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ORIGINAL ARTICLE

Comparative Study of Beta-Blockers Versus Calcium Channel Blockers in the Management of Stable Angina in Elderly Patients

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ABSTRACT

Background: Stable angina is a common clinical manifestation of coronary artery disease in the elderly population. Age-related physiological changes, polypharmacy, and comorbidities often complicate its management. Beta-blockers and calcium channel blockers (CCBs) are widely used anti-anginal agents; however, limited comparative data exist specifically for elderly cohorts regarding their efficacy and safety profiles.

Objective: To compare the clinical efficacy and safety of beta-blockers versus calcium channel blockers in elderly patients with stable angina.

Methods: This prospective, comparative cross-sectional study included 100 patients aged 65 years or older with a confirmed diagnosis of stable angina. Patients were recruited from the cardiology departments of Aziz Bhatti Shaheed Teaching Hospital, Gujrat, and Mayo Hospital, Lahore, between April 2022 and April 2023. Participants were divided into two equal groups: Group A received beta-blockers (metoprolol or bisoprolol) and Group B received calcium channel blockers (amlodipine or diltiazem). Clinical assessments were conducted at baseline, 6 weeks, and 12 weeks, evaluating angina episode frequency, CCS class improvement, exercise tolerance (treadmill test), resting heart rate, blood pressure, and adverse drug events. Statistical analysis was performed using SPSS version 26.0, with a p-value <0.05 considered significant.

Results: Both treatment groups demonstrated significant clinical improvement over the 12-week period. The mean angina episodes per week were lower in Group A (2.1 ± 0.9) compared to Group B (2.4 ± 1.1), though not statistically significant (p=0.18). CCS class improvement by at least one grade occurred in 76% of Group A and 68% of Group B patients (p=0.37). Group A showed a slightly longer mean exercise duration (7.8 ± 1.6 vs. 7.3 ± 1.5 minutes; p=0.09) and a delayed time to onset of angina. Resting heart rate was significantly lower in Group A (65.6 ± 6.8 bpm) than in Group B (72.4 ± 7.3 bpm; p<0.001). Peripheral edema occurred more frequently in Group B (16%) versus Group A (4%; p=0.04), while fatigue was reported slightly more in Group A (20% vs. 12%; p=0.27). Drug discontinuation due to side effects was low in both groups.

Conclusion: Both beta-blockers and calcium channel blockers are effective and well-tolerated treatments for stable angina in elderly patients. Beta-blockers offer better heart rate control and slight improvement in exercise tolerance, whereas CCBs remain suitable alternatives for patients with contraindications to beta-blockers. Individualized therapy selection based on comorbidities, hemodynamic parameters, and side-effect profiles is essential for optimizing outcomes in this high-risk population.

Keywords: Angina, Beta-blockers, Calcium-channel-blockers, Elderly, Exercise, Heart-rate, Pharmacotherapy

INTRODUCTION

Stable angina pectoris, a clinical manifestation of myocardial ischemia, remains a significant health concern among elderly populations due to age-associated comorbidities, vascular stiffening, and impaired endothelial function [1]. As the global demographic trend shifts toward an aging population, the prevalence of stable angina in individuals aged ≥65 years has escalated, necessitating an optimized therapeutic strategy tailored to this high-risk cohort [2]. The pathophysiology of stable angina in elderly patients is often compounded by diffuse atherosclerotic disease, microvascular dysfunction, and altered autonomic regulation, making therapeutic decisions more complex and outcomes more variable [3]. Management strategies must therefore balance efficacy in symptom control with safety in terms of hemodynamic stability and tolerability [4].

Among the cornerstone pharmacologic agents employed for angina management are beta-adrenergic blockers (beta-blockers) and calcium channel blockers (CCBs), both of which exert anti-ischemic effects through distinct yet complementary mechanisms [5]. Beta-blockers act by reducing myocardial oxygen demand through negative chronotropic and inotropic effects, thereby diminishing cardiac workload and increasing diastolic perfusion time [6]. These agents are especially beneficial in patients with coexisting hypertension, arrhythmias, or post-myocardial infarction status. However, in elderly patients, the potential for bradycardia, fatigue, and exacerbation of peripheral vascular disease may limit their use[6].

