvette. It should be remembered that, because the sample is volatile, the test is completed as soon as the capillary is full of sample, and it must be ensured that the capillary is full of sample.

The final procedure is to put R2 reagent into R1 cuvette, then put R1 cuvette into test channel, the test will be finished automatically. The test results will be displayed in the window screen and printed.

2.7.2 Serum creatinin

The procedure for checking serum creatinine begins with equalizing the sample at room temperature. Then, 500 µl of sample was taken into a cuvette that had been given a sample identity. Furthermore, the chemistry analyzer tool, which already contains reagents, is programmed to check serum creatinine. After the tool program is complete, insert the sample in the cuvette into the cuvette wells on the chemistry analyzer in the order

on the monitor screen. Then press the start writing on the monitor screen. The examination will be completed automatically, and the examination results will be displayed on the monitor screen in the result menu.

2.7.3 eGFR

The eGFR value is obtained from the creatinine value which is then processed with the MDRD (Modification of Diet in Renal Disease) formula with 4 variables (Levey, et al., 2009: Afiatin dan Roesli, 2009: Johnson, et al., 2012: Inker, et al., 2012: Irawan, 2015) :

GFR = 186.3 (serum creatinine)-1.154 x (age)-0.203 x (for women: 0.742) x (if skin color is black: 1.212)

2.8 Data analysis

Data analysis in this study used statistical tests to determine the relationship between variables. The statistical test used in this study is the Pearson correlation test, which is a statistical test that functions to measure the relationship between 2 variables. (Safitri, 2016). To be able to use the Pearson correlation test, the data used must be interval or ratio scale data, and data normally distributed (Kountur, 2018). Therefore, the normality test was carried out first. The normality test used in this study is the Shapiro-Wilk normality test. After the normality test using the Pearson correlation test to determine the relationship between HbA1C and eGFR values

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3. RESEARCH RESULTS

3.1 HbA1C examination data and eGFR values

The results of examining HbA1C levels and eGFR values in 30 DM patients who took Prolanis at the Ultra Medica Tulungagung Clinical Laboratory are available in the following table:

Sample Code	HbA1C Rate (%)	Explanation	eGFR	Explanation
1	5.6	Normal	96.7	Normal
2	6.1	Normal	91.6	Normal
3	5.5	Normal	92.3	Normal
4	6.0	Normal	81.4	Tidak
5	5.8	Normal	93.3	Normal
6	6.9	Tidak	86.4	Tidak
7	5.9	Normal	91.0	Normal
8	4.0	Normal	96.1	Normal
9	7.1	Tidak	89.9	Tidak
10	4.3	Normal	91.5	Normal
11	7.3	Tidak	83.4	Tidak
12	7.7	Tidak	87.9	Tidak
13	6.7	Tidak	96.5	Normal
14	5.1	Normal	98.6	Normal
15	6.6	Tidak	94.1	Normal
16	6.2	Normal	91.3	Normal
17	8.1	Tidak	79.4	Tidak
18	8.1	Tidak	78.5	Tidak
19	4.9	Normal	92.3	Normal
20	4.1	Normal	92.1	Normal
21	6.9	Tidak	85.3	Tidak
22	7.1	Tidak	72.5	Tidak
23	5.9	Normal	89.7	Tidak
24	5.5	Normal	98.5	Normal
25	6.8	Tidak	86.2	Tidak
26	8.5	Tidak	77.5	Tidak
27	4.7	Normal	92.3	Normal
28	6.3	Normal	81.7	Tidak
29	6.1	Normal	93.6	Normal
30	5.8	Normal	81.7	Tidak
Rata-rata	**6.2**	-	**88.7**	-

Tabel 3.1 Examination results of HbA1C levels and eGFR values

Table 3.1 shows that the lowest HbA1C level was in sample code number 8, which was 4.0% and the highest HbA1C level was in sample code number 26, which was 8.5%, where the average HbA1C examination was 6.2%. In the table above, it shows that the lowest eGFR value is in sample code number 22, which is 72.5 mL/min/1.73/m2 and the highest eGFR value is in sample code number 14, which is 98.6 mL/min/1.73/m2.

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Level of Examination	Frequency (f)	Percentage (%)
Normal	18	60
More than normal	12	40
Jumlah	30	100

Tabel 3.2 Frequency distribution of HbA1C levels in DM patients

Based on Table 3.2, it shows that the highest frequency of respondents who have HbA1C levels in the normal category is 18 respondents with a percentage of 60%.

Level of Examination	Frequency (f)	Percentage (%)
Normal	16	53
More than normal	14	47
Jumlah	30	100

Tabel 3.3 Frequency distribution of eGFR values in DM patients

Based on Table 3.3, it shows that the highest frequency of respondents who have an eGFR value in the normal category is 16 respondents with a percentage of 53%.

