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The Impact of Hemodialysis on Blood Pressure Improvement in Stage V Chronic Kidney Disease (CKD) Patients

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ABSTRACT

Hemodialysis is an act to partially replace kidney function and dispose of substances (water, urea, creatinine, potassium, magnesium, etc.) that are not needed in the blood. Typically, 70% - 90% of hemodialysis patients have recently had high blood pressure (hypertension) during the first hemodialysis. After passing through the first month of hemodialysis (extracellular volume downhill), blood pressure decreased progressively, reaching a normal level of variable proportion (30% - 95%) in patients who are already been doing hemodialysis for a few months. Mean Arterial Pressure predialysis patients with a high initial decline in the first-week dialysis, then Mean Arterial Pressure settled and stable enough after three months of hemodialysis. This study aims to prove that there is an improvement in blood pressure after hemodialysis for patients with Chronic Kidney Disease at Universitas Kristen Indonesia Hospital. The methodology used is the analytic ex post facto with data collected retrospectively from the Archives of Medical Record Universitas Kristen Indonesia Hospital Inpatient and use quota-type sampling. The table above shows that of 52 patients with Chronic Kidney Disease Stage V undergoing hemodialysis, 29 individuals experienced an improvement (55.8%). While 23 individuals experienced no improved blood pressure (44.2%).

Keywords: CKD, hemodialysis, improvement of blood pressure

INTRODUCTION

Hemodialysis is an action to replace some kidney functions, such as removing substances (water, urea, creatinine, potassium, magnesium, etc.) [1] that are not needed in the blood. This action relies on the principles of diffusion of solutes across a semipermeable membrane. Transfer of metabolic waste products occurs following a decreasing concentration gradient from the circulation into the dialysate. [2] Hemodialysis is often performed on Stage V Chronic Kidney Disease (CKD) patients. Hemodialysis is usually performed 3 x 8 – 12 hours per week and can be done in the morning, afternoon, or evening depending on patient availability and condition. In the hemodialysis process, three main processes occur a) the process of diffusion, namely the movement of dissolved materials due to differences in levels in the blood and the dialysate. The larger the molecule, the slower the transfer rate across the membrane. A small molecule, such as urea, undergoes substantial clearance, while a larger molecule, such as creatinine, has a lower clearance efficiency; b) Ultrafiltration process, namely the process of moving water and dissolved materials due to differences in hydrostatic pressure in the blood and dialysate. A convective clearance occurs due to solvent drag with solutes being swept along with water through the semipermeable dialysis membrane; and c) The process of

osmosis, namely the process of moving water due to chemical energy, namely the difference in osmolarity of blood and dialysate. [3]

In hemodialysis, several substances, such as bicarbonate, are put into the patient's blood. The bicarbonate produced by carbonic anhydrase activity leaves the erythrocytes to be exchanged with chloride and can get hydrogen ions in the plasma. Hydrogen ions are then buffered by hemoglobin. It is also important in preventing the increase in pH that would normally accompany the deoxygenation of hemoglobin.

Chronic Kidney Disease (CKD) is a spectrum of pathophysiological processes associated with impaired kidney function and a progressive decrease in the glomerular filtration rate (GFR) [4]. Based on the latest guidelines from the National Kidney Foundation [Kidney Dialysis Outcomes Quality Initiatives (KDOQI)], the CKD stage is defined according to estimated GFR. One of the complications of CKD that can cause a poor prognosis is hypertension. In epidemiological studies of dialysis patients, low blood pressure can bring a worse prognosis than high blood pressure. Usually, 70% - 90% of new hemodialysis patients have high blood pressure (hypertension) the first time they undergo hemodialysis. After the first month of hemodialysis (decreased VCES), blood pressure decreased progressively, reaching normal levels of a variable proportion (30% - 95%) in patients who had been on hemodialysis for several months. The high initial MAP of predialysis patients decreased in the first week of dialysis, then the MAP remained and was quite stable after three months of hemodialysis.

