Relationship Between Glomerular Filtration Rate and Anemia in Chronic Kidney Disease Patients at RSUD Dr. H. Chasan Boesoirie

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Abstrak

Penyakit ginjal kronik (PGK) adalah kondisi penurunan fungsi ginjal dengan tanda kerusakan pada ginjal atau keduanya, dengan durasi minimal 3 bulan. Pasien PGK akan mengalami anemia akibat penurunan kemampuan ginjal dalam memproduksi eritropoietin dengan seimbang. Tujuan penelitian ini untuk mengetahui hubungan antara laju filtrasi glomerulus dengan anemia pada pasien PGK di RSUD Dr. H. Chasan Boesoirie. Jenis penelitian ini yaitu penelitian *cross-sectional* observasional analitik dengan menggunakan uji *Spearman's rho*. Sampel pada penelitian ini yaitu pasien yang diambil menggunakan teknik *total sampling*. Alat pengumpulan data berupa rekam medik di RSUD Dr.H. Chasan Boesoirie pada tahun 2020-2022. Penelitian ini mendapatkan distribusi pasien PGK terbanyak pada jenis kelamin wanita 52 pasien (53,6%), paling banyak pada kelompok usia 55-64 tahun 36 pasien (37,1%), kadar hemoglobin paling banyak ditemukan di bawah normal atau anemia 91 pasien (93,1%), dan LFG terbanyak pada LFG <15 ml/menit/1.73m^2 yaitu 89 pasien (91,8%). Hasil analisis bivariat menunjukan terdapat hubungan antara laju filtrasi glomerulus dengan anemia dengan *p-value*=0,039 (p<0,05) dan koefisien korelasi sebesar 0,210 menunjukan bahwa arah korelasi positif dengan kekuatan korelasi sangat lemah. Terdapat hubungan laju filtrasi glomerulus dengan anemia pada pasien penyakit ginjal kronik di RSUD Dr. H. Chasan Boesoirie.

Kata Kunci: *anemia; laju filtrasi glomerulu; penyakit ginjal kronik; RSUD Dr. H. Chasan Boesoirie; hemoglobin*

Abstract

Chronic kidney disease (CKD) is a condition of decreased kidney function with signs of damage to the kidneys or both, with a minimum duration of 3 months. CKD patients will experience anemia due to a decrease in the ability of the kidneys to produce erythropoietin in balance. The purpose of this study was to determine the relationship between glomerular filtration rate and anemia in CKD patients at Dr. H. Chasan Boesoirie Hospital. This type of research is analytic observational cross-sectional research using Spearman's rho test. The sample in this study were patients who were taken using the total sampling technique. Data collection tools in the form of medical records at Dr.H. Chasan Boesoirie Hospital in 2020-2022. This study found that the distribution of CKD patients was mostly female 52 patients (53.6%), most in the age group 55-64 years 36 patients (37.1%), most hemoglobin levels were found to be below normal or anemia 91 patients (93.1%), and most GFR in GFR <15 ml/min/1.73m2, namely 89 patients (91.8%). The results of bivariate analysis showed that there was a relationship between glomerular filtration rate and anemia with a p-value = 0.039 (p <0.05) and a correlation coefficient of 0.210 indicating that the direction of the correlation was positive with a very weak correlation strength. There is a relationship between glomerular filtration rate and anemia in patients with chronic kidney disease at Dr. H. Chasan Boesoirie Hospital.

Keywords*: anemia, glomerular filtration rate, chronic kidney disease, RSUD Dr. H. Chasan Boesoirie, hemoglobin.*

Introduction

Chronic kidney disease (CKD) is defined as a condition of decreased kidney function with signs of damage to the kidneys or both, with a minimum duration of 3 months (1). Globally, CKD in the community is a health problem with an increasing incidence and prevalence that requires high-cost treatment and a poor prognosis (2). According Global Burden of Disease (GBD) data in 2016 showed that 752.7 million people suffered from CKD. Based on gender, 335.7 million men and 417 million women suffered from CKD (3). CKD is one of the top 10 causes of death in Singapore, Greece and Israel (4). A cohort study conducted by Ping Liu et al in Canada showed that the incidence of chronic kidney disease based on age was more pronounced in the age group over 65 years than in the age group less than 40 years (60% higher), about 75% of people suffering from chronic kidney disease at the age of 65 years or more had a Glomerular Filtration Rate (GFR) of 45-59 ml/min/1.73 m2 (5).

