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Observation of the Effect of Irbesartan + Metoprolol in the Treatment of Hypertension and Analysis of its Impact on effectiveness

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Abstract: *Objective:* To analyze the clinical effectiveness of irbesartan combined with metoprolol in the treatment of hypertension and its impact on the effectiveness. *Methods:* 76 patients with hypertension admitted to our hospital from December 2023 to December 2024 were selected as the research subjects and divided into two groups using the random number table method. Thirty-eight patients in the experimental group were treated with irbesartan combined with metoprolol, and 38 patients in the conventional group were treated with irbesartan alone. The treatment effectiveness, incidence of adverse reactions, and blood pressure variability indicators before and after treatment were compared between the two groups. *Results:* The treatment effectiveness of the experimental group was higher than that of the conventional group ($P < 0.05$); the incidence of adverse reactions between the two groups was not significantly different ($P > 0.05$); the blood pressure variability index of the experimental group after intervention was better than that of the conventional group ($P < 0.05$). *Conclusion:* Irbesartan combined with metoprolol in the treatment of hypertension can improve the therapeutic efficiency, optimize blood pressure variability, and has good safety.

Keywords: Irbesartan; Metoprolol; Hypertension; Therapeutic effect; Blood pressure variability

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1. Introduction

Hypertension is a clinically common chronic cardiovascular disease, and its incidence rate is increasing year by year worldwide. The prevalence of hypertension among adults in my country has exceeded 27.5%, and the affected group is gradually becoming younger, posing a major public health problem [1]. Poor long-term blood pressure control can easily induce cardiovascular, cerebrovascular and other multi-organ complications. The risk of serious events such as stroke and myocardial infarction will increase significantly with the increase in blood pressure, seriously interfering with the patient's quality of life and even affecting life safety [2]. The current clinical treatment of hypertension focuses on drug regulation. Irbesartan, as an angiotensin II receptor antagonist, can effectively block the vasoconstriction pathway to reduce blood pressure and has a certain protective effect on the kidneys. Metoprolol, a beta-blocker, can help reduce blood pressure by slowing the heart rate and reducing myocardial oxygen consumption, while also improving myocardial remodeling [3]. However, in clinical practice, the use of a single drug is affected by

factors such as individual differences among patients and the severity of the condition. Some patients still do not have satisfactory blood pressure control, and even experience large fluctuations in blood pressure, making it difficult to effectively reduce the risk of long-term complications. Based on this current situation, this study selected patients with hypertension who were diagnosed and treated in our hospital as the research subjects to explore the effectiveness of irbesartan combined with metoprolol treatment and its impact on treatment efficiency. The purpose is to provide a more sufficient reference basis for clinical optimization of hypertension treatment programs and improvement of the quality of blood pressure control.

2. Materials and methods

2.1. General information

76 patients with hypertension admitted to our hospital from December 2023 to December 2024 were selected as the research subjects and divided into two groups using the random number table method. The experimental group included 38 patients, including 21 men and 17 men, aged 42 to 75 (58.62 ± 5.34) years old. There were 38 patients included in the conventional group, including 20 men and 18 men, aged 43 to 76 (59.15 ± 5.28) years old. The basic information of the two groups of patients was comparable ($P > 0.05$). Inclusion criteria: (1) Meet the diagnostic criteria for hypertension in the "China Guidelines for the Prevention and Treatment of Hypertension 2023 Edition"; (2) Blood pressure persists ≥ 140/90 mmHg and is ineffective after lifestyle intervention; (3) Voluntarily participate in this study and sign an informed consent form. Exclusion criteria: (1) Combined with severe heart, liver, kidney and other organ dysfunction; (2) Allergic to the medication used in this study; (3) Combined with secondary hypertension.