CKD patients with blood pressure reaching 140/90 mmHg will be given antihypertensive drugs. [5] However, all antihypertensive medication was discontinued in all CKD Stage V patients after two months of hemodialysis. 90% of all cases stop in the first two weeks of hemodialysis. It is a very important point for any patient who has decreased consumption of antihypertensive drugs during the first few weeks of dialysis and is associated with a decrease in Extracellular Fluid Volume (VCES) to achieve dry weight and normotension.

The drastic decrease in VCES (average 2 kg or 2 liters of VCES) is very different from the gradual decrease in MAP after several months of hemodialysis. The time difference between the VCES change and the blood pressure response is a very important point. This is usually thought to be due to vascular repair and leads to slower removal of medium-sized vasoactive mediator molecules such as asymmetric dimethyl arginine and Na-K-ATPase. This explains why continuous weight loss after hemodialysis is often not immediately followed by a decrease in blood pressure. After two months of hemodialysis, blood pressure continues to decrease. Due to the improvement in the blood pressure of hemodialysis patients, researchers are encouraged to research to know the impact of hemodialysis on improving blood pressure in patients with Chronic Kidney Disease Stage V. The problem answered in this study is whether there is an improvement in the patient's blood pressure CKD after carrying out hemodialysis at UKI Hospital? The study aimed to prove that there was an improvement in blood pressure in CKD patients after hemodialysis at UKI General Hospital.

LITERATURE REVIEW

The kidneys are oval and lie retroperitoneally on the posterior abdominal wall, one on each side of the vertebral column at the level of vertebrae T12 – L3. Most of the kidney is covered by the arcus costalis. The right ren is slightly lower than the left ren because of the large right lobe of hepatitis. Each ren has an outer renal cortex and an inner renal medulla. The renal medulla consists of the medulla pyramids. The part of the cortex that projects into the medulla between the adjacent medullary pyramids is called the renal column. The striped portion extending from the base of the renal pyramids to the cortex is called the radii medullary.

The functional unit of the kidney is the nephrons. Each nephron consists of Bowman's capsule, a proximal tubule, descending loop of Henle, a loop of Henle, ascending loop of Henle, a distal tubule, and a collecting duct. The nephron is the structural and functional unit of the kidney. Each kidney contains more than 1 million units that process blood, a process that forms urine. In addition, there are thousands of collecting ducts, each collecting ducts collecting fluid from several nephrons to the renal pelvis. Each nephron contains a glomerulus, a capillary plate, and a renal tubule. Collectively, the glomerular capsule and accompanying glomeruli are called renal corpuscles. [6]

The endothelium of the glomerular capillaries is perforated by many pores, thus making it a multi-pore. It allows large amounts of solutes, especially protein-free fluids, to pass from the blood into the glomerular capsule. Fluid derived from plasma or filtrate is the basic material of the renal tubular process for urine formation.

Each nephron has an area called the juxtaglomerular apparatus, which includes two populations of cells that play important roles in regulating the rate of filtrate formation and systemic (renin-containing) blood pressure. Granular cells act as mechanoreceptors that sense blood pressure in afferent arterioles. The macula densa is a collection of tall, tightly closed ascending loops of Henle cells adjacent to the granular cells. Macula densa cells are chemoreceptors that react to changes in the NaCl content in the filtrate. The third cell population is the extraglomerular mesangial cells, which are also part of the juxtaglomerular apparatus. These cells are interconnected by gap junctions and can transmit signals between the macula densa and the granular cells.

The kidneys perform the following specific functions, which mostly help maintain the stability of the internal fluid environment. The kidney regulates the amount and concentration of the majority of ECF ions, maintains proper plasma volume, aids in maintaining acid-base balance in the body, excretes the waste products of body metabolism, removes many foreign compounds, produces erythropoietin and renin, and converts vitamin D into its active form. The kidney also regulates the amount and balance of H2O in the body. [7]

Chronic kidney disease (CKD) is a spectrum of pathophysiological processes associated with impaired kidney function and a progressive decrease in the glomerular filtration rate (GFR). Chronic renal failure is a persistent and irreversible process of a significant reduction in the number of nephrons and usually corresponds to CKD stages 3-5 [8]. The discouraging terms, kidney disease and end-stage renal disease, reflect a stage of CKD. At this stage, there is an accumulation of toxins, fluids, and electrolytes that are normally excreted by the kidneys causing the uremic syndrome. This syndrome causes death unless the toxin is removed by renal replacement therapy, dialysis, or a kidney transplant.

