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Review Article

Amlodipine in the Management of Hypertension: Pharmacological Profile, Clinical Efficacy, Safety, and Future Perspectives

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Hypertension is a leading cause of cardiovascular disease worldwide. Amlodipine, a long-acting calcium channel blocker, is widely used because of its effectiveness, prolonged action, and good safety profile.To review the pharmacology, mechanism of action, clinical efficacy, safety, therapeutic uses, and future prospects of amlodipine in hypertension management. A narrative review of published literature, clinical guidelines, and scientific databases was conducted to evaluate current evidence regarding amlodipine. Amlodipine effectively lowers blood pressure by inhibiting L-type calcium channels, producing sustained vasodilation and 24-hour blood pressure control. It is effective as monotherapy or in combination therapy and is particularly beneficial in elderly patients and those with diabetes, coronary artery disease, or chronic kidney disease. Peripheral edema is the most common adverse effect, while overall tolerability is excellent. Amlodipine remains a first-line antihypertensive agent due to its proven efficacy, once-daily dosing, and favorable safety profile. Future developments in personalized medicine and novel drug delivery systems may further enhance its clinical utility.

Keywords: Amlodipine, Hypertension, Calcium Channel Blockers, Antihypertensive Therapy, Blood Pressure, Clinical Efficacy.

INTRODUCTION

Hypertension is one of the most common chronic diseases and a major risk factor for cardiovascular disorders such as stroke, myocardial infarction, heart failure, and chronic kidney disease. Effective blood pressure control is essential to reduce these complications. Calcium channel blockers are among the recommended first-line antihypertensive drugs. Amlodipine, a long-acting dihydropyridine calcium channel blocker, lowers blood pressure by blocking L-type calcium channels, causing vasodilation and reducing peripheral vascular resistance. Its long half-life allows convenient once-daily dosing and improves patient adherence. Clinical studies have demonstrated that amlodipine effectively controls blood pressure and reduces cardiovascular risk. It is particularly beneficial in elderly patients and individuals with diabetes, chronic kidney disease, and coronary artery disease. The drug is generally well tolerated, with peripheral edema being the most common adverse effect. Recent advances, including fixed-dose combinations, sustained-release formulations, pharmacogenomics, and personalized medicine, are expected to further improve the therapeutic role of amlodipine. This review summarizes the pharmacological properties, clinical efficacy, safety profile, and future perspectives of amlodipine in the management of hypertension.

METHODOLOGY

This review was conducted using a narrative literature review approach to comprehensively evaluate the role of amlodipine in the management of hypertension. The methodology involved the systematic identification, selection, appraisal, and synthesis of published scientific evidence related to the pharmacology, therapeutic efficacy, safety, and clinical applications of amlodipine. The review was designed to provide an updated overview of the current evidence while highlighting recent advances and future directions in antihypertensive therapy. The thesis on which this review is based outlines a literature-based methodology that includes study design, data sources, search strategy, selection criteria, data extraction, analysis, quality assessment, ethical considerations, and methodological limitations.

Study Design

A narrative review design was employed to summarize and critically analyze available literature regarding amlodipine as an antihypertensive agent. This approach enabled the integration of findings from clinical trials, systematic reviews, observational studies, and evidence-based clinical practice guidelines to provide a comprehensive understanding of the drug's therapeutic profile.

Literature Search Strategy

A comprehensive literature search was performed using electronic databases, including PubMed, Scopus, Google Scholar, ScienceDirect, and Web of Science. Relevant publications published in English between 2015 and 2025 were considered. The search strategy combined Medical Subject Headings (MeSH) and free-text keywords using Boolean operators. Search terms included:

"Amlodipine", "Hypertension", "Calcium channel blockers", "Antihypertensive therapy", "Blood pressure control", "Clinical efficacy", "Safety profile", "Pharmacokinetics", "Cardiovascular outcomes"

Reference lists of eligible articles were also manually screened to identify additional relevant studies.