Riskesdas data in Indonesia in 2018 showed the prevalence of CKD based on doctor's diagnosis in the population aged ≥15 years by sex, in men reaching 335,726 and for women reaching 358,057 with a total of 713,783. For the prevalence of CKD in North Maluku Province based on doctor's diagnosis in the population aged ≥15 years by sex, males reached 5,000 and females reached 4,907 with a total of 9,907 (6,7). The kidney is an organ that produces erythropoietin which functions as a regulator of erythrocyte production, when CKD occurs, the patient will experience anemia due to a decrease in the ability of the kidneys to produce erythropoietin in a balanced manner (8).

Anemia is a condition where red blood cells (erythrocytes) or hemoglobin mass in the blood circulation decreases so that its function as an oxygen carrier to all tissues does not meet physiological needs (9). The prevalence of anemia globally in 204 countries from 1990-2019, found that there was an increase in total anemia cases from 1.42 billion in 1990 to 1.74 billion in 2019. Central Africa, West Africa, and South Asia are the 3 regions with the highest incidence of anemia in the world (10). According to the 2018 Riskesdas data, the prevalence of anemia according to characteristics based on gender, in men reached 23,849 and for women reached 23,616 (6).

Similar research was conducted by D. Natalia, et al at Dr. Mohammad Hoesin Palembang Hospital in 2017. The study found that there was a significant relationship between GFR and the degree of anemia in patients with chronic kidney disease using the chi-square test with a value of (p=0,000) (11). Research in North Maluku on the relationship between GFR and Anemia in patients with chronic kidney disease has never been done, especially at Dr. H. Chasan Boesoirie Hospital, so that researchers feel interested and need to choose this title for

research.

Methods

This type of research uses an analytical observational cross-sectional research design conducted at Dr. H. Chasan Boesoirie Ternate Hospital in November 2023 using the total sampling technique. with a total sample population at the initial data collection of CKD patients in 2020-2022. when collecting data in medical records, the sample population of CKD patients was 119 patients, then 97 patients were found to meet the inclusion criteria. the data obtained were analyzed statistically univariate and bivariate with Spearman test using SPSS software. The data analyzed included gender, age, hemoglobin levels, GFR.

Research Results

This research was conducted at Dr. H. Chasan Boesoire Hospital by taking a sample population of chronic kidney disease in 2020-2022 based on gender, age, hemoglobin level and GFR by recording 97 patients' medical records. The description is detailed in the following table:

Table 1. Characteristics of the Research Sample

Variable	Frequency (N)	Presentage (%)
Gender		
Male	45	46,4
Female	52	53,6
Age		
15-24 Years	1	1
25-34 Years	6	6,2
35-44 Years	8	8,2
45-54 Years	30	30,9
55-64 Years	36	37,1
65-74 Years	13	13,4
≥75 Years	3	3,1
Anemia		
Normal Hb	6	6,2
Low Hb	91	93,8
GFR		
GFR 45-59 ml/min/1,73 m^2	1	1
GFR 30-44 ml/min/1,73 m^2	1	1
GFR 15-29 ml/min/1,73 m^2	6	6,2
GFR <15 ml/min/1,73 m^2	89	91,8
Total	**97**	**100**

Based on table 1, the distribution of the research sample profile based on gender is the most, namely in women by 53.6%, then for the age profile using the 2018 Riskesdas classification, which is the largest at the age of 55-64 years 37.1%. Furthermore, in the table, the distribution of profiles seen from hemoglobin levels with the largest percentage is low Hb (anemia) 93.8%. For the GFR profile, the highest GFR value was <15 ml/min/1.73m2 by 91.8%.

Table 2. Results of Analysis of the Relationship Between GFR and Anemia using the Spearman rho test

GFR	History of Anemia		Total	*P-Value*	Spearman's rho Correlation Test
	Normal Hb	**Low Hb**			
GFR 45-59 ml/min/1,73 m^2	1	0	1		
GFR 30-44 ml/min/1,73 m^2	1	0	1		
GFR 15-29 ml/min/1,73 m^2	1	5	6	0,039	0,210*
GFR <15 ml/min/1,73 m^2	3	86	89		
Total	6	91	97		

Based on table 2. above, the result is 0.039 which shows that there is a significant correlation between GFR values and anemia. The Spearman correlation value of 0.210 indicates that the direction of the correlation is positive with a very weak correlation strength.

Discussion

Based on the results of the study in table 1, it shows that of the 97 patients with chronic kidney disease, 52 patients (53.6%) were female. This study is in line with research conducted at Prof. Dr. R. Kandou Manado Hospital by Tamsil (2019) on 131 samples of chronic kidney disease patients with female gender as many as 71 patients (54.19%) (12). Supported by Han's research (2016) in Korea with a sample of participants based on Korean national health and nutrition examination survey data, patients with chronic kidney disease were found to be mostly female, namely 9,886 patients (13). The results of another similar study conducted by Hapsari (2022) at Ibnu Sina Hospital Makassar on 50 samples of chronic kidney disease patients were mostly female at 34 patients (68.0%) (14), but in contrast to the results of research conducted at Sanglah Denpasar General Hospital by Sanjaya (2019) on 73 samples of chronic kidney disease patients 32 (59.3%) were male (15).

