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The effect of low-dose statins on blood pressure in patients with prehypertension and borderline elevated blood lipids

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Abstract

Objective: This study aimed to examine the effects of low-dose statins on blood pressure in individuals diagnosed with prehypertension and borderline elevated blood lipids.

Methods: From January 2020 to June 2021, a cohort of 150 patients with prehypertension and borderline elevated blood lipids was recruited from the Kangqiao Community Health Service Center, Pudong New Area, Shanghai. Participants were randomly divided into an experimental group and a control group, each comprising 75 patients. Both groups received standard lifestyle interventions. Additionally, the experimental group was treated with low-dose statins, while the control group was given with placebo. The treatment duration was three months. Blood pressure (systolic blood pressure (SBP), diastolic blood pressure (DBP)), blood lipids (total cholesterol (TC), triglycerides (TG), low-density lipoprotein cholesterol (LDL-C), high-density lipoprotein cholesterol (HDL-C)), vascular endothelial function (nitric oxide (NO), endothelin-1 (ET-1), flow-mediated dilation (FMD)), and carotid intima-media thickness (IMT) were measured. These parameters were assessed at baseline, one month into treatment, and at the end of the three-month treatment period. Subsequently, patients were followed for two years to evaluate the incidence of hypertension.

Results: Both SBP and DBP showed a progressive decrease from baseline to three months in both the experimental group and control group, with the experimental group experiencing a more significant reduction. Statistically significant differences were observed between the two groups, over time, and in group-by-time interactions ($P < 0.05$). Similarly, reductions in TC, TG, and LDL-C were more pronounced in the experimental group, with significant differences between the two groups, time points, and group-by-time interactions ($P < 0.05$). Improvements in NO and FMD levels and reductions in ET-1 levels were more marked in the experimental group, with statistically significant differences ($P < 0.05$). IMT reduction was also more notable in the experimental group, with significant differences between groups, over time, and in group-by-time interactions ($P < 0.05$). After two years of follow-up, the experimental group had a lower prevalence of hypertension compared to the control group ($P <0.05$).

Conclusion: Low-dose statin therapy could effectively lower blood pressure and blood lipid levels, enhance vascular endothelial function, delay arteriosclerosis progression, and reduce the incidence of hypertension in patients with prehypertension and borderline elevated blood lipids.

Introduction

Prehypertension represents the intermediate stage between normotension and hypertension. Recent public health strategies emphasize early disease prevention, making prehypertension a critical phase for hypertension prevention[1]. Prehypertension is