2.2. Method

The conventional group was simply treated with irbesartan and given irbesartan tablets (Jiangsu Hengrui Pharmaceutical Co., Ltd., National Drug Approval No. H20000513) orally. The initial dose was 150 mg/time, once/d. According to the patient's blood pressure, it could be adjusted to 300 mg/time, once/d, and the treatment was continued for 12 weeks. The experimental group was treated with irbesartan combined with metoprolol. The administration method and dosage of irbesartan were the same as those in the conventional group. At the same time, metoprolol sustained-release tablets (AstraZeneca Pharmaceutical Co., Ltd., National Drug Approval No. H32025391) were administered orally. The initial dose was 23.75 mg/time, once/d. After 1 week of treatment, if the patient tolerated it, it could be adjusted to 47.5 mg/time, once/d, and the treatment was continued for 12 weeks. During the treatment period, blood pressure was monitored regularly in both groups, and patients were instructed to maintain a low-salt and low-fat diet and have a regular schedule.

2.3. Observation indicators

(1) Compare the treatment effectiveness of the two groups and set standards based on blood pressure control
Effective means systolic blood pressure < 130 mmHg and diastolic blood pressure < 80 mmHg after treatment; effective means systolic blood pressure 130–139 mmHg or diastolic blood pressure 80–89 mmHg after treatment; ineffective means the above standards are not met. The total effective rate = (number of markedly effective cases + number of effective cases)/total number of cases × 100.

(2) Compare the incidence of adverse reactions between the two groups, and count the occurrence of adverse reactions such as dizziness, fatigue, dry cough during treatment

(3) Compare the blood pressure variability indicators between the two groups before and after treatment, and use an ambulatory blood pressure monitor to record the 24-h systolic blood pressure standard deviation and the 24-h diastolic blood pressure standard deviation

2.4. Statistical methods

Data were analyzed using SPSS24.0. Measurement data that conform to normal distribution are expressed as mean plus or

minus standard deviation and subjected to t test; count data are expressed as percentage and subjected to χ^2 test. $P < 0.05$ represents significant difference.

3. Results

3.1. Comparison of treatment effectiveness between the two groups

The treatment effectiveness of the experimental group was higher than that of the conventional group ($P < 0.05$), see **Table 1** for details.

Table 1. Comparison of treatment effectiveness between the two groups [n (%)]

Group	Effective	Valid	Invalid	Always efficient
Regular group ($n = 38$)	14 (36.84)	12 (31.58)	12 (31.58)	26 (68.42)
Experimental group ($n = 38$)	22 (57.89)	13 (34.21)	3 (7.89)	35 (92.11)
χ^2				6.728
P				0.009

3.2. Comparison of the incidence of adverse reactions between the two groups

There was no significant difference in the incidence of adverse reactions between the two groups ($P > 0.05$). See **Table 2** for details.

Table 2. Comparison of the incidence of adverse reactions between the two groups [n (%)]

Group	Dizziness	Weakness	Dry cough	Overall incidence
Regular group ($n = 38$)	2 (5.26)	1 (2.63)	1 (2.63)	4 (10.53)
Experimental group ($n = 38$)	3 (7.89)	2 (5.26)	0 (0.00)	5 (13.16)
χ^2				0.000
P				1.000

3.3. Comparison of blood pressure variability indicators between the two groups before and after treatment

Before the intervention, the blood pressure variability indicators of the two groups were similar ($P > 0.05$). After the intervention, the standard deviation of 24-hour systolic blood pressure and the standard deviation of 24-hour diastolic blood pressure in the experimental group were lower than those of the conventional group ($P < 0.05$). See **Table 3** for details.

Table 3. Comparison of blood pressure variability indicators between the two groups before and after treatment (mean ± SD, mmHg)

Group	24h systolic blood pressure standard deviation (before intervention)	24h systolic blood pressure standard deviation (after intervention)	24h diastolic blood pressure standard deviation (before intervention)	24h diastolic blood pressure standard deviation (after intervention)
Regular group ($n = 38$)	15.62 ± 2.34	13.25 ± 2.18	10.86 ± 1.75	9.34 ± 1.52
Experimental group ($n = 38$)	15.78 ± 2.41	10.56 ± 1.87	10.92 ± 1.81	7.23 ± 1.36
t	0.294	5.773	0.147	6.377
P	0.770	0.000	0.884	0.000

