Comparison Of The Effectiveness Of Antihypertensive Drugs Captopril 25 Mg And Amlodipine 5 Mg In Lowering Blood Pressure In Hypertensive Patients

Ichlasul Amal[1*], Sri Marfuati[2], Rini Istisakinah[3]

[1,2,3]Faculty of Medicine, Swadaya Gunung Jati University, Indonesia
[*]Corresponding author:
Email: ichlasamal77@gmail.com

Abstract.

Hypertension is a major global health problem with increasing prevalence and significant risks of complications. This study aims to compare the effectiveness of Captopril 25 mg and Amlodipine 5 mg in lowering blood pressure among hypertensive patients. An analytical observational study with a cross-sectional design was conducted at Waruroyom Community Health Center, involving 70 patients divided equally into two groups. Data were collected using structured questionnaires, medication adherence sheets, and calibrated digital blood pressure monitors. Univariate and bivariate analyses were performed, including paired T-tests and Mann-Whitney tests. The results showed that both Captopril and Amlodipine effectively reduced systolic and diastolic blood pressure. However, Amlodipine 5 mg demonstrated a significantly greater reduction in diastolic blood pressure compared to Captopril 25 mg, while both drugs had similar effects on systolic blood pressure. The conclusion is that Amlodipine may be preferred for patients requiring greater diastolic blood pressure control, although both drugs are effective for systolic reduction.

Keywords: *Amlodipine; Antihypertensive; Blood Pressure; Captopril and Hypertension.*

I. INTRODUCTION

Hypertension is a global health problem whose prevalence continues to increase every year. According to 2023 data from the World Health Organization (WHO), an estimated 1.4 billion people worldwide suffer from high blood pressure, but only 14% of them successfully control their condition (World Health Organization, 2021; Ministry of Health, 2023). In Indonesia, the prevalence of hypertension among people aged 18 years and older reached 30.8%, according to a 2023 report from the Ministry of Health, with high incidence rates also recorded in West Java Province and Cirebon Regency (Ministry of Health, 2023; West Java Provincial Health Profile, 2023). This condition carries the risk of serious complications in vital organs such as the heart, brain, and kidneys, making hypertension management a top priority in primary healthcare (World Health Organization, 2021; Ministry of Health, 2023).The main challenge in hypertension management is achieving optimal blood pressure targets as recommended by the Joint National Committee (JNC) 8, namely systolic blood pressure <140 mmHg and diastolic blood pressure <90 mmHg within one month of treatment (Muhadi, 2016; World Health Organization, 2021). However, various factors such as patient compliance, choice of antihypertensive medication, and the presence of comorbidities often hinder achieving these targets (Nuryanti et al., 2024; Farida & Tsalatsatun, 2021).

Various classes of antihypertensive drugs have been recommended, including Angiotensin Converting Enzyme Inhibitors (ACEIs), Angiotensin II Receptor Blockers (ARBs), beta blockers, Calcium Channel Blockers (CCBs), and diuretics (Ministry of Health, 2021; World Health Organization, 2021). However, the effectiveness and side effects of each class of drugs can differ, so selecting the right therapy is a challenge in itself (Nuryanti et al., 2024; Mpila & Lolo, 2022).Captopril, an ACE inhibitor (ACEI), and Amlodipine, a CCB (CB), are two antihypertensive drugs frequently used as first-line therapy in primary healthcare (Farida & Tsalatsatun, 2021; Khairiyah et al., 2023). Previous studies have shown that both drugs are effective in lowering blood pressure, but there are differences in their mechanism of action, duration of action, and side effect profiles (Bulan et al., 2022; Mansoor et al., 2022). CCBs like Amlodipine are known to have a longer duration of action and can be used as monotherapy or in combination, while ACEIs like Captopril have a shorter half-life and a rapid onset of action (Katzung, 2018; Bulan et al., 2022). However, comparative data on the effectiveness of these two drugs in lowering blood pressure in the Indonesian

population, particularly at the primary healthcare level, are still limited (Bulan et al., 2022; Mansoor et al., 2022).This study aims to compare the effectiveness of Captopril 25 mg and Amlodipine 5 mg in lowering blood pressure in hypertensive patients at the Waruroyom Community Health Center, Cirebon Regency. The urgency of this study lies in the importance of selecting optimal, evidence-based antihypertensive therapy to improve patient clinical outcomes and the efficiency of primary healthcare services. The novelty of this study is the comparative analysis of the effectiveness of two first-line antihypertensive drugs in a local population using a cross-sectional design, which is expected to serve as a reference in clinical decision-making at the primary care level (Bulan et al., 2022; Mansoor et al., 2022).