associated with target organ damage, vascular functional and structural changes, endothelial dysfunction, and an increased risk of cardiovascular events[2,3]. Prehypertension represents an opportune window for early intervention, as interventions at this stage can effectively prevent or delay the onset of hypertension, thereby reducing the risk of cardiovascular diseases and enhancing patient quality of life[4]. Managing blood pressure in prehypertensive patients poses significant challenges. Current guidelines, both domestic and international, generally advocate for lifestyle interventions as the primary treatment, except in cases requiring antihypertensive medication[5]. However, the blood pressure reduction recommended by current guidelines is inadequate for lowering the prevalence of hypertension in this patient population. Dyslipidemia is closely linked to hypertension, with a high rate of comorbidity, and both conditions are significant risk factors for cardiovascular diseases. The combination of hypertension and dyslipidemia exacerbates the risk of cardiovascular events[6,7]. This comorbid condition not only escalates the risk of cardiovascular events such as heart disease and stroke but also adversely impacts renal health. In China, hypertension and dyslipidemia, particularly hypercholesterolemia and hypertriglyceridemia, constitute prevalent public health concerns. According to the "Report on Nutrition and Chronic Diseases among Chinese Residents," the prevalence of hypertension among Chinese adults approaches 30%, with rates of dyslipidemia escalating annually. Economic development and lifestyle changes, characterized by unhealthy dietary habits, physical inactivity, and obesity, contribute to the sustained rise in hypertension and dyslipidemia incidence[8]. Claudio Borghi et al.[9] underscore the benefits of combined antihypertensive and lipid-lowering therapies, highlighting their efficacy in concurrently managing blood pressure and lipid levels to reduce cardiovascular disease incidence. These studies emphasize the pivotal role of lifestyle modifications, such as dietary adjustments, increased physical activity, and smoking cessation, all of which demonstrate positive effects in lowering blood pressure and improving lipid profiles. Statins are a primary treatment for dyslipidemia and have been shown in previous studies to have ancillary blood pressure-lowering effects[10,11]. Anglo-Scandinavian Cardiac Outcomes Trial--Lipid Lowering Arm (ASCOT-LLA) study shows that the treatment with atorvastatin 10 mg can significantly reduce the major cardiovascular events in hypertensive patients with multiple risk factors[12]. ALLHAT-LLT study included patients over 55 years old with hypertension, at least one CHD risk factor and no CVD; The experimental group received pravastatin 40mg/d, while the control group received routine treatment. The results showed that pravastatin group did not benefit, and the risk of all-cause death increased[13]. At the 2016 academic annual meeting of the American Heart College (ACC), the HOPE-3 research was announced. The study found that for men ≥55 years old or women ≥60 years old with a risk factor, taking 10 mg of rosuvastatin every day can reduce cardiovascular death, stroke or heart attack by 25%[14]. Woohyeun Kim et al. [15] demonstrated significant therapeutic efficacy and favorable safety profiles of a fixed-dose combination of amlodipine and rosuvastatin in patients with concurrent dyslipidemia and hypertension. Most prior research has focused on high-risk populations with established hypertension and dyslipidemia, with limited studies addressing medium- and low-risk populations with prehypertension and borderline elevated blood lipids. The potential benefits of statins in patients with prehypertension and borderline elevated blood lipids remain unclear. Therefore, this study aims to investigate the impact of low-dose statins on blood pressure in patients with prehypertension and borderline elevated blood lipids, providing a theoretical basis for clinical hypertension prevention.

Materials and Methods

Study Design

In this study, blood pressure differences were used as indicators to evaluate the effect of low-dose statins on the improvement of blood pressure in patients with prehypertension and borderline hyperlipidemia. The effect size of 0.62500 was derived from a literature review using G*Power 3.1.9.2 software[16]. A total of 150 patients with prehypertension and borderline hyperlipidemia were recruited from Kangqiao Community Health Service Center in Pudong New Area between January 2020 and June 2021, accounting for 10% of the dropout rate.

Diagnostic Criteria

Prehypertension: as defined by the National Joint Commission on the Prevention, Detection, Evaluation, and Treatment of Hypertension (JNC-7)[17] and the 2018 Revised Edition of the Chinese Guidelines for the Prevention and Treatment of Hypertension[18]. Specifically, adults with no history of hypertension and not receiving antihypertensive therapy and two consecutive clinic visits with systolic blood pressure (SBP) of 120-139 mmHg and/or diastolic blood pressure (DBP) of 80-89 mmHg are classified as prehypertensive.

Borderline Elevated Blood Lipids: Defined according to the 2016 Revised Edition of the Chinese Guidelines for the Prevention and Treatment of Dyslipidemia in Adults[19], as total cholesterol (TC) ≥5.2 mmol/L but <6.2 mmol/L and/or low-density lipoprotein cholesterol (LDL-C) ≥3.4 mmol/L but <4.1 mmol/L and/or triglycerides (TG) ≥1.7 mmol/L but <2.3 mmol/L.

Inclusion, Exclusion, and Elimination Criteria

Inclusion Criteria

- Patients meet the diagnostic criteria for prehypertension and borderline elevated blood lipids.
- Age between 60 and 75 years.
- Signed informed consent for the study.

Exclusion Criteria

- Patients with comorbid cerebrovascular diseases or coronary heart disease.
- Patients with acute or chronic kidney disease.
- Patients with diabetes mellitus.
- Patients with malignant hematological or autoimmune diseases.
- Patients with malignant tumors.
- Patients with severe liver dysfunction.
- Patients with poor medication compliance.
- Patients with psychiatric disorders or cognitive impairments that would interfere with study participation.

