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Efficacy and Safety of Antihypertensive Drugs in Chronic Kidney Disease Patients at Menggala Regional General Hospital

Denny Ardhianto[1*], Made Laksmi Meiliana[1], Dwi Ismayati[1], Syaripah Ulandari[1], Okta Puspita[1], Rena Oktaviana[2]

[1] Department of Pharmacy, Faculty of Medicine, Universitas Lampung, Bandar Lampung, Lampung, Indonesia
[2] Department of Pharmacy, STIKES Adila, Bandar Lampung, Lampung, Indonesia

ABSTRACT: Chronic kidney disease (CKD) is a progressive condition characterized by a gradual decline in glomerular filtration rate, often accompanied by hypertension, necessitating antihypertensive therapy. This study aimed to evaluate the effectiveness of antihypertensive drugs in achieving blood pressure targets (<140/90 mmHg or a mean arterial pressure reduction of ≥20 mmHg) and to identify the incidence of adverse effects in CKD patients at Menggala Regional General Hospital during 2024. A retrospective observational study was conducted using medical records from 199 CKD inpatients selected via purposive sampling. Data analysis employed descriptive statistics, paired t-tests for effectiveness, and chi-square tests for associations between drug types. Results indicated that combination therapy with furosemide IV, candesartan, and amlodipine was the most common (77.4%) and demonstrated effectiveness in 50.8% of cases (p=0.01). Adverse effects occurred in only 1.0% of patients, primarily peripheral edema. The findings underscore the efficacy of combination therapies involving diuretics, ARBs, and CCBs in managing hypertension in CKD, with minimal adverse events. This research provides valuable insights for optimizing antihypertensive regimens in similar settings.

Keywords: Chronic kidney disease; antihypertensive drugs; adverse effects

[*]Corresponding author:
Name : Denny Ardhianto
Email : ardhianto.denny@fk.unila.ac.id
Address : Jl. Prof. Dr. Ir. Sumantri Brojonegoro, Bandar Lampung, Lampung, Indonesia

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INTRODUCTION

The kidneys are vital organs in the human body, functioning to regulate fluid balance, prevent waste accumulation, and maintain blood composition. Additionally, the kidneys produce hormones and sustain stable electrolyte levels, such as sodium, potassium, and phosphate (Prasetya et al., 2022). The progressive decline in renal function, impairing the body's ability to maintain homeostasis, is termed chronic kidney disease (CKD) (Arisandy & Carolina, 2023). This gradual deterioration is characterized by a reduction in the glomerular filtration rate (GFR) or estimated glomerular filtration rate (eGFR) (Ministry of Health, 2023).

According to the 2018 Basic Health Research findings, approximately 713,783 individuals in Indonesia are afflicted with chronic kidney disorders, while in Lampung Province, CKD affects 22,171 patients (Ningsih et al., 2024). Data from the 2018 Indonesian Renal Registry (IRR) report indicate an increase in the number of CKD patients undergoing hemodialysis in Indonesia, rising from 77,892 in 2017 to 132,142 in 2018 (Nisrina et al., 2023). This escalating prevalence underscores the urgent public health crisis posed by CKD, as untreated or poorly managed cases contribute to soaring mortality rates, cardiovascular complications, and overwhelming healthcare costs, demanding immediate attention to optimize therapeutic strategies before the burden becomes unsustainable.

Impaired renal function can lead to elevated blood pressure, potentially resulting in hypertension among patients with kidney disease (Pradiningsih et al., 2020). Therapeutic efficacy in CKD patients can be assessed using clinical data from patients receiving antihypertensive agents alongside chronic renal disease, specifically by achieving target blood pressure levels of <140/90 mmHg. A drug is deemed adequate if it reduces blood pressure, thereby confirming the efficacy of antihypertensive therapy in CKD patients. Agents with robust efficacy mitigate vascular damage (Purwanti, 2024). Treatment effectiveness also hinges on the success of the administered regimen. Pharmacotherapy typically commences with monotherapy, a single agent, which can often reduce systolic blood pressure by 7–13 mmHg and diastolic blood pressure by 4–8 mmHg (Husna et al., 2024). Blood pressure management constitutes a foundational aspect of CKD care.