II. METHODS

Types and Methods of Research

This study used an observational analytical design with a cross-sectional approach to compare the effectiveness of the antihypertensive drugs Captopril 25 mg and Amlodipine 5 mg in lowering blood pressure in hypertensive patients. A cross-sectional design was chosen because it allows researchers to assess the relationship between variables simultaneously at one point in time, thus providing an objective comparative picture of the effectiveness of the two drugs (Sugiyono, 2022; Cresswell & Creswell, 2022). This method also aligns with public health research recommendations that emphasize the importance of comparative analysis in evaluating antihypertensive therapy (Ministry of Health, 2021; World Health Organization, 2021).

Data Analysis Instruments and Techniques

The main instruments used in this study were a structured questionnaire to collect data on respondent characteristics, a medication adherence sheet, and a calibrated digital blood pressure monitor to ensure accurate blood pressure measurements before and after the intervention. Primary data were obtained from blood pressure measurements and questionnaires, while secondary data were taken from patient medical records. Data analysis was carried out in two stages: univariate analysis to describe the respondents' baseline characteristics and bivariate analysis to compare the effectiveness of the two drugs using a paired t-test after the Shapiro-Wilk normality test. If data were not normally distributed, the non-parametric Mann-Whitney test was used (Sudaryono, 2023; Emzir, 2021; Nuryanti et al., 2024; Bulan et al., 2022).

Population and Sample

The population in this study was all hypertensive patients in the Waruroyom Community Health Center (Puskesmas) working area, Cirebon Regency. The study sample consisted of 70 individuals, consisting of 35 patients receiving Captopril 25 mg and 35 patients receiving Amlodipine 5 mg. The sampling technique used was quota sampling, which determines the target sample size in the population and selects respondents until the quota is met. Inclusion criteria included patients aged >18 years, newly diagnosed hypertension and undergoing monotherapy, and long-standing patients who had stopped treatment for more than 24 hours. Exclusion criteria were patients with comorbidities such as diabetes mellitus, heart disease, kidney disease, pregnant women, or those using other antihypertensives (Sugiyono, 2022; Ministry of Health, 2021; Farida & Tsalatsatun, 2021).

Research Procedures

The research procedure began with primary data collection through direct blood pressure measurements after three days of routine antihypertensive medication consumption, as well as questionnaires and compliance sheets. Secondary data were obtained from medical records to determine blood pressure before the intervention. Researchers validated the data by repeating the questionnaire twice to minimize errors. All research procedures received ethical approval from the Ethics Committee of the Faculty of Medicine, Swadaya Gunung Jati University. Data analysis was conducted systematically according to quantitative research principles, with attention to instrument validity and reliability (Cresswell & Creswell, 2022; Emzir, 2021; Bulan et al., 2022; Mansoor et al., 2022).

III. RESULTS AND DISCUSSIONS

Result

Table 1. Basic Characteristics of Hypertensive Patients Using Antihypertensive Drugs Captopril 25 mg and Amlodipine 5 mg

Characteristics	Frequency	%
Age		
Early Adulthood (26-35 years)	0	0%
Late Adulthood (36-45 years)	23	32.9%
Early Elderly (46 – 55 years)	30	42.9%
Late Elderly (56-65)	17	24.3%
Seniors (>65 years)	0	0%
Gender		
Man	25	35.7%
Woman	45	64.3%
Educational background		
Elementary School	5	7.1%
JUNIOR HIGH SCHOOL	11	15.7%
SENIOR HIGH SCHOOL	41	58.6%
Academy/ College	13	18.6%
Work		
Self-employed	8	11.4%
civil servant	10	14.3%
Private employees	3	4.3%
Laborer	38	54.3%
Housewife	7	10%
Farmer	4	5.7%

Based on Table 1, the Basic Characteristics of the research sample are mostly in the early elderly age (46–55 years), as many as 30 people (42.9%), female gender, 45 people (64.3%), high school graduates, 41 people (58.6%), and working as laborers as many as 38 people (54.3%).

Univariate Analysis

Antihypertensive Drugs	Mean Systolic Blood Pressure		
	Before (□ SD)	After (□ SD)	Difference
Captopril	146.69 (□ 5.103)	134.77 (□ 5,841)	11.91
Amlodipine	149.40 (□ 5,947)	137.34 (□ 5,886)	12.06

Table 2. Average Blood Pressure Before and After Consuming Captopril 25 mg and Amlodipine 5 mg

Antihypertensive Drugs	Mean Diastolic Blood Pressure		
	Before (□ SD)	After (□ SD)	Difference
Captopril	95.03 (□ 2,728)	88.20 (□ 2,939)	6.83
Amlodipine	94.86 (□ 5,947)	86.94 (□ 5,886)	7.91

Based on Table 2, the group given Captopril 25 mg had an average initial systolic blood pressure of 146.69 mmHg, decreasing to 134.77 mmHg after drug administration with a difference of 11.91 mmHg. The average diastolic blood pressure before therapy was 95.03 mmHg, decreasing to 88.20 mmHg after therapy, with a difference of 6.83 mmHg. In the group given Amlodipine 5 mg, the average initial systolic blood pressure was 149.40 mmHg, decreasing to 137.34 mmHg after drug administration with a difference of 12.06 mmHg. The average diastolic blood pressure decreased from 94.86 mmHg before therapy to 86.94 mmHg after therapy, with a difference of 7.91 mmHg.