Eligibility Criteria

Inclusion Criteria

- Original research articles, randomized controlled trials, observational studies, systematic reviews, and meta-analyses.
- Studies evaluating the efficacy, safety, pharmacology, pharmacokinetics, or clinical use of amlodipine.
- Human studies published in peer-reviewed journals.
- Articles published in English between 2015 and 2025.

Exclusion Criteria

Animal or in vitro studies not directly applicable to clinical practice. Conference abstracts, editorials, letters, and non-peer-reviewed publications. Duplicate publications. Articles lacking sufficient methodological or clinical information.

Data Extraction

Relevant information was extracted independently from the selected studies using a standardized data collection format. Extracted variables included:

Author and publication year, Study design, Sample size and patient characteristics, Intervention and comparator, Primary and secondary outcomes, Blood pressure reduction, Adverse drug reactions, Clinical efficacy and safety outcomes, Major conclusions

The extracted information was organized into thematic categories to facilitate comparison across studies.

Data Synthesis

A qualitative synthesis was performed because of variations in study design, patient populations, interventions, and reported outcomes. The evidence was grouped under the following themes:

- Pharmacological properties
- Mechanism of action
- Pharmacokinetic characteristics
- Clinical efficacy

- Safety and tolerability
- Drug interactions
- Combination therapy
- Special populations
- Emerging therapeutic developments

Findings from high-quality clinical trials and current hypertension guidelines were prioritized during evidence synthesis.

Quality Assessment

The methodological quality of the included studies was evaluated by considering study design, sample size, risk of bias, statistical methodology, and consistency of reported outcomes. Greater emphasis was placed on randomized controlled trials, systematic reviews, meta-analyses, and evidence-based clinical guidelines because they provide higher levels of clinical evidence.

Ethical Considerations

As this study is based exclusively on published literature, no human participants or experimental animals were directly involved, and institutional ethical approval was not required. All information was obtained from publicly available scientific publications, and appropriate academic standards were maintained through accurate citation and acknowledgment of the original sources.

Limitations

This review has certain limitations. Only English-language publications were included, which may have introduced language bias. Variability in study designs, patient populations, treatment durations, and outcome measures limited direct comparison among studies. Additionally, the narrative review approach does not provide quantitative estimates of treatment effects as would be obtained through a systematic review or meta-analysis. Despite these limitations, the review provides a comprehensive and clinically relevant overview of the current evidence regarding amlodipine in the management of hypertension.

RESULTS AND DISCUSSION

RESULTS

The literature reviewed in this study consistently demonstrates that amlodipine is an effective and well-tolerated antihypertensive agent. Evidence from randomized controlled trials, observational studies, systematic reviews, and international hypertension guidelines indicates that amlodipine provides sustained reductions in both systolic and diastolic blood pressure through selective inhibition of L-type calcium channels in vascular smooth muscle. Its prolonged elimination half-life (30–50 hours) enables effective 24-hour blood pressure control with once-daily dosing, thereby improving medication adherence and reducing blood pressure variability. The reviewed studies also demonstrate that amlodipine significantly lowers the incidence of major cardiovascular events when adequate blood pressure control is achieved. It has shown comparable or superior efficacy to several other first-line antihypertensive drug classes, including beta-blockers and some angiotensin-converting enzyme inhibitors, particularly in elderly individuals and patients with isolated systolic hypertension. Combination therapy involving amlodipine and agents such as angiotensin receptor blockers or angiotensin-converting enzyme inhibitors further enhances antihypertensive efficacy while minimizing dose-related adverse effects. Overall, the available evidence supports the continued recommendation of amlodipine as a first-line antihypertensive medication because of its proven efficacy, predictable pharmacokinetic profile, favorable safety characteristics, and excellent patient compliance.