Per the Joint National Committee (JNC-8) guidelines, angiotensin-converting enzyme inhibitors (ACEIs) and angiotensin receptor blockers (ARBs) are recommended as first-line therapies for patients with hypertension and chronic renal failure (Octariani et al., 2021). CKD patients frequently receive combination antihypertensive regimens to attain or maintain target blood pressure levels (Sholihah & Chalim, 2020). Antihypertensive pharmacotherapy may also elicit adverse effects in patients, which vary depending on the drug class, dosage, patient condition, and individual characteristics (Jayanti et al., 2023). Common complications associated with antihypertensive use include vasodilatory edema, while the most prevalent adverse effects encompass headache, constipation, rash, nausea, dizziness, hypotension, and hyperkalemia (Putri et al., 2023).

Findings from Paranoan et al. (2019) demonstrate that blood pressure in the valsartan and amlodipine group declined rapidly on average, affecting both systolic and diastolic values. However, rapid blood pressure reduction via oral antihypertensives may precipitate hypotension and other comorbidities. In contrast, the amlodipine-telmisartan combination yielded a modest, safe reduction in blood pressure. Telmisartan exhibits superior efficacy in lowering blood pressure compared to valsartan, attributable to its greater potency or longer plasma half-life. Consequently, this study concludes that the amlodipine-telmisartan combination is the most effective and appropriate for reducing

blood pressure. Adverse effects included edema in 7.14% of amlodipine users, hyperkalemia in 14.28% of amlodipine-telmisartan recipients, and dizziness in 14.28% of amlodipine-valsartan users. Results from Lestari (2021) indicate that combination antihypertensive therapy is more efficacious than monotherapy in patients with CKD. This is evidenced by data showing that only 13.7% of CKD patients with hypertension received single-agent treatment, primarily from ARB or ACE inhibitor classes. Meanwhile, 86.3% received combination therapy, including ARB + CCB, loop diuretic + CCB, or ACE inhibitor + CCB. Among these combinations, loop diuretic + CCB proved most effective in achieving blood pressure targets, with reductions approximating ±129/79 mmHg.

Despite these data, significant research gaps persist, particularly in region-specific evaluations of antihypertensive efficacy and adverse effects in Indonesian healthcare settings like Lampung Province, where local patient demographics, access to care, and real-world adherence may influence outcomes differently than in broader studies.

Menggala Regional General Hospital is located in Lampung Province, specifically in Tulang Bawang Regency. This facility serves as a referral centre for patients with CKD undergoing hemodialysis. CKD ranks among the top 10 diseases at Menggala Regional General Hospital and holds the first position in the hemodialysis unit, with 1,861 patients recorded in 2024. This study aims to evaluate the efficacy of antihypertensive drug use by blood pressure reduction effectiveness and the adverse effects in chronic renal failure patients at Menggala Regional General Hospital during the 2024 period.

METHODS

This study employed a non-experimental observational design with retrospective data collection. Non-experimental research involves observing a set of characteristics (variables) without the investigator manipulating them. Retrospective data retrieval was conducted by reviewing historical documents, specifically examining the medical records of inpatients with CKD at Menggala Regional General Hospital during 2024. Purposive sampling was used for the 2024 period.

Inclusion criteria required patients to have CKD stages 3 through 5 inpatients, comorbid hypertension, be at least 18 years old, initial systolic and diastolic blood pressure >140/90 mmHg, medical records of patients hospitalized for more than 2 days and have received antihypertensive treatment for a minimum of 3 months who were admitted to Menggala Regional General Hospital from January to December 2024. Patients were excluded if their records were incomplete or if they underwent renal replacement therapies other than hemodialysis, such as peritoneal dialysis. Informed consent was waived for this retrospective study involving medical record review, and all patient data were anonymized prior to analysis to ensure confidentiality and compliance with ethical standards. Data extraction focused on demographic variables, CKD staging based on estimated glomerular filtration rate (eGFR), baseline and follow-up blood pressure measurements, specific antihypertensive regimens, and documented adverse events.

