

Effectiveness Profile of Antihypertension Use in Ischemic Stroke Patients in the Inpatient Installation of Muhammadiyah Hospital, Jombang

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Cardiovascular disease and cancer are the leading causes of death globally. Stroke is characterized by sudden clinical symptoms lasting more than 24 hours or leading to death due to impaired cerebral circulation. This study aims to determine the effectiveness of antihypertensive treatment in ischemic stroke patients at the Inpatient Installation of Muhammadiyah Hospital, Jombang. This research utilized a non-experimental retrospective observational design. Purposive sampling was applied to select 50 inpatient ischemic stroke patients who met the inclusion criteria. Evaluated variables included age, gender, antihypertensive drug classes, therapeutic attainment of blood pressure, and length of stay (LOS). Medical records from the hospital database served as the primary research instrument. Data were then evaluated through descriptive and analytical analysis. The study included 50 patients; predominantly male (52%) and aged over 60 years old (64%). CCB (Amlodipine) was the most prescribed monotherapy (64.3%), while CCB+ARB (Amlodipine+Candesartan) was the most common combination (62.5%). CCBs showed the highest average blood pressure reduction (14/9 mmHg) and the shortest average length of stay (4.4 days). For combination regimens, CCB+ARB showed the most substantial blood pressure reduction by 13/8 mmHg. Both monotherapy and combination antihypertensive treatments are effective for inpatient ischemic stroke patients. Calcium Channel Blockers (CCBs), either as a single agent or combined with ARBs, represent the most frequent and efficient choice in achieving blood pressure reduction and minimizing hospitalization duration.



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A stroke attack is a life-threatening disease because it kills 1.9 million brain cells every minute. Globally, stroke is the second most common cause of death and disability. In Indonesia, stroke accounts for 18.5% and 11.2% of all disabilities. The incidence rate of stroke in Indonesia reached 8.3 per 1,000 people,

according to data from the 2023 Indonesian Health Survey [1].

Stroke is an acute clinical manifestation that occurs due to neurological dysfunction in the brain, retina, and spinal cord, either global or partial, that persists for >24 hours. Stroke is divided into two types:

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ischemic stroke and hemorrhagic stroke. Stroke can occur due to a blockage in a blood vessel (ischemic stroke) with a prevalence of 80%, or bleeding (hemorrhagic stroke) with a prevalence of 15-20% of all total stroke cases [2]. Modifiable risk factors include hypertension, heart disease, diabetes mellitus, and smoking; non-modifiable risk factors include age, gender, and family history.

Hypertension is one of the modifiable risk factors for stroke. Hypertension increases endothelial layer thickening, lipid accumulation, adhesion of platelets, leukocytes, and monocytes, as well as other endothelial dysfunctions, which lead to atherosclerosis. In such situations, blood flow carrying oxygen to the brain is obstructed. This is caused by carotid atherosclerosis, which leads to plaque rupture, allowing for collagen exposure, platelet aggregation, and clot formation; all of which result in emboli and thrombi that stop blood flow to the brain. For stroke prevention, especially ischemic stroke, patients may receive antiplatelet, antihypertensive, and statin therapy. The treatment of ischemic stroke in hypertension sufferers can also reduce the risk of stroke recurrence because this therapy reduces cerebral edema and prevents further damage to blood vessels. Some of the most commonly used antihypertensive drugs are angiotensin-converting enzyme inhibitors (ACEI), angiotensin receptor blockers (ARB), calcium channel blockers (CCB), and beta-blockers [3].

In a 2023 study, Shela Rita et al. [4] investigated 93 patient medical records from November to December 2023 regarding the profile of antihypertensive use in stroke patients at Samarinda Citra Medika. The results showed that the most widely used single antihypertensive was CCB, consisting of Amlodipine at 75.5%. In an additional study at the Inpatient Installation of RSUD dr. Soeroto Ngawi, the most widely used single-drug hypertension medication was CCB at 34.5%, which effectively achieved the target of less than 140/90 mmHg. However, single-drug diuretics were not yet known to be effective due to the duration of stay [5]. The researcher conducted a study comparable to this to

determine the effectiveness profile of the use of antihypertensive drugs in ischemic stroke patients at the Inpatient Installation of Muhammadiyah Hospital, Jombang.

Results and Discussion

Patient Demographics

A total of 50 inpatient ischemic stroke patients met the complete inclusion criteria. The demographic profile indicated that the disease is predominantly observed in male patients (52% = 26 patients) and individuals aged over 60 years old (64%).

