

Difference in Effectiveness Between The Use of Captopril and Amlodipine on Lowering Blood Pressure in Primary Hypertension Cases at The Piyungan Health Center

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ABSTRACT

Background: Hypertension is one of the leading causes of morbidity worldwide, with sufferers estimated to reach 1.5 billion and mortality reaching 9.4 million individuals by 2025. In Indonesia, hypertension prevalence reached 34.1% (Riskesdas, 2018), with the Special Region of Yogyakarta (DIY) recording 11.01%. Captopril and amlodipine are commonly used first-line antihypertensive drugs. This study aims to determine the difference in effectiveness between captopril and amlodipine in reducing blood pressure among patients with primary hypertension. Method: This retrospective, before-after (pre-post) comparative study used secondary data from the medical records of 151 outpatients at the Piyungan Health Center (31 receiving captopril and 120 receiving amlodipine). Blood pressure was assessed before and after drug administration. Based on data normality and homogeneity testing, the Kruskal-Wallis test was used to analyze systolic blood pressure and the One-Way ANOVA test to analyze diastolic blood pressure. Results: Both tests showed significant results ($p=0.000$; $p<0.05$). Post hoc analysis showed that captopril reduced systolic and diastolic blood pressure by 5.387 and 5.774 mmHg, respectively, while amlodipine reduced them by 11.858 and 5.258 mmHg. Conclusion: Both captopril and amlodipine significantly reduced blood pressure. Amlodipine was significantly more effective in reducing systolic blood pressure, whereas the difference between the two drugs in reducing diastolic blood pressure was minimal and not clinically meaningful.

INTRODUCTION

Hypertension is one of the diseases that always receives attention from the world. This is because hypertension is one of the largest causes of morbidity in the world. Hypertension sufferers by 2025 are estimated to reach 1.5 billion of the total world population and the mortality caused could reach 9.4 million individuals (Just, 2021).

The prevalence of hypertension in Indonesia is 34.1% based on Basic Health Research (Riskesdas 2018). This has increased when compared to the prevalence of hypertension in Riskesdas in 2013 which was 25.8%. Hypertension cases in Indonesia are estimated to be only 1/3 diagnosed while the rest are undiagnosed (Ministry of Health, 2020).

The prevalence of hypertension in the Special Region of Yogyakarta (DIY) according to Riskesdas in 2018 was 11.01%, this figure is higher than the national value of 8.8%. This makes DIY the fourth province in Indonesia with the highest hypertension cases (Profile DIY Health, 2021)

An abnormal increase in blood pressure in the arterial blood vessels continuously over a period of time is the definition of hypertension or high blood pressure. The normal limit of blood pressure is 120/80 mmHg, while a person is declared to have hypertension if his blood pressure is $>140/90$ mmHg based on the World Health Organization (WHO). Borderline Hypertension is the blood pressure between normotension and hypertension. The WHO limit does not distinguish between age and gender (Udayani et al., 2018)

Hypertension is divided into two types, namely essential hypertension or primary hypertension and secondary hypertension, based on the cause. A condition in which high blood pressure occurs of unknown cause is definitely primary hypertension. Meanwhile, a condition of high blood pressure whose cause is specifically known as the presence of other diseases is secondary hypertension (Rumaenda et al., 2016)

Hypertension is one of the most dangerous health problems worldwide. Hypertension is a major risk factor that causes cardiovascular diseases such as heart attack, heart failure, stroke, and kidney disease. In 2016, the WHO announced that ischemic heart disease and stroke were the two leading causes of death in the world (Arum et al., 2019)

The group of antihypertensive drugs known as first-line drugs that are commonly used are ACE-inhibitors, Calcium Channel Blockers (CCB), β -blockers, Angiotensin Receptor Blockers (ARBs) and diuretics (Pratiwi, 2017). Captopril and amlodipine are drugs commonly used in hypertension therapy. Captopril is an ACE (Angiotensin Converting Enzyme) inhibitor drug, and amlodipine is a calcium channel blocker (CCB) drug that has high selectivity (Andhyka et al., 2019)