On the other hand, calcium channel blockers, particularly the dihydropyridine and non-dihydropyridine classes, improve myocardial oxygen balance primarily through vasodilation and afterload reduction [7]. Non-dihydropyridines such as verapamil and diltiazem also provide rate control, making them suitable for patients with comorbid supraventricular arrhythmias. Importantly, CCBs may offer advantages in patients with contraindications to beta-blockers, such as severe reactive airway disease. Nonetheless, the risk of hypotension, peripheral edema, and constipation particularly prominent in the elderly necessitates cautious selection and dose adjustment [8].

Despite their established roles, a direct comparative evaluation of beta-blockers versus calcium channel blockers in elderly populations with stable angina remains insufficiently explored in clinical practice [9]. While randomized controlled trials and meta-analyses have demonstrated efficacy for both drug classes in the general population, the unique pharmacodynamic responses, polypharmacy interactions, and organ functional decline in elderly patients call for more focused evidence [10]. Age-related changes in drug metabolism, higher likelihood of frailty, and greater incidence of silent ischemia or atypical anginal symptoms further justify the need for geriatric-specific data to inform treatment decisions [11].

This comparative study is designed to critically evaluate and contrast the therapeutic effectiveness, safety profile, and tolerability of beta-blockers and calcium channel blockers in the management of stable angina in elderly patients. Through this investigation, we aim to elucidate which class of agents confers

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superior clinical benefit in terms of symptom control, exercise tolerance, and quality of life, while also minimizing adverse outcomes in this vulnerable population. By addressing this clinical gap, the study seeks to provide an evidence-based framework for tailoring anti-anginal therapy in older adults, aligning with the goals of precision medicine and geriatric cardiovascular care [12].

MATERIALS AND METHODS

This prospective, comparative cross-sectional study was conducted to evaluate the efficacy and safety of beta-blockers versus calcium channel blockers in the management of stable angina among elderly patients. The study was carried out over a 12-month period, from April 2022 to April 2023, at two tertiary care teaching hospitals in Punjab, Pakistan: the Department of Cardiology, Aziz Bhatti Shaheed Teaching Hospital, Gujrat, and the Department of Cardiology, Mayo Hospital, Lahore. Both centers serve as referral hubs for cardiovascular care in urban and semi-urban populations, allowing a representative inclusion of elderly patients with chronic ischemic heart disease. The study was approved by the institutional ethical review committees of both hospitals, and written informed consent was obtained from all participants prior to enrollment.

A total of 100 patients aged 65 years and above, diagnosed with stable angina based on the Canadian Cardiovascular Society (CCS) classification, were included. Stable angina was defined as exertional chest pain of at least three months' duration, relieved by rest or sublingual nitroglycerin, and supported by evidence of myocardial ischemia on resting electrocardiogram (ECG) or treadmill stress testing. Patients were divided into two treatment groups: Group A received beta-blocker therapy (n = 50) and Group B received calcium channel blocker therapy (n = 50). The allocation to each treatment arm was done by the attending physician based on individual clinical indication, comorbidities, and drug tolerability.

Patients in Group A received either metoprolol succinate (50–100 mg once daily) or bisoprolol (5–10 mg once daily), while those in Group B received either amlodipine (5–10 mg once daily) or diltiazem (120–240 mg/day in divided doses). Patients already on combination therapy involving both beta-blockers and calcium channel blockers, or any additional anti-anginal medications beyond the study scope (such as long-acting nitrates or ivabradine), were excluded to maintain comparability. Inclusion criteria comprised age ≥65 years, CCS Class I–III stable angina, LVEF ≥40%, and preserved cognitive function allowing adherence and follow-up. Exclusion criteria included recent myocardial infarction within the preceding three months, unstable angina, previous coronary revascularization (CABG or PCI), LVEF <40%, significant valvular or structural heart disease, uncontrolled hypertension (SBP ≥180 mmHg or DBP ≥110 mmHg), severe renal (eGFR <30 mL/min/1.73 m²) or hepatic dysfunction (ALT/AST >3× ULN), chronic pulmonary disease with recent exacerbation, and cognitive impairment interfering with consent or compliance.

