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The Correlation between Total Urine Protein Levels and The Frequency of Hemodialysis in Chronic Kidney Failure Patients

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Abstract: Chronic Kidney Failure (CKF) is a global health problem with a high prevalence, including in Indonesia. Renal replacement therapy, such as hemodialysis, is used to maintain the life of patients with CKF. The study aims to analyze the correlation between total urine protein levels and the frequency of hemodialysis in patients with chronic kidney failure at PKU Muhammadiyah Gamping Hospital from January to September 2023. The research is quantitative and descriptive, using cross-sectional survey methods and secondary data from patient medical records. Statistical analysis uses the Spearman test to test the correlation between variables. Total of HD frequency 1x/week = 6, 2x/week = 58, 3x/week= 1. In order, the trace of protein + 1 = 6, +2 = 58 , +3 = 1. The result of the analysis showed that the total urine protein rate with a frequency of hemodialysis was negatively correlated (r= 0,026; p= 0,84), also did not correlate with gender (r= -0,039; p= 0,756), comorbid (r= -0,038; p= 0,766), and age (r= 0,174; p= 0,166). The conclusion is that there is no correlation between total urine protein levels and the frequency of hemodialysis in patients with chronic kidney failure at PKU Muhammadiyah Gamping Hospital.

Keywords: Chronic Kidney Failure, Hemodialysis, Proteinuria, Frequency of Hemodialysis, Survival Rate.

INTRODUCTION

Chronic Kidney Failure (CKF) has become a global health problem with high economic costs.[1] In 2017, its global prevalence was 9.1%, ranging from 8.5% to 9.8%. China has 132.3 million cases, almost a third of all cases, and India has 115.1 million cases. Many countries, such as Indonesia, Japan, Russia, the United States, and Vietnam, all have over ten million cases.[2] According to National Basic Health Research (Riskesdas), chronic kidney failure in Indonesia was 0.38% prevalent in 2018, up from 0.2% in 2013. [3]

According to Riskesdas 2018, The most common risk factors for chronic kidney failure include hypertension, obesity, and diabetes mellitus. Hypertension, obesity, and diabetes mellitus are all linked to metabolic syndrome components. [4]

Pathophysiology of chronic kidney disease initially depends on the underlying disease, but in its development, the process occurs almost similarly. The decrease in kidney mass leads to structural (hypertrophic) and functional changes in the remaining nephrons as a compensatory response, mediated by vasoactive molecules such as cytokine growth factor, resulting in an excessive increase infiltration, followed by an increase in pressure in the capillaries and blood flow in the glomerulus. This adaptation process lasts for a while, followed by a maladaptation process of sclerosis in the remaining nephrons. Finally, there was a progressive decline in nephron function, even though the underlying disease was no longer active. [5]

The presence of protein in urine is identified as proteinuria, which is closely related to kidney disease. Urine protein is formed when the glomerular filtration leaks, so the protein molecules will be wasted in the urine, causing proteinuria. When the glomerulus membrane is damaged, selective filtration is inhibited, and there is an increase in the amount of serum protein. Eventually, red blood cells and leukocytes penetrate the membrane and are excreted into the urine. The urine protein test results were categorized as negative, trace, +1, +2, and +3. [6]

The most common renal replacement therapy is hemodialysis.[7] Hemodialysis is a medical treatment method used to remove toxins and toxins from a patient's blood.[8] The frequency of hemodialytic therapy varies depending on how many kidney functions are left. Patients receive hemodialysis 2-3 times a week (4-5 hours per session), but some patients only receive it once a week due to economic factors and home distances from distant hospitals.[9] However, hemodialysis can cause protein degradation, which can lead to malnutrition.[10] While Protein provides a quantity of fuel and glucose for the body's energy needs, survival, the development and maintenance of body composition, and supporting metabolic processes. [11,12]

In hemodialysis, the blood flow filled with toxins and nitrogen waste is transferred from the patient's body to the dialyzer, where the blood is cleansed and then returned to the patient. Most dialyzers are flat plates or artificial fiber kidneys that contain thousands of fine cellophane tubes and work as semipermeable membranes. The blood flow will pass through the tubules as the dialysis fluid circulates it. There are three basic principles of hemodialysis: osmosis, diffusion, and ultrafiltration. [13]

Unrelated findings were discovered regarding the long-term relationship between hemodialysis and nutritional status in individuals with chronic kidney failure.[14] According to study,[15] there is a positive relationship between hemodialysis and malnutrition due to protein degradation. This article examines the relationship between urinary protein levels (proteinuria) and the frequency of hemodialysis, a unique approach compared to other studies that focus on the impact of hemodialysis frequency on quality of life or general clinical status. This study also considers other variables such as gender, age, and comorbidities like diabetes and hypertension. It was found that comorbidities significantly affect patient outcomes, highlighting the complex relationship between various factors that are not often explained in similar studies. This approach provides a more comprehensive understanding of the impact of hemodialysis on patient outcomes. Furthermore, since there has been no specific research conducted on the frequency of hemodialysis and urinary total protein levels at RS PKU Muhammadiyah Gamping, this study will discuss the correlation between urinary total protein levels and the frequency of chronic kidney disease patients at RS PKU Gamping to determine whether undergoing hemodialysis can affect urinary total protein levels and the patient's quality of life.