The pathophysiology of CKD initially depends on the underlying disease, but in subsequent developments, the process is more or less the same. Reduction in kidney mass results in structural and functional hypertrophy of the remaining nephrons as a compensatory effort mediated by vasoactive protein molecules such as cytokines and growth factors. [9] It results in hyperfiltration followed by increased capillary pressure and glomerular blood flow. This adaptation process lasts a short time, finally followed by a maladaptation process in the form of sclerosis of the remaining nephrons. This process is finally followed by a progressive decline in nephron function, even though the underlying disease is no longer active. The increased activity of the intrarenal renin-angiotensin-aldosterone axis also contributes to hyperfiltration, sclerosis, and progression. Long-term activation of the renin-angiotensin-aldosterone axis is partly mediated by growth factors such as Transforming Growth Factor β (TGF-β). Albuminuria, hypertension, hyperglycemia, and dyslipidemia are also considered to play a role in CKD progression. There is

interindividual variability in the occurrence of glomerular and tubulointerstitial sclerosis and fibrosis. At the earliest stage of CKD, kidney reserve power is lost in the basal state GFR is still normal or even increased. Then slowly but surely, there will be a progressive decline in nephron function characterized by increased serum urea and creatinine levels. Up to a GFR of 60%, the patient still has no complaints, but increased serum urea and creatinine levels have increased. Up to a GFR of 30%, complaints began to occur in patients, such as nocturia, weakness, nausea, lack of appetite, and weight loss. Until the GFR is below 30%, the patient shows obvious signs and symptoms of uremia, such as anemia, increased blood pressure, phosphorus and calcium metabolism disturbances, pruritus, nausea, vomiting, and so on. Patients are also susceptible to urinary tract infections, respiratory tract infections, and gastrointestinal infections. There will also be water balance disorders, such as hypovolemia or hypervolemia, and electrolyte balance disorders, including sodium and potassium. At GFR below 15%, more serious symptoms and complications will occur, and the patient already requires kidney replacement therapy, including dialysis or kidney transplant. In this condition, the patient is said to have reached the stage of kidney failure or CKD Stage V. [10]

Clinical features of patients with chronic kidney disease include: (a) According to the underlying disease such as diabetes mellitus, urinary tract infections, urinary tract stones, hypertension, systemic lupus erythematosus, and so on. (b) Uremia syndrome consists of weakness, lethargy, anorexia, nausea, vomiting, nocturia, excess fluid volume, and so on. (c) Symptoms of complications include hypertension, anemia, renal osteodystrophy, metabolic acidosis, and electrolyte balance disturbances [11]. Laboratory features of chronic kidney disease include: (a) According to the underlying disease. (b) Decreased kidney function resulted from increased serum urea and creatinine levels and decreased GFR calculated using Kockcroft-Gault. Serum creatinine level alone cannot be used to estimate kidney function. (c) Blood biochemical abnormalities include decreased hemoglobin levels, increased uric acid levels, hyperkalemia or hypokalemia, hyponatremia, hyperchloremia or hypochloremia, hyperphosphatemia, hypocalcemia, and metabolic acidosis. (d) Urinalysis abnormalities include proteinuria, hematuria, leukosuria, and so on. Radiological examination of CKD: (a) Plain photo of the abdomen, radio-opaque stones can be seen. (b) Antegrade or retrograde pyelography is performed as indicated. (c) Ultrasound of the kidneys may show reduced kidney size, thinned cortex, presence of hydronephrosis or kidney stones, cysts, masses, and calcifications. (d) Examination of kidney scans or renography is done when indicated.