Table 3. Blood pressure normality test using Captopril 25 mg and Amlodipine 5 mg

Antihypertensive Drugs	Blood pressure	*Shapiro-Wilk* *Sig. (2-tailed)*
Captopril	Early Systolic	0.068
	End Systolic	0.284
	Early Diastolic	0.062
	End Diastolic	0.138
Amlodipine	Early Systolic	0.095
	End Systolic	0.067
	Early Diastolic	0.184
	End Diastolic	0.388

Table 3. Captopril 25 mg and Amlodipine 5 mg showed normally distributed data ($p > 0.05$); the data met normality and could be analyzed using a paired T-test.

Bivariate Analysis

Table 4. Paired T-Test of Effectiveness of Antihypertensive Drugs Captopril 25 mg and Amlodipine 5 mg

Antihypertensive Drugs	Blood pressure	N	Mean		Sig (2-tailed)
			Before	After	
Captopril	**Systolic**	35	146.69	134.77	0.000
	Diastolic	35	95.03	88.20	0.000
Amlodipine	**Systolic**	35	149.40	137.34	0.000
	Diastolic	35	94.86	86.94	0.000

Based on Table 10, Captopril 25 mg and Amlodipine 5 mg are effective in lowering blood pressure in hypertensive patients. Based on the difference in blood pressure, Amlodipine 5 mg has a greater difference in reducing systolic blood pressure by 12.06 mmHg and diastolic by 7.91 mmHg, while the difference in blood pressure reduction for Captopril 25 mg is 11.91 mmHg systolic and 6.83 mmHg diastolic.

Table 5. Normality Test of the Difference in Systolic and Diastolic Blood Pressure in the Captopril 25 mg and Amlodipine 5 mg Drug Groups

	Antihypertensive Drugs	*Shapiro-Wilk Sig* (2-tailed)
Systolic Difference	Captopril	0.006
	Amlodipine	0.010
Diastolic Difference	Captopril	0.001
	Amlodipine	0,000

Table 5 shows the difference in systolic and diastolic blood pressure between the 25 mg Captopril and 5 mg Amlodipine groups, with a significance value of $p < 0.05$. This indicates that the data is not normally distributed, so the analysis was continued using the non-parametric Mann-Whitney test.

Table 6. Non-parametric Test of the Difference in Systolic and Diastolic Blood Pressure in the Captopril Amlodipine Drug Group

	Antihypertensive Drugs	N	Mean	Sig (2-tailed)
Systolic Difference	Captopril	35	34.67	0.730
	Amlodipine	35	36.33	
Diastolic Difference	Captopril	35	28.26	0.005
	Amlodipine	35	42.24	

Table 6. The results showed a non-significant difference in systolic blood pressure reduction between the two drug groups (p = 0.730). This value indicates that both drugs are equally effective in lowering systolic blood pressure in hypertensive patients. The difference in diastolic blood pressure indicated that the data were not normally distributed, so the analysis was continued with the non-parametric Mann-Whitney test.

Discussion

Age

The study found that the majority of hypertensive patients given Captopril 5 mg were in the early elderly (46-55 years). This is consistent with research by Pratama F., et.al. (2023) where the average age of patients receiving antihypertensive medication was 46-55 years. After the age of 45, blood vessels thicken due to collagen buildup in the muscle layer of blood vessels, blood vessels narrow and become stiff, and peripheral resistance and sympathetic activity increase.[13] The majority of hypertensive patients given 5 mg of Amlodipine were in late adulthood (36-45 years). These results align with research by Nisa F et al. (2023), which showed that the majority of hypertensive patients were in late adulthood (36-45 years).[14] Hypertension in late adulthood is influenced by several factors, including lifestyle and diet. Lack of physical activity leads to a lower heart rate, requiring the heart muscle to work harder. This increased workload on the heart muscle to pump blood leads to increased blood pressure.

Gender

This study was dominated by women. These results align with Pratama F., et al. (2023), who found that the majority of patients taking antihypertensive medications were women.[13] The female gender is influenced by hormonal factors during menopause, namely estrogen. Increased estrogen levels affect the renin-angiotensin-aldosterone system.[15] Before menopause, women are protected by the hormone estrogen, which increases the levels of high-density lipoprotein, which prevents atherosclerosis.