Women in this study were found to have more comorbid diabetes mellitus and hypertension than men. There were 18 patients who experienced diabetes mellitus, in women totaling 12 patients (67%) and in men totaling 6 patients (33%), while patients with comorbid

hypertension were found in 31 patients, where in women there were 19 patients (61%) and in men there were 12 patients (39%), so that the female variable in this study had a higher risk factor for chronic kidney disease due to these comorbidities. Diabetes mellitus is a condition where high glucose levels in the body (hyperglycemia) can cause damage to the small blood vessels in the kidneys so that the glomerulus is also damaged which causes the kidney's filtration ability to decrease and the presence of hypertension will increase kidney damage by encouraging sclerosis in the kidneys. Chronic kidney disease patients who have comorbid diabetes mellitus have an approximately two-fold increased risk of anemia due to hyperglycemia which causes persistent hypoxia in the renal interstitium and prolonged toxic exposure to glucose can damage mature red blood cells and cause impaired erythropoietin production (16–18). The results of the study in table 1 can be seen that the group at the age of 55-64 years there are 36 patients (37.1%) is the age group with the largest number of patients.

The results obtained are in line with research conducted by Sundari Hervinda et al at Dr. Mohammad Hoesin Palembang Hospital (2014) on 300 samples of CKD patients with an age group of 50-59 years as many as 95 patients (31.7%) (19). Another study conducted by Sanjaya at Sanglah Denpasar General Hospital (2019) on 54 samples of chronic kidney disease patients with the highest age of 46-65 years totaling 32 patients (59.3%) (15). Another study conducted by Maina (2016) on 121 samples of CKD patients with the highest age group of 36-65 years totaling 125 patients (59.0%) (20). As well as research that supports this research conducted by Hapsari (2022) at the Ibnu Sina Makassar hospital on 50 samples of chronic kidney disease patients in the age group 55-64 as many as 15 patients (30.0%) (14).

One of the risk factors for CKD is age, as the age increases, kidney function will decrease. Increasing age can affect both the anatomical structure and physiology of the kidneys. In addition, increasing age can cause thickening of the glomerular basement membrane, expansion of the glomerular mesangium and extracellular matrix deposits which can lead to glomerulonecrosis. The kidneys can atrophy and the thickness of the renal cortex decreases by about 20% every decade after the age of 30 (15,19).

This study obtained 97 samples of patients with the prevalence of anemia in chronic kidney disease patients at Dr. H. Chasan Boesoirie Hospital there are more who have hemoglobin below normal values or experience anemia as many as 91 patients (93.8%). As for the degree of anemia, the most in the degree of mild anemia as many as 38 patients (40%) and for low hemoglobin levels or experiencing anemia most in the female gender, namely 50 patients (56%).

The results of this study are in line with research conducted by Sanjaya (2019) at Sanglah Denpasar General Hospital on 54 samples of chronic kidney disease patients who experienced anemia as many as 52 patients (96.3%) (15). other studies that support this research were conducted by Alemu (2021) at the Addis Ababa general hospital in Ethiopia on 387 samples of chronic kidney disease patients, the most anemia was 207 patients (53.49%) (21). A parallel study regarding the degree of anemia by Senduk (2016) at the Special Action Installation (ITK) Hemodialysis of Prof. dr. R.D. Kandou Hospital Manado on 60 samples, the highest number of chronic kidney disease patients with mild degree anemia was 27 patients (45%) (22). Meanwhile, a parallel study regarding the gender of anemia was conducted by Alemu (2021) at the Addis Ababa general hospital in Ethiopia on 387 samples of patients with chronic kidney disease, most of whom had anemia were female, totaling 220 patients (56.8%) (21).