Naturally, the body has an autoregulation system that regulates high blood pressure, so that tissue perfusion remains sufficient. Several factors influence the increase in blood pressure to maintain tissue perfusion, including humoral mediators, vascular adaptability and elasticity, blood volume and viscosity, cardiac output, and neural stimulation. In addition, blood pressure is influenced by genetic predisposition and sodium intake. The kidneys have several functions in the body, including the renin-angiotensin system and sodium regulation in the body. These two factors play a dominant role in regulating blood pressure balance. It is also possible that early kidney disorders or abnormalities that cannot be proven are the causes that play a role in the process of primary hypertension, and hypertension that lasts longer and gets more severe will cause nephrosclerosis. The role of positive sodium balance in the body is dominant in the pathogenesis of hypertension but is not the sole factor in the pathogenesis of hypertension in chronic kidney disease. One of the efforts to reduce the progression of chronic kidney disease is to control blood pressure and when to consult someone more competent. The management of this patient is

divided into two parts: (1) controlling blood pressure and (2) assessing kidney abnormalities and reducing progression. There are two types of hypertension treatment to control blood pressure: non-pharmacological and pharmacological drugs. According to the Joint National Committee (JNC) 8 and K/DOQI, blood pressure in kidney disease with hypertension reaches ≥ 140/90 mmHg, especially when accompanied by proteinuria. It should be noted that if you are >70 years old and without proteinuria, there is no need to aggressively lower your blood pressure. To achieve the target of lowering blood pressure, especially with good control of fluids and sodium. Excess fluid and sodium play an important role in the pathogenesis of hypertension in patients with chronic kidney disease. Controlling extracellular fluid and excess sodium can be done by restricting salt intake, increasing ultrafiltration, and prescribing sodium dialysate levels. The first step in managing hypertension in patients with chronic kidney disease is to achieve an ideal body weight. Experts recommend several types of antihypertensives for certain types of chronic kidney disease. Naturally, the body has an autoregulation system that regulates high blood pressure, so that tissue perfusion remains sufficient. In addition, blood pressure is influenced by genetic predisposition and sodium intake. There are three parameters to determine blood pressure's value: stroke volume, heart rate, and systemic vascular resistance. However, blood pressure can change during the cardiac cycle. Therefore, using the Mean Arterial Pressure (MAP) is better because it tends not to change in the arterial system from the ascending aorta to the peripheral arteries. MAP is the average arterial blood pressure required for blood circulation to the brain.

Hemodialysis relies on the principles of diffusion of solutes across a semipermeable membrane. Transfer of metabolic waste products occurs following a decreasing concentration gradient from the circulation into the dialysate. The rate of diffusive transport increases in response to several factors, including the size of the concentration gradient, the surface area of the membrane, and the mass transfer coefficient of the membrane [12]. Finally, it is a function of the membrane's porosity and thickness, the solute molecules' size, and the flow conditions on both sides of the membrane. A small molecule, e.g., urea (60 Da), experiences substantial clearance, while a larger molecule, e.g., creatinine (113 Da), has a lower clearance efficiency. In addition to diffusive clearance, ultrafiltration can transfer wastes from circulation into the dialysate. A convective clearance occurs due to solvent drag, with solutes being swept along with the water across the semipermeable dialysis membrane [13].

The hemodialysis procedure aims to remove solutes with low and high molecular weight. This procedure consists of pumping heparinized blood through the dialyzer at a flow rate of 300-500 mL/min while the dialysate flows in the opposite counter-current direction at a rate of 500-800 mL/min. The flow of blood determines the dialysis efficiency through the dialyzer and the characteristics of the dialyzer (i.e., its efficiency in removing solutes). Dialysis dose, currently defined as the fractional derivative of urea clearance over a single course of dialysis therapy, is determined by patient size, remaining renal function, dietary protein intake, degree of anabolism or catabolism, and presence of co-morbidities.