Antihypertensive effectiveness was assessed by comparing baseline and follow-up blood pressure measurements obtained from medical records. Baseline blood pressure was defined as the first recorded measurement at admission, and follow-up blood pressure as the last recorded measurement prior to discharge. When more than one measurement was recorded on the same day, the average value was used. Therapy was considered effective if blood pressure fell to <140/90 mmHg or mean arterial pressure decreased by ≥20 mmHg. Medical record data from CKD inpatients at Menggala Regional General Hospital in 2024 were collected and documented via medical charts. The obtained data were analyzed using

bivariate analysis in SPSS. Bivariate analysis is employed to test the direct relationship between two variables, followed by the T-test and the Chi-square test. The T-test is a parametric statistical method used to measure mean differences between two distinct groups and to assess their interrelationships; in this study, it was applied to compare changes in blood pressure and the effectiveness of antihypertensive drugs in CKD patients. The Chi-square test evaluates whether observed frequencies in one or more categories align with expected frequencies and determines associations between two variables; in this study, it was utilized to examine the correlation between drug types in CKD patients. Collected data will be presented in tabular form to evaluate the effectiveness of single or combination antihypertensive therapy and the number of CKD patients experiencing adverse effects from antihypertensive drug use.

RESULT AND DISCUSSION

This retrospective study analyzed medical records of patients diagnosed with CKD who were prescribed antihypertensive therapy at Menggala Regional Hospital from January to December 2024. The analysis of the data presented in Table 1 reveals that at Menggala Regional General Hospital, 199 CKD patients were treated during the 2024 period. This research included both male and female patients, with females constituting the majority (112, 56.3% of the total) and males numbering 87 (43.7%). Although a higher proportion of female patients was observed, the present study did not evaluate the biological mechanisms underlying sex differences. Possible explanations involving hormonal or metabolic factors have been suggested by Chang et al. (2016). They should be interpreted as literature-based hypotheses rather than direct findings of this study.

Table 1. Patient demographic

Demographic		Sample (n)	Percentage (%)
Sex	Male	87	43.7
	Female	112	56.3
Age	40-50	55	27.6
	51-60	79	39.7
	61-70	52	26.1
	71-80	13	6.5
Duration	< 3 days	105	52.8
	> 3 days	94	47.2
Total		199	100

Further examination indicates that the highest prevalence of CKD at Menggala Regional General Hospital in 2024 occurred among patients aged 51-60 years, with 79 cases comprising 39.7% of the sample. This observation is consistent with prior research by Badariah et al. (2017) and Ariyani et al. (2019). Individuals aged 40 years or older experience a decline in renal function and nutrient absorption compared to their younger counterparts. Around age 40 and beyond, the kidneys begin to lose nephrons—critical filtration units—and arterial blood vessels exhibit reduced elasticity, leading to elevated blood pressure (Badariah et al., 2017). As age advances, susceptibility to CKD increases;

after age 40, glomerular filtration rate diminishes progressively, estimated at approximately 1% annually (Ariyani et al., 2019).

Regarding length of hospital stay, the majority of patients had shorter stays: 105 patients (52.8%) were hospitalized for fewer than 3 days, compared to 94 patients (47.2%) who stayed longer than 3 days. Typically, inpatient care for CKD or comorbid conditions extends beyond 7 days. The association between hospitalization duration and CKD stems from blood pressure fluctuations, where sustained hypertension can impair renal function in affected patients (Kurniawati et al., 2025). Although hospitalization duration was reported, its association with blood pressure control, antihypertensive selection, or adverse events was not formally analyzed. Therefore, potential effects of hospitalization duration on treatment outcomes cannot be inferred from the present study.

The most frequently prescribed antihypertensive regimen for CKD patients was the combination of intravenous furosemide, candesartan, and amlodipine, administered to 154 patients (77.4%). This triad is appropriate given its complementary mechanisms for reducing blood pressure. Calcium channel blockers (CCBs) have been established as safe and effective for lowering blood pressure with good tolerability (Herawati et al., 2021). The valsartan-amlodipine combination demonstrates superior efficacy, yielding substantial reductions in both systolic and diastolic pressures (Paranoan, 2019). However, oral antihypertensives that rapidly lower blood pressure are not without risks, potentially inducing hypotension or other complications. The predominance of the intravenous furosemide, candesartan, and amlodipine regimen (77.4%) reflects a relatively uniform prescribing practice at Menggala Regional General Hospital, likely influenced by institutional treatment protocols, formulary availability, and the clinical severity of hospitalized CKD patients, who often require combination therapy. As this study was conducted in a referral setting with a high proportion of advanced CKD cases, the frequent use of this regimen may indicate disease complexity rather than preferential selection, and its observed effectiveness should therefore be interpreted within the context of local practice patterns and patient characteristics rather than as comparative superiority.