Anemia is a state of erythrocytes or Hb whose levels are below normal in the body. Anemia occurs around 80%-90% in CKD patients when the kidneys have decreased function by around 20%-50%. When the kidneys begin to experience damage, there will be a reduction in the production of erythropoietin, which is a hormone to stimulate the bone marrow in producing erythrocytes. In addition, there are other things that are considered to play a role in CKD patients with anemia, namely shortening the life span of erythrocytes due to hemolysis, bone marrow stress due to uremia, iron deficiency, folic acid deficiency, bleeding, and chronic and acute infections. These things eventually cause anemia in CKD patients. The degree of anemia in chronic kidney disease develops as the function of the kidneys decreases, but in certain circumstances patients can experience an increase in hemoglobin levels after hemodialysis in patients with adequate hemodialysis. The action causes erythopoiesis to improve significantly because when dialysis is performed there is a removal of uremic toxins as metabolic waste so that the erythropoietin response in producing erythrocytes increases. Anemia is more prone to occur in women because women have less iron reserves around 0-300 mg compared to men around 500-1500 mg, where the iron reserves are stored in the bone marrow and spleen. In addition, women with ≥3 children increase the risk of anemia or it can be said that the increasing number of pregnancies is the cause of increased risk factors for anemia in women (15–17,23).

Based on the results of the study in table 5.1, it can be seen that the frequency of CKD patients obtained the highest value in GFR <15 ml/min/1.73 m2 as many as 89 patients (91.8%).

The results of this study are in line with research conducted by Wayan (2023) at

Sanjiwani Gianyar Hospital on 80 samples of chronic kidney disease patients with the most GFR <15 ml/min/1.73 m2 totaling 63 patients (78.8%) (24). Another study that supports this research was conducted by Aisyafitri (2018) at Santo Antonius Pontianak General Hospital on 46 samples of CKD patients, the majority with GFR <15 ml/min/1.73 m2 with a percentage of 42 patients (25).

GFR is a measurement in assessing the overall functions of the kidneys. GFR is the rate at which the glomerulus filters plasma to produce ultrafiltration and can be assessed by the clearance or serum levels of filtration markers. The lower the GFR, the more impaired the kidney function. GFR is used to diagnose, stage, confirm prognosis related to chronic kidney disease, and determine drug dosage. When the patient is still in the early stages of chronic kidney disease (stages I and II) there are still no typical symptoms found in the patient, and will usually appear after the patient has decreased kidney function by more than 10%-25%. Meanwhile, chronic kidney disease patients in stages III, IV, and V have theoretically caused complications that lead to higher incidence rates in health services (11,24,26).

The results of the analytical test analysis using Spearman's rho obtained a p-value = 0.039 (p <0.05), so the H1 hypothesis is statistically accepted so that there is a significant relationship between glomerular filtration rate and anemia in patients with chronic kidney disease at Dr. H. Chasan Boesoirie Hospital. The Spearman's rho correlation value is 0.210 which shows a positive correlation direction with very weak strength.

The results of this study are in line with research conducted by Natalia (2017) which explains that there is a significant relationship between GFR and the degree of anemia with the chi-square test with p-value=0.000 (11). There is another study that is in line with this study by Ladesvita (2021) regarding the relationship between glomerular filtration rate and hemoglobin levels using the Pearson correlation test with a p-value = 0.000 (17). As well as other studies that support this research conducted by faridz (2021) regarding the relationship between hemoglobin levels and glomerular filtration rate using the Pearson correlation test, the results obtained p-value=0.000 (27).

Based on the results of the above studies, it can be concluded that hemoglobin will decrease along with the decrease in glomerular filtration rate. Chronic kidney disease patients begin to experience anemia when the glomerular filtration rate decreases to <60 ml/min/1.73 m2. Anemia is a common complication of CKD that develops early and increases in severity as kidney function declines. The cause of anemia in patients with chronic kidney disease is

multifactorial, but the main cause is a decrease in erythropoietin production due to kidney impairment. Other factors besides decreased erythropoietin production are shortened erythrocyte life span due to uremia, acute and chronic inflammation, nutritional deficiencies such as iron, vitamin A, vitamin B9 and cobalamin deficiencies, and patients with severe hyperparathyroidism (11,28,29).

Conclusions and Suggestions

Based on the results of research and discussion about the relationship between family support and knowledge about self-care of leprosy patients, it can be concluded that the distribution of chronic kidney disease patients with anemia based on gender is the most, namely women as many as 52 patients (53.6%). The distribution of chronic kidney disease patients with anemia based on the highest age, namely 55-64 years old as many as 36 patients (37.1%). The distribution of chronic kidney disease patients with anemia based on hemoglobin levels was mostly below normal or anemic as many as 91 patients (93.8%). The distribution of chronic kidney disease patients with anemia based on GFR was mostly for the GFR profile, which was <15 ml/min/1.73m2 as many as 89 patients (91.8%). There is a relationship between glomerular filtration rate and anemia in chronic kidney disease patients at Dr. H. Chasan Boesoirie Hospital with p-value=0.039. The correlation coefficient value of 0.210 shows that the direction of the correlation is positive with a very weak correlation strength.

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