4. Discussions

The course of hypertension is long, and the progression is insidious. Most patients show no obvious discomfort in the early stages of the disease. As a result, varying degrees of vascular damage are already present when the disease is diagnosed. Long-term elevated blood pressure will continue to damage the endothelial function of blood vessels and cause atherosclerosis, which in turn induces serious complications such as coronary heart disease and stroke. Therefore, effective control of blood pressure levels is very important to improve the prognosis of patients with hypertension [4]. From the analysis of pathophysiological mechanisms, the occurrence and development of hypertension are closely related to pathological links such as activation of the renin-angiotensin-aldosterone system and sympathetic nerve excitation. Activation of the renin-angiotensin-aldosterone system will increase the production of angiotensin II, causing vasoconstriction, water and sodium retention, thereby increasing blood pressure. Sympathetic nerve excitation can further increase blood pressure by accelerating heart rate, enhancing myocardial contractility, constricting peripheral blood vessels, etc., and there is a mutual promotion between these two systems, jointly promoting the increase in blood pressure and target organ damage. The core goal of clinical treatment of hypertension is to steadily regulate blood pressure and reduce the risk of cardiovascular and cerebrovascular events. Drug therapy is the main intervention method. Its core principle is to target the key pathological links of hypertension and rationally select antihypertensive drugs and combination regimens to achieve synergistic lowering of blood pressure, reduce adverse reactions, and protect target organs. Therefore, the selection of scientific and effective combination drug regimens is the key to improving treatment effectiveness and improving long-term prognosis of patients [5].

The results of this study show that the treatment effectiveness of the experimental group is higher than that of the conventional group. This result shows that irbesartan combined with metoprolol can significantly improve the treatment effectiveness in the treatment of hypertension. As an angiotensin II receptor antagonist, irbesartan can specifically block the binding of angiotensin II to receptors on vascular smooth muscle, adrenal glands and other tissues. It not only effectively inhibits vasoconstriction but also reduces the release of aldosterone and reduces water and sodium retention, thus exerting a stable antihypertensive effect. At the same time, the drug can expand the renal efferent arterioles and reduce intraglomerular pressure, forming a certain protective effect on the kidneys [6]. Metoprolol is classified as a selective β1-receptor blocker that mainly acts on β1-receptors in the heart and kidneys. By blocking cardiac β1-receptors, it slows down the heart rate, reduces myocardial contractility and cardiac output, directly weakening the driving force for increased cardiogenic blood pressure. It also inhibits the release of renin from juxtaglomerular cells in the kidneys, reduces the production of angiotensin II, inhibits the activation of the renin-angiotensin-aldosterone system from the source, and assists in achieving the antihypertensive effect. The mechanisms of action of the two drugs are different and complementary. The combined application can simultaneously act on the two key pathological links of the renin-angiotensin-aldosterone system and the sympathetic nerve to achieve synergistic antihypertensive effects through multiple pathways. Compared with single irbesartan treatment, it can more comprehensively cover the pathological mechanisms of hypertension, adapt to the individual differences of different patients, and thus more effectively reduce blood pressure levels and allow more patients to meet treatment standards. Therefore, the treatment effectiveness of the experimental group is significantly higher. From the analysis of data differences, the total effective rate of the experimental group was 92.11%, which was 23.69% higher than that of the conventional group (68.42%). This data further confirmed the advantages of combined medication in improving the effectiveness rate. Judging from clinical practice, when irbesartan is used alone, some patients may experience an accelerated heart rate and poor blood pressure control due to compensatory sympathetic nerve excitation. However, when combined with metoprolol, it can make up for this defect by inhibiting sympathetic nerve excitation and further improving the blood pressure control effect. This is also one of the important reasons why the combined medication is more effective [7].

In terms of adverse reactions, the total incidence rates of the two groups were 13.16% and 10.53% respectively. There was no significant difference after comparison, indicating that combined medication did not significantly increase the risk of adverse reactions and was safe. Common adverse reactions of irbesartan include dry cough and dizziness. Dry cough is