Antihypertensive Prescribing Patterns

Antihypertensive therapies were divided into monotherapy and combination therapy categories. This study involved 42 patients (84.0%) who received single antihypertensive therapy and 8 patients who received combination antihypertensive therapy. The Calcium Channel Blocker (CCB) class, specifically Amlodipine, was the most widely used drug, namely for 27 patients (64.3%). The Angiotensin-Converting Enzyme Inhibitor (ACEI) class, such as Captopril, was used in 6 patients (14.3%), the Angiotensin Receptor Blocker (ARB) class was also used in 6 patients (14.3%), and the remaining were Beta-blockers in 2 patients (4.8%) and Diuretics in 1 patient (2.4%).

In contrast, combination therapy was prescribed to only 8 patients (16.0%). The combination patterns of antihypertensive drugs used included CCB + ARB, CCB + ACEI, Diuretic + Beta-blocker, and ACEI + Beta-blocker. The most widely used combination was CCB + ARB (Amlodipine + Candesartan), specifically in 5 patients (62.5%). Other combinations prescribed in this study were CCB + ACEI (Amlodipine + Captopril), Diuretic + Beta-blocker (Furosemide + Bisoprolol), and ACEI + Beta-blocker (Captopril + Bisoprolol), each used in 1 patient (12.5%). After data collection on the administration of medications and therapy, data collection regarding the effectiveness of the therapy was carried out.

Clinical Effectiveness Outcomes

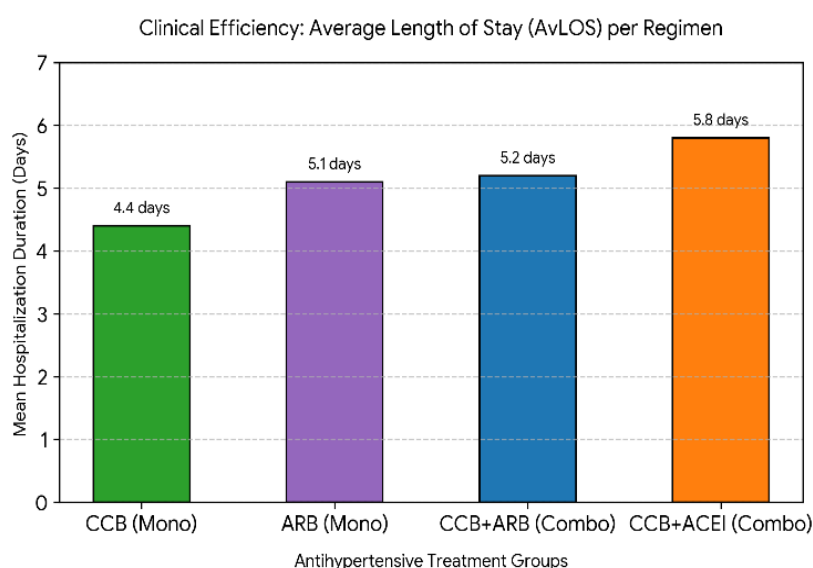
Therapeutic effectiveness was measured by evaluating mean systolic and diastolic blood pressure (BP) reductions alongside the Average Length of Stay (AvLOS). CCB monotherapy demonstrated the most efficient clinical profile, yielding a mean BP reduction of 14/9mmHg and the shortest hospital stay (AvLOS= 4.4 days).

According to the table of Effectiveness of Combination Antihypertensive Drugs Based on the Reduction in Blood Pressure, the CCB + ARB class lowered blood pressure the most by 13/8 mmHg. CCB + ACEI at 11/8 mmHg was second, the third was Diuretic + Beta-blocker at 10/5 mmHg, and ACEI + Beta-blocker at 8/10 mmHg was fourth.

The calculation result for the AVLOS (Average Length of Stay) of ischemic stroke patients was an average of 5.41 days of hospitalization, according to the table of Effectiveness of Antihypertensive Drugs Based on Length of Stay. However, the Calcium Channel Blocker (CCB) class, which was prescribed for ischemic stroke patients, had an average length of stay of 4.4 days, and therapy with ACE Inhibitors (ACEI) had an average length of stay of 4.6 days, which is almost the same as the CCB group results. Patients receiving Angiotensin Receptor Blocker (ARB) therapy spent an average of 5 days of hospitalization, with Beta-blockers averaging 5.5 days, and the Diuretic group having the longest hospitalization with an average of 6 days for single therapy. Other regimen, such as CCB + ARB and ACEI, Diuretic + Beta-blocker, and ACEI + Beta-blocker, were also recorded.

