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Analysis of the Effective Rate of Amlodipine Besylate Combined with Metoprolol in the Treatment of Elderly Patients with Essential Hypertension

Haowen Tian

Jingjiang People's Hospital Affiliated to Yangzhou University, Jingjiang 214500, Jiangsu, China

Abstract: *Objective*: To analyze the therapeutic effect of amlodipine besylate combined with metoprolol in elderly patients with essential hypertension. *Methods*: A total of 600 elderly patients with essential hypertension who were treated from August 2023 to August 2024 were selected as samples and grouped by random number table. Group A was treated with amlodipine besylate combined with metoprolol, while Group B was treated with metoprolol. Cardiovascular function indicators, vascular endothelial indicators, blood viscosity indicators, and adverse reactions were compared. *Results*: Systolic blood pressure (SBP), diastolic blood pressure (DBP), mean arterial pressure (MAP), and heart rate (HR) in Group A were lower than those in Group B, with $P < 0.05$; Nitric oxide (NO) in Group A was higher than that in Group B, while endothelin-1 (ET-1) was lower than that in Group B, with $P < 0.05$; Plasma viscosity (PV), low-shear whole blood viscosity (LBV), and high-shear whole blood viscosity (HBV) in Group A were lower than those in Group B, with $P < 0.05$; There was no significant difference in adverse drug reactions between Group A and Group B, with $P > 0.05$. *Conclusion*: The combination of amlodipine besylate and metoprolol in the treatment of elderly patients with essential hypertension results in stable hemodynamic indicators, improved vascular endothelial function, reduced blood pressure and heart rate, and is highly effective and feasible.

Keywords: Elderly essential hypertension; Metoprolol; Amlodipine besylate

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1. Introduction

Essential hypertension is prevalent among middle-aged and elderly populations, necessitating active blood pressure management to prevent the onset of secondary cardio-cerebrovascular complications. Currently, pharmacological treatment is the mainstay for managing essential hypertension in clinical practice. Metoprolol, a first-line antihypertensive drug, acts rapidly when administered orally, swiftly exerting its selective blocking effect on β1 adrenergic receptors. Adhering to prescribed dosages can reduce peripheral vascular resistance and

inhibit renin secretion, thereby achieving blood pressure reduction. However, due to the complexity of essential hypertension and the influence of underlying diseases in elderly patients, metoprolol alone may not be sufficient to maintain stable blood pressure. Amlodipine besylate, a calcium antagonist, has minimal impact on cardiac contractility and can enhance vascular tone and maintain stable blood pressure [1]. Based on this, this study investigates the therapeutic efficacy of combining amlodipine besylate with metoprolol in 600 elderly patients with essential hypertension who were treated from August 2023 to August 2024.

2. Materials and methods

2.1. Materials

A sample of 600 elderly patients with essential hypertension who sought medical treatment from August 2023 to August 2024 was randomly divided into groups using a random number table. The baseline data of elderly patients with essential hypertension in Group A were compared with those in Group B, with $P > 0.05$ (**Table 1**).

Table 1. Baseline data analysis table for elderly patients with essential hypertension

Group	n	Gender (%)		Age (years)		Course of disease (years)	
		Male	Female	Range	Mean ± SD	Range	Mean ± SD
Group A	300	156 (52.00)	144 (48.00)	48–72	56.28 ± 3.29	1–5	2.43 ± 0.61
Group B	300	159 (53.00)	141 (47.00)	48–73	56.31 ± 3.31	1–6	2.49 ± 0.66
χ^2/t		0.0602		0.1113		1.1563	
P		0.8063		0.9114		0.2480	

2.2. Inclusion and exclusion criteria

The inclusion criteria are as follows:

(1) Meeting the criteria for essential hypertension outlined in the "Chinese Guidelines for the Prevention and Treatment of Hypertension" [2];

(2) Signing an informed consent form;

(3) Taking medication as prescribed, adhering to the dosage and schedule.