In Indonesia, captopril is one of the most commonly used antihypertensive drugs, especially in basic health facilities such as health centers. Captopril is given in tablet form with doses of 12.5 mg and 25 mg daily, three times a day (depending on the patient's blood pressure). Therefore, the absorption of captopril is affected by digestive enzymes, so it should be consumed two hours before meals. According to JNC VIII on hypertension management algorithms, capotrpil, one of the ACEI groups, is the first line choice (Mayasari, 2020). This drug can also inhibit heart complications due to its heart-protecting properties. (Whelton et al., 2018)

Amlodipin works as an antihypertensive through the mechanism of action of the Calcium Channel Blocker (CCB). Most amlodipine is sold in tablet form. The drug is administered orally in the form of tablets. If taken orally, amlodipin has low plasma levels, which means that the organism has only low absorbance (Alawiyah, 2017).

As an antihypertensive, the mechanism of action of amlodipin is by inhibiting calcium channels which can cause smooth muscle relaxation so as to cause a decrease in blood pressure. When calcium enters cells through tension-dependent L-type calcium channels, there is usually a contraction of the smooth muscle of the blood vessels. Calcium binds to intracellular calmodulin, which binds to and activates (Alawiyah, 2017) myosin light-chain kinase (MLCK). MLCK is responsible for the phosphorylation of the myosine light chain, which in turn leads to muscle contraction and vasoconstriction. The calcium-induced release

of calcium from the sarcoplasmic reticulum strengthens the smooth muscle contractions of blood vessels. This series of events increases blood pressure, vascular resistance, and cross-sectional area of blood vessels (Ferrari et al., 2019)

Several previous studies have examined the effectiveness of captopril and amlodipine in lowering blood pressure, but with varying settings and comparison approaches. Andhyka et al. (2019) described the effectiveness profile of captopril and amlodipine among outpatients at the Selaparang Health Center but did not perform a direct statistical comparison between the two drugs. Azizah et al. (2021) compared several classes of antihypertensive therapy among PROLANIS patients at a health center in Banyumas, while Suprapti (2023) only described the pattern of antihypertensive drug use at the Kotagede II Health Center without evaluating comparative effectiveness on blood pressure outcomes. These studies indicate that direct, statistically supported comparisons between captopril and amlodipine at the primary care (Puskesmas) level, using real-world medical record data, remain limited, particularly in the Special Region of Yogyakarta, despite the province recording the fourth-highest hypertension prevalence in Indonesia (11.01%). This gap is important because the selection of first-line antihypertensive therapy at the primary care level relies heavily on locally relevant comparative evidence, which previous studies have not specifically provided for the Piyungan Health Center working area (Jobe et al., 2025; Rosende et al., 2023; Schutte et al., 2023; Teh et al., 2020).

This study therefore offers novelty by directly comparing the effectiveness of captopril and amlodipine in reducing systolic and diastolic blood pressure among primary hypertension patients using medical record data at the Piyungan Health Center, an area that has not previously been examined for this specific comparison (Hikmayani & Rachmawan, 2024; Huda, 2026; Pradnyaparamitha, 2020).

Based on this background, this study aims to determine the difference in effectiveness between the use of captopril and amlodipine in reducing systolic and diastolic blood pressure in cases of primary hypertension at the Piyungan Health Center. The results of this study are expected to provide practical benefit for healthcare providers at the Piyungan Health Center and other primary care facilities in considering the selection of first-line antihypertensive therapy, and to contribute academically to the body of evidence on comparative antihypertensive effectiveness at the primary care level in Indonesia.