MATERIALS AND METHOD

This study used a descriptive quantitative research approach and a cross-sectional survey to explore the correlation dynamics between dependent variables and independent variables simultaneously. This study aims to find out the correlation between total urine protein levels and the frequency of hemodialysis in chronic kidney failure patients undergoing hemodialytic therapy at PKU Muhammadiyah Gamping Hospital.

The inclusion criteria in this study include Inpatients at RS PKU Gamping diagnosed with chronic kidney failure and comorbidities, and the medical records used are those of inpatients who lived and died at RS PKU Gamping. The exclusion criteria in this study include patients with incomplete medical record data.

The data collection technique in this study uses secondary data from the medical records of chronic kidney failure patients who underwent hemodialysis therapy in PKU Muhammadiyah Gamping Hospital from January to September 2023. The total number of medical records of patients with chronic kidney failure at PKU Muhammadiyah Gamping Hospital is 178, of which there are 65 complete medical records with data on total urine protein rates and frequency of hemodialysis. Bivariate analysis was conducted to prove the research hypothesis using Spearman's statistical test. This research was accepted by the ethical committee of PKU Muhammadiyah Gamping Hospital, No. 002/KEP-PKU/I/2023.

RESULT

Table 1. Frequency Distribution of Subject Characteristics

Characteristic of Subject		Frequency (n)	Percentage (%)
Age	>60 years	88	49.4%
	<60 years	90	50.6%
Gender	Female	78	43.8%
	Male	100	56.2%
Survival Rate	Died	21	11.8%
	Survive	157	88.2%
Diabetes	Yes	56	31.5%
	No	122	68.5%
Hypertension and CVD (Stroke, CHF, STEMI)	Yes	84	47.2%
	No	94	52.8%
Others (Pneumonia, Dyspneu, Trombositosis)	Yes	38	21.3%
	No	140	78.7%

According to the above table, the study's findings indicate that there were 88 (49.4%) patients over 60, 78 (43.8%) females, and 100 (56.2%) males with chronic kidney failure; 21 (11.8%) patients who died from the condition, and 157 (88.2%) patients who survived it; 56 (31.5%) subjects had comorbid diabetes; 84 (47.2%) subjects had hypertension and cardiovascular disease; and 38 (21.3%) subjects had other conditions.

Table 2. Spearman correlation of total urine protein rate with hemodialysis frequency

Variable	**Frequency of Hemodialysis**								
Total Urine Protein Rate	1x/week		2x/week		3x/week		Total		*p* Value
	F	%	F	%	F	%	F	%	
Negative	2	6,7	28	93,3	0	0	30	100	0,840
Trace	1	33,3	2	66,7	0	0	3	100	
1+	0	0	8	100	0	0	8	100	
2+	2	13,3	12	80,0	1	6,7	15	100	
3+	1	11,1	8	88,9	0	0	9	100	
Total	6	9,2	58	89,2	1	1,5	65	100	

Negative (<10 mg per dL), Trace (10 to 20 mg/dL), +1 (30 mg/dl), +2 (100 mg/dl), or +3 (300 mg/dl).

The study's findings on patients with chronic kidney disease receiving hemodialysis at PKU Muhammadiyah Gamping Hospital use the Spearman method and bivariate analysis to see if there is a correlation between the frequency of hemodialysis and total urine protein rate (Table 3).

Table 3. Spearman correlation between frequency of hemodialysis, gender, comorbid, age, and total urine

		Frequency of Hemodialysis	Gender	Comorbid	Age	Total Urine Protein Rate
Frequency of Hemodialysis	spearman-rho	1	-0,049	0,096	0,039	0,026
	P-value	-	0,699	0,446	0,758	0,84
Gender	spearman-rho	-	1	-0,127	-0,295	-0,039
	P-value	-	-	0,312	0,017	0,756
Comorbid	spearman-rho	-	-	1	0,187	-0,038
	P-value	-	-	-	0,136	0,766
Age	spearman-rho	-	-	-	1	0,174
	P-value	-	-	-	-	0,166
Total Urine Protein Rate	spearman-rho	-	-	-	-	1
	P-value	-	-	-	-	-

The study found no significant correlation between total urine protein rates and hemodialysis frequency in patients with chronic kidney failure. The correlation also did not exist with gender, comorbidities, or age. The negative correlation coefficient between total urine protein rates, gender, and comorbidities indicates a reverse direction. This low correlation is due to metabolic variations and biological interactions in samples, such as nutritional status, physical activity, and environmental conditions.