The exclusion criteria are as follows:

(1) Acute myocardial infarction;

(2) Stroke;

(3) Self-administration of other antihypertensive drugs.

2.3. Treatment methods

For Group A, initially administered oral metoprolol tartrate tablets (Yantai Juxian Pharmaceutical Co., Ltd.; National Medical Products Administration Approval Number H20143225; 25 mg) at a dose of 12.5 mg twice daily. After 7 days of medication, the single dose was increased to 50 mg twice daily. Initially administered oral amlodipine besylate tablets (Guangdong Bidi Pharmaceutical Co., Ltd.; National Medical Products Administration Approval Number H20057316; 5 mg) at a dose of 2.5 mg once daily. After 7 days of medication, the single dose was increased to 5mg once daily. Treatment was administered for 8 weeks.

For Group B, the medication method for metoprolol tartrate tablets was the same as that in Group A, and

treatment was administered for 8 weeks.

2.4. Observation indicators

The indicators are as follows:

(1) Cardiovascular function indicators: SBP and DBP were measured using a standard mercury sphygmomanometer, and MAP was calculated; HR was detected by electrocardiogram;

(2) Vascular endothelial function indicators: Fasting venous blood samples (5 ml) were collected from enrolled patients before and after medication. The serum was separated for examination, and NO and ET-1 levels were detected using the enzyme-linked immunosorbent assay method;

(3) Blood viscosity indicators: Fasting venous blood samples (5 ml) were collected from enrolled patients before and after medication. PV, LBV, and HBV were detected using a hemorheology analyzer;

(4) Adverse reactions: The occurrence of dizziness, fatigue, lower extremity edema, and palpitations was recorded.

2.5. Statistical analysis

Data processing was completed using SPSS 23.0. Count data were recorded using the chi-square test and percentages, while measurement data were recorded using the *t*-test and mean ± standard deviation (mean ± SD). Statistical differences were considered significant when $P < 0.05$.

3. Results

3.1. Cardiovascular function indicators

After medication, SBP, DBP, MAP, and HR in group A were all lower than those in group B, with $P < 0.05$ (**Table 2**).

Table 2. Analysis table of cardiovascular function indicators (mean ± SD)

Group	SBP (mmHg)		DBP (mmHg)		MAP (mmHg)		HR (beats/min)	
	Before	After	Before	After	Before	After	Before	After
Group A (n = 300)	151.84 ± 6.81	124.66 ± 2.49	99.51 ± 3.84	73.28 ± 1.89	103.88 ± 4.06	80.57 ± 2.49	99.28 ± 3.51	78.22 ± 2.49
Group B (n = 300)	151.79 ± 6.79	130.58 ± 4.11	99.49 ± 3.89	78.62 ± 2.43	103.91 ± 4.09	95.06 ± 3.81	99.31 ± 3.48	85.06 ± 3.06
t	0.0901	21.3378	0.0634	30.0446	0.0902	55.1409	0.1051	30.0303
P	0.9283	0.000	0.9495	0.000	0.9282	0.001	0.9163	0.000

3.2.Vascular endothelial function indicators

After medication, Group A exhibited higher levels of nitric oxide (NO) and lower levels of endothelin-1 (ET-1) compared to Group B, with $P < 0.05$ (**Table 3**).

Table 3. Analysis table of vascular endothelial function indicators (mean ± SD)

Group	NO (μmol/L)		ET-1 (ng/L)	
	Before medication	After medication	Before medication	After medication
Group A (n = 300)	51.84 ± 4.25	66.28 ± 5.19	79.06 ± 5.19	60.02 ± 3.25
Group B (n = 300)	51.79 ± 4.31	60.11 ± 4.87	79.11 ± 5.21	66.26 ± 4.19
t	0.1431	15.0156	0.1178	20.3821
P	0.8863	0.000	0.9063	0.000

3.3. Blood viscosity indicators

After medication, the PV, LBV, and HBV indicators in Group A were all lower than those in Group B, with $P < 0.05$ (**Table 4**).

