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RESEARCH ARTICLE

Amlodipine Versus Cilnidipine: A Comparative Study in Blood Pressure Control and Treatment Cost Among Hypertensive Patients.

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Abstract: ***Background***: High blood pressure is a significant public health issue and a crucial risk element for heart disease. Calcium channel blockers such as amlodipine and cilnidipine are commonly prescribed, yet there is limited comparative evidence on their effectiveness and cost-effectiveness. This study seeks to assess the efficacy of amlodipine compared to cilnidipine in managing blood pressure and heart rate, as well as to analyze the treatment costs for patients with hypertension. ***Methods***: A forward-looking comparative study was performed on 100 patients with hypertension, evenly split into two groups. Group A was given amlodipine, while cilnidipine was administered to Group B. Baseline demographic and clinical data were collected, and follow-up assessments included systolic blood pressure (SBP), diastolic blood pressure (DBP), and heart rate. Statistical analysis was conducted, with $p < 0.05$ deemed significant. The cost of medication on a monthly basis was compared among the groups. ***Results***: The average age was similar across the groups (Amlodipine: 56.78 years; Cilnidipine: 56.14 years), with a nearly identical distribution of genders. The pre-treatment SBP in the cilnidipine group was marginally elevated (158.14 mmHg) compared to the amlodipine group (155.8 mmHg). After treatment, cilnidipine resulted in a more significant decrease in SBP (30.90 ± 5.75 mmHg) than amlodipine (20.90 ± 9.50 mmHg), with statistical significance ($p < 0.001$). The reduction in DBP was comparable between the two groups (10.12 ± 6.92 vs. 10.24 ± 6.58 mmHg, $p = 0.92$). Cilnidipine led to a significantly larger reduction in heart rate (6.16 ± 4.80 bpm) than amlodipine (0.84 ± 1.04 bpm, $p < 0.001$). Monthly treatment cost per patient was lower with Amlodipine (Rs. 60) in comparison to Cilnidipine (Rs. 84). ***Conclusion***: Cilnidipine exhibited greater effectiveness in lowering systolic blood pressure and heart rate, whereas both medications displayed similar reductions in diastolic blood pressure. Nonetheless, amlodipine proved to be more economical, indicating that medication choices should weigh clinical advantages against cost.

Keywords: Blood pressure, Amlodipine, cilnidipine, treatment cost.

INTRODUCTION

Hypertension is a major worldwide health issue, playing a substantial role in the illness and death linked to cardiovascular diseases [1]. The World Health Organization (WHO) estimates that around 1.28 billion adults between 30 and 79 years old globally have hypertension, with two-thirds residing in low- and middle-income nations [2]. Unmanaged blood pressure is a quiet but strong risk factor for stroke, heart failure, and kidney problems. In India, the increasing occurrence of hypertension is a significant public health issue, with the National Family Health Survey (NFHS-5) indicating a considerable rise in both urban and rural communities [3]. This highlights the critical demand for efficient and cost-effective antihypertensive treatments that can maintain consistent blood pressure management and patient compliance, especially in low-resource environments.

Among the pharmacological options, calcium channel blockers (CCBs) are frequently used as initial treatments because of their effectiveness, tolerability, and limited metabolic side effects. Amlodipine, a dihydropyridine calcium channel blocker, is commonly utilized because of its prolonged effect and demonstrated effectiveness in managing both systolic and diastolic blood pressure. Nonetheless, it is linked to dose-dependent side effects like pedal edema, potentially resulting in decreased patient adherence [4,5]. In recent years, cilnidipine, a novel dual L/N-type calcium channel blocker, has surfaced as a possible alternative. Besides promoting vasodilation, cilnidipine also inhibits sympathetic nerve activity, potentially providing extra advantages in decreasing proteinuria and lessening side effects like edema [6].

Although cilnidipine's use is on the rise, there is still an absence of definitive evidence directly assessing its antihypertensive effectiveness and cost-efficiency in comparison to amlodipine, especially within the Indian clinical setting. Limited head-to-head studies have investigated both clinical and economic results, which are essential for informing treatment choices in a cost-conscious group. Furthermore, the available research shows inconsistent results, with certain studies indicating similar effectiveness while others suggest a minor

advantage for cilnidipine regarding renal protection and side effect profile [7-9].

This research aimed to fill this gap by performing a comparative assessment of amlodipine and cilnidipine regarding blood pressure management and treatment expenses in hypertensive individuals. A prospective, randomized, parallel-group design was utilized, enrolling adult individuals diagnosed with stage I or II essential hypertension. Participants were allocated to receive either amlodipine or cilnidipine, and their blood pressure measurements, side effects, and medication expenses were observed over 12-week duration. This design selection guarantees a direct comparison in controlled settings, improving the trustworthiness of the results.