Elimination Criteria

- Loss to follow-up.
- Unexpected incidents during the follow-up period.

This cohort comprised 91 men and 59 women, aged 60-75 years, with a mean age of 66.48 ± 3.29 years. The BMI ranged from 18.4 to 28.6 kg/m^2, with a mean of 23.57 ± 2.34 kg/m^2. Educational levels included 70 patients with junior high school education or below and 80 patients with senior high school education or above. In addition, 39 patients were smokers, and 76 were alcohol consumers.

Randomization and Allocation

Based on the aforementioned criteria, patients were randomly allocated into two groups using a random number table, with 75 patients in each group:

Experimental Group: 44 men and 31 women, aged 60-75 years, with a mean age of 66.21 ± 3.30 years, and a BMI of 18.4-28.5 kg/m^2, with a mean of 23.45 ± 2.29 kg/m^2. Educational levels included 34 patients with junior high school education or below, and 41 patients with senior high school education or above. There were 20 smokers and 39 alcohol consumers.

Control Group: 47 men and 28 women, aged 60-75 years, with a mean age of 66.59 ± 3.17 years, and a BMI of 18.6-28.6 kg/m^2, with a mean of 23.64 ± 2.37 kg/m^2. Educational levels included 36 patients with junior high school education or below, and 39 patients with senior high school education or above. There were 19 smokers and 37 alcohol consumers. No statistically significant differences in general characteristics were observed between the two groups *(P* > 0.05), indicating comparability. This study conforms to the ethical standards outlined in the Declaration of Helsinki.

Methods

Both Groups Received Standard Lifestyle Interventions

Health Education

Utilizing multimedia tools such as pictures and videos, patients were educated in accessible language about the risk factors, dangers, and lifestyle intervention measures pertinent to prehypertension and borderline elevated blood lipids. Educational booklets detailing lifestyle interventions were distributed.

Lifestyle Intervention Measures

Dietary Intervention: Patients were instructed to replace regular salt with low-sodium salt, use a salt control spoon to limit salt intake to less than 5g per day, and reduce high-sodium condiments such as monosodium glutamate, soy sauce, and pickled foods. They were also encouraged to increase dietary potassium intake by consuming potassium-rich foods, control total caloric intake, reduce fatty and fried foods, increase whole grains and legumes, and consume more fresh fruits, vegetables, and low-fat dairy products.

Smoking and Alcohol Intervention: Patients were advised to quit smoking and avoid passive smoking, and to either quit alcohol or limit alcohol intake.

Weight Management: Patients with waist circumferences ≥90 cm for men and ≥85 cm for women were advised to manage their weight to maintain a normal BMI.

Physical Activity: Based on personal preferences and physical condition, patients were encouraged to engage in moderate-intensity aerobic exercises such as brisk walking, square dancing, cycling, Tai Chi, or Baduanjin, for 30 minutes per session, 5-7 sessions per week.

Psychological Intervention: Psychological counseling was provided, teaching patients mindfulness or meditation practices to reduce stress and maintain a calm state of mind.

Sleep Management: Causes of poor sleep were identified and addressed with targeted interventions, with sedative-hypnotic medications provided as necessary.

Additional Intervention for Experimental Group

The experimental group additionally received low-dose statin therapy, specifically atorvastatin (Pfizer Pharmaceuticals, National Drug Approval Number J20030047, 10 mg/tablet), administered at a dose of 10 mg once daily with dinner.

Placebo for Control Group

The control group received a placebo, identical in appearance to atorvastatin tablets, with the same dosing regimen. Both groups underwent treatment for a duration of three months.

