

Clinical Analysis of Diabetic Nephropathy Risk Factors and Correlation with Blood Pressure Control

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Abstract: *Objective:* To explore the risk factors of diabetic nephropathy and its correlation with blood pressure control. *Methods:* A retrospective analysis of 80 patients with diabetic nephropathy (diabetic nephropathy group) and another 80 patients with diabetes (diabetic group) who were admitted to the Department of Nephrology and Endocrinology at our hospital from October 2021 to October 2022 was conducted. The general data of the two groups were compared, the influencing factors associated with the two groups were analyzed unilaterally, and unconditional dichotomous logistic regression was performed to analyze the influencing factors in patients with diabetic nephropathy. *Results:* There were no significant differences in high-density lipoprotein, systolic blood pressure, diastolic blood pressure, and creatinine between the two groups ($P > 0.05$); however, compared with the diabetic group, the DN group had significantly elevated glycated hemoglobin, low-density lipoprotein, 24-h urine protein, insulin resistance, and diabetes duration ≥ 10 years ($P < 0.05$). *Conclusion:* The clinical research on the correlation between the incidence of hypertension and the control of blood pressure in patients with diabetic nephropathy should be strengthened in order to formulate reasonable and feasible treatment plans.

Keywords: Diabetic nephropathy; Risk factors; Blood pressure control

Online publication: March 31, 2023

1. Introduction

Diabetic nephropathy (DN) is a common chronic complication of diabetes and an independent risk factor for end-stage renal disease and cardiovascular disease (CVD). Early hypertension improves renal microcirculation by increasing renal blood perfusion and glomerular filtration rate and promotes early recovery of renal damage. With the progression of DN, renal biopsy should be done to confirm the pathological changes in renal tissue and the level of proteinuria should be identified so that individualized treatment can be carried out. Since elevated blood pressure is one of the risk factors for DN, further research on the damage and impact of high blood pressure on the kidneys is needed. Hypertension is closely related to DN and affects glomerular filtration rate, renal function, and the course and complications of diabetes. Elevated blood pressure is one of the important risk factors leading to the onset of DN, which can increase the risk of cardiovascular events and is also an independent risk factor for cardiovascular events^[1]. In the process of antihypertensive treatment for patients with DN, further research is needed on how to prevent adverse events induced by increased blood pressure and reduce cardiovascular and cerebrovascular complications.

2. Materials and methods

2.1. General Information

A retrospective analysis of 80 patients with diabetic nephropathy and another 80 patients with diabetes who were admitted to the Department of Nephrology and Endocrinology at our hospital from October 2021 to October 2022 was conducted. They were divided into diabetic nephropathy group and diabetic group. According to the recommended standards of the International Society of Hypertension (ISH), controlling the blood pressure such that it is below 140/90 mmHg is considered stable and effective. The subjects were 18–70 years old, and the blood pressure target of all the subjects was 150/90 mmHg. All research subjects underwent 24-h ambulatory blood pressure monitoring and a complete set of biochemical examinations to monitor blood concentration. There were some subjects who did not undergo 24-h ambulatory blood pressure monitoring, and they were treated with sodium nitroprusside, an antihypertensive drug. Those whose blood pressure did not reach the target underwent full biochemical examination.

2.2. Method

The patients' clinical data, including gender, age, medical history, course of disease, fasting blood glucose, glycosylated hemoglobin, low-density lipoprotein, high-density lipoprotein, systolic blood pressure, diastolic blood pressure, creatinine, 24-h urine protein, insulin resistance, and so on, were collected.

2.3. Observation indicators

The general data of the two groups were compared, the influencing factors were analyzed by univariate analysis, and the influencing factors of patients with DN were analyzed by unconditional binary logistic regression.

2.4. Statistical analysis

All data in this study were processed by SPSS 22.0; the measurement data were expressed as mean \pm standard deviation and tested by t-test, while the enumeration data (%) were expressed by chi-squared (χ^2) test.