This study seeks to offer evidence-based recommendations for clinicians and policymakers in enhancing hypertension management by emphasizing both the clinical effectiveness and economic aspects. The findings are anticipated to clarify existing disputes and significantly enhance the advancing treatment approach in hypertension management, particularly in resource-limited environments.

METHODOLOGY

Type of Study and Study Design: This study is a comparative, prospective, observational study conducted to evaluate and compare the efficacy of Amlodipine (group A) and Cilnidipine (group B) in controlling blood pressure and assessing the associated treatment cost among hypertensive patients. The study was conducted in the outpatient department (OPD) of Saraswati Medical College, Unnao, Uttar Pradesh. The study protocol was submitted to the Institutional Ethics Committee (IEC) and written informed consent was obtained from all participants before inclusion.

Study Population and Sample Size: The study population includes patients diagnosed with essential hypertension who attend the general medicine outpatient clinic. The participants was either newly diagnosed or already on monotherapy with either Amlodipine or Cilnidipine. A total of 100 patients were enrolled, with 50 patients each in the Amlodipine and Cilnidipine groups. Patients were selected using consecutive sampling until the desired sample size is reached.

Inclusion Criteria: Adults between 30 and 70 years of age, diagnosed with Stage I or II essential hypertension according to JNC 8 (Eighth Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure) or ESC (European Society of Cardiology) guidelines, who were willing to provide informed consent and were either newly diagnosed or already receiving amlodipine or cilnidipine monotherapy for at least four weeks, were included in the study.

Exclusion Criteria: Patients with secondary hypertension, those receiving combination antihypertensive therapy, individuals with a history of cardiac, renal, or hepatic failure, pregnant or lactating women, and patients with a known allergy to dihydropyridine calcium channel blockers were excluded from the study.

Proposed Intervention: The study is observational. Patients already on either Amlodipine or Cilnidipine as prescribed by their treating physician were followed for assessment of blood pressure control and treatment cost over a period of 3 months.

Data Collection Procedures: Blood Pressure was measurement using a calibrated mercury sphygmomanometer, with patients seated for at least 5 minutes before reading. Readings was taken at baseline and at monthly intervals for 3 months. Prescriptions and pharmacy bills were used to record the drug name, dosage, frequency, and monthly expenditure in order to conduct a cost study of the drug. Structured Case Report Forms (CRFs) was used to collect demographic data, clinical history, comorbidities, baseline BP, and follow-up readings.

Statistical Tools: Data was analyzed using SPSS (Statistical Package for Social Sciences) 28.0. T-test was used for group comparison. A p-value <0.05 was considered statistically significant.

RESULTS:

Patients with hypertension treated with amlodipine (Group A) and cilnidipine (Group B) are distributed by age in Table and figure no**.** 1 In the amlodipine group, the highest percentage of patients was in the 61–65 years age range (22%), followed by those aged 46–50 years (20%) and 66–70 years (18%). The age groups with the highest proportion of patients in the cilnidipine group were those aged 51–55 years (22%) and 56–60 years (18%), followed by those aged 66–70 years (18%). As a result, the age distributions of the two groups were comparable, with most patients being over 50.

Table and figure no**.** 2 presents the baseline clinical parameters and those measured after treatment for comparison. The average age of patients was comparable in both groups (Amlodipine: 56.78 years, Cilnidipine: 56.14 years). The distribution of genders was nearly equal. The average BMI was marginally elevated in the amlodipine group (27.05) in comparison to the cilnidipine group (26.55). Prior to treatment, the average systolic blood pressure (SBP) was somewhat greater in the cilnidipine group (158.14 mmHg) than in the amlodipine group (155.8 mmHg). Post-treatment, the reduction in SBP was more significant with cilnidipine (127.24 mmHg) compared to amlodipine (134.9 mmHg). Average diastolic blood pressure (DBP) decreased in both groups, recording 78.8 mmHg in the amlodipine group and 80.2 mmHg in the cilnidipine group. Heart

rate was more effectively managed with cilnidipine (decreased from 87.2 to 81.04 bpm) in contrast to amlodipine (83.26 to 82.42 bpm).