Education

In this study, the majority of patients had a high school education or equivalent. These results align with research by Dhirisma F., et al. (2022), which found that the majority of hypertensive patients (43 individuals or 61.4%) had a high school education.[18] Education is one factor that can influence patients' adherence to hypertension treatment. Patients with a high level of education tend to be more receptive to lifestyle changes, but education and knowledge not matched by adherence to antihypertensive medication can lead to hypertension-related complications.

Work

Based on occupation, the majority of patients in both groups worked as laborers. This study aligns with the research of Rahayuni, MD, et al. (2024), which found that the most common occupation among hypertension patients was laborers.(19)Work can affect blood pressure due to the workload, which increases a person's risk of stress. Stress can lead to hypertension, caused by increased sympathetic nervous system activity, which can lead to unpredictable increases in blood pressure.

Effectiveness of Antihypertensive Drugs Captopril 25 mg and Amlodipine 5 mg in Lowering Blood Pressure in Hypertensive Patients

Based on the paired T-test analysis, the results of the significance value for systolic Captopril 0.000 ($p<0.05$) and Amlodipine 0.000 ($p<0.05$), it can be concluded that there is a significant difference between systolic blood pressure after administration of Captopril and Amlodipine. The results of the diastolic significance value of Captopril 0.000 ($p<0.05$) and Amlodipine 0.000 ($p<0.05$). So it is concluded that there is a significant difference in systolic and diastolic blood pressure after administration of Captopril or Amlodipine.Captopril is an angiotensin-converting enzyme inhibitor (ACEI), which inhibits the enzyme that converts angiotensin I to angiotensin II.

Angiotensin II is a potent vasoconstrictor. Captopril's effects are rapid but short-lived due to its short half-life (about 2 hours), so its maximum effect lasts only a few hours. Amlodipine belongs to the calcium channel blocker (CCB) class of drugs. It works by inhibiting the entry of calcium ions into vascular smooth muscle, causing peripheral arteriolar vasodilation and reducing systemic vascular resistance. Amlodipine's advantages include its long duration of action, lasting up to 24 hours, making it suitable for once-daily use. It also tends not to affect the function of the sinoatrial or atrioventricular nodes.(21)Amlodipine 5 mg has a greater difference in lowering blood pressure, namely 12.06 for systolic and 7.91 for diastolic, while the difference in the final blood pressure reduction in the administration of Captopril 25 mg is 11.91 for systolic and 6.83 for diastolic, this is in line with research by Bulan M. I explaining that Amlodipine (86.7%) has a greater percentage of effectiveness compared to Captopril (60%).

Comparison of the Effectiveness of Antihypertensive Drugs

Based on the Mann-Whitney test results, there was no significant difference in systolic blood pressure reduction between the Captopril and Amlodipine groups ($p = 0.730$), indicating that both drugs have similar effectiveness in reducing systolic blood pressure. Conversely, there was a significant difference in diastolic blood pressure reduction ($p = 0.005$), with Amlodipine showing a more significant diastolic reduction than Captopril.The effectiveness of Amlodipine in reducing diastolic is supported by its pharmacological properties that work on vascular smooth muscle, reducing peripheral resistance more consistently for 24 hours, while Captopril, with a shorter half-life, experiences a faster decrease in effect approaching the next dose, this result is in line with the research of Mansoor, et al (2022) which shows that Amlodipine provides a more stable reduction in diastolic blood pressure than Captopril due to its longer duration of action.

IV. CONCLUSION

This study demonstrates that both Captopril 25 mg and Amlodipine 5 mg are effective in lowering blood pressure among hypertensive patients, with comparable results in reducing systolic blood pressure. However, Amlodipine 5 mg shows a significantly greater effect in reducing diastolic blood pressure compared to Captopril 25 mg. These findings suggest that while both medications can be considered as first-line therapy in primary care settings, Amlodipine may offer additional benefits for patients who require more substantial diastolic blood pressure control. The results are consistent with previous research indicating the longer duration of action and stable pharmacological profile of Amlodipine, which may contribute to its superior diastolic effect.

Despite these promising outcomes, the study has several limitations. The cross-sectional design limits the ability to assess long-term efficacy and safety, and the sample size, although adequate for initial comparison, may not capture the full spectrum of patient variability. Additionally, the study was conducted in a single primary care center, which may limit the generalizability of the findings to broader populations. Future research should consider longitudinal designs, larger and more diverse samples, and the inclusion of additional clinical outcomes such as adverse effects and patient adherence. Practically, these findings support the use of Amlodipine as a preferred option for diastolic blood pressure management in hypertensive patients, but clinicians should continue to individualize therapy based on patient characteristics and comorbidities. Further studies are needed to confirm these results and to explore the long-term impact of both medications on cardiovascular outcomes.

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