At baseline, all participants underwent comprehensive clinical and diagnostic evaluations. This included a detailed history, physical examination, 12-lead ECG, transthoracic echocardiography to assess left ventricular ejection fraction and wall motion abnormalities, and treadmill exercise testing using the Bruce protocol to determine exercise capacity and time to angina onset. Laboratory investigations comprised serum electrolytes, fasting blood glucose, renal and liver function tests, and lipid profile.

Patients were followed for a total duration of 12 weeks, with assessments performed at baseline, 6 weeks, and 12 weeks. The primary efficacy outcomes included frequency of weekly angina episodes, change in CCS angina class, total treadmill exercise duration (in minutes), and time to onset of angina during exercise testing. Resting heart rate and systolic/diastolic blood pressure were measured at each visit to evaluate hemodynamic response. Safety outcomes included assessment of adverse drug effects such as bradycardia, hypotension, fatigue, dizziness, and peripheral edema. Patient adherence was monitored through direct questioning, pill counts, and maintenance of medication diaries.

All data were entered and analyzed using IBM SPSS Statistics version 26.0. Continuous variables were expressed as mean ± standard deviation (SD) and compared between the two groups using the independent sample t-test. Categorical variables were expressed as frequencies and percentages and compared using the chi-square test or Fisher's exact test where appropriate. A p-value less than 0.05 was considered statistically significant. This structured methodology ensured a robust and clinically relevant comparison of beta-blockers and calcium channel blockers in elderly patients with stable angina, focusing on both therapeutic effectiveness and tolerability profiles.

RESULTS

A total of 100 elderly patients with stable angina were enrolled in the study and equally divided into two treatment groups: Group A (beta-blockers, n = 50) and Group B (calcium channel blockers, n = 50). Both groups were comparable in terms of baseline demographic and clinical characteristics. Table-1 presents the baseline demographic and clinical characteristics of the study population, comparing patients receiving beta-blockers (Group A) and those receiving calcium channel blockers (Group B). The mean age of patients in Group A was 69.4 ± 4.8 years, while in Group B it was 70.1 ± 5.2 years, with no statistically significant difference between the two groups (p = 0.42). The gender distribution was also comparable, with males comprising 64% of Group A and 60% of Group B, and females accounting for 36% and 40%, respectively (p = 0.68 for both).

Hypertension was a common comorbidity, present in 76% of patients in Group A and 72% in Group B (p = 0.64), while diabetes mellitus was observed in 48% of Group A and 52% of Group B (p = 0.69), indicating no significant difference in the burden of these conditions. The mean body mass index (BMI) was similar in both groups, recorded at 26.3 ± 3.2 kg/m² for Group A and 25.9 ± 3.4 kg/m² for Group B (p = 0.56). A history of smoking was noted in 28% of patients in Group A and 24% in Group B (p = 0.64), again showing no significant intergroup variation. Left ventricular ejection fraction (LVEF), an important indicator of cardiac function, was almost identical between groups, with a mean of 55.1 ± 6.3% in Group A and 54.7 ± 6.1% in Group B (p = 0.72). Overall, the demographic and baseline clinical parameters were well balanced between the two groups, allowing for a fair and unbiased comparison of treatment outcomes.

The demographic data indicate that both treatment groups were well matched in terms of age, gender distribution, comorbidities such as hypertension and diabetes, BMI, smoking history, and left ventricular ejection fraction (LVEF), with no statistically significant differences between groups. Following the 12-week follow-up period, patients were evaluated for clinical outcomes including angina frequency, exercise tolerance, heart rate, blood pressure control, and adverse events as shown in table 1

Table-2 summarizes the clinical outcomes observed in both treatment groups after 12 weeks of therapy. Patients in Group A (beta-blockers) experienced a slightly lower frequency of weekly angina episodes compared to Group B (calcium channel blockers), with mean values of 2.1 ± 0.9 and 2.4 ± 1.1 respectively, though this difference did not reach statistical significance (p = 0.18). Clinical improvement, defined as at least one grade improvement in the Canadian Cardiovascular Society (CCS) classification, was achieved in 76% of patients in the beta-blocker group and 68% in the calcium channel blocker group (p = 0.37), indicating similar efficacy in symptom control. Exercise tolerance, measured by mean treadmill exercise duration, was marginally higher in the beta-blocker group (7.8 ± 1.6 minutes) compared to the calcium channel blocker group (7.3 ± 1.5 minutes), with a p-value of 0.09, suggesting a trend toward better functional capacity, although not statistically significant. Similarly, the time to onset of angina during

stress testing was slightly longer in the beta-blocker group (5.2 ± 1.1 minutes) versus 5.0 ± 1.3 minutes in the calcium channel blocker group (p = 0.46).