mainly caused by the accumulation of bradykinin in the body after inhibiting the production of angiotensin II. Dizziness is mostly related to a rapid drop in blood pressure or too low regulation. Metoprolol may cause fatigue, bradycardia, dizziness and other adverse reactions. Fatigue is related to bradycardia and the drug inhibits myocardial contractility and slows down the heart rate. Dizziness is also related to abnormal blood pressure regulation. In this study, the main adverse reactions in both groups were dizziness, fatigue, and dry cough, and the incidence rates were low. There were no serious adverse reactions such as severe bradycardia and anaphylactic shock. The reason may be that when used in combination, both drugs use conventional initial doses, and the doses are gradually adjusted according to the patient's tolerance during the medication, which avoids a sudden drop in blood pressure or a rapid drop in heart rate caused by an excessive initial dose, thereby reducing the risk of adverse reactions such as dizziness and fatigue. At the same time, there are certain differences in the adverse reaction spectrum of the two drugs. There is no additive effect of adverse reactions when used together. On the contrary, the synergistic antihypertensive effect can appropriately reduce the dosage adjustment range of a single drug, further reducing the possibility of adverse reactions [8]. In addition, during the treatment process of this study, the patients' blood pressure and heart rate were closely monitored. Once minor adverse reactions occurred, intervention measures such as dietary guidance and posture adjustment were promptly provided, which effectively alleviated the uncomfortable symptoms and improved the patient's tolerance. This result suggests that irbesartan combined with metoprolol in the treatment of hypertension can improve the efficacy without significantly aggravating the patient's physical burden and is well tolerated by the patient. This provides a sufficient safety basis for the promotion and application of this combination regimen in patients with hypertension of different ages and different degrees of illness.

This study innovatively selected blood pressure variability as the observation index. The results showed that the standard deviation of 24-hour systolic blood pressure and the standard deviation of 24-hour diastolic blood pressure in the experimental group after the intervention were lower than those of the conventional group, suggesting that combined medication has obvious advantages in stabilizing blood pressure fluctuations. Blood pressure variability reflects the degree of fluctuations in blood pressure within a specific period of time. Increased values are closely related to the increased risk of cardiovascular and cerebrovascular events. Related studies have shown that even if the average blood pressure is controlled within the normal range, if the blood pressure variability is too large, the patient's risk of stroke and myocardial infarction will still be significantly increased. This is because severe fluctuations in blood pressure will repeatedly impact the vascular endothelium, aggravate endothelial damage and accelerate the progression of atherosclerosis. At the same time, increased cardiac load will induce adverse events such as myocardial ischemia. Compared with simply monitoring the average blood pressure, blood pressure variability can more comprehensively reflect the quality of blood pressure control and is an important supplementary indicator for evaluating the effectiveness of hypertension treatment. The blood pressure variability index of the combined medication group was better, indicating that the combined use of irbesartan and metoprolol can not only reduce blood pressure levels but also effectively stabilize blood pressure fluctuations. The reason is that the two drugs have a longer action time. The half-life of irbesartan is about 11 to 15 hours. Oral administration once a day can achieve 24-hour continuous blood pressure reduction, while metoprolol is sustained-release. The tablets use sustained-release preparation technology, which can achieve stable drug release over 24 hours, avoiding the peaks and troughs in blood concentration that may occur with ordinary preparations. The combined use of the two drugs can make the antihypertensive effect more lasting and stable, forming a synergistic and stable antihypertensive effect, effectively avoiding the blood pressure peaks and troughs that may occur with a single drug, thereby reducing blood pressure variability. In addition, the protective effect of irbesartan on vascular endothelial function can improve the elasticity and compliance of blood vessels, reduce the reactivity of blood vessels to exogenous and endogenous stimuli, and further help stabilize blood pressure fluctuations; the inhibitory effect of metoprolol on sympathetic nerves can reduce sympathetic nerve excitement caused by factors such as mood swings and physical activity, and avoid sudden rises and falls in blood pressure. This is also an important reason for the better blood pressure variability in the combined medication group. Stable blood pressure control can reduce the impact damage to the vascular endothelium, delay the progression of atherosclerosis, and further reduce the risk of cardiovascular and cerebrovascular complications. This is also an important advantage of the

combined medication regimen compared with a single medication, and provides strong support for improving the long-term treatment effect of patients with hypertension.

5. Conclusion

Taken together, irbesartan combined with metoprolol has significant advantages in the treatment of hypertension. It can improve the treatment efficiency through synergy, effectively optimizing blood pressure variability indicators without increasing the risk of adverse reactions.

Disclosure statement

The author declares no conflict of interest.

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