The statistical analysis of treatment outcomes is shown in Table and figure no**.** 3. The cilnidipine group experienced a significantly greater average SBP reduction (30.90 ± 5.75 mmHg) than the amlodipine group (20.90 ± 9.50 mmHg), with a p-value of <0.001 indicating strong statistical significance. The DBP drop was not statistically significant (p = 0.92) and was nearly the same for both groups (10.12 ± 6.92 vs. 10.24 ± 6.58 mmHg). However, there was a statistically significant difference in the heart rate change, with cilnidipine causing a larger decrease (6.16 ± 4.80) compared to amlodipine (0.84 ± 1.04) (p < 0.001).

Table no. 4 emphasizes the analysis of costs. The monthly expense for each patient taking amlodipine was Rs. 60, while for cilnidipine it was Rs. Certainly! Please provide the text you would like me to paraphrase. Taking into account 50 patients per group, the overall monthly spending amounted to Rs. 3000 for amlodipine and Rs. 4200 for cilnidipine indicated that amlodipine treatment was more economical

Table no. 1: Showing the frequency distribution of age of hypertensive patients managed by Amlodipine versus cilnidipine

Age (In Yrs.)	Hypertensive patients managed by Amlodipine		Hypertensive patients managed by Cilnidipine	
	n = 50	%	n = 50	%
35-40	3	6%	4	8%
41-45	3	6%	5	10%
46-50	10	20%	4	8%
51-55	6	12%	11	22%
56-60	8	16%	9	18%
61-65	11	22%	8	16%
66-70	9	18%	9	18%

Figure no. 1: showing the frequency distribution of age of hypertensive patients managed by Amlodipine versus cilnidipine

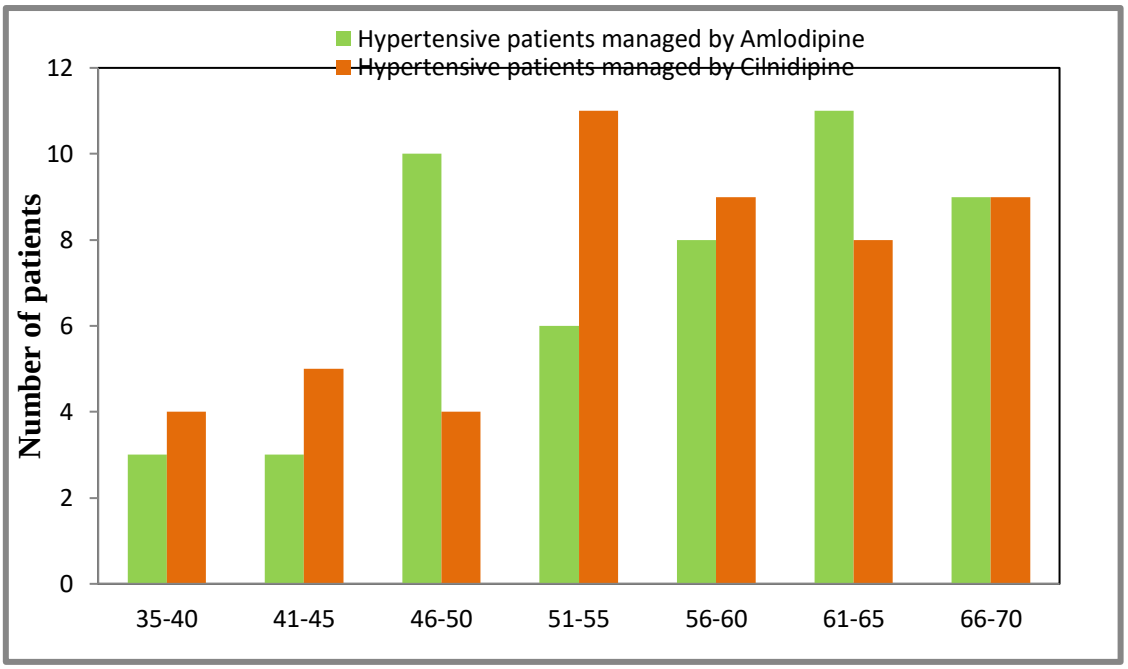

Table no. 2: Showing the comparative analysis of blood pressure, heart rate, pulse rate and body mass index (BMI) of hypertensive patients managed by Amlodipine versus Cilnidipine

Parameter	**Group A (Amlodipine)**	**Group B (Cilnidipine)**
Sample Size (n)	50	50
Mean Age (years)	56.78	56.14
Gender Distribution (M/F)	26/24	22/28
Mean BMI	27.054	26.552

Mean SBP Before (mmHg)	155.8	158.14
Mean SBP After (mmHg)	134.9	127.24
Mean DBP Before (mmHg)	88.92	90.44
Mean DBP After (mmHg)	78.8	80.2
Mean Heart Rate Before	83.26	87.2
Mean Heart Rate After	82.42	81.04
Mean Pulse Rate	84.06	87.4
Treatment cost per month	60	84