METHOD

The research was conducted using an observational method with a retrospective, before-after (pre-post) comparative design. Data collection was carried out by collecting secondary data obtained from the medical records of the Piyungan Health Center. The population in this study is all hypertensive patients. The sample in this study is patients with a diagnosis of primary outpatient hypertension at the Piyungan Health Center based on inclusion and exclusion criteria, using the non-probability sampling method with purposive sampling techniques. Blood pressure was measured before and after drug administration to evaluate the reduction achieved with captopril and amlodipine therapy. The data of this study was analyzed using Statistical Product and Service Solutions (SPSS) version 22.0 for Windows using the One Way ANOVA and Kruskal-Wallis methods, with the choice of test based on the results of data normality and homogeneity testing.

RESULTS AND DISCUSSION

Table 1. Sample characteristics

Features	Quantity	
	n	%
Age		
17-25	1	0,7
26-35	1	0,7
36-45	15	9,9
46-55	35	23,2
56-65	48	31,8
>65	51	33,7
Gender		
Male	41	27,2
Women	110	72,8
Medication		
Captopril	31	20,5
Amlodipine	120	79,5

Based on table 1, the results showed that most of the patients were > 65 years old with a total of 51 patients (33.7%). Most of the patients were female with a total of 110 patients (72.8%).

Most of the patients received amlodipin with a total of 120 patients (79.5%). On the other hand, the number of patients who received captopril was 31 patients (20.5%).

Table 2. Uji Kruskal-Valais Sistol

Factor	Significance
Treatment	0,000*

It can be seen based on table 2, the results show a significance value of $p=0.000$ ($p<0.05$) which means a significant result. So it can be concluded that there is a difference between the use of captopril and amlodipin in reducing systolic blood pressure in cases of primary hypertension at the Piyungan Health Center.

Table 3. Test *Post Hoc* LSD systole

Treatment	Average Difference	Significance
Captopril	5,387	0,187
Amlodipine	11,858	0,000*

Table 3 shows that between captopril before and after there was no significant difference with a value of $p=0.187$ ($p>0.05$), while amlodipine before and after showed a significant difference with a value of $p=0.000$ ($p<0.05$).

Captopril can lower systolic blood pressure by 5.387, while amlodipine lowers systolic blood pressure by 11.858. A comparison of the two drugs in lowering systole blood pressure was found to be greater in amlodipin (11,858) than captopril (5,387).

Table 4. Test *One Way Anova* diastole

Factor	Significance
Treatment	0,000*

Based on table 4, the results show a significance value of $p=0.000$ ($p<0.05$) which means a significant result. So it can be concluded that there is a difference between the use of captopril and amlodipin in reducing diastole blood pressure in cases of primary hypertension at the Piyungan Health Center.

Table 5. Test *Post Hoc* LSD diastole

Treatment	Average Difference	Significance
Captopril	5,774	0,038*
Amlodipine	5,258	0,000*

Table 5 shows that there was a significant difference between captopril before and after with a value of $p=0.038$ ($p<0.05$). Meanwhile, amlodipine before and after also showed a significant difference with a value of $p=0.000$ ($p<0.05$).

Captopril can lower diastole blood pressure by 5.774, while amlodipin lowers diastole blood pressure by 5.258. A comparison of the two drugs in lowering blood pressure diastole was found to be slightly greater in the reduction value of captopril (5,774) than amlodipine (5,258).

Discussion

The characteristics of the sample based on age were obtained that hypertension patients over 65 years old had the highest percentage (33.7%) with a total of 51 patients. This study is in accordance with the results of the study, where the results of the study were obtained by the most elderly hypertensive patients (≥ 65 years) with a percentage of 71.9%, while the young age group (< 55 years) was only 8.3% and the middle-aged group (55-65 years) was only 19.8%. This study is also in accordance with the results of the study, it was found that hypertension patients over the age of 65 years have the highest percentage, which is (57.1%) compared to other age groups.