Table 4. Analysis table of blood viscosity indicators (mean ± SD)

Group	PV (mPa·s)		LBV (mPa·s)		HBV (mPa·s)	
	Before medication	After medication	Before medication	After medication	Before medication	After medication
Group A (n = 300)	2.52 ± 0.48	1.44 ± 0.18	17.51 ± 1.89	12.41 ± 1.01	6.53 ± 1.21	5.02 ± 0.49
Group B (n = 300)	2.53 ± 0.49	1.88 ± 0.26	17.53 ± 1.91	14.52 ± 1.43	6.55 ± 1.18	5.51 ± 0.62
t	0.2525	24.0998	0.1289	20.8751	0.2050	10.7397
P	0.8007	0.000	0.8975	0.000	0.8377	0.000

3.4. Adverse reaction indicators

There was no significant difference in adverse drug reactions between Group A and Group B, with $P > 0.05$ (**Table 5**).

Table 5. Analysis table of adverse drug reactions (n, %)

Group	Dizziness	Fatigue	Lower limb edema	Palpitation	Incidence rate
Group A (n = 300)	2 (0.67)	2 (0.67)	1 (0.33)	2 (0.67)	7 (2.33)
Group B (n = 300)	1 (0.33)	2 (0.67)	0 (0.00)	2 (0.67)	5 (1.67)
χ^2	-	-	-	-	0.3401
P	-	-	-	-	0.5597

4. Discussion

Essential hypertension is a prevalent disease among the elderly, associated with a decrease in elastic fibers and an increase in collagen fibers in the blood vessel walls during aging, leading to reduced elasticity and increased stiffness of the blood vessel walls over time. Additionally, factors such as decreased sensitivity of pressure receptors and altered activity of the renin-angiotensin-aldosterone system (RAAS) contribute to abnormal increases in blood pressure. In clinical practice, pharmacological treatment is commonly used to manage essential hypertension in the elderly, focusing on regulating blood pressure and preventing cardiovascular and

cerebrovascular complications. Beta-blockers are frequently prescribed to lower blood pressure by competitively inhibiting the binding of adrenaline and noradrenaline to beta receptors, thereby suppressing myocardial contraction, slowing heart rate, reducing cardiac output, and blocking the release of renin and angiotensin II, ultimately achieving a blood pressure-lowering effect [3]. However, due to the complex nature of essential hypertension in the elderly, blood pressure fluctuations are regulated by multiple factors, including peripheral vascular resistance, neurohumoral regulation, and cardiac function, making it difficult for a single drug to comprehensively intervene in the complex pathophysiological processes. Based on this, the combination of amlodipine besylate, which selectively inhibits the transmembrane entry of calcium ions into myocardial and vascular smooth muscle cells, can stimulate the dilation of peripheral arteries, inhibit vascular smooth muscle contraction, and thereby reduce peripheral vascular resistance and lower blood pressure [4].

Based on the data analysis in this study, after treatment with amlodipine besylate combined with metoprolol, indicators such as systolic blood pressure (SBP), diastolic blood pressure (DBP), mean arterial pressure (MAP), and heart rate (HR) all decreased. The underlying reasons are as follows: the primary pathological features of essential hypertension patients include increased peripheral vascular resistance and disordered regulation of cardiac output. Oral administration of metoprolol selectively blocks beta-1 receptors in the heart, slowing myocardial contraction and reducing the automaticity of the sinoatrial node, thereby decreasing cardiac output and reducing blood pressure against the vessel walls. It also inhibits the release of renin and blocks the activation of the RAAS system, leading to a decrease in peripheral vascular resistance and lower blood pressure and MAP. The combined treatment with amlodipine besylate synergistically blocks L-type calcium channels in vascular smooth muscle cells, inhibits calcium influx, relaxes smooth muscle, stimulates the dilation of peripheral small arteries, improves vascular stiffness caused by calcium overload, and further reduces blood pressure and MAP. Additionally, abnormal heart rate in elderly patients with essential hypertension increases the risk of heart failure and coronary heart disease. The combined treatment with metoprolol can slow the depolarization rate of the sinoatrial node, reduce automaticity, prolong atrioventricular conduction, and directly slow heart rate [5]. Another set of data indicates that after treatment with amlodipine besylate combined with metoprolol, nitric oxide (NO) levels increased while endothelin-1 (ET-1) levels decreased. The reasons are as follows: one of the core pathological links in elderly essential hypertension is impaired vascular endothelial function, characterized by an imbalance between vasoconstrictive and vasodilatory factors, which further elevates blood pressure and exacerbates vascular sclerosis. The combined medication synergistically protects the vascular endothelium.