Observation Indicators

Blood Pressure Levels

Blood pressure (SBP and DBP) was measured at baseline, and at 1 month and 3 months during treatment according to the Chinese Blood Pressure Measurement Guidelines [20]. Patients abstained from alcohol and vigorous exercise for 30 minutes prior to measurement and rested quietly for 5 minutes before measurement. In a seated position, blood pressure was measured using an upper arm electronic sphygmomanometer (Shenzhen Dedakj Technology Co., Ltd., Model: DE-X20). The cuff was placed on the right upper arm above the brachial artery, ensuring the cuff's balloon was level with the right atrium and wrapped with enough tightness to allow two fingers under the cuff. The cuff was deflated slowly at a rate of 2-4 mmHg per heartbeat. Blood pressure was measured twice consecutively with at least a 1-minute interval between measurements. If the two measurements differed by more than 5 mmHg, a third measurement was taken. The average of multiple measurements was recorded as the final SBP and DBP.

Blood Lipid Levels

Fasting venous blood (3 ml) was collected at baseline, and at 1 month and 3 months during treatment. Serum was separated via centrifugation and analyzed using an automatic biochemical analyzer (Shanghai Kehua Bio-Engineering Co., Ltd., Model: ZY-1280M) to measure TC, TG, LDL-C, and high-density lipoprotein cholesterol (HDL-C) levels. Reagents were provided by Shanghai Zhengkang Bio-Technology Co., Ltd.

Vascular Endothelial Function

Fasting venous blood (4 ml) was collected at baseline, and at 1 month and 3 months during treatment, and centrifuged at 2500 r/min for 10 minutes to separate serum. Nitric oxide (NO) levels were measured using indirect colorimetry, while endothelin-1 (ET-1) levels were measured using chemiluminescence immunoassay. Reagents were sourced from Anhui Daqian Bioengineering Co., Ltd. and Beijing Taige Kexin Biotechnology Co., Ltd., respectively. Patients were placed in a supine position with the right arm abducted at 15°. A color Doppler ultrasound (Shenzhen Mindray Bio-Medical Electronics Co., Ltd., Model: DC-8) was used to scan the brachial artery 2-5 cm above the elbow, taking its longitudinal section and measuring the artery diameter (D0) at end-diastole. Measurements were taken over three cardiac cycles and averaged. A blood pressure cuff was placed distal to the artery, inflated to 50 mmHg above systolic pressure for 4 minutes, and then deflated. The diameter (D1) was measured at the same location within 1 minute of deflation. Throughout the process, the ultrasound probe remained in the same position. Endothelium-dependent vasodilation (FMD) was calculated as FMD = [(D1 - D0)/D0] × 100%.

Carotid Intima-Media Thickness (IMT)

IMT was measured at baseline, and at 1 month and 3 months during treatment using color Doppler ultrasound. Patients were positioned supine, and a longitudinal scan of both common carotid arteries was performed. The vertical distance from the inner edge of the intima to the outer edge of the media was measured at the carotid bulb and/or distal common carotid artery. Three measurements were taken on each side, and the averages were recorded as the final IMT.

Hypertension Prevalence

After the treatment period, patients were followed for 2 years, with follow-ups every six months, to determine the prevalence of hypertension in both groups.

Statistical Methods

Data analysis was conducted using SPSS 25.0 software. Measurement data were presented as mean ± standard deviation (±s) and analyzed using t-tests and general linear repeated measures ANOVA for multiple time points. Categorical data were expressed as percentages (%) and analyzed using the χ^2 test. Statistical significance was defined as $P < 0.05$.

Results

Comparison of Blood Pressure Levels Between Groups

From baseline to 3 months into treatment, both SBP and DBP gradually decreased in both groups, with the experimental group exhibiting a more pronounced reduction. Comparisons between groups, time points, and group × time point interactions revealed statistically significant differences ($P < 0.05$). The results were shown on Table 1.