3. Results

There was no significant difference in high-density lipoprotein, systolic blood pressure, diastolic blood pressure, and creatinine between the two groups ($P > 0.05$). Compared with the diabetic group, the DN group had significantly increased glycated hemoglobin, low-density lipoprotein, 24-h urinary protein, insulin resistance, and diabetes duration ≥ 10 years ($P < 0.05$), as shown in **Table 1**.

Table 1. Univariate analysis of the influencing factors in both groups

Influencing factor	Diabetic nephropathy group	Diabetes group	χ^2	<i>P</i>
Diabetes duration ≥ 10 years	64	26	36.673	< 0.001
Elevated glycated hemoglobin	60	24	32.481	< 0.001
Elevated LDL	61	16	42.602	< 0.001
Elevated HDL	54	55	0.029	0.878
Elevated systolic blood pressure	45	41	0.482	0.691
Elevated diastolic blood pressure	46	42	0.491	0.589
Elevated creatinine	31	27	0.433	0.269
Elevated 24-h urine protein	54	23	24.059	< 0.001
Insulin resistance	53	16	34.885	< 0.001

Abbreviations: HDL, high-density lipoprotein; LDL, low-density lipoprotein.

4. Discussion

4.1. Analysis of blood pressure control in patients with diabetic nephropathy

Although hypertension is one of the most common complications of diabetes, it is preventable and treatable. Early control of blood pressure through drug treatment and lifestyle intervention can help prevent DN. With the progression of the disease, hypertension is an independent risk factor for cardiovascular disease in patients with DN. In the present study, all patients underwent computed tomography (CT) angiography of both renal arteries and percutaneous nephrocentesis; however, renal parenchymal lesions could not be diagnosed by percutaneous nephrocentesis. According to guidelines, when controlling systolic blood pressure, 130–140 mmHg is a reasonable and effective target blood pressure. Although the majority of patients can achieve this goal, there are still some patients who demonstrated poor or ineffective treatment. Studies have shown that for patients with DN, elevated systolic blood pressure can cause varying degrees of damage to target organs like the heart, brain, retina, and kidney; in addition, allopurinol, febuxostat, *etc.* can be used to reduce blood uric acid levels in diabetic patients who have drug-induced elevated blood uric acid levels; however, such lipid-lowering drugs may affect renal function [2]. Selective diuretics such as captopril or enalapril can be taken to relieve symptoms of decreased urine output in patients who are intolerant to antihypertensive drugs [3]. The effects of different antihypertensive drugs vary due to the different degrees of renal function impairment and abnormal renin-angiotensin-aldosterone system (RAAS) activity [4]. Studies have shown that amlodipine can be used concurrently with non-calcium channel blockers to obtain better antihypertensive effect [5] and a complete set of biochemical tests can be performed to screen patients with DN and determine the range of appropriate individualized antihypertensive drugs [6]. Due to differences in the pathophysiological state and clinical manifestations of different patients, some studies did not record those whose blood pressure was found to be significantly elevated in the complete set of biochemical examinations. In addition, some patients also showed labile hypertension, high systolic blood pressure, and low diastolic blood pressure. Since the effects of different antihypertensive drugs vary, only relevant studies were selected for analysis in this study