Table 1: Baseline Demographic and Clinical Characteristics of the Study Population

Parameter	Group A (Beta-Blockers) n=50	Group B (Calcium Channel Blockers) n=50	p-value
Mean Age (years)	69.4 ± 4.8	70.1 ± 5.2	0.42
Male (%)	32 (64%)	30 (60%)	0.68
Female (%)	18 (36%)	20 (40%)	0.68
Hypertension (%)	38 (76%)	36 (72%)	0.64
Diabetes Mellitus (%)	24 (48%)	26 (52%)	0.69
Mean BMI (kg/m²)	26.3 ± 3.2	25.9 ± 3.4	0.56
Smoking History (%)	14 (28%)	12 (24%)	0.64
LVEF (%)	55.1 ± 6.3	54.7 ± 6.1	0.72

Table 2: Clinical Outcomes After 12 Weeks of Treatment

Clinical Parameter	Group A (Beta-Blockers)	Group B (Calcium Channel Blockers)	p-value
Mean Angina Episodes/Week	2.1 ± 0.9	2.4 ± 1.1	0.18
CCS Class Improvement ≥1 Grade (%)	38 (76%)	34 (68%)	0.37
Mean Exercise Duration (minutes)	7.8 ± 1.6	7.3 ± 1.5	0.09
Time to Onset of Angina (minutes)	5.2 ± 1.1	5.0 ± 1.3	0.46
Mean Resting Heart Rate (bpm)	65.6 ± 6.8	72.4 ± 7.3	<0.001
Mean Systolic BP (mmHg)	124 ± 10	122 ± 11	0.24
Peripheral Edema (%)	2 (4%)	8 (16%)	0.04
Fatigue (%)	10 (20%)	6 (12%)	0.27
Dizziness (%)	6 (12%)	5 (10%)	0.75
Drug Discontinuation Due to Side Effects (%)	2 (4%)	3 (6%)	

A statistically significant difference was observed in resting heart rate, which was lower in the beta-blocker group (65.6 ± 6.8 bpm) compared to the calcium channel blocker group (72.4 ± 7.3 bpm), with a p-value of less than 0.001. This reflects the known negative chronotropic effect of beta-blockers. Mean systolic blood pressure was well-controlled in both groups, with no significant difference (124 ± 10 mmHg in Group A vs. 122 ± 11 mmHg in Group B, p = 0.24). In terms of adverse effects, peripheral edema was significantly more frequent in the calcium channel blocker group (16%) compared to the beta-blocker group (4%), with a p-value of 0.04. Fatigue was reported in 20% of patients on beta-blockers and 12% on calcium channel blockers (p = 0.27), while dizziness occurred in 12% and 10% of patients, respectively (p = 0.75), with both side effects showing no significant intergroup difference. Drug discontinuation due to side effects was low in both groups, occurring in 2 patients (4%) on beta-blockers and 3 patients (6%) on calcium channel blockers.

Overall, both drug classes were effective in reducing angina frequency and improving functional status. Beta-blockers demonstrated superior control of heart rate and marginally better exercise tolerance, while calcium channel blockers were associated with a higher incidence of peripheral edema. These findings highlight the importance of individualized therapy selection in elderly patients with stable angina, considering both therapeutic benefits and side effect profiles.