	Sig.
HbA1c	0.868
eGFR	0.117

Tabel 3.4 The results of the Shapiro-Wilk normality test for the relationship between HbA1C levels and eGFR values

Based on table 3.4 above, it can be seen that the significance value of HbA1c is 0.868 (ρ>0.05) and the significance value of eGFR is 0.117 (ρ>0.05), so that the Shapiro-Wilk normality test shows that the data is normally distributed.

	Pearson Correlation	Sig. (2-tailed)
HbA1c	-0.719	0.000
eGFR	-0.719	0.000

Tabel 3.5 Pearson correlation test results on the relationship between HbA1C levels and eGFR values in DM patients

R in sufferers Based on table 4.7, the value of Sig. (2-tailed) which is 0.000 (ρ<0.05) where these results indicate a significant correlation between HbA1c and eGFR values in DM patients. Apart from that, the strength value of the correlation or Pearson correlation (r) of the two variables is -0.719, so based on the guidelines for the degree of relationship it shows that statistically there is a strong correlation between the two variables, with a negative correlation direction which means that when there is an increase in HbA1c it will be related with decreased eGFR in DM patients (Dahlan, 2014; Notoadmodjo, 2010).

4. Discussion

Based on the research results, the collected data was analyzed using the Pearson correlation test with the help of the SPSS 16 application program. According to Safitri (2016), in making a Pearson correlation test decision, it is done by looking at the significance in the table Sig. (2-tailed) and Pearson correlation values. The significance decision is made by comparing it with the critical limit, namely α = 0.05, if the results are Sig. (2-tailed) exceeds 0.05, the relationship in the variable is significant. While the decision making of the Pearson correlation value is based on the degree of relationship guidelines.

In this study, the results of the Pearson correlation test based on Sig. (2-tailed) the result is 0.000 (ρ<0.005) which means that the result shows a significant correlation between HbA1c and eGFR value in DM patients. While the results of the Pearson correlation test are based on the Pearson

Correlation value or the strength of the correlation or Pearson correlation (r) of the two variables, namely -0.719, then based on the guidelines for the degree of relationship shows that the results statistically have a strong correlation between the two variables, with a negative correlation direction which means when it occurs an increase in HbA1c will be associated with a decrease in eGFR in DM patients (Dahlan, 2014; Notoadmodjo, 2010).

HbA1C is a monitor of the average blood glucose level during the previous 1-3 months (Paputungan et al., 2014). So that high HbA1C levels describe the high average blood glucose levels for 1-3 months. HbA1c levels that exceed normal values are used as a benchmark for the development of complications of Diabetes Mellitus (Indrayanti, 2008; Sukohar dkk., 2018). Diabetes Mellitus (DM) is a metabolic disease characterized by chronic hyperglycemia resulting from defects in insulin secretion, insulin action or both (ADA, 2010). In uncontrolled hyperglycemia, it can trigger hyperfiltration resulting in hypertrophy in the kidney which results in reduced glomerular filtration area. These changes cause kidney function to be disrupted and become glomerulosclerosis which ends in kidney failure (Probosari, 2013).

The prevalence of kidney failure is dominated by the male sex group which is equal to 57% compared to the female sex group which is equal to 43% (RRI, 2018). This is due to the influence of differences in reproductive hormones; lifestyle such as consumption of protein, salt, cigarettes and alcohol consumption in men and women (Iseki, 2008).

The occurrence of impaired kidney function is one of the risks of DM disease (Nasution dkk., 2020). The results of the analysis show that respondents with DM have a 2.5 times greater risk of experiencing chronic kidney failure than those who do not suffer from DM. This is because high blood sugar levels (hyperglycemia) will affect the structure of the kidneys, and damage the fine blood vessels in the kidneys (nodular and diffuse glomerulosclerosis). Damage to the blood vessels in the kidney will cause damage to the glomerulus which functions as a blood filter (Sulistiowati dkk., 2015). Other studies explain that hyperglycemia can cause glycosylation of proteins in the basement membrane, resulting in thickening of the basement membrane and accumulation of basement membrane glycoprotein-like substances in the mesangium. As a result, gradually the glomerular capillaries are pushed, so that blood flow is disrupted, causing glomerulosclerosis and nephron hypertrophy which will lead to diabetic nephropathy (Rivandi, 2015). In addition, a state of hyperglycemia also results in the interaction of metabolic and hemodynamic factors, causing a decrease in the value of the glomerular filtration rate (GFR) (Hendromartono, 2014).

5. RESULT

Based on the research explanation above, the results showed that there was a significant relationship between HbA1C and eGFR in Diabetes Mellitus patients who took Prolanis at the Ultra Medica Clinical Laboratory, Tulungagung

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