Metoprolol inhibits sympathetic nerve activation, suppresses oxidative stress reactions, upregulates the expression of endothelial nitric oxide synthase, and promotes the synthesis and release of NO. Amlodipine besylate acts on vascular smooth muscle, inhibits calcium influx-induced damage to the vascular endothelium, reduces the release of inflammatory factors such as interleukin-6 and tumor necrosis factor-alpha, further activates endothelial nitric oxide synthase, increases NO synthesis, and achieves multiple effects such as vasodilation, improved vascular elasticity, and antiplatelet aggregation [6]. Furthermore, metoprolol inhibits sympathetic nerve activity, reduces adverse stimulation of endothelial cells, blocks ET-1 gene transcription and secretion, and, in combination with amlodipine besylate, improves endothelial energy metabolism. By increasing NO levels, it feedback inhibits the secretion of ET-1, thereby suppressing the vasoconstrictive effect of ET-1 and its promotion of smooth muscle cell proliferation, which is beneficial for slowing the process of vascular remodeling [7]. Another set of data shows that after treatment with amlodipine besylate combined with metoprolol, indicators such as plasma viscosity (PV), low-shear whole blood viscosity (LBV), and high-shear whole blood viscosity (HBV) decreased. The reasons are

as follows: elderly patients with essential hypertension often experience increased blood viscosity due to elevated blood pressure. If not promptly intervened, this can easily induce microcirculation disorders, insufficient tissue perfusion, and even exacerbate target organ damage. The use of metoprolol can slow heart rate, regulate cardiac output, stabilize hemodynamics, avoid platelet adhesion and red blood cell aggregation caused by fluctuations in blood flow velocity, and, in combination with amlodipine besylate, stimulate peripheral vascular dilation, reduce blood flow resistance, and relieve microcirculation stasis, thereby improving blood viscosity indicators [8].

Furthermore, the combined treatment with metoprolol and amlodipine besylate synergistically reduces oxidative stress-induced damage to red blood cell membranes, avoids intracellular calcium overload in red blood cells, maintains cell membrane fluidity, protects red blood cell deformability, and further improves blood viscosity indicators [9]. The final set of data indicates that there was no statistically significant difference in the incidence of adverse drug reactions between the two groups. The reasons are as follows: elderly patients have poor drug tolerance. The combined treatment with metoprolol and amlodipine besylate, which have different mechanisms of action, does not increase the doses of a single component, avoiding adverse events caused by high doses of a single drug. Additionally, oral administration of metoprolol may cause dizziness and fatigue due to peripheral vasoconstriction, while the vasodilatory effect of amlodipine besylate can counteract these adverse reactions. Oral administration of amlodipine besylate may induce reflex tachycardia, while the negative chronotropic effect of metoprolol can effectively alleviate this adverse reaction [10].

5. Conclusion

In conclusion, the combined treatment with metoprolol and amlodipine besylate in elderly patients with essential hypertension results in more stable blood pressure and heart rate, improved blood viscosity indicators, and reduced vascular endothelial damage, making it worthy of promotion.

Disclosure statement

The author declares no conflict of interest.

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