In old age, it causes large arteries to become stiff and lose their flexibility, so that the arteries cannot expand at the time the heart pumps blood through those arteries. The blood in each heartbeat is forced to pass through narrower than normal vessels and eventually results in a rise in blood pressure (Wulandari *et al*, 2023)

The characteristics of the sample based on gender were found that hypertension patients were mostly female with a percentage of 72.8% and amounted to 110 patients. This research is in accordance with the results of the research where it was found that most of the patients studied were women, namely as many as 80.1% of patients, while men were only 19.9%. This is because the high incidence of hypertension in women often occurs after menopause due to the cessation of endogenous estrogen production which causes the body to be unable to maintain vasodilation that can control blood pressure Azizah *et al*, (2021)

The distribution of drugs obtained by patients showed that most patients received amlodipin drugs with a total of 120 patients (79.5%). Meanwhile, the number of patients who received captopril amounted to 31 patients (20.5%). This study is in accordance with the results of the study, that the use of antihypertensive drugs of the CCB group, especially amlodipine, is higher than other antihypertensive groups. In the study, 48.80% of respondents received amlodipine 5 mg and 36.75% of respondents received amlodipine 10 mg. On the other hand, 6.62% of respondents received captopril 12.5 mg and 4.82% received captopril 25 mg. However, this study is not in accordance with the results of the study, where the results of 58

patients were obtained with the most ARB group with a total of 25 patients, while those who received ACEI were in second place with a total of 13 patients and those who received CCB were only 10 patients.

Based on the results of the *Kruskal-Wallis* test on systole and the *One Way Anova* test on diastole, both results showed a significance value of $p=0.000$ ($p<0.05$) which means a significant result. These results mean that there is a difference between the use of captopril and amlodipine to reduce systole and diastole blood pressure in cases of primary hypertension at the Piyungan Health Center. This study is in accordance with the results of the study, which shows a difference in blood pressure reduction in the use of amlodipin and captopril. Amlodipine is greater lowers systole blood pressure values by 9.6% while Captopril by 5.6%. However, this study does not match the results of the study, which states that the difference in blood pressure between captopril and amlodipin is not significant.

Based on the *Post Hoc* LSD test on systole, there was no significant difference between captopril before and after, while amlodipin before and after showed a significant difference. This means that there is no significant difference in the reduction of systolic blood pressure on the drug caprotpil. Meanwhile, in amlodipine there is a significant difference in the reduction of cystic blood pressure. The magnitude of the difference or effectiveness seen from the mean decrease in blood pressure before and after showed a greater decrease in systole blood pressure in amlodipin (11,858) than captopril (5,387). This means that amlodipin is more effective in lowering systolic blood pressure than captopril.

Based on *Post Hoc* LSD tests on diastole, there was a significant difference between captopril before and after and amlodipine before and after both. This means that there is a significant difference in diastole blood pressure reduction in captopril and amlodipine. The magnitude of the difference or effectiveness indicated a decrease in blood pressure diastole slightly greater in captopril (5,774) than in amlodipin (5,258) a difference of only 0.516 mmHg. slightly more effective This minimal difference is not considered clinically meaningful; therefore, based on these results, neither drug can be concluded as superior to the other for diastolic blood pressure reduction without a direct statistical comparison between the two treatment groups.

This result is in accordance with the study where the results of the blood pressure study of respondents who were given captopril 25 mg for a period of 30 days saw an average decrease of 8.6 mmHg. The results of the blood pressure study from patients who were given amlodipin 10 mg over a period of 30 days showed an average decrease in systolic blood pressure of 16.4 mmHg.

These results are also in line with studies that state that amlodipine prescribed as monotherapy or adjunct therapy during routine clinical practice can significantly reduce systolic and diastole blood pressure in patients in India aged ≤ 45 and ≥ 65 years with mild to moderate hypertension. It also emphasizes that amlodipin may be a good candidate for blood pressure control in patients in India with mild to moderate hypertension, and essential hypertension in this age group.