4.2. Relationship between diabetic nephropathy and hypertension and cardiovascular events

Diabetes mellitus is a chronic metabolic disease characterized by insulin resistance, hyperglycemia, and impaired glucose tolerance. The pathogenesis of diabetes is related to both environmental and genetic factors. With the progression of diabetes, the risk of developing complications and end-stage renal disease increases. One of the most common cardiovascular complications is hypertension. Hypertension is prevalent in diabetic patients and closely related to the disease process. In a study of five urban populations in China, people with systolic blood pressure ≥ 140 mmHg (1 mmHg = 0.133 kPa) and blood pressure $\geq 150/90$ mmHg had an increased risk of developing hypertension, while there was no difference between those with blood pressure below 150/90 mmHg and those without hypertension. Systolic and diastolic blood pressures, heart rate, and blood pressure levels rise with age. In patients with DN, the incidence of hypertension is positively correlated with glomerular filtration rate; however, the blood pressure in these patients fluctuates greatly with the course of diabetes and in the stage of renal insufficiency. With the progression of DN and the aggravation of renal function damage, the risk of CVD in patients will also increase. This may be related to atherosclerotic lesions and/or the decline of glomerular filtration rate. Glomerulosclerosis is also one of the most common causes of end-stage renal disease. Chronic kidney disease is often accompanied by hypertension and impaired glucose tolerance. The increased risk of hypertension in patients with DN is primarily related to renal damage, hyponatremia, and hyperlipidemia. For patients with renal insufficiency or renal artery stenosis, the control of blood pressure can reduce the risk of CVD, while for patients with chronic kidney disease and vascular stenosis, a good control of blood pressure can reduce the occurrence of cardiovascular events. In a comparative analysis of monotherapy in

1,048 patients with DN and 1,051 patients with non-DN in five cities in China, the combined drug regimen can reduce the risk of cardiovascular events, but there was no significant difference. In addition, an association between hypernatremia and hypertension has been observed in patients with non-diabetic kidney disease. Poor blood pressure control may lead to proteinuria, hypotension, and increased risk of cardiovascular events. Diabetic complications are one of the independent risk factors leading to an increased risk of vascular events [7-11]. Therefore, comprehensive treatment measures should be taken to control blood pressure to reduce the incidence of hypertension-related cardiovascular events. There is still a need for further exploration and research on the antihypertensive treatment plan for patients with hypertension complicated with DN. With the increase in number of diabetic patients and diabetic complications annually, treatment using antihypertensive drugs has become one of the important clinical tasks. In the 2020 Standards of Medical Care in Diabetes by the American Diabetes Association, it is recommended that hypertension should be defined as a systolic blood pressure ≥ 140 mmHg or a diastolic blood pressure ≥ 90 mmHg or blood pressure $> 130/80$ mmHg (1 mmHg = 0.133 kPa). A comparative study of single antihypertensive drug therapy in 348 patients with moderate and severe DN in five cities in China has found that combined drug use could prevent the risk of cardiovascular events in DN. For patients with diabetic complications, although the selection of antihypertensive drugs is one of the key links in clinical diagnosis and treatment, there are individual differences in antihypertensive treatment and no unified guidelines to adhere to.

4.3. Protective effect and mechanism of diastolic blood pressure on renal function in patients with diabetic nephropathy

Studies have found that the reduction of diastolic blood pressure is significantly related to the mortality of patients with DN. However, it is still unclear whether the reduction of diastolic blood pressure can improve the prognosis of patients with DN. Song *et al.* studied two groups of DN patients with 24-h urine protein > 1.0 g and found that there were no significant differences in urine albumin, kidney disease, renal function, and creatinine clearance between the control group and the antihypertensive group. Wang *et al.* randomly divided 80 patients with DN into an antihypertensive group (systolic blood pressure < 140 mmHg and diastolic blood pressure < 90 mmHg) and a control group (systolic blood pressure > 140 mmHg and diastolic blood pressure > 90 mmHg) and found that the degree of renal function impairment in the antihypertensive group was significantly lower than that in the control group. Studies have found that diastolic blood pressure has a protective effect on renal function in patients with DN. Doub *et al.* observed that there was no significant difference in the occurrence of kidney disease and the incidence of cardiovascular and cerebrovascular events within 3 years between patients with systolic blood pressure controlled at 130 mmHg and those with diastolic blood pressure controlled at 90 mmHg [12-19].

In short, hypertension is significantly associated with the risk of cardiovascular and cerebrovascular events in patients with DN. As blood pressure increases, the risk of cardiovascular events increases significantly. Compared with systolic blood pressure, diastolic blood pressure has a stronger protective effect against DN, coronary heart disease, and stroke.

Disclosure statement

The authors declare no conflict of interest.

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