DISCUSSION

This comparative study evaluated the clinical efficacy and safety of beta-blockers versus calcium channel blockers in elderly patients diagnosed with stable angina. The findings demonstrate that both pharmacological agents are effective in reducing the frequency of angina episodes and improving exercise tolerance and overall functional status, with some differences in physiological effects and adverse event profiles [13]. Although the reduction in mean weekly angina episodes was slightly greater in the beta-blocker group compared to the calcium channel blocker group, the difference was not statistically significant. Similarly, the proportion of patients achieving a ≥1 grade improvement in the Canadian Cardiovascular Society (CCS) angina classification was higher in the beta-blocker group (76% vs. 68%), but this also did not reach statistical significance. These results are consistent with prior literature suggesting that both classes of drugs have comparable anti-anginal efficacy in stable coronary artery disease, particularly in elderly patients where symptom burden often overlaps with other age-related cardiovascular limitations [14].

One of the notable findings in this study was the significant reduction in resting heart rate in the beta-blocker group, which is expected due to the negative chronotropic effects of beta-adrenergic blockade [15]. This heart rate-lowering effect has important clinical implications, as it improves myocardial oxygen supply-demand balance, increases diastolic perfusion time, and may contribute to the improvement in anginal symptoms and exercise capacity. Conversely, while calcium channel blockers also improve myocardial perfusion, they act primarily through vasodilation and afterload reduction, which may be more beneficial in patients with vasospastic or hypertensive angina [16]. Exercise duration and time to onset of angina were marginally better in the beta-blocker group, suggesting a trend toward improved functional performance. Although these differences did not reach statistical significance, they may reflect the additional hemodynamic benefits of heart rate control and reduced myocardial oxygen consumption provided by beta-blockers. However, the clinical relevance of these small differences should be interpreted with caution, particularly in elderly populations where multiple comorbidities and physical deconditioning may influence exercise tolerance independently of pharmacologic therapy [17].

In terms of adverse events, peripheral edema was significantly more common in the calcium channel blocker group (16%) compared to the beta-blocker group (4%). This is in line with known pharmacodynamic effects of dihydropyridine calcium channel blockers, such as amlodipine, which cause preferential arteriolar dilation leading to capillary leakage and fluid accumulation in dependent tissues. In contrast, beta-blockers were associated with higher rates of fatigue, though not statistically significant, which is a well-documented side effect due to their negative inotropic and central nervous system effects [18]. Importantly, drug discontinuation due to adverse events was low in both groups, indicating acceptable tolerability among elderly patients. This supports the continued use of either agent as a first-line option instable angina management, provided individual patient characteristics and comorbid conditions are taken into account [19].

These findings align with major clinical guidelines from the American College of Cardiology (ACC) and the European Society of Cardiology (ESC), which advocate for either beta-blockers or calcium channel blockers as initial anti-anginal therapy, with therapy tailored according to patient-specific factors such as heart

rate, blood pressure, left ventricular function, and risk of side effects [20]. This study has several strengths, including a well-matched population at baseline, the use of standardized CCS classification and treadmill testing, and follow-up assessments conducted over a reasonable duration. However, it is limited by its relatively small sample size and short follow-up period. Longer-term studies with larger populations and the inclusion of quality-of-life measures and cardiovascular events would provide more robust data to guide optimal pharmacologic strategies in elderly angina patients[16,20].

CONCLUSION

In conclusion, this study demonstrates that both beta-blockers and calcium channel blockers are effective and well-tolerated options for the management of stable angina in elderly patients. Beta-blockers provided better control of resting heart rate and showed a trend toward improved exercise tolerance and delayed onset of anginal symptoms, likely due to their negative chronotropic and inotropic effects, making them particularly useful in patients with prior myocardial infarction, hypertension, or arrhythmias. Calcium channel blockers, while slightly less effective in heart rate control, served as suitable alternatives in patients with contraindications to beta-blockers, such as chronic obstructive pulmonary disease or bradycardia. Although peripheral edema was more frequent in the calcium channel blocker group, the overall incidence of adverse effects was low in both groups, indicating good tolerability. The differences in clinical efficacy between the two groups were not statistically significant, underscoring the importance of tailoring anti-anginal therapy based on individual patient profiles, comorbidities, and side-effect susceptibility. These findings support the current guideline recommendations for a personalized, patient-centered approach in the pharmacologic management of stable angina in the aging population, while also highlighting the need for larger, long-term studies to validate and extend these observations.

Availability of Data and Materials: The datasets generated and/or analyzed during the current study are available from the corresponding author upon reasonable request.

Competing Interests: The authors declare that they have no competing interests.

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