Figure no. 2: Showing the comparative analysis of blood pressure, heart rate, pulse rate and body mass index (BMI) of hypertensive patients managed by Amlodipine versus Cilnidipine

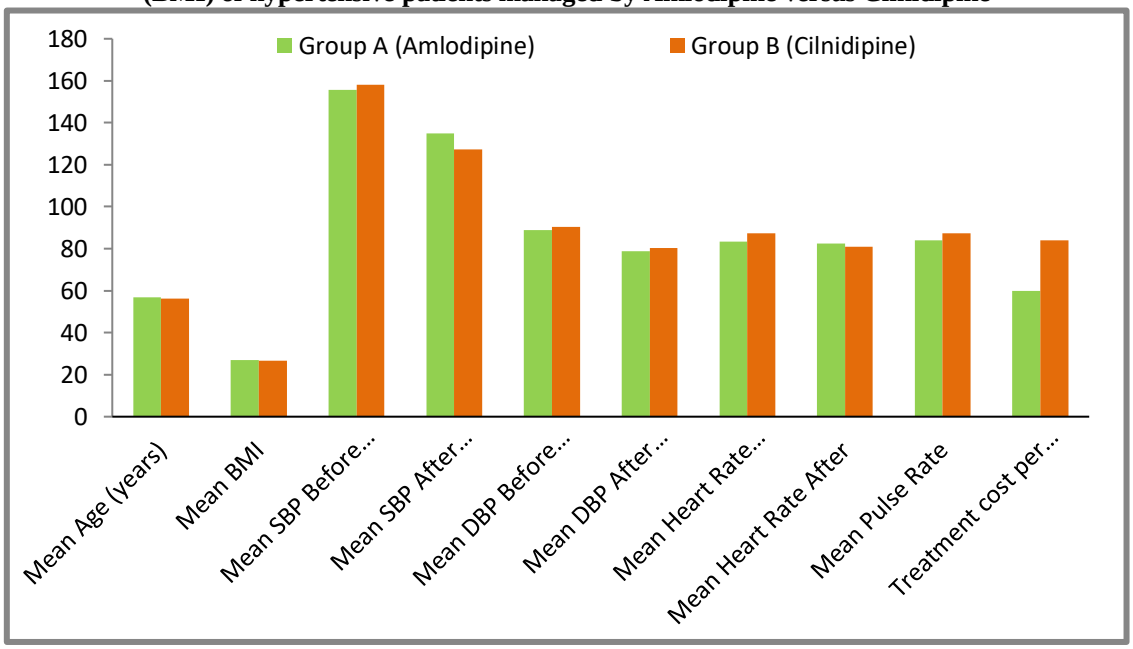

Table no. 3: Showing the Statistical Comparison between Group A (patients managed by Amlodipine) versus Group B (patients managed by Cilnidipine)

Parameter	**Group A (Amlodipine) Mean ± SD**	**Group B (Cilnidipine) Mean± SD**	**p-value**	**Interpretation**
SBP Reduction	20.90 ± 9.50	30.90± 5.75	0.00**	Statistically highly significant
DBP Reduction	10.12 ± 6.92	10.24± 6.58	0.92	Statistically not significant
Heart Rate Change	0.84± 1.04	6.16 ± 4.80	0.00**	Statistically highly significant

Figure no. 3: Showing the Statistical Comparison between Group A (patients managed by Amlodipine) versus Group B (patients managed by Cilnidipine)