Table 1. Distribution of Antihypertensive Therapy Profiles (n=50)

Therapy Category	Drug Class / Regimen	Patient Count (n)	Percentage within Category (%)	Percentage of Total Sample (%)	Mean BP Reduction (mmHg)	Av
Monotherapy (n=42)	CCB (Amlodipine)	27	64.3%	54.0%	14 / 9	4.4
	ARB (Candesartan)	15	35.7%	30.0%	11 / 7	5.1
Combination (n=8)	CCB + ARB	5	62.5%	10.0%	13 / 8	5.2
	CCB + ACEI	3	37.5%	6.0%	10 / 6	5.8



Picture 1. Clinical Efficiency: Average Length of Stay (AvLOS) per-Regimen

In the patient demographics based on gender, the dominance of male patients compared to female patients indicates that males have a higher risk of experiencing a stroke. This is related to risk factors more commonly found in males, including smoking habits, alcohol consumption, unhealthy eating patterns, and less optimal hypertension control. Appelros et al.[6] reported that the incidence of stroke is higher in males than in females in various populations. Although females still have a significant risk, especially after menopause. This is due to the decrease in estrogen hormone levels which, during reproductive age, functions to provide a protective effect on the cardiovascular system. Benjamin et al. (2019)[7] research also revealed that although the prevalence of stroke is slightly higher in males, females often experience worse clinical outcomes because strokes usually occur at an older age with the presence of comorbidities.

In the patient population based on age, the majority of patients were over 60 years old. This is in line with the research of Misbach & Kalim, 2015[8], which found that most stroke cases in Indonesia occur in old age, and according to the AHA/ASA 2019[9], the risk of stroke doubles every ten years after the age of 55. The degenerative process of blood vessels causes atherosclerosis, decreased vascular elasticity, and increased risk factors such as hypertension, diabetes mellitus, dyslipidemia, and atrial fibrillation in old age, which leads to this condition[10]. However, strokes are more common in young people aged 30 to 50 years due to unhealthy lifestyles (smoking, obesity, lack of physical activity), genetic factors, or blood vessel abnormalities. This has a major impact on reproductive age as it reduces quality of life and productivity. At Muhammadiyah Hospital, Jombang, patients suffering from ischemic stroke use CCB as a single antihypertensive drug. The use of CCBs has increased in accordance with clinical guidelines, which state that these drugs are effective in lowering blood pressure, have a good safety profile, and can reduce the risk of stroke recurrence [17], because of their stable effect and lack of significant impact on renal function, CCBs are also considered beneficial in elderly patients and patients with

cerebrovascular disease[18]. The ACEI class reduces cardiovascular morbidity and mortality and prevents target organ damage, including the brain[15], but due to dry cough, some patients switch to ARBs, which do the same thing in inhibiting the renin-angiotensin system with fewer side effects [19]. However, beta-blockers, such as bisoprolol, are more commonly prescribed in patients with a history of ischemic heart disease, heart failure, or arrhythmia. However, in stroke patients without cardiovascular comorbidities, their use is rare. This is because their benefit in preventing recurrent stroke is lower than that of CCBs, ACEIs, or ARBs [15].

Inpatient ischemic stroke patients at Muhammadiyah Hospital, Jombang, receive five types of antihypertensives (CCB, ARB, ACEI, β -blocker, and diuretics) according to their respective indications. CCB (Calcium Channel Blocker), especially amlodipine, is the most frequently prescribed drug. This is in accordance with research conducted at RSUD dr. Soetomo Surabaya (January 1, 2014–December 31, 2015), which found that CCBs were the most commonly used type of antihypertensive. CCBs, especially dihydropyridines, have many advantages in ischemic stroke patients because they control blood pressure well and lower it quickly. In addition, some studies show that CCBs can reduce the risk of heart disease [20]. A long half-life (30–50 hours), peak time (T_{max}) of 6–9 hours, and high bioavailability (65–90%) make amlodipine one of the most popular CCBs [12, 13].

At Muhammadiyah Hospital, Jombang, the CCB + ARB regimen (Amlodipine + Candesartan) is the most common choice for ischemic stroke patients in combination therapy. This combination works well because of its complementary mechanisms. CCBs do this through peripheral arterial vasodilation, and ARBs do it by suppressing the vasoconstriction effects of angiotensin II. This results in better control over blood pressure with fewer side effects. This is in line with recommendations made by JNC 8 and ESC/ESH [15, 16], which indicate that the combination of CCB + ARB or ACEI is more effective than monotherapy in preventing recurrent heart failure. There are also

combinations of CCB + ACEI (Amlodipine + Captopril), diuretic + blocker (Furosemide + Bisoprolol), and ACEI + blocker (Captopril + Bisoprolol). The CCB + ACEI combination reduces the risk of stroke recurrence (PROGRESS trial), while diuretic + β -blocker is widely given to patients with heart failure or edema. ACEI + β -blocker is also used in patients with ischemic heart disease because it provides additional cardiovascular protection. In general, choosing an antihypertensive combination for ischemic stroke patients demonstrates the application of evidence-based therapy based on the patient's clinical condition and their additional conditions.