DISCUSSION

The gender data results are the same as the data in Indonesia in 2018, where there were 64,584 people undergoing hemodialysis, consisting of 36,976 men (57%) and 27,608 women (43%).[16] This tendency is caused by men being more likely to suffer from non-communicable diseases, which are a risk factor for chronic kidney failure. Lifestyle habits also play an important role in the development of diseases, considering that men are more likely to have smoking and alcohol consumption habits.[17] Compared to men, women are more capable of maintaining their health, leading a healthy lifestyle, and are more likely to adhere to treatment.[18]

The Indonesian Renal Registry reported that 90.8% of patients with chronic kidney failure aged 35-70 underwent hemodialytic therapy, with the 45-54 age group being the most affected.[16] According to research carried out by [19], GFR falls by 10 mL/min per decade after 40, making the elderly more susceptible to chronic kidney disease. This decrease in kidney function, combined with risk factors and the effects of angiotensin renin system activation, contributes to the disease.

The high percentage of CVD as a comorbid is due to the close relationship between these two conditions. Kidney diseases can trigger hypertension, and persistent high blood pressure can worsen kidney disease.[20] Long-lasting hypertension can cause structural changes in arterioles throughout the body, such as fibrosis and hyalinization of blood vessels. In the kidneys, arteriosclerosis caused by prolonged high blood pressure leads to nephrosclerosis. This condition directly causes ischemia by restricting the lumen of the internal blood arteries. This narrowing of the arteries and arterioles causes glomerulus damage and tubule atrophy, which ultimately destroys the entire nephron and leads to chronic kidney failure.[21]

Most hemodialysis patients have a good quality of life, with comorbidities significantly affecting their quality of life.[22] This is a measure of the success of hemodialysis therapy. The quality of life of renal failure patients is influenced by sociodemographic characteristics, mental aspects (depression), and the severity of kidney disease. Noncompliance with prescribed medication and nutritional issues during hemodialysis are serious comorbidities. Protein-energy waste (PEW) is a leading cause of kidney failure. Nutrition services aim to slow disease progression, improve quality of life, and reduce cardiovascular disease severity.[23]

Proteinuria can be seen as a marker of glomerular disease with an increase in the amount of urine protein that reflects a greater degree of glomerulus injury. In addition, proteinuria has been proven to have a more direct impact on the development of renal disease by causing tubular injury while passing through the lumen. [24]

In the early stages, when the nephron disappears, the functional nephrons that remain undergo hypertrophy. The glomerular capillary flow and pressure increased in these nephrons, and more peritels of soluble substances were filtered to compensate for the kidney mass of missing substances. This increased need causes the remaining nephrons to develop glomerular sclerosis, resulting in nephron damage in the end. Proteinuria caused by glomerular damage is suspected to cause tubular injury. This ongoing decrease in nephron function may continue even after the initial illness process has been overcome. [25]

Based on the findings of this study, not all patients undergoing routine hemodialysis therapy twice a week had an appropriate total urine protein level. This is in line with the research[26], which mentions that some factors that can cause proteinuria include the presence of diabetes mellitus as a comorbid, the duration of patients suffering from hypertension, the severity of high blood pressure, nutritional status, excessive salt consumption, and a family history of illness. Moreover, several epidemiological studies have linked proteinuria to an increased risk of cancer. Proteinuria, CKD, and cancer may share pathological mechanisms, such as oxidative stress, hypertension, chronic inflammation, and diabetes mellitus. Research conducted by [23] discovered that trace and positive proteinuria enhanced the likelihood of CRC occurrences as compared to no proteinuria. A dipstick urine test for proteinuria can help identify those who are more likely to develop CRC in the future.

According to research conducted by[27], proteinuria in chronic hemodialysis is significantly greater in diabetic nephropathy patients than in other causes. It is associated with inflammation and heart stress. It is unclear whether severe proteinuria, in addition to diabetes, is linked to shorter hemodialysis survival. Proteinuria should be evaluated while evaluating cardiovascular and inflammatory problems in individuals undergoing hemodialysis. The authors emphasize the important role of proteinuria in hemodialysis as a marker of cardiovascular disease as well as forgotten and neglected inflammation. This study also found that as proteinuria worsened, there was a trend toward shortening the duration of hemodialysis. It is unknown whether severe proteinuria, in addition to diabetes, is related to shorter hemodialysis survival.

CONCLUSION

The conclusion is that there is no correlation between total urine protein levels and the frequency of hemodialysis in patients with chronic kidney failure at PKU Muhammadiyah Gamping Hospital.

ETHICAL CONSIDERATIONS

The study has received approval from the ethical committee of PKU Muhammadiyah Gamping Hospital, No. 002/KEP-PKU/I/2023.

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CONFLICT OF INTEREST

All authors declare no conflict of interest.

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