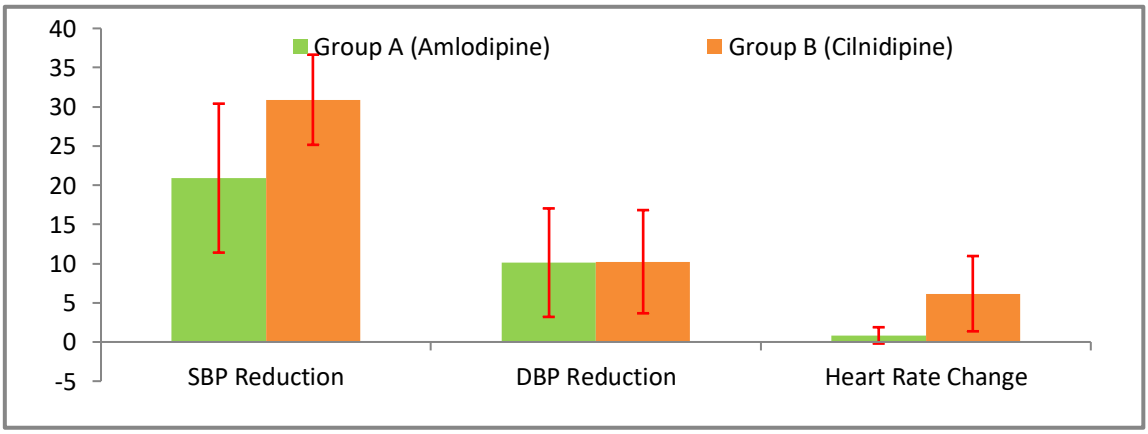

Table no. 4: Showing the Cost Comparison between Group A (patients managed by Amlodipine) versus Group B (patients managed by Cilnidipine)

Drug	Monthly Cost (Rs)	Number of Patients	Total Monthly Cost (Rs)
Amlodipine	60	50	3000.00
Clinidipine	84	50	4200.00

DISCUSSION:

Hypertension is a leading risk factor for cardiovascular morbidity and mortality, and calcium channel blockers (CCBs) remain a cornerstone in its pharmacological management. Amlodipine, a widely used long-acting dihydropyridine CCB, is often compared with cilnidipine, a newer agent that not only blocks L-type but also N-type calcium channels, conferring additional benefits. This study compared the efficacy and cost of amlodipine and cilnidipine in hypertensive patients.

The baseline demographic and clinical characteristics were comparable between the two groups, with the majority of patients aged over 50 years. This is consistent with the known epidemiology of hypertension, which is more prevalent in older populations [10]. Such comparability strengthens the reliability of treatment outcome analysis. Both drugs significantly reduced systolic and diastolic blood pressure after treatment. However, the magnitude of systolic blood pressure (SBP) reduction was significantly greater with cilnidipine (30.9 ± 5.75 mmHg) compared to amlodipine (20.9 ± 9.50 mmHg), with $p < 0.001$. This finding is clinically important, as isolated systolic hypertension is more strongly associated with cardiovascular events in elderly patients. Cilnidipine's additional mechanism of suppressing sympathetic activity through N-type calcium channel blockade may explain this superior SBP reduction [11].

The effect on diastolic blood pressure (DBP) was similar between the groups, with no statistically significant difference. This suggests that while both drugs are equally effective in controlling DBP [12], cilnidipine provides added benefit in systolic pressure control, which may be advantageous in patients at high cardiovascular risk. Another key difference was observed in heart rate control. Cilnidipine significantly reduced heart rate (mean reduction 6.16 bpm) compared to amlodipine (0.84 bpm), with $p < 0.001$. Reflex tachycardia, often a limitation of traditional dihydropyridines, was better controlled with cilnidipine due to its sympatholytic effect. This property may make cilnidipine particularly useful in patients with concomitant ischemic heart disease or tachyarrhythmias, where heart rate reduction is desirable [13].

However, cost analysis revealed that amlodipine therapy was more economical, with a per-patient monthly cost of Rs. 60 compared to Rs. 84 for cilnidipine. For larger patient groups, this cost difference becomes substantial, especially in resource-limited settings where affordability is a critical determinant of treatment adherence. Thus, while cilnidipine offers superior clinical benefits, amlodipine's affordability ensures wider accessibility. The results indicate that cilnidipine may be clinically preferable in patients requiring better systolic blood pressure and heart rate control, whereas amlodipine remains advantageous in terms of cost-effectiveness [14].

CONCLUSION:

Both amlodipine and cilnidipine are effective in managing hypertension. Cilnidipine showed superior reduction in systolic blood pressure and heart rate, whereas amlodipine was more cost-effective. Treatment choice should be individualized, balancing clinical efficacy with economic feasibility. Cilnidipine may be preferred in patients with systolic hypertension and tachycardia, while amlodipine remains suitable for cost-sensitive patients requiring adequate blood pressure control.

Limitations: This study had some limitations. The sample size was relatively small and limited to a single center, which may restrict generalizability. The study duration was short, and long-term outcomes such as cardiovascular morbidity, mortality, and adverse drug effects were not assessed. Additionally, quality-of-life measures and treatment adherence were not evaluated, which could provide further insights. Future research with larger, multicentric trials and longer follow-up is recommended to confirm these findings. Studies incorporating cost-effectiveness analyses with real-world adherence data and outcome measures such as reduction in stroke, myocardial infarction, and heart failure would provide stronger evidence to guide clinical decision-making.

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