Table 1. Summary of Major Clinical Studies Evaluating Amlodipine in Hypertension

Study	Study Design	Population	Major Findings	Clinical Significance
ALLHAT (2002)	Randomized controlled trial	High-risk hypertensive patients	Amlodipine effectively reduced blood pressure with cardiovascular outcomes comparable to chlorthalidone.	Supports amlodipine as an effective first-line antihypertensive agent.

ASCOT-BPLA (2005)	Randomized controlled trial	Hypertensive patients with cardiovascular risk factors	Amlodipine-based therapy reduced stroke incidence and cardiovascular events more effectively than atenolol-based therapy.	Demonstrated superior cardiovascular protection in selected patient populations.
VALUE (2004)	Randomized controlled trial	Patients with hypertension at high cardiovascular risk	Amlodipine achieved faster blood pressure control during early treatment compared with valsartan.	Early blood pressure control contributes to improved cardiovascular outcomes.
CAMELOT (2004)	Randomized controlled trial	Patients with coronary artery disease	Amlodipine reduced cardiovascular events despite minimal changes in coronary stenosis.	Demonstrated vascular protective effects beyond blood pressure reduction.
Recent Systematic Reviews (2018–2024)	Systematic review and meta-analysis	Multiple randomized trials	Confirmed excellent efficacy, long-term safety, and improved adherence due to once-daily dosing.	Reinforces current guideline recommendations for amlodipine.

DISCUSSION

The findings of this review demonstrate that amlodipine remains one of the most effective and widely prescribed calcium channel blockers for the management of hypertension. Its antihypertensive effect is achieved through selective inhibition of L-type calcium channels, resulting in peripheral vasodilation, reduced vascular resistance, and sustained blood pressure control. The drug's long elimination half-life allows convenient once-daily dosing, improving patient adherence and maintaining stable 24-hour blood pressure control. Clinical studies have shown that amlodipine is effective both as monotherapy and in combination with other antihypertensive agents, particularly angiotensin-converting enzyme inhibitors, angiotensin receptor blockers, and thiazide diuretics. It has demonstrated significant benefits in elderly patients and those with diabetes mellitus, chronic kidney disease, coronary artery disease, and isolated systolic hypertension. The drug effectively reduces cardiovascular risk while maintaining a favorable safety profile. Peripheral edema is the most common adverse effect associated with amlodipine; however, it is generally mild and rarely requires treatment discontinuation. Other adverse effects, such as headache, dizziness, flushing, and palpitations, are usually transient. Despite its excellent efficacy, combination therapy may be preferred in some patients to achieve optimal blood pressure control and minimize adverse effects. Recent advances in personalized medicine, pharmacogenomics, artificial intelligence-assisted hypertension management, and novel drug delivery systems are expected to further improve the therapeutic potential of amlodipine. Overall, the available evidence supports amlodipine as a cornerstone of modern antihypertensive therapy because of its sustained efficacy, good tolerability, convenient once-daily dosing, and proven ability to reduce cardiovascular complications.

CONCLUSION

Hypertension is a major global health problem and an important risk factor for cardiovascular diseases. Effective blood pressure control is essential to prevent complications such as stroke, heart failure, and chronic kidney disease. Based on the available evidence, amlodipine is one of the most effective and widely used first-line antihypertensive agents due to its long duration of action, favorable pharmacological profile, and good safety. Amlodipine effectively lowers blood pressure by blocking L-type calcium channels, resulting in vasodilation and reduced vascular resistance. Its once-daily dosing improves patient adherence and provides sustained 24-hour blood pressure control. Clinical studies have demonstrated its efficacy as both monotherapy and combination therapy, particularly in elderly patients and those with diabetes, coronary artery disease, or chronic kidney disease. Although peripheral edema is the most common adverse effect, amlodipine is

generally well tolerated with a favorable benefit–risk profile. Emerging developments in pharmacogenomics, personalized medicine, and novel drug delivery systems are expected to further enhance its therapeutic role. Overall, amlodipine remains a cornerstone in the management of hypertension because of its proven efficacy, safety, and ability to reduce cardiovascular risk.

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