Calcium Channel Blockers (CCB) are single antihypertensive drugs that, based on the reduction in blood pressure, show the most significant reduction in intensity compared to other drug classes. According to research, the stable effect and accuracy profile of CCBs make them relatively safe in ischemic stroke patients. The use of angiotensin receptor blockers (ARB) or angiotensin-converting enzyme inhibitors (ACEI) is also effective because they not only lower blood pressure but also offer vascular protection through the control of the renin-angiotensin-aldosterone system. In addition, they show that the use of ACEIs or ARBs improves endothelial function. The selection of beta-blockers is usually based on specific indications such as heart disease or fluid retention; both lower blood pressure slightly less than CCBs, ARBs, and ACEIs. Single antihypertensive therapy not only lowers blood pressure but also affects the length of stay; a faster stable reduction in blood pressure is associated with clinical improvement, so the length of stay can be shortened. CCBs, which lower blood pressure significantly, have been proven to help stabilize patients more quickly. Ideal blood pressure control in the acute phase of stroke improves clinical outcomes and reduces the risk of neurological complications. However, recommend that blood pressure reduction in ischemic stroke be done gradually to avoid cerebral hypoperfusion. This is because a reduction in blood pressure can decrease cerebral perfusion, especially in the penumbra area. Consequently, the length of stay will be extended [14].

Research at RSUD Mandau showed a reduction in systolic blood pressure of 7–13 mmHg and diastolic of 4–8 mmHg. Pharmacological therapy can be started with the use of a single drug, known as monotherapy. This is due to the fact that one drug can lower blood pressure significantly. CCB is the most widely used single drug at Muhammadiyah Hospital, Jombang. Its mechanism of action is vasodilation, which slows the heart rate and reduces myocardial contractility, effectively lowering blood pressure. Not only monotherapy, but combination antihypertensives have also proven effective[16]. Systolic blood pressure dropped by up to 13 mmHg and diastolic dropped by up to 8 mmHg with a combination of antihypertensive drugs, according to research at RSUD Mandau. The combination of CCB and ARB lowers blood pressure better than other combinations. This is in line with research by Erna Nurul 2021 (5), which found that the combination of CCB and ARB lowers blood pressure better than other combinations. The pharmacological use of dihydropyridine CCBs can cause acute diuresis and natriuresis, which causes the body to lose a lot of water and sodium. The renin-angiotensin-aldosterone system (RAAS) will be activated as compensation for the loss. Thus, it is considered better to combine CCBs and ARBs, because ARBs are able to stop the RAAS activation triggered by CCBs, which results in better blood pressure control.

Regarding the effectiveness of antihypertensive drugs based on the length of stay, it is known that through cerebral arterial vasodilation, CCBs lower blood pressure and maintain the hemodynamic stability of ischemic stroke patients. This improves brain perfusion and accelerates recovery. With the impact of cerebrovascular protection, ACEIs and CCBs are almost equally effective [19], but ARBs are more effective. Patients with severe hypertension or more complex clinical conditions usually require a longer length of stay for combination therapy. To achieve the target blood pressure, combinations such as CCB + ACEI, Diuretic + Beta-Blocker, or ACEI + Beta-Blocker can help, but do not always reduce the duration of stay. According to research conducted at RSUP dr. Kariadi in Semarang,

the duration of stay for patients suffering from ischemic stroke is between 4 and 6 days[11].

Conclusion

According to the analysis of research data and data discussion, the most widely used antihypertensive drugs are single Calcium Channel Blockers (CCB) (Amlodipine) and combination therapy (CCB + ARB). Single and combination CCBs are considered the most effective for reducing blood pressure and reducing the length of stay. The results of the study indicate that researchers should conduct additional research to find out other things that have not been studied in this research. To obtain more comprehensive and better generalizable results, researchers are advised to change the parameters, the number of samples, and the research location.

Material and Methods

This study utilized a non-experimental retrospective observational design to evaluate the effectiveness profile of antihypertensive drugs. The research was conducted at the Inpatient Installation of Muhammadiyah Hospital, Jombang, using data archived up to 2026. A purposive sampling technique was applied to select patients who met the following inclusion criteria: diagnosed with ischemic stroke, admitted to the inpatient ward, and received antihypertensive therapy during hospitalization. Out of the initial sample pool, a final sample of 50 patients was successfully recruited and analyzed.

The evaluated variables in this study comprised patient demographics (age and gender), antihypertensive drug classes (monotherapy and combination regimens), therapeutic attainment of blood pressure target reductions, and average length of stay (AvLOS). Patient medical records from the hospital's database served as the primary research instrument. Data collection was strictly carried out by extracting clinical parameters from the electronic and physical charts. The gathered data were then subjected to descriptive and analytical analysis using frequency distribution and percentage tracking to

determine drug deployment and therapeutic efficiency.

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