ACE-I drugs work by inhibiting angiotensin 1 to angiotensin 2 in the RAAS (Renin Angiotensin Aldosterone) system. A system that regulates the balance between salt and water and is one of the most important blood pressure regulators in the body is the definition of the RAAS system. Angiotensin 1 is converted to angiotensin 2 by ACE, which is a type of enzyme

that is widely found in the capillaries of the lungs. The first and most important effect after the formation of angiotensin 2 is that it can cause vasoconstriction of blood vessels which leads to an increase in blood pressure. By inhibiting the ACE enzyme, it will inhibit the change of angiotensin 1 to angiotensin 2 so that the effects caused can be inhibited.

Amlodipin is an antihypertensive drug of the CCB group. Amlodipin works by inhibiting calcium from entering the smooth muscle cells of blood vessels and myocardial cells so that a decrease in peripheral vascular resistance can occur. In addition, this will lead to an increase in depolarization time in the smooth muscles of the heart which becomes longer. Amlodipin will bind to the α_1 receptor and inhibit the L-type calcium channel resulting in a decrease in blood pressure.

The pharmacological aspects of captopril are well absorbed orally, with peak plasma concentrations reached within about 1 hour after administration. Foods can lower the bioavailability of captopril, and captopril should be given 1 hour before meals. Distribution volume 0.8 L/kg. Plasma protein binding is about 25% to 30%. Captopril can cross the blood-brain barrier. Captopril is metabolized into cysteine-captopril disulfide and captopril dimer disulfide. The kidneys are the main pathway of captopril elimination. The clearance is 0.7 L/hour/kg, and the elimination half-life is approximately 2 hours.

The pharmacological aspects of amlodipine for bioavailability between 64% and 90% and are not affected by food. Peak plasma concentrations are reached between 6 and 12 hours. Stable plasma levels are achieved after 7 to 8 days of daily administration of amlodipine. Amlodipin has high plasma protein bonds (93%). Amlodipin is extensively metabolized by the liver into inactive metabolites. CYP3A4 and CYP3A5 play important roles in amlodipine metabolism. The plasma half-life of amlodipin is biphasic in nature, with a terminal elimination half-life of about 30 to 50 hours, which increases with liver dysfunction. Amlodipine is mainly excreted through the kidneys with details of 10% of the parent compound and 60% of its metabolites excreted through urine.

The captopril and amlodipine groups in this study were also markedly unequal in size (31 versus 120 patients), an imbalance that may have reduced the statistical power available to detect differences in the captopril group and may limit the comparability of baseline characteristics between the two groups; this imbalance should be taken into account when interpreting the comparative results above. More broadly, the differences in response to captopril and amlodipine observed in this study may also be influenced by variation in patient characteristics, dosage, duration of therapy, medication adherence, comorbidities, and the possible concurrent use of other medications. Because these variables were not measured or statistically controlled for in the present study's methods, the extent to which they may have confounded the observed treatment differences cannot be evaluated, and this should be considered an important limitation when interpreting the findings.

CONCLUSION

Based on the results and discussion, it can be concluded that both captopril and amlodipine significantly reduced blood pressure among primary hypertension patients at the Piyungan Health Center, with amlodipine significantly more effective than captopril in lowering systolic blood pressure, whereas for diastolic blood pressure the difference between the two drugs was minimal (0.516 mmHg) and not clinically meaningful, so neither drug can

be considered superior for this outcome; these findings suggest that amlodipine may be a favorable option when a greater reduction in systolic blood pressure is the treatment priority, while the choice for diastolic blood pressure control may be guided by other clinical considerations such as patient comorbidities, tolerability, and cost, and given that this study used a retrospective design with an unequal group size (31 captopril versus 120 amlodipine patients) and did not statistically control for potential confounding factors such as comorbidities, medication adherence, and concurrent medication use, future research is recommended to use a prospective design with more balanced group sizes, to control for relevant confounding factors, and to involve multiple primary care facilities in order to strengthen the generalizability of findings on the comparative effectiveness of captopril and amlodipine in primary hypertension management.

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