ORIGINAL RESEARCH

Effects of Valsartan and Amlodipine Tablets Combined with α-Lipoic Acid on T-AOC, IL-6 and β2-MG Levels in Patients with Diabetic Nephropathy

Fengting Su, BS; Qing Xia, MM

ABSTRACT

Diabetic nephropathy (DN) is the most important cause of chronic renal and end-stage kidney disease in China. Hypertension (HTN) is highly prevalent in individuals with diabetic nephropathy. Arterial HTN affects two-thirds of people with type 2 diabetes (T2D). In these patients, HTN increased the potential of both micro- and macrovascular complications, and the co-occurrence of 2 such principal causes results in a 4-fold increased risk for cardiovascular disease (CVD) when contrasted with normotensive controls without diabetes. Therefore, the results of valsartan and amlodipine tablets combined with alpha-lipoic acid on total antioxidant capacity (T-AOC) need to be investigated.

The aim of this study was to analyze the effects of valsartan (VA) and amlodipine tablets combined with alpha-lipoic acid (α-LA) on T-AOC, IL-6 and β2-MG levels in patients with DN. We performed statistical analysis including the chi-square test, independent t-test, paired *t* test and Analysis of Variance (ANOVA). Our findings indicate that VA, amlodipine and α-LA has a significant effect in patients with DN. (*Altern Ther Health Med.* 2023;29(5):126-131).

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INTRODUCTION

Diabetic nephropathy (DN) is currently the major cause of chronic kidney disease and end-stage renal disease (ESRD) worldwide, and accounts for approximately 16.4% of all cases of ESRD in China. Although DN is generally treated medically, individuals with unusual symptoms should undergo a renal biopsy. A quick rise in proteinuria, a quick deterioration in kidney function, the development of proteinuria without retinopathy, a shorter period of diabetes and evident glomerular hematuria have all been proven to forecast non-diabetic renal disease (NDRD) in individuals with diabetes.[1] DN, a leading cause of ESRD, is linked to higher morbidity, mortality and healthcare costs. Over the last 20 years, the increased incidence of diabetes has increased the impact of diabetic kidney disease (DKD). Albuminuria, a decreased glomerular filtration rate (GFR), or both, are symptoms of DKD. The evolution of DKD was formerly thought to go as follows: incipient nephropathy with microalbuminuria, then a continuous fall in GFR. However, when the renin-angiotensin array blocker dose is increased, albuminuria's value as a biomarker of renal dysfunction decreases, as seen by a decreasing incidence of albuminuria but an increasing prevalence of lower GFR (see Jiang, et al[2] and Mody, et al.[3]) Figure 1 shows how type 2 diabetes (T2D) develops.

The Renal Pathology Society (RPS) developed a pathologic categorization method in 2010 to quantify the severity of DK lesions. Numerous studies were conducted to verify the diagnostic usefulness of this scheme due to the variety of kidney nodules and the complicated natural course of this illness, but the results were mixed. RPS glomerular classification, tubular atrophy, segmental sclerosis, extra capillary hypercellularity and interstitial fibrosis have all been linked to ESRD (Zhao, et al[4]; Garg, et al[5]). Traditional Chinese Medicine (TCM), like Chinese Herbal Medicine (CHM), acupuncture, or tuina, is widely used in Asian cultures, like Taiwan, and the viability of employing CHM in in individuals with chronic kidney disease (CKD) pre-dialysis is unknown. The majority of clinical and laboratory research has indicated that TCM would be useful in patients with CKD, but they lack knowledge on specific phases or long-term results as described by Guo, et al.[6] Figure 2 shows the comparison of healthy and T2D kidneys.

Figure 1. Development of type 2 diabetes.