Amlodipine is suitable across all levels of renal function, as it is well-tolerated in kidney-impaired patients, maintains a consistent half-life in renal failure, and requires no dose adjustments. Research by Lestari (2021) supports the superiority of combination antihypertensives over monotherapy in CKD management. Such combinations are particularly recommended for hypertensive patients with elevated blood pressure, especially when values deviate significantly from JNC-8 targets (Paranoan et al., 2019).

The mean blood pressure before taking antihypertensive medication was 165 mmHg systolic and 97 mmHg diastolic. After taking antihypertensive medication, the mean blood pressure was 146 mmHg systolic and 82 mmHg diastolic. Descriptive analysis of 101 patients (50.8%) in Table 3 achieved an effective blood pressure reduction of at least 20 mmHg, while 98 patients (49.2%) did not. A one-sample *t*-test was subsequently performed to determine whether the observed 20 mmHg reduction in blood pressure was statistically significant. The results of the one-sample *t*-test demonstrated a p-value < 0.001, indicating a statistically significant reduction. These findings suggest that both systolic and diastolic blood pressure reductions reached the expected therapeutic target of 20 mmHg and can therefore be considered clinically effective. Large randomized clinical trials and individual-participant meta-analyses have consistently shown that the magnitude of systolic blood pressure reduction is proportional to improvement in cardiovascular outcomes; for example, for every 5 mmHg decrease in systolic blood pressure there is approximately a 10% reduction in the risk of major cardiovascular events,

implying that larger reductions such as ~20 mmHg confer clinically important benefit in reducing cardiovascular risk among patients with hypertension (Canoy et al, 2022).

In terms of drug classes, the diuretic + angiotensin II receptor blocker (ARB) + CCB combination was the most common, used in 154 patients (77.4%), followed by CCB + ARB in 25 patients (12.6%), as shown in Table 2. These patterns are corroborated by guidelines from the Joint National Committee (JNC 8) and Kidney Disease: Improving Global Outcomes (KDIGO 2021), which endorse ARBs and CCBs for CKD patients (Momuat & Annisaa', 2023). For adults aged 18 years or older with CKD, initial (or adjunct) antihypertensive therapy should incorporate an ACE inhibitor or ARB to enhance renal outcomes. This is in line with our findings at RSUD Menggala, where the diuretic + ARB + CCB regimen was the most common (Muhadi, 2016).

Table 2. Antihypertensive drug use profile

Drug	Sample (n)	Percentage (%)
Furosemide IV + Candesartan + Amlodipine	154	77.4
Amlodipine + Candesartan	25	12.6
Amlodipine + Candesartan + Nicardipine IV + Furosemide IV	3	1.5
Amlodipine + Furosemide	8	4
Furosemide IV + Irbesartan + Amlodipine	1	0.5
Furosemide + Candesartan	2	1
Furosemide IV	2	1
Amlodipine	1	0.5
Furosemide IV + Amlodipine + Bisoprolol + Candesartan	2	1
Bisoprolol + Ramipril + Furosemide IV	1	0.5
Total	199	100

Table 3. Effectiveness the use of antihypertensive drug with 20 mmHg decrease

Efectiveness	Number (n)	Percentage	Sig. (2 tailed)
Not effective	98	49.2%	0.00
Effective	101	50.8%	
Total	199	100%	

Adverse drug reactions occurred in only 2 of 199 patients (1.0%), with 197 (99.0%) experiencing none. While dosing may inevitably lead to unintended effects, these can often be mitigated through prevention strategies. Clinical manifestations include new complaints, symptoms, or conditions arising from pharmacological actions (Maliza et al., 2024). In our study at Menggala Regional General Hospital, 2 CKD patients reported adverse effects from antihypertensive medications. The low rate of reported adverse effects may reflect underreporting inherent to retrospective medical record reviews, including incomplete documentation, variability in clinician reporting practices, and the relatively short duration of inpatient observation. As a result, the true incidence of antihypertensive-related adverse events in this population may be underestimated. While the analysis indicated statistical significance, the limited number of adverse events undermines confidence in the validity of the test assumptions, particularly regarding expected cell frequencies. Consequently, these results should be interpreted cautiously and are insufficient to support definitive conclusions regarding the observed association.