Table 1. Comparison of Blood Pressure Levels Between Two Groups （$\bar{x}$ ±s，mmHg）

Group	Number	Time Point	SBP	DBP
Experimental group	75	Before treatment	131.47±3.90	84.20±1.87
		1 month of treatment	127.11±4.27^{ab}	82.25±2.03^{ab}
		3 months of treatment	122.79±3.86^{abc}	79.71±2.12^{abc}
Control group	75	Before treatment	131.96±3.84	84.47±1.79
		1 month of treatment	129.33±4.25^{b}	83.35±1.94^{b}
		3 months of treatment	126.17±3.96^{bc}	81.92±2.06^{bc}
$F_{(group)}$ $P_{(group)}$	-	-	24.505/＜0.001	43.833/＜0.001
$F_{(time\ point)}$ $P_{(time\ point)}$	-	-	133.703/＜0.001	116.606/＜0.001
$F_{(group)\cdot(time\ point)}$ $P_{(group)\cdot(time\ point)}$	-	-	5.416/0.005	8.934/＜0.001

Note: Compared with the control group at the same time point, a$P < 0.05$; compared with the same group before treatment, b$P < 0.05$; compared with the same group at 1 month of treatment, c$P < 0.05$.

Table 2. Comparison of Blood Lipid Levels Between the Two Groups ($\bar{x}$ ±s, mmol/L)

Group	Number	Time Point	TC	TG	LDL-C	HDL-C
Experimental group	75	Before treatment	5.43±0.42	1.82±0.26	3.63±0.30	1.23±0.22
		1 month of treatment	5.18±0.36^{ab}	1.64±0.28^{ab}	3.38±0.34^{ab}	1.31±0.25
		3 months of treatment	4.53±0.33^{abc}	1.48±0.21^{abc}	2.96±0.30^{abc}	1.39±0.24^{b}
Control group	75	Before treatment	5.51±0.40	1.89±0.25	3.68±0.32	1.21±0.23
		1 month of treatment	5.37±0.38^{b}	1.78±0.26^{b}	3.54±0.30^{b}	1.27±0.24
		3 months of treatment	5.21±0.37^{bc}	1.69±0.22^{bc}	3.42±0.29^{bc}	1.33±0.26^{b}
$F_{(group)}$ $P_{(group)}$	-	-	70.006/＜0.001	38.692/＜0.001	46.338/＜0.001	4.634/0.033
$F_{(time\ point)}$ $P_{(time\ point)}$	-	-	106.052/＜0.001	43.011/＜0.001	105.228/＜0.001	12.888/＜0.001
$F_{(group)\cdot(time\ point)}$ $P_{(group)\cdot(time\ point)}$	-	-	28.657/＜0.001	3.748/0.025	20.884/＜0.001	0.263/0.769

Note: Compared with the control group at the same time point, a$P < 0.05$; compared with the same group before treatment, b$P < 0.05$; compared with the same group at 1 month of treatment, c$P < 0.05$.

Table 3. Comparison of Endothelial Function Between the Two Groups ($\bar{x}$ ±s)

Group	Number	Time Point	NO (μmol/L)	ET-1 (ng/L)	FMD (%)
Experimental group	75	Before treatment	31.68±4.17	84.72±6.58	7.45±1.07
		1 month of treatment	38.42±4.09^{ab}	74.67±6.20^{ab}	8.63±1.41^{ab}
		3 months of treatment	49.16±3.22^{abc}	60.63±5.39^{abc}	10.15±1.76^{abc}
Control group	75	Before treatment	32.02±4.25	75.29±6.46	7.53±1.05
		1 month of treatment	35.39±4.11^{b}	71.08±6.37^{b}	8.12±1.30^{b}
		3 months of treatment	40.76±3.64^{bc}	65.87±5.51^{bc}	9.03±1.63^{bc}
$F_{(group)}$ $P_{(group)}$	-	-	91.093/＜0.001	21.183/＜0.001	15.002/＜0.001
$F_{(time\ point)}$ $P_{(time\ point)}$	-	-	444.167/＜0.001	279.740/＜0.001	87.148/＜0.001
$F_{(group)\cdot(time\ point)}$ $P_{(group)\cdot(time\ point)}$	-	-	49.498/＜0.001	53.987/＜0.001	7.290/0.001

Note: Compared with the control group at the same time point, a$P < 0.05$; compared with the same group before treatment, b$P < 0.05$; compared with the same group at 1 month of treatment, c$P < 0.05$.