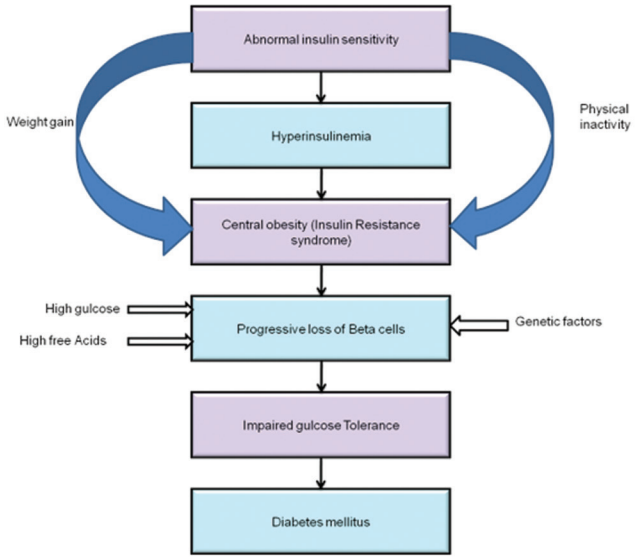
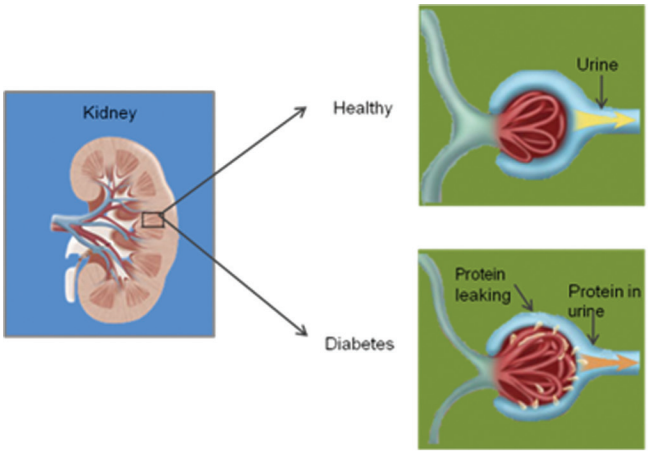


Figure 2. Comparison of healthy and T2D kidneys.



The number of individuals with diabetes has risen worldwide in the last 20 years, owing to a rise in obesity rates and a shift in lifestyle. Per the International Diabetes Federation's most recent statistics, there were 463 million individuals with diabetes worldwide in 2019. By 2030, the population with diabetes is expected to rise to 578 million, and by 2045, to 700 million. The population of the emerging world is expected to see the greatest increase. Diabetes and its complications are among the leading causes of death, putting a great burden on patients, particularly individuals in developing or poor nations (Wang, et al.[7]; Ahmed, et al.[8])

In our study, we analyzed the effects of valsartan and amlodipine tablets combined with α-lipoic acid on T-AOC, IL-6 and β2-MG levels in individuals with T2D and hypertension (HTN). HTN may lead to several complications, the most severe of which is hypertensive nephropathy. Its prevalence is rising in tandem with the rise in HTN, and it has turned into a common source of life-threatening health issues. Hypertensive nephropathy is caused by the longer-term effects of HTN on tiny renal arteries, which results in stenosis and blockage of the lumen, leading to a shortage of blood flow to the kidneys and, eventually, irreparable kidney damage and renal dysfunction. Antihypertensive medication is currently the most common treatment for hypertensive nephropathy, which may successfully regulate blood pressure but not significantly relieve external symptoms or postpone the course of chronic renal failure. As a result, there is an ongoing search for improved therapeutic alternatives.