Since the important studies by Sargent and Gotch linking dialysis dose measurement using urea concentration with morbidity in the National Cooperative Dialysis Study, dispensed dialysis dose has been measured and considered a tool to guarantee and improve quality. Although fractional excretion of urea nitrogen and its derivatives is considered the standard method of measuring "dialysis adequacy," a multicenter randomized clinical trial (HEMO study) could not demonstrate differences in mortality related to large differences in urea clearance. Many observational studies and expert opinion suggest higher dialysis doses; current goals include a urea-lowering ratio

(fractional reduction of blood urea nitrogen per hemodialysis session) of >65-70% and a body water-indexed clearance x time product (KT/V) above 1.3 or 1.05, depending on whether the urea "balanced or not."

For most patients with Stage V CKD, between 9 and 12 hours of dialysis per week are required, usually divided into three equal sessions. Several studies suggest that longer hemodialysis sessions may be beneficial, although these studies have a confounding factor: the variability of patient characteristics, including body size and nutritional status. The "dose" of hemodialysis needs to be individualized, and factors other than urea nitrogen need to be considered, including the adequacy of ultrafiltration or fluid removal. Some authors emphasize the increased outcome with more frequent hemodialysis sessions (more than three times a week), although these studies also contain multiple troublemaker factors. A randomized clinical trial is underway to determine whether more frequent dialysis results in differences in physiological and functional markers.

Hypotension is hemodialysis's most common acute complication, especially in people with diabetes. Many factors appear to increase the risk of hypotension, including excessive ultrafiltration with inadequate vascular filling, impaired vasoactive or autonomic responses, osmolar shifts, over-administration of antihypertensive drugs, and reduced cardiac reserve. Patients with arteriovenous grafts and fistulas may develop heart failure due to the diversion of blood through the dialysis access; sometimes, this necessitates ligation of the fistula or graft. Due to the vasodilatory and cardiodepressive effects of acetate, its use as a buffer in dialysates was a frequent cause of hypotension. Since the introduction of bicarbonate-containing dialysates, dialysis-induced hypotension has become increasingly rare. Treatment of hypotension during dialysis is the discontinuation of ultrafiltration, administration of 100-250 ml of isotonic saline or 10 ml of 23% saturated hypertonic saline, and administration of salt-poor albumin. Hypotension during dialysis is often prevented by careful evaluation of dry weight and by ultrafiltration models, such that more fluid is removed at the start of the procedure than at the end. Other measures include sequential ultrafiltration followed by dialysis; use of midodrine, a selective α1-adrenergic pressor drug; cooling the dialysate during the dialysis process; and avoiding eating a lot during dialysis.

Muscle cramps during dialysis are common complications during dialysis. The etiology of dialysis-related cramps is still unclear. Changes in muscle perfusion due to overly aggressive volume depletion especially underestimated dry weight, and the use of a low-sodium dialysate are thought to be triggers for cramps on dialysis. Strategies to prevent cramps include reducing volume loss during dialysis, closing the ultrafiltration profile, and using a higher sodium concentration in the dialysate.

Anaphylactoid reactions to dialyzers, especially in the first use, have been reported in biocompatible cellulose-containing membranes. With the use of kuprofan membranes decreasing in the United States, reactions to dialyzers have become relatively rare. These dialyzer reactions can be divided into two types, A and B. Type A reactions are caused by an IgE-mediated fast-type hypersensitivity reaction to the ethylene oxide used in the newer dialyzer sterilizers. This reaction usually occurs soon after therapy is started (within the first few minutes) and can progress to complete anaphylaxis if therapy is not stopped immediately. Steroids and epinephrine may be necessary if symptoms are severe. The type B reaction is a symptom complex of nonspecific chest and back pain, which appears to be due to complement activation and cytokine release. Symptoms usually appear a few minutes after dialysis starts and generally subside with time, even if dialysis is continued.