Drug efficacy is assessed by its performance in patients, with blood pressure measurements serving as a key indicator of therapeutic response in hypertension management. Both monotherapy and combination regimens can reduce blood pressure (Isnaini et al., 2021). ARBs and CCBs exhibit comparable therapeutic effects in lowering blood pressure among CKD patients (Nuryanti et al., 2024).

The leading antihypertensive combinations at Menggala Regional General Hospital for CKD included furosemide IV + candesartan + amlodipine (154 patients), amlodipine + candesartan (25 patients), and amlodipine + furosemide (8 patients), as shown in Table 2. The CCB-ARB pairing, such as amlodipine and candesartan, accelerates blood pressure normalization while reducing morbidity and mortality from complications, offering cardioprotective benefits during the process. A meta-analysis reported that the addition of an angiotensin receptor blocker ARB to CCB therapy markedly enhanced the attainment of target blood pressure levels compared with CCB therapy alone. Their efficacy arises from distinct mechanisms of action (Cho et al., 2023; Maritha, 2021).

Among the 199 CKD patients, only 2 experienced antihypertensive adverse effects, while 197 did not. This is supported by Paranoan et al. (2019) at Dr Wahidin Sudirohusodo Hospital, where 3 of 28 CKD inpatients reported such effects. Routine monitoring of side effects is crucial, even at low incidence rates. Common reactions, such as a dry cough or edema, may compromise long-term adherence.

Combination antihypertensives involving two or more classes are advised for hypertensive CKD patients with high blood pressure, particularly when readings fall short of JNC-8 goals. This aligns with evidence showing combinations are more prevalent and effective for blood pressure control in CKD (Lestari, 2021). Chi-square results ($p < 0.05$) confirm the dominance of combination therapy over monotherapy, influenced by factors such as therapeutic efficacy and patient clinical status, with a priority on rapid target achievement.

Of the 199 patients, peripheral edema as an adverse effect occurred in 2 individuals (0.2%). This is consistent with Maliza et al. (2024), who noted that while CCBs are frontline for hypertension, they carry risks of bothersome side effects, with peripheral edema being widespread. Our findings at Menggala Regional General Hospital are consistent with this: 2 of 199 CKD patients experienced peripheral oedema from CCB.

Limitations include the retrospective nature, which may introduce selection bias due to incomplete documentation, and the single-centre focus, which limits generalizability to diverse Indonesian settings. Confounding by unmeasured variables, such as adherence or lifestyle factors, could also influence results. In this retrospective investigation, purposive sampling was preferred over consecutive sampling to intentionally select CKD patients fulfilling predetermined inclusion criteria from the comprehensive 2024 medical records database at Menggala Regional General Hospital, thereby improving the study's applicability and practicality; nevertheless, this approach may engender selection bias through the prioritization of more readily available or representative cases, and although the sample size of 199 is adequate for preliminary examination, the omission of explicit power calculations or rationale is recognized as a constraint that could compromise statistical reliability. Future prospective multicenter trials should incorporate ambulatory blood pressure monitoring and long-term endpoints, such as eGFR decline or cardiovascular events, to validate these findings.

CONCLUSION

Antihypertensive combination regimen use comprising a diuretic, angiotensin receptor blocker (ARB), and calcium channel blocker (CCB), specifically furosemide IV,

candesartan, and amlodipine, was observed in 154 patients with CKD, demonstrating superior efficacy in reducing blood pressure at Menggala Regional General Hospital during 2024. Additionally, the study identified peripheral edema as an adverse effect associated with antihypertensive use among CKD patients at Menggala Regional General Hospital during the same period.

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None to declare.

AUTHOR CONTRIBUTION

DA: Concepts or ideas; design; definition of intellectual content; literature search; experimental studies; data analysis; manuscript editing and preparation.
MLM: definition of intellectual content; literature search; experimental studies; data analysis.
DI: Manuscript editing; manuscript review, experimental studies, data analysis.
SU: Manuscript editing; manuscript review, experimental studies, data analysis.
OP: Manuscript editing; manuscript review, experimental studies, data analysis.
RO: Manuscript editing; manuscript review, experimental studies, data analysis.

ETHICS APPROVAL

The research had been approved by the ethics commission of Menggala Regional General Hospital with number of B/800/2.2/379/VII/TB/IV/2025.

CONFLICT OF INTEREST

None to declare.

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