LITERATURE REVIEW

Wang, et al.[9] looked at the links between 617C/A (rs6721961) polymorphisms in the nuclear factor-erythroid factor 2-related factor 2 (NRF2) promoter and DN in Chinese Han individuals with T2D. In patients with T2D, researchers assessed the efficacy and security of combining sodium-glucose cotransporter 2 inhibitors with RAAS blockers like angiotensin-converting enzyme inhibitors and angiotensin receptor blockers (Tian, et al.[10]). According to Shahabaz, et al.,[11] high-dose rate (HDR) brachytherapy reduces diagnosis periods and avoids radiation. A human source's dwell period may increase dosage dispersion. Short treatment times do not enable error checking, and errors can harm patients. HDR brachytherapy should be done properly. Pregabalin, duloxetine and their combination with epalrestat were studied for their effectiveness and safety in patients with T2D with neuropathy by Sing, et al.[11] Rumi, et al.[14] studied how treatment with calcium channel blockers (CCBs) affect blood sugar levels in patients with HTN at Central Sulawesi Province's Ubandate District General Hospital. Sasso, et al.[15] evaluated the effectiveness of multimodal intensive treatment vs standard-of-care in a group of patients with DKD with albuminuria and retinopathy with fatal and non-fatal cardiovascular incidents. Prolonged follow-up of many years beyond the conclusion of the nursing period was used to examine the durability of the impact of intensive therapy. Salihu, et al,[16] in order to determine the presence of physicochemical and organochlorine pesticides in the soil, took samples from several vegetable farms located around the state of Zamfara in Nigeria. QuEChERS with GC-MS was used for the analysis of both the testing technique and the results. The researchers discussed a few appropriate issues regarding the utilization of the combination of CCB and RAAS inhibitors in HTN therapy (Rubio-Guerra, et al.[17]). Shigihara, et al.[18] studied the impact of aggressive blood pressure management on urine albumin excretion in individuals with HTN and T2D. Huang, et al.[19] conducted a survey to examine the renoprotective impact of an angiotensin-converting enzyme (ACE) inhibitor and CCB vs ACE inhibitor monotherapy. White, et al.[20] evaluated the treatment of individuals with diabetes and HTN and the significance of strict blood pressure management. Per the suggestions of *The Cochrane Handbook for Systematic Reviews of Interventions*, Redon, et al.[21] conducted a survey of the assessable medical evidence on the utilization of integrated treatments comprising an ACE inhibitor and CCB vs other combinations in managing hyperglycemia and reducing

coronary morbidity. Fu, et al.[22] assessed the risks for kidney replacement treatment, morbidity and main cardiovascular events in patients with severe CKD. Yang, et al.[23] looked at the real-world prescription of anti-hypertensive drugs in Chinese patients with HTN who had the following comorbidities: coronary artery disease, diabetes, cardiac arrest, stroke and kidney disease. HTN or renal illness are both compelling reasons to use RAAS antagonists; CCBs are frequently used in these individuals. Chen, et al.[24] compared the impact of dihydropyridine CCBs on ischemic incidents in individuals with anti-coagulated non-valvular atrial fibrillation (NVAF) in a multicenter historical cohort study at 71 sites in Japan. The use of vitamin K antagonists for NVAF was a criterion for inclusion.

METHODS

The primary aim of this study was to analyze the impacts of valsartan and amlodipine tablets combined with α-lipoic acid on T-AOC, IL-6 and β2-MG levels in individuals with T2D and HTN. Figure 3 depicts the proposed study methodology.

Dataset

A prospective randomized, open, parallel-controlled study was conducted at the department of endocrinology at Zhejiang Provincial People's Hospital in China in a total of 124 older individuals who were diagnosed with mild to severe DN. The study was approved by the hospital's ethics committee.

Inclusion criteria

Patients had to meet the following criteria: (1) age 52 to 82 years; (2) good blood sugar regulation; (3) urinary albumin excretion rate (UAER) 20 to 199 ug/min after washout before random selection; (4) reference level of creatinine; (5) have halted anti-hypertensive medications and taking only placebo during the 2-week washout period; (6) blood pressure fluctuations ≥140 to 179 mmHg.

Exclusion criteria

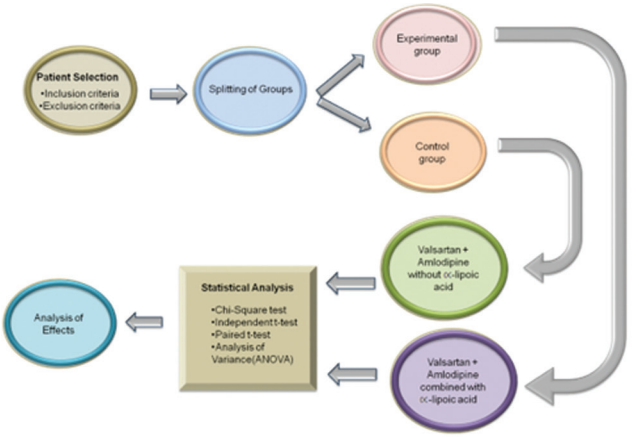
Patients could not: (1) have secondary HTN; (2) primary renal disease; (3) glomerular filtration rate (GFR) <45 ml/minute/1.73m^2; (4) use ACE inhibitors, serum uric acid synthesis-inhibiting drugs, uricosuric drugs or lipid-lowering drugs ≥3 months; (5) have acute diabetic dysmetabolic syndrome; (6) be pregnant or lactating women; (7) have cancerous tumors; (8) have severe dyslipidemia; (9) have serum potassium <3.5 mmol/L or >5.5mmol/L; (10) have serious cardiovascular, liver and other diseases.