Cardiovascular disease is the main cause of death in patients with Stage V CKD. Cardiovascular events and mortality rates are higher in dialysis patients than in post-

transplantation patients, although these rates are very high in both populations. The underlying cause of cardiovascular disease is still unclear. However, it may be related to co-risk factors such as diabetes mellitus, chronic inflammation, massive changes in extracellular volume (especially high inter-dialysis weight gain), inadequate treatment of hypertension, dyslipidemia, anemia, dystrophic vascular calcification, hyperhomocysteinemia, and possibly changes in cardiovascular dynamics during dialysis. Several studies studied cardiovascular risk reduction in Stage V CKD patients, but none have shown consistent results. However, most experts advocate conventional cardioprotective strategies (e.g., lipid-lowering drugs, β-adrenergic antagonist aspirin) in dialysis patients based on the cardiovascular risk profile of patients who appear to be increased more than one-fold relative to those without renal disease. [14]

RESEARCH METHOD

This study is an ex post facto analytic study with data collected retrospectively from the Archives of Inpatient Medical Records at the General Hospital of the Indonesian Christian University. The study was conducted at the medical records department at the General Hospital of the Christian University of Indonesia on September 5 – September 16, 2016. Secondary data was used in this study, namely the medical records of hemodialysis patients in September 2016 [15]. The number of samples taken using the quota sampling method, namely 52 medical records of Stage V CKD patients undergoing hemodialysis at the General Hospital of the Christian University of Indonesia in September 2016 who met the inclusion criteria, were sampled. The sampling technique used is quota sampling, namely by determining the number of sample members by quota or quota. The data collected came from medical records of hemodialysis patients and patients' blood pressure before and after hemodialysis at the Indonesian Christian University General Hospital in September 2016, which were included in the inclusion criteria. The data that has been collected will be grouped based on age, sex, and the length of time the patient has been on hemodialysis and then processed statistically using the Statistical Product and Service Solution (SPSS) program. The data to be analyzed is the distribution according to improvement in blood pressure seen from (MAP), age, gender, duration of hemodialysis, and patient's past medical history. This study followed the rules following the applicable research ethics by keeping the patient's identity confidential. Documents regarding identity and data related to research on blood pressure in patients with chronic kidney disease before and after hemodialysis are only used for research purposes.

RESULT AND DISCUSSION

Table 1. Frequency of Improvement and No Improvement

	Frequency	Percent	Valid Percent	Cumulative Percent
Improvement	29	55.8	55.8	55.8
No Improvement	23	44.2	44.2	100.0
Total	**52**	**100.0**	**100.0**	

The table above shows that of the 52 CKD Stage V patients undergoing hemodialysis, 29 experienced improvements (55.8%). In contrast, those who did not experience improvement were 23 people (44.2%). It shows that more patients with CKD Stage V undergoing hemodialysis experience improvement. One of the influencing factors is the change in plasma Na concentration. The lower the plasma Na, the lower the systolic blood pressure. An increase in plasma Na can increase the stiffness of the endothelial cells so that the blood pressure rises. Conversely, if the plasma Na decreases, the stiffness of the endothelial cells also decreases and causes blood pressure to also fall. Increased plasma Na can cause an increase in the concentration of Na

in the cerebrospinal fluid by activating osmoreceptors in the periventricular tissue of the third ventricle and excessive activity of angiotensin II in the hypothalamus so that outflow from the sympathetic nerves also increases.

Table 2. Effect of Hemodialysis on Blood Pressure

	Mean	N	Std. Deviation	Std.Error Mean
MAP Before HD	10.02	52	4.483	.622
MAP After HD	8.31	52	3.166	.439

In the Mean column of the table above, it can be seen that the MAP before Hemodialysis was 10.02, while the MAP after Hemodialysis was 8.31. It shows that there is an effect between hemodialysis and blood pressure improvement seen from MAP before hemodialysis and MAP after hemodialysis.