Comparison of Blood Lipid Levels Between Groups

From baseline to 3 months into treatment, TC, TG, and LDL-C levels gradually decreased in both groups, with the experimental group exhibiting a more significant reduction. Comparisons between groups, time points, and group × time point interactions revealed statistically significant differences ($P < 0.05$). The results are shown on Table 2.

Comparison of Vascular Endothelial Function Between Groups

From baseline to 3 months into treatment, NO and FMD levels gradually increased, while ET-1 levels gradually decreased in both groups, with the experimental group exhibiting more significant changes. Comparisons between groups, time points, and group × time point interactions revealed statistically significant differences ($P < 0.05$). See Table 3.

Table 4. Comparison of IMT Between the Two Groups ($\bar{x}$ ±s), mm)

Group	Number	Time Point	Left IMT	Right IMT
Experimental group	75	Before treatment	0.89±0.15	0.90±0.14
		1 month of treatment	0.80±0.12^{ab}	0.80±0.11^{ab}
		3 months of treatment	0.71±0.09^{abc}	0.71±0.10^{abc}
Control group	75	Before treatment	0.90±0.14	0.91±0.15
		1 month of treatment	0.85±0.13^{b}	0.84±0.11^{b}
		3 months of treatment	0.79±0.10^{bc}	0.78±0.09^{bc}
$F_{(group)}$ $P_{(group)}$	-	-	13.752/＜0.001	11.933/0.001
$F_{(time\ point)}$ $P_{(time\ point)}$	-	-	50.203/＜0.001	73.001/＜0.001
$F_{(group)\cdot(time\ point)}$ $P_{(group)\cdot(time\ point)}$	-	-	3.262/0.043	3.372/0.038

Note: Compared with the control group at the same time point, aP < 0.05; compared with the same group before treatment, bP < 0.05; compared with the same group at 1 month of treatment, cP < 0.05.

Comparison of IMT Between Groups

From baseline to 3 months into treatment, left and right IMT gradually decreased in both groups, with the experimental group exhibiting a more significant reduction. Comparisons between groups, time points, and group × time point interactions revealed statistically significant differences (P < 0.05). See Table 4.

Comparison of Hypertension Incidence Between Groups

After a two-year follow-up, the incidence of hypertension in the experimental group was 5.33% (4/75), with four cases progressing to hypertension. In contrast, the control group exhibited a hypertension incidence of 16.00% (12/75), with twelve cases progressing to hypertension. The incidence of hypertension in the experimental group was significantly lower than that in the control group, with a statistically significant difference (χ^2 = 4.478, P = 0.034).

Discussion

Hypertension is a highly prevalent chronic disease, widely recognized for its detrimental impact on health. However, insufficient emphasis is often placed on its early stages. Without adequate control, elderly individuals in the prehypertensive stage are prone to progressing to hypertension within a short period, thereby increasing the risk of cardiovascular and cerebrovascular diseases and imposing significant economic burdens on families and society[21,22]. Therefore, it is imperative to shift the focus towards early prevention and treatment of prehypertension in elderly patients.

Similarly to prehypertension, borderline dyslipidemia lies between normal lipid levels and lipid abnormalities and is not considered a disease but rather a suboptimal health status. Clinical recommendations for managing borderline dyslipidemia primarily involve lifestyle interventions[23]. However, both prehypertension and borderline dyslipidemia pose threats to cardiovascular health. When these conditions coexist, clinicians must exercise heightened vigilance.

Building on the pleiotropic effects of statins beyond lipid-lowering, this study explored their potential application in patients with prehypertension and borderline dyslipidemia. Our results demonstrated a gradual decrease in SBP, DBP, TC, TG, and LDL-C levels from baseline to 3 months of treatment in both groups, with a more pronounced reduction observed in the experimental group. This suggests that low-dose statin therapy effectively controls blood pressure and lipid levels in these patients. Atorvastatin, classified as a 3-hydroxy-3-methylglutaryl coenzyme A (HMG-CoA) reductase inhibitor, reduces cholesterol synthesis by inhibiting the enzyme, thereby regulating lipid metabolism[24,25].