Termination criteria

Patients could not have (1) increase in serum potassium >5.5 mmol/L; (2) inability to maintain blood pressure (BP) at the goal value; (3) major adverse medication responses that they could not tolerate.

All patients signed an informed consent form.

Figure 3. Proposed study methodology.



The selected patients were divided into 2 groups: the control group (n=62) and the experimental group (n=62). The mean age in the control group was 65.81±5.96 years, with 36 men and 26 women. The mean age in the experimental group was 66.42±6.12 years, with 38 men and 24 women. The experimental group received valsartan and amlodipine tablets combined with α-lipoic (thiocyanic) acid, and the control group did not.

Statistical analysis

The chi-square test, independent *t* test, paired test and Analysis of Variance (ANOVA) were used to evaluate the data and show the efficiency of valsartan and amlodipine tablets combined with α-lipoic acid on T-AOC, IL-6, and β2-MG levels in individuals with T2D and HTN.

Chi-square Test. The chi-square test is one of the most useful statistical methods for evaluating a hypothesis when the parts being studied are very small, as is frequently the case in medical research. The chi-square test stands out among other statistical procedures because it has the potential to not only determine whether or not there is statistically substantial variation, but also the precise groups that are to blame for those variations, making the chi-square test one of a kind.

$$(1) \quad \Sigma\chi^2_{i\text{-}j} = \frac{(N - P)^2}{P}$$

Where: N = present point; P = real point; χ^2= Chi-square value; $\Sigma\,\chi^2$ = Sum of all the Chi-square values in a given cell using this formula.

Regardless of whether or not patients have received treatment, the formula for estimating chi-square values is:

$$(2) \quad P = \frac{R_s \times R_D}{b}$$

Where: P = the work value of the unit; R_D= that row of nuclei; R_S = that row-edge cell, and b = the sample group as a whole

The sample size is divided by each cell's row and column margins.

$$(3) \quad \chi^2 = \frac{(N - P)^2}{P}$$

Correlation measures are statistical assessments of the strength of a relationship. The Cramer's V test is the most often utilized chi-square strength test. Using the formula below, it's easy to calculate:

$$(4) \quad \sqrt{\frac{(\chi^2 / b)}{P}} = \sqrt{\frac{b}{b\,(k - 1)}}$$

Chi-square is a valuable technique for analyzing research data.

***T* test.** The supposition that there is no difference in performance between the 2 groups was put to the test with the use of the independent t-test in a wide range of contexts:

$$(5) \quad d = \frac{(v - x)}{NE}$$

Where: v = sample mean; x = population mean; and NE = standard error of mean

$$(6) \quad d = \frac{k_1 - k_2}{NE_{k_1 - k_2}}$$

Where $k_1 - k_2$ signifies the distinction.

It was determined to predict that the data from the 2 variable samples differed considerably.

When variables are measured in the same participants during a drug course, a paired *t* test is commonly used. The paired *t* test equation is:

$$(7) \quad d = \frac{h}{NE_h}$$

Where: h stands for the overall mean and NE stands for the standard error of the variance.

Analysis of Variance

ANOVA divides variability data into portions for subsequent testing. When analyzing ≥3 data sets, a one-way ANOVA is used. The ANOVA F-statistic is the ratio of the null model's average sums squared to the total model. All variances are equal; therefore parameters are found using least-squares. This may be expressed as:

$$(8) \quad H = MS_{between} / MS_{error}$$

Where:

$$(9) \quad MS_{between} = \frac{\sum_{i-1}^{g} p_i (\bar{x}_i - \bar{x})^2}{g - 1}$$

and

$$(10) \quad MS_{error} = \frac{\sum_{i=1}^{g} \sum_{z=1}^{g} (\bar{x}_{iz} - \bar{x}_i)^2}{p - g}$$