Table 3. Correlation between Hemodialysis and Blood Pressure

	N	Correlation	Sig.
MAP Before HD & MAP After HD	52	.313	.024

The table above shows the correlation between MAP before and after hemodialysis is 0.313. It shows a significant moderate correlation between MAP before and after hemodialysis. This moderate correlation can be related to factors affecting blood pressure in CKD patients. Stage V undergoing hemodialysis. Some of the factors reviewed, namely:

Table 4. Frequency of MAP Relationships Before and After Gender

			Gender		Total
			Male	Female	
MAP Before and After	Improvement	Count	14	15	29
		% of total	26.9%	28.8%	55.8%
	No Improvement	Count	16	7	23
		% of total	30.8%	13.5%	44.2%

The table above shows that of the 29 people who experienced improvement, 14 were men (48.3%), and 15 were women (51.7%).

Table 5. Correlation between Blood Pressure Improvement and Gender

	Value	df	p-value
Pearson Chi-Square	2.383	1	.103

In the table above, the p-value = .103. It indicates that the correlation between blood pressure improvement in Stage V CKD patients undergoing hemodialysis and gender is insignificant because a correlation can be significant if the p-value <0.05. The results above show that gender does not have a significant effect on improving blood pressure. However, if you look at the number of improvements, more women experience improvements than men. It is because women have the hormone estrogen. This hormone increases the production response of vasorelaxant substances such as nitric oxide, which act directly on vascular smooth muscle cells and reduce the cardiovascular stress response to adrenergic stimuli. Meanwhile, testosterone in males can increase the secretion of vasoconstrictors such as endothelin and stimulate the renin-angiotensin-aldosterone system, causing inadequate sodium excretion when arterial blood pressure increases. [16]

Table 6. Frequency of relationship between MAP before and after hemodialysis with patient's age

			Patient Age				Total
			30-39	40-40	50-59	≥60	
MAP Before and After	Improvement	Count	5	8	10	6	29
		% of total	9.6%	15.4%	19.2%	11.5%	55.8%
	No Improvement	Count	5	4	11	3	23
		% of total	9.6%	7.7%	21.2%	5.8%	44.2%

The table above shows that of the 29 people who experienced improvement, five people aged 30-39 years (17.2%), eight people aged 40-49 years (27.6%), ten people aged 50-59

years, and six people aged ≥ 60 years (20.7%).

Table 7. Correlation between Blood Pressure Improvements and Patient Age

	Value	df	*p-value*
Pearson Chi-Square	1.711[a]	3	.634

Suppose you look at Pearson Chi-Square, p-value = .634. It indicates that the correlation between blood pressure improvement in Stage V CKD patients undergoing hemodialysis and the patient's age is not significant because a correlation can be said to be significant if the p-value <0.05. The analysis above shows that the patient's age does not affect improving blood pressure in Stage V CKD patients undergoing hemodialysis. However, when viewed from the number of CKD Stage V patients undergoing hemodialysis at a young age, the relationship between systolic and diastolic blood pressure is consistent with increased peripheral vascular resistance and decreased vascular compliance. In patients with CKD Stage V undergoing hemodialysis at an older age, there is expected to be an additional decrease in vascular compliance and cardiac output.

Table 8. Frequency of relationship between MAP before and after with duration of hemodialysis

			Lama HD						Total
			7 hours/ week	8 hours/ week	9 hours/ week	10 hours/ week	12 hours/ week	12.5 hours/ week	
MAP Before and After	Improvement	Count	1	1	18	5	4	0	29
		% of total	1.9%	1.9%	34.6%	9.6%	7.7%	0.0%	55.8%
	No Improvement	Count	0	1	17	3	0	2	23
		% of total	0.0%	1.9%	32.7%	5.8%	0.0%	3.8%	44.2%

The table above shows that of the 29 people who experienced improvement, one person underwent hemodialysis for 7 hours/week (1.9%), one person underwent hemodialysis for 8 hours/week (1.9%), 18 people underwent hemodialysis for 9 hours/week (34.6%), five people underwent hemodialysis for 10 hours/week (9.6%), four people underwent hemodialysis for 12 hours/week. None underwent hemodialysis for 12.5 hours/week (0.0%).