Kwang Kon Ko et al. [26] found that combined therapy with atorvastatin and amlodipine provides additive benefits in lowering blood pressure. Patients treated with combination therapy showed significant reductions in blood pressure compared to those treated with amlodipine alone, indicating that atorvastatin supplementation enhances antihypertensive efficacy. AI Kanaki et al. [27] demonstrated that low-dose atorvastatin significantly lowers dynamic blood pressure in these patients, suggesting its effective blood pressure control even at low doses. Furthermore, they found that low-dose atorvastatin reduces arterial stiffness and decreases central aortic pressure augmentation [28]. This suggests that atorvastatin not only effectively lowers peripheral blood pressure but also offers potential benefits in improving vascular health and reducing cardiovascular event risks. Juncos LI et al. demonstrated that atorvastatin could improve sodium handling and decreases blood pressure in salt-loaded rats with chronic renal insufficiency. The mechanism may have been due to the decreased oxidant stress and/or increased NO, either of which may act by directly inhibiting tubular sodium excretion or by increasing renal medullary blood flow with the consequent increases in renal interstitial pressure and passive back-diffusion of sodium through the paracellular pathway.

Endothelial dysfunction plays a crucial role in the pathogenesis of hypertension, serving as an initiator and carrier of cardiovascular events[29]. Comparisons of endothelial function between the two groups in our study showed gradual increases in NO and FMD levels and a gradual decrease in ET-1 levels from baseline to 3 months of treatment, with more significant changes observed in the experimental group. This indicates that low-dose statins can improve endothelial function in patients with prehypertension and borderline dyslipidemia. Statin medications regulate the release of endothelial inflammatory cytokines, suppress inflammatory responses, protect endothelial cells, and prevent endothelial tissue damage[30].

IMT is a commonly used indicator for assessing arterial sclerosis, with its levels indirectly reflecting the extent of target organ damage[31]. The study found a gradual decrease in left and right IMT from baseline to 3 months of treatment in both groups, with a more significant reduction observed in the experimental group. This suggests that low-dose statins may delay arterial sclerosis in patients with prehypertension and borderline dyslipidemia by reducing lipid infiltration and exerting preventive or delaying effects on atherosclerosis[32].

Furthermore, follow-up results demonstrated a significantly lower incidence of hypertension in the experimental group compared to the control group, indicating that low-dose statins effectively reduce the incidence of hypertension in patients with prehypertension and borderline dyslipidemia. This may be attributed to the more significant reductions in blood pressure and lipid levels, improved endothelial function, and markedly delayed progression of arterial sclerosis observed with low-dose statin treatment.

Nevertheless, our study has certain limitations: Due to constraints in manpower and resources during participant recruitment, the study did not incorporate home blood pressure monitoring for diagnosis, potentially introducing some interference in the study results. The follow-up duration was relatively short, precluding the evaluation of long-term cardiovascular events. Therefore, future studies should extend follow-up periods to further explore these outcomes.

Conclusion

For patients with prehypertension and borderline dyslipidemia, low-dose statins demonstrate favorable effects in lowering blood pressure and lipid levels, improving endothelial function, delaying arterial sclerosis, and reducing the incidence of hypertension. These findings suggest that incorporating low-dose statins into the management of patients with prehypertension and borderline elevated blood lipids may offer significant cardiovascular protective benefits. Future research should aim to validate these findings over longer follow-up periods and in larger, more diverse populations to further support the use of low-dose statins in clinical practice for the prevention of hypertension.

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Contributions

Zhuang Lu, Jing Liu, Tangjia Cui, Yehua Lu, Zhongwei Bao, Qiuming He, and Yaming Yan contributed to the study conception and design; material preparation, data collection and analysis were performed by Zhuang Lu, Zhongwei Bao, Qiuming He; Zhuang Lu, Zhongwei Bao, Qiuming He drafted the work or revised it critically for important intellectual content; all authors approved the version to be published.

Conflict of Interests

The authors declare no conflict of interest.

Data availability

The data sets generated and/or analyzed during this study are available from the corresponding author upon reasonable request.

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