The Welch-test-statistic is defined as

$$(11) \quad Y = \frac{\sum_{i=1}^{g} y_j [(\bar{x}_{iz} - \tilde{x})^2 / (g-1)]}{1 + \frac{2(g-2)}{g^2 - 1} \sum_{i=1}^{g} [(1 - y_j / u)^2 / (p_i - 1)]}$$

$Y_j = \frac{m}{s_i^2}$, $v = \sum_{i=1}^{g} Y_i$ and $X = \frac{1}{v} \sum_{i=1}^{g} Y_i X_i$ is defined as

$$(12) \quad h = \frac{g^2 - 1}{3 \sum_{i=1}^{g} [(1 - y_j / u)^2 / (p_i - 1)]}$$

The Brown-Forsythe-test-statistic is defined as

$$(13) \quad H^* = \frac{\sum_{i=1}^{g} p_i (\bar{x}_i - \bar{x})^2}{\sum_{i=1}^{g} (1 - p_i) / s_i^2}$$

When L_o is factual, the allocation of H* is appropriate by a central H distribution with degrees of freedom g - 1 and h, where h is defined as:

$$(14) \quad 1/h = \sum_{i=1}^{g} c_i^2 / (p_i - 1),\ c_i = \frac{(1 - p_i / P)\, S_i^2}{\sum_{i=1}^{g} (1 - p_i) / s_i^2}$$

To estimate the generalized *P* value, it is now computed as o = 1 - q, where q is the sample size.

$$(15) q = E\left(J_{g-1,\,p-g}\left(\frac{p-g}{g-1 s^2} \tilde{S}_d\left(\frac{p_1 s_1^2}{D_1 D_2, \ldots D_{g-1}}, \frac{p_2 s_2^2}{D_1 D_2, \ldots D_{g-1}}, \frac{p_2 s_2{}^2}{(1-D_2) D_3, \ldots D_{g-1}}, \ldots \frac{p_1 s_g^2}{(1-D_{g-1})}\right)\right)\right)$$

The prediction is calculated with regard to separate Beta stochastic process in an E-distribution having g - J,U - g dof.

$$(16) \quad D_Z \sim \text{Beta}\left(\sum_{i=1}^{Z} \frac{(p_i - 1)}{2}, \frac{(p_{z+1} - 1)}{2}, z = 1,2, \ldots, g - 1\right.$$

The o-value is calculated by numerically integrating the anticipated value in the o-value formula about the Beta random variables.

RESULTS

Results in the 2 groups were statistically analyzed with the help of datasets including the chi-square test, independent t-test, paired *t* test and ANOVA. Before treatment, there was no statistically significant difference in diastolic (DBP) and systolic blood pressure (SBP) between the 2 groups ($P > .05$). Compared with before treatment, the DBP and SDP in the 2 groups were significantly lower after treatment; the experimental group was lower than the control group, with a statistically significant difference ($P < .05$) (Table 1).

Table 1. Comparison of Blood Pressure in the Two Groups Before and After Treatment ($\bar{x} \pm s$)

Group	n	Systolic pressure (mmHg)		Diastolic pressure (mmHg)	
		Before treatment	After treatment	Before treatment	After treatment
Control	62	157.44 ± 20.81	135.73 ± 17.44	100.86 ± 10.36	95.34 ± 6.78
Experimental	62	158.32 ± 21.03	125.82 ± 16.34	101.68 ± 9.58	84.15 ± 6.03
t		0.233	3.264	0.459	9.715
P value		.817	.001	.647	<.001

Before treatment, there was no significant difference between the 2 groups in serum creatinine (sCr), blood urea nitrogen (BUN) and urinary albumin excretion rate (UAER) ($P > .05$) levels. Compared with before treatment, SCr, BUN and UAER levels in the 2 groups were significantly lower after treatment. The experimental group was lower than the control group, with a statistically significant difference ($P < .05$) (Table 2).

Table 2. Comparison of Renal Function Indices in the Two Groups Before and After Treatment ($\bar{x} \pm s$)

Group	n	sCr (μg/L)		BUN (mmol/L)		UAER (μg/min)	
		Before treatment	After treatment	Before treatment	After treatment	Before treatment	After treatment
Control	62	68.36 ± 9.13	60.26 ± 8.24	5.27 ± 0.26	4.12± 0.22	143.36 ± 26.28	129.22 ± 22.14
Experimental	62	69.22 ± 9.36	51.16 ± 7.42	5.34 ± 0.29	3.41± 0.20	144.26 ± 27.58	103.36 ± 18.38
t		0.518	6.469	1.392	18.961	0.186	7.076
P value		.606	<.001	.166	<.001	.853	<.001

Abbreviations: BUN, blood urea nitrogen; sCr, serum creatinine; UAER, urinary albumin excretion rate.

Table 3. Comparison of T-AOC, IL-6 and β2-MG Levels in the Two Groups ($\bar{x} \pm s$)

Group	n	T-AOC (IU/mL)		IL-6 (mmol/L)		β2-MG (μg/min)	
		Before treatment	After treatment	Before treatment	After treatment	Before treatment	After treatment
Control	62	9.02 ± 0.96	10.68 ± 0.68	48.16 ± 13.14	27.34 ± 9.87	6.11 ± 1.56	3.12 ± 0.87
Experimental	62	9.10 ± 0.98	12.08 ± 0.77	47.09 ± 12.97	20.44 ± 8.21	6.02 ± 1.41	2.26 ± 0.72
t		0.478	10.720	0.456	4.232	0.355	5.978
P value		.634	<.001	.649	<.001	.723	<.001

Abbreviations: β2-MG, beta 2-microglobulin; IL-6, interleukin 6; T-AOC, total antioxidant capacity.

Table 4. Comparison of Adverse Events in the Two Groups During Treatment

Group	n	Nausea n (%)	Palpitation n (%)	Drowsiness n (%)	Loss of appetite n (%)	Total n (%)
Control	62	3 (4.84%)	1 (1.61%)	1 (1.61%)	2 (3.23%)	7 (11.29%)
Experimental	62	2 (3.23%)	3 (4.84%)	1 (1.61%)	5 (8.06%)	11 (17.74%)
$\chi^2 = 1.040$						
$P = .308$						

Before treatment, there was no statistically significant difference between serum T-AOC, IL-6 or β2-MG levels in the 2 groups ($P > .05$). Compared with before treatment, patient IL-6 and β2-MG levels in both groups decreased significantly after treatment, and in the experimental group was lower than in the control group. The serum T-AOC levels in both groups increased significantly after treatment, and was higher in the experimental group than in the control group. The difference was statistically significant ($P < .05$) (Table 3).

No significant serious complications occurred in either group during treatment. Any adverse events (AEs) were treated symptomatically or instantaneously. By recording any toxicities that occurred in the 2 groups during treatment, we determined that the incidence of AEs was similar in both groups, with no significant variation ($P > .05$) (Table 4).

Diabetes and HTN have a high probability of coexistence, and the incidence of DN combined with HTN is significantly higher than in patients with diabetes alone. Diabetes, HTN and DN affect each other and form a vicious cycle. If targeted intervention is not started in time, it will seriously affect patients life and health, and the development of advanced stage nephropathy will lead to kidney failure and can become life-threatening. The complexity of the medication, the use of multiple medications and the number of doses that need to be administered throughout the day are all variables that may contribute to poor patient compliance. For example, combining medications to lower blood pressure from a variety of pharmacological groups is 2 to 5 times more effective than increasing the dose of a single medication. The pharmacological mechanism of 1 drug may well interfere with a detrimental reaction to a second drug. Medications that prevent fluid retention stimulated by bronchodilators and RAAS blockers avoid RAAS initiation generated by medications. With heart problems, the current medication regimens reduce coronary incidents by 29% and cerebral hemorrhage by 40%. However, combining medications with different pharmacologic mechanisms lessens cardiac incidents by 40% and stroke by 40%. But they are in higher cost and also involve AEs such as intense abdominal pain, nausea, joint pain, low energy, eye irritation and water retention. In addition, medication combinations have the potential to simplify treatment regimens and enhance patient adherence, and the suggested combinations may be less costly than the individual elements. Combination therapy has also been found to have better renoprotective and metabolic benefits than monotherapy, leading to the recommendation of the Chinese Endocrine Society in patients at high risk for diabetes who need combination treatment to achieve therapeutic objectives.

The results of our study conclude that