Table 9. Correlation between Blood Pressure Improvements and Hemodialysis Duration

	Value	df	P value
Pearson Chi-Square	6.929a	5	.226

Suppose you look at Pearson Chi-Square, p-value = .226. It indicates that the correlation between blood pressure improvement in Stage V CKD patients undergoing hemodialysis and the length of time the patient is undergoing hemodialysis is not significant because a correlation can be said to be significant if the p-value <0.05. The results show that the correlation between blood pressure improvement in Stage V CKD patients undergoing hemodialysis and the frequency of a patient undergoing hemodialysis every week is not significant. It has also been explained in a journal that says that blood pressure can change after hemodialysis and before Subsequent hemodialysis weight depending on the patient's dry weight, not on the frequency of a patient undergoing hemodialysis. Dry weight is the weight at the end of hemodialysis that can cause blood pressure to be normotensive until the next dialysis, even though there is salt retention in the body. Dry weight can change if body mass decreases and fat in the body also changes. Incorrect dry weight estimation can lead to chronic excess fluid fulfillment or chronic lack of hydration. If the patient remains hypertensive after hemodialysis or becomes hypertensive before the next hemodialysis, the patient's dry weight is above the patient's estimated dry weight. However, other journals say that the longer the duration of hemodialysis per week, the better the blood pressure. The longer duration of a person undergoing hemodialysis causes an increase in the dose of dialysis that is distributed so that nutritional intake becomes good and can control anemia and serum phosphate in the body.

Table 10. Frequency of relationship between MAP before and after with the patient's past medical history

			Past Medical History			Total
			Hypertension	Diabetes	Hypertension + Diabetes	
MAP Before and After	Improvement	Count	18	6	5	29
		% of total	34.6%	11.5%	9.6%	55.8%
	No Improvement	Count	18	5	0	23
		% of total	34.6%	9.6%	0.0%	44.2%

The table above shows that of the 29 people who experienced improvement, 18 had a hypertension history (34.6%). Six people had a history of diabetes (11.5%), and five had hypertension and diabetes (9.6%).

Table 11. Correlation between Blood Pressure Improvement and Past Medical History

	Value	df	*p-value*
Pearson Chi-Square	4.458	2	.108

Suppose you look at Pearson Chi-Square, p-value = .108. It indicates that the correlation between blood pressure improvement in Stage V CKD patients undergoing hemodialysis and the patient's age is not significant because a correlation can be said to be significant if the p-value <0.05. From the results obtained, it is known that the correlation between the improvement in blood pressure in Stage V CKD patients undergoing hemodialysis and a history of previous illnesses in patients undergoing hemodialysis is not significant. It is because hemodialysis directly takes electrolyte fluids in the blood, especially sodium, which can cause blood pressure to drop. It has also been described in journals that explain the metabolic relationship between hypertension and diabetes.

Table 12. Proving the Hypothesis

	Paired Difference					t	df	p-value
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
				Lower	Upper			
MAP Before HD – MAP After HD	1.712	4.607	.639	.429	2.994	2.679	51	.010

The table above shows that the author's hypothesis is correct because the result in the p-value column is 0.010, so hypothesis 0 is rejected. The alternative hypothesis is accepted: an improvement in blood pressure in Stage V CKD patients undergoing hemodialysis at UKI Hospital in September 2016.

CONCLUSION

Based on the results of a study conducted on 52 medical records of Stage V CKD patients undergoing hemodialysis at the Indonesian Christian University General Hospital in September 2016, it can be concluded that hemodialysis can improve blood pressure. However, there is a correlation between blood pressure improvement and gender, patient age, the duration/length of the patient undergoing hemodialysis, and the frequency of a patient undergoing hemodialysis every week were not significant. However, if seen from the number, more women experience improvement than men because they are influenced by the hormone estrogen, which can act as a vasorelaxant, while men have the hormone testosterone, which acts as a vasoconstrictor. The older the patient, the more they experience improvement. Then the longer the patient undergoes hemodialysis, the better the improvement. Finally, if we look at the past medical history, more patients with a history of hypertension experienced improvement.

Declaration by Authors

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