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Monitoring Kidney Function Through the Use of Candesartan, Telmisartan or Valsartan Antihypertensive Therapy towards Patients CKD

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ABSTRACT

Chronic Kidney Disease (CKD) lower kidney function caused by an irreversible reduction in normal nephron function. Globally, CKD contributes to the cause of death. Activation of the Renin-Angiotensin-Aldosterone system is involved in the pathogenesis. ARBs have a cardiorenal protective effect. The purpose of this study was to determine the changes in kidney function with the use of Candesartan, Telmisartan or Valsartan antihypertensive therapies in CKD patients. This research method was a prospective observational cohort study looking at changes in kidney function (BUN and Serum Creatinine) at 1 and 6 months of using Antihypertensive Drugs Valsartan, Telmisartan, and Candesartan and tested by statistical analysis. The number of samples in this study was 72 patients which are 24 patients (Candesartan), 27 patients (Telmisartan), and 21 patients (Valsartan). The results showed that the Candesartan group experienced a decrease in average BUN of 0.13±0.85 mg/dl and serum creatinine of 0.004±0.09 mg/dl with independent t-test p=0.479 (p>0.05), Serum Creatinine p= 0.809 (p>0.05). The Telmisartan group experienced a decrease in average BUN of 4.74±5.16 mg/dl and serum creatinine of 0.33±0.20 mg/dl with Wilcoxon BUN test results p=0.000 (p<0.05), Serum Creatinine p=0.000 (p<0.05). In contrast, in the valsartan group, there was no change. So, it can be said that telmisartan has the highest effectiveness in kidney function (BUN and Serum Creatinine).

INTRODUCTION

Hypertension is a health problem because of the extensive prevalence rate so that an assessment of the use of antihypertensive drugs is needed because it is a potent killer disease in this world.[1] Joint National Committee on Detection, Evaluation, and Treatment of High Blood Pressure (JNC), hypertension is defined as blood pressure 140/90 mmHg. Blood pressure above normal that is not handled properly will cause more severe complications, one of them is kidney disease.[1,2] Chronic Kidney Disease (CKD) is kidney damage that causes the kidney to be unable to remove toxins and waste products from the blood, which is characterized by the presence of protein in the urine and a decrease in the Glomerular Filtration Rate (GFR) that lasts for more than three months.[3] According to the Kidney Disease Outcomes Quality Initiative, stage V CKD damage kidney tissue or decreased GFR less than 15 mL/min/1.73 m2 for more than three months and undergoing hemodialysis (HD).[3] According to Riskesdas (2018), the prevalence of chronic kidney failure (now called CKD) in Indonesia to the patients aged fifteen years and over Indonesia, which was recorded based on the number of cases diagnosed by doctors about 0.2%.[4]

There is a strong relation between chronic kidney disease and high blood pressure, which can cause or worsen the other's conditions. High blood pressure will cause pressure in the kidney to increase, resulting in damage to the nephrons (increased interglomerular pressure) which can cause proteinuria (presence of protein in the urine). Blood pressure control is the cornerstone of the patient care with CKD and relevant throughout all stages of CKD regardless of the underlying cause.[5] So that blood pressure control is an essential aspect in the management of all forms of kidney disease.[6]

Antihypertensive drugs have a route of elimination through the kidneys. In conditions of renal failure, antihypertensive drugs can cause accumulation in the kidneys to worsen the renal prognosis. Therefore, special attention and action are needed, especially selecting antihypertensive drugs that are comfortable for the kidneys.[7] The treatment regimen recommended by the Eighth Joint National Committee and the Guidelines for Clinical Care Ambulatory, as the initial treatment option for chronic kidney disease with hypertension, is an antihypertensive Angiotensin-Converting Enzyme Inhibitor (ACEI) or Angiotensin Receptor Blockers (ARB) with the target blood pressure being achieved. 140/90mmHg. Efficient lowering of blood pressure can avoid vasoconstriction of blood vessels and reduce morbidity and mortality. Rational use of drugs, either alone or in combination, can lower blood pressure.[8] The use of ACEIs and ARBs as first-line drugs to treat hypertension and the treatment of disorders of cardiovascular system are numerous. Besides being effective as an antihypertensive, this drug also has another function as a renoprotector, to protect the kidney.[9]

Antihypertensive ARBs are widely used because they act as angiotensin II receptor antagonists by blocking the angiotensin II receptor type 1 (AT1) which mediates the effects of angiotensin II vasoconstriction, aldosterone release, antidiuretic hormone release and constriction of efferent arterioles from the glomerulus. ARBs have deficient side effects compared to other antihypertensive drugs. Research has shown that ARBs have cardiorenal protection. Losartan, candesartan, irbesartan, valsartan, telmisartan, olmesartan, and eprosartan have been approved for the treatment of hypertension. Antagonistic effect on Angiotensin II, this drug relaxes smoothly, causes vasodilation, increases salt and water excretion and reduces plasma volume.[10]

Based on the previous study reporting on the Irbesartan Diabetic Nephropathy Trial (IDNT) in hypertensive patients with diabetic nephropathy, their besartan group had a 37% lower risk than amlodipine for increasing serum creatinine (p<0.001) and 33% lower than the placebo group (p=0.003). Progression of end-stage renal disease was lower than Inberstand, amlodipine and placebo but did not reach statistical significance (p=0.07).[11] Another study also stated that in the study of Reduction of Microalbuminuria With Valsartan towards Patients With Type 2 Diabetes Mellitus, compared the anti-proteinuric effects of valsartan and amlodipine in patients with type 2 diabetes and microalbuminuria with blood pressure of 135/85 mmHg. The urinary albumin excretion rate in 24 weeks with valsartan 80 mg/day was 56% compared with 92% from baseline with amlodipine 5 mg/day (p<0.001). In addition, more patients returned to normal

buminuria with valsartan than with amlodipine (29.9% versus 14.5%, respectively; $p<0.001$).[12] Based on the description that has been explained, this study was conducted to determine the monitoring of changes in kidney function in the use of antihypertensive therapy candesartan, telmisartan and valsartan towards patients with chronic kidney disease.

MATERIAL AND METHOD

This type of study is a retrospective observational cohort by looking at changes in kidney function (BUN and Serum Creatinine) in the first month and sixth month 6 following the use of Antihypertensive Drugs Valsartan, Telmisartan and Candesartan in hypertensive patients with chronic kidney disease. Sampling was carried out using a non-probability sampling technique by means of Consecutive Selection.

Inclusion Criteria: Outpatients diagnosed with hypertension with CKD complications without hemodialysis aged 18 years at the Outpatient Polyclinic of Haji General Hospital Surabaya received antihypertensive therapy with Valsartan, Telmisartan, or Candesartan monotherapy who underwent laboratory tests of kidney function (BUN and serum creatinine). The data obtained from this study were 72 patients who met the inclusion criteria, consisting of 24 patients on candesartan therapy, 27 patients on telmisartan therapy, and 21 patients on valsartan therapy. Independent variable Valsartan, Telmisartan, and Candesartan. The Dependent variable is the Effectiveness of kidney function (BUN and Serum Creatinine).

Data analysis was performed using the SPSS statistical program. with the normality test before performing statistical tests. The form of research data in the form of intervals. For normality test using Shapiro Wilk and homogeneity test using Levene test. If it is customary to use an independent t-test, if not standard/inhomogeneous, use the Wilcoxon test. To test the comparison of the effectiveness of kidney function (BUN and Serum Creatinine) and the three antihypertensive drugs, the Kruskal-Wallis test was used. Prior to this research, the ethics committee test was conducted at the Ethics Committee Institute of the University of Surabaya, and it was declared ethically worthy without an ethics permit certificate 154/KE/I/2021.

RESULTS

The data obtained from the study were 72 patients who met the inclusion criteria consisted of 24 patients on candesartan therapy, 27 patients on telmisartan therapy, and 21 patients on valsartan therapy. From the observed data, the results of the patient characteristics are as follows:

Demographic Data of Research Subjects

The demographic data of the subjects in this study were observed in terms of several characteristics, including age, gender, BMI, and the degree of CKD stage. Demographic data of research subjects are presented in more detail in table 1.

From table 1, patient characteristics can be seen in terms of age classification, it is known that the highest frequency of patients diagnosed with hypertension with chronic kidney disease who were treated with antihypertensive Angiotensin Receptor Blockers (ARBs), Valsartan, Telmisartan, or Candesartan aged 56-65 years were 21 patients (29.17%). In bivariate analysis, *p-value*=0.561(> 0.05) which means that there is no significant relation between age and ARB therapy in the Candesartan, Telmisartan, and Valsartan groups given.

Based on the patient characteristics in terms of gender characteristics, it can be seen that there were 38 patients (52.78%) male and 34 patients (47.22%) female from 72 patients diagnosed with hypertension with chronic kidney disease who were treated with antihypertensive ARBs Valsartan, Telmisartan or Candesartan. In the bivariate analysis, the *p-value*=0.923(> 0.05) means that there is no significant relation between gender and the ARB therapy given to the Candesartan, Telmisartan, and Valsartan groups.

Based on the characteristics of research data in terms of Body Mass Index (BMI) can be seen from Table 1 shows that most of the normal BMI category about 42 patients (58.33%) of 72 patients diagnosed with hypertension with chronic kidney disease who were treated with antihypertensives ARBs. Valsartan, Telmisartan or Candesartan in bivariate analysis, *p-value* =0.108(> 0.05) which means that there is no significant relation between BMI and ARB therapy in the Candesartan, Telmisartan, and Valsartan

groups given.

Based on the characteristics in terms of the stage of CKD, patients diagnosed with hypertension with chronic kidney disease who were treated with antihypertensives ARBs who received Valsartan Therapy were dominated by 19 patients (90.48%), Telmisartan Therapy in the stage IV about 15 patients (55.55%) and Candesartan Therapy in the stage II about 14 patients (58.33%) with bivariate analysis obtained, *p-value*=0.000 (<0.05) which means that there is relation between the level of CKD stage and the therapy given.

From the analysis data on the use of antihypertensive Angiotensin Receptor Blockers (ARBs) on the effectiveness of kidney function, in Table 2 and 3, the results of these measurements showed that patients who used candesartan therapy, BUN, and initial serum creatinine obtained patients who used candesartan therapy with an average decrease in initial BUN of 15±2.74 mg/dl, Serum Creatinine 0.94±0.20 mg/dl after 6 months of therapy there was a change in kidney function to BUN 15.19±2.58 mg/dl, Serum Creatinine 0.94±0.17 mg/dl (Table 3) so that the average BUN decreased by 0.13±0.85 mg/dl and Serum Creatinine of 0.004±0.09 mg/dl (Table 2). The results of independent t-test on BUN levels were *p-value*=0.479(*p*>0.05), Serum Creatinine, *p-value*=0.809 (*p*>0.05). So, it can be concluded that after 6 months of therapy there was no difference in the effect of decreasing kidney function (BUN and Serum Creatinine) in hypertensive patients with chronic kidney disease who were treated with Candesartan.

Table 2. Average Decline in Kidney Function (BUN and Serum Creatinine) on the Use of Antihypertensive Therapy Angiotensin Receptor Blockers

Kidney Function	ARB Therapy		
	Candesartan	Telmisartan	Valsartan
BUN	0.13±0.85	4.74±5.16	0±0
Serum Creatinine (Cr)	0.004±0.09	0.33±0.20	0±0

Source: Primary Data, 2021

Table 1. Characteristics of Patients Diagnosed with Hypertension with Chronic Kidney Disease Who Were Treated with Antihypertensive ARB

Patient Characteritics	ARB Therapy			Total	*p-value*
	Candesartan	Telmisartan	Valsartan		
	n (%)	n (%)	n (%)	n = 72 (%)	
Age (Years)					
26- 35	5 (20.83)	2 (7.41)	0 (0)	7 (9.72)	0.561
36-45	5 (20.83)	5 (18.52)	5 (23.81)	15 (20.83)	
46-55	4 (16.67)	5 (18.52)	6 (28.57)	15 (20.83)	
56-65	6 (25)	9 (33.33)	6 (28.57)	21 (29.17)	
66-75	4 (16.67)	6 (22.22)	4 (19.05)	14 (19.44)	
Gender					
Male	12 (50.00)	15(55.55)	11 (5238)	38 (52.78)	0.923
Female	12 (50.00)	12 (44.45)	10 (47.62)	34 (47.22)	
Body Mass Index					
Thin	0 (0)	1 (2.20)	0 (0)	1 (1.38)	0.108
Normale	11 (45.83)	21 (77.78)	10 (47.62)	42 (58.33)	
Obesity	12 (50)	4 (14.82)	9 (42.86)	25 (34.72)	
Obesitas	1 (4.17)	1 (2.20)	2 (9.52)	4 (5.55)	
Stage degree CKD					
St. I	9 (37.50)	0 (0)	0 (0)	9 (12.50)	0.000
St. II	14 (58.33)	0 (0)	19 (90.48)	33 (45.83)	
St. IIIA	1 (4.17)	4 (14.82)	2 (9.52)	7 (9.72)	
St. IIIB	0 (0)	8 (29.63)	0 (0)	8 (11.11)	
St. IV	0 (0)	15 (55.55)	0 (0)	15 (20.83)	

Source: Primary Data, 2021

In patients receiving telmisartan therapy, the results of BUN and initial Serum Creatinine measurements were 34.07±10.59 mg/dl; Serum Creatinine 2.32±0.67 mg/dl after 6 months of therapy there was a change in kidney function to BUN 29.33±7.46 mg/dl, Serum Creatinine 1.99±0.64 so that the average BUN decreased by 4.74±5.16 mg/dl and Serum Creatinine by 0.33±0.20 mg/dl with Wilcoxon test results on BUN levels, *p-value*=0.000 (p<0.05), Serum Creatinine, *p-value*=0.000 (p<0.05), so it can be concluded that after 6 months of therapy there was a difference in the effect of decreasing kidney function (BUN and serum creatinine) in hypertensive patients with chronic kidney disease who were treated with Telmisartan.

DISCUSSION

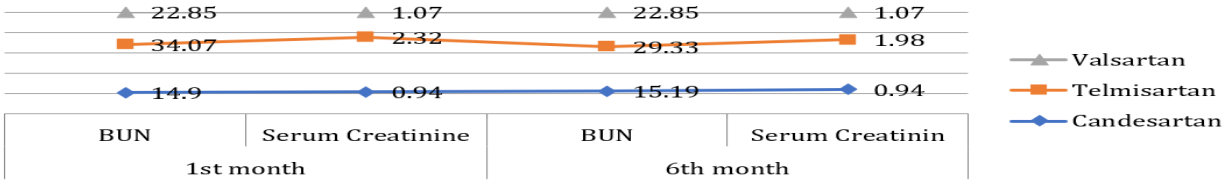
Patient characteristics can be seen in terms of age classification, it is known that the highest frequency of patients diagnosed with hypertension with chronic kidney disease who were treated with Antihypertensive Angiotensin Receptor Blockers (ARBs), Valsartan, Telmisartan, or Candesartan aged 56-65 years were 21 patients (29.17%). In bivariate analysis, *p-value*= 0.561 which means that there is no significant relation between age and ARB therapy in the Candesartan, Telmisartan, and Valsartan groups given. This is in line with research conducted by Udayani in 2017 in Bali.[13] Renal function will change with age. After 40 years, there will be a progressive decrease in the glomerular filtration rate until 70 years, approximately 50% of normal. With aging, the kidneys lose their ability to respond to acute fluid and electrolyte changes. About 50% of patients who develop CKD during hospitalization for medical or surgical problems are over 60 years old.[14]

Based on the patient characteristics in terms of gender characteristics, it can be seen that there were 38 patients (52.78%) male and 34 patients (47.22%) female from 72 patients diagnosed with hypertension with chronic kidney disease who were treated with antihypertensive ARBs Valsartan, Telmisartan or Candesartan. In the bivariate analysis, the *p-value*=0.923 means that there is no significant relation between gender and the ARB therapy given to the Candesartan, Telmisartan, and Valsartan groups. This means that male and female respondents have the same opportunity to receive the two combination therapies.[15,16] Basically, from some literature, it is explained that CKD patients are not influenced by gender, men and women have the same risk for suffering from CKD. According to the researchers in this study, there were more male respondents because it was caused by the lifestyle of male respondents who like to smoke and drink coffee, wherefrom interviews with respondents generally CKD was initiated by hypertension and some others suffered from a stroke, where the disease can lead to stroke. Caused by smoking and caffeine consumption. Prolonged hypertension can be a risk factor for CKD.[17]

Table 3. Mean Kidney Function (BUN and Serum Creatinine) Before and After the Use of Antihypertensive Therapy Angiotensin Receptor Blockers (ARBs) Treated with the Antihypertensive ARBs Valsartan, Telmisartan or Candesartan

Kidney Function	ARB Therapy								
	Candesartan			Telmisartan			Valsartan		
	Pre	Post	*p-value*	Pre	Post	*p-value*	Pre	Post	*p-value*
BUN	15 ± 2.74	15.19 ± 2.58	0.479	34.07 ± 10.59	29.33 ± 7.46	0.000	22.86 ± 1.35	22.86 ± 1.350	No Change
Serum Creatinine (Cr)	0.94 ± 0.20	0.94 ± 0.17	0.809	2.32 ± 0.67	1.99 ± 0.64	0.000	1.07 ± 0.23	1.07 ± 0.23	No Change

Source: Primary Data, 2021



Source: Primary Data, 2021

Figure 1. Mean Renal Function (BUN and Serum Creatinine) in Hypertensive Patients with CKD Treated with the Antihypertensive ARBs Valsartan, Telmisartan or Candesartan

Body Mass Index (BMI) can describe the level of adiposity or fat accumulation in a person's body. Excess fat in the body can cause health risks.[18,19] Based on the characteristics of research data in terms of BMI can be seen from Table 1 shows that most of the normal BMI category about 42 patients (58.33%) of 72 patients diagnosed with hypertension with chronic kidney disease who were treated with Antihypertensives ARBs. Valsartan, Telmisartan or Candesartan, in bivariate analysis, *p-value*=0.108 which means that there is no significant relation between BMI and ARB therapy in the Candesartan, Telmisartan, and Valsartan groups given. An increased BMI has been shown to increase the risk of developing pre-existing kidney disease, including diabetes and hypertension. Obese patients with chronic kidney disease have a higher rate of decreased glomerular filtration rate and Build End-Stage of Renal Disease (ESRD) more rapidly. an increase in BMI is an independent risk factor for the development of ESRD in obese individuals compared with normal weight.[20] Obesity is associated with an increased risk of developing chronic kidney disease. Renal plasma flow, renin–angiotensin–aldosterone system activity, and intraglomerular pressure are each increased in obesity and can cause kidney damage. Obesity also increases the risk of diabetes and hypertension, which are the most common causes of kidney disease.[21]

Based on the characteristics in terms of the stage of CKD, patients diagnosed with hypertension with chronic kidney disease who were treated with antihypertensives ARBs received Valsartan Therapy were dominated by 19 patients (90.48%), Telmisartan Therapy at stage IV about 15 patients (55.55%) and Candesartan Therapy at stage II about 14 patients (58.33%) with bivariate analysis obtained, *p-value* = 0.000 which means that there is a relationship between the level of CKD stage and the therapy given. Antihypertensives of the ARB working group by blocking the AT1 receptor, causing vasodilation, increasing Na + and fluids (reducing plasma volume), reducing vascular hypertrophy. Apart from blocking AT1, ARBs do not decrease the concentration of angiotensin II in the blood if more AT2 is stimulated by angiotensin II, which causes vasodilation and antiproliferative action.[7]

Analysis of the Use of Antihypertensives Angiotensin Receptor Blockers (ARBs) on the Effectiveness of Kidney Function

CKD is associated with increased activity of the RAAS. Reduced blood flow in the peritubular capillaries downstream from the sclerosis of glomeruli. As a result, the glomeruli in this Hypersecretion area of renin, thereby increasing circulating levels of angiotensin II. Angiotensin II has a direct vasoconstrictor effect, which increases systemic vascular resistance and blood pressure. Because there are fewer functioning glomeruli in CKD, each remaining glomerulus must increase the Glomerular Filtration Rate (GFR), increasing systemic arterial pressure helping to increase perfusion pressure and GFR.[10]

Antihypertensives of the ARB class is widely used because they can act as angiotensin II receptor antagonists by blocking the angiotensin II type 1 (AT1) receptor which mediates the effects of angiotensin II which are known in human, namely: vasoconstriction, aldosterone release, release of antidiuretic hormone and constriction of efferent arterioles from the glomerulus. ARBs have the lowest side effects compared to other antihypertensive drugs.

From the analysis data on the use of Antihypertensive Angiotensin Receptor Blockers (ARBs) on the effectiveness of kidney function, in Tables 2 and 3, the results of these measurements showed that patients who used Candesartan Therapy, BUN, and initial Serum Creatinine obtained patients used Candesartan Therapy with an average decrease in initial BUN of 15 ±2.74 mg/dl, serum creatinine 0.94±0.20 mg/dl after 6 months of therapy there was a change in kidney function to BUN 15.19±2.58 mg/dl, serum creatinine 0.94±0.17 mg/dl so that the average BUN decreased by 0.13± 0.85 mg/dl and serum creatinine of 0.004±0.09 mg/dl. The results of independent t-test on BUN levels were, *p-value*=0.479, serum creatinine *p-value*=0.809. So, it can be concluded that after 6 months of therapy there was no difference in the effect of decreasing kidney function (BUN and serum creatinine) in hypertensive patients with chronic kidney disease who were treated with candesartan.

The results of independent t-test on BUN lev-

els were, *p-value*=0.479, serum creatinine, *p-value*=0.80. So, it can be concluded that after 6 months of therapy there was no difference in the effect of decreasing kidney function (BUN and serum creatinine) in hypertensive patients with chronic kidney disease who were treated with candesartan.

In patients who received telmisartan therapy, the results of BUN and initial serum creatinine measurements were 34.07±10.59 mg/dl; serum creatinine 2.32±0.67 mg/dl after 6 months of therapy there was a change in kidney function to BUN 29.33±7.46 mg/dl, serum creatinine 1.99±0.64 so that the average BUN decreased by 4.74±5.16 mg/dl and serum creatinine by 0.33±0.20 mg/dl with Wilcoxon test results on BUN levels, *p-value*=0.000, serum creatinine *p-value*=0.000, so it can be concluded that after 6 months of therapy there was a difference in the effect of decreasing kidney function (BUN and serum creatinine) in hypertensive patients with chronic kidney disease who were treated with telmisartan.

Meanwhile, in patients using Valsartan Therapy, the results of the initial and final BUN and serum creatinine measurements did not change, so it can be concluded that there was no difference in the effect of decreasing kidney function (BUN and serum creatinine) in hypertensive patients with chronic kidney disease who were treated with Valsartan.

So, it can be concluded that of the three antihypertensive drugs of the Angiotensin Receptor Blocker (ARB), Valsartan, Telmisartan or Candesartan which have effectiveness in kidney function (BUN and serum creatinine) the best in outpatients with a diagnosis of hypertension with chronic kidney disease is telmisartan. Telmisartan is an angiotensin II receptor antagonist (ARB) used in the management of hypertension. Telmisartan is given orally. After giving a dose, the peak effect of lowering blood pressure is achieved within 3 hours and lasts for 24 hours. The maximum blood pressure-lowering effect occurs about 4 to 8 weeks after starting therapy.[22]

Telmisartan is rapidly absorbed from the gastrointestinal tract. Oral bioavailability is dose-dependent, about 42% after a 40 mg dose and 58% after 160 mg. Peak plasma concentrations of telmisartan is reached about 0.5 to 1 hour after an oral dose. Telmisartan is bound to plasma proteins more than 99.5%. Telmisartan has a long elimination half-life of 24 hours and a total clearance of more than 800 ml/min.[23] The choice of ARB therapy cannot be separated from various pharmacological considerations, including pharmaceutical, pharmacokinetic, and pharmacodynamic profiles.

The physicochemical properties of ARBs underlie differences in oral bioavailability, affinity, degree of dissociation, and even other effects that are not mediated by AT1 receptor binding. The tetrazole group in telmisartan is replaced by a carboxyl group, increasing lipophilicity and bioavailability compared to Candesartan. Telmisartan is 4′ - {[4 – Methyl – 6 - (1-methyl – 2 - benznidazole) – 2 – propyl – 1 bensimidazolyl] methyl} – 2 - biphenyl carboxylic acid with the empirical formula C33H30N4O2.[24] Telmisartan was the most lipophilic with a log *p-value* (partition coefficient) of 6.66; followed by Candesartan with a partition coefficient (logP) of 4.02 and valsartan with a partition coefficient of 3.68. Only the lipophilic of the circulating active drug is relevant for tissue penetration after the drug is absorbed. Lipophilicity of the active molecule is essential for distribution in the body.[25]

A recent meta-analysis of 20 randomized controlled trials of telmisartan performed primarily in diabetic patients concluded that telmisartan therapy may be effective in easing proteinuria or preventing its development. Telmisartan caused statistically significant reductions in percent change in urinary albumin/protein excretion and urinary albumin/protein to creatinine to telmisartan ratio relative to ARBs, AFIs, and other therapies by 20, 14, and 40%.[24] Other studies have also suggested that ARBs have renoprotection and this effect of telmisartan appears to be stronger than Losartan, Candesartan, or Olmesartan in the early stage of DN patients.[25]

There are also studies that show the results that creatinine is significantly reduced by 18% from baseline (p<0.05). On the use of telmisartan 40 mg once daily for 12 months and the reduction was significantly greater than in the amlodipine group (p<0.05).[22] So, in this study showed that telmisartan is effective in the progression of kidney function (BUN and Serum Creatinine) in

CKD patients. Based on the results of the study, the impact of public health, especially in health services, is to provide information to medical personnel about the effectiveness of using anti-hypertensive drugs so that they can improve the quality of services to the community and prevent disease progression.

CONCLUSION AND RECOMMENDATION

Therefore, it can be concluded that of the three antihypertensive drugs, the Angiotensin Receptor Blocker (ARB), Valsartan, Telmisartan, or Candesartan have the best kidney function effectiveness (BUN and Serum Creatinine) in outpatients with a diagnosis of hypertension with chronic kidney disease is telmisartan. The results of this study can provide information to health services in achieving the effectiveness of antihypertensive therapy in the progression of CKD patients.

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AUTHOR CONTRIBUTIONS

From the research process until the writing of this article, all authors played a role in this research. The correspondent author plays a role in compiling and designing research, the second author acts as a data analyzer, and 3rd author, 4th author, acts as data collection in the field.

CONFLICTS OF INTEREST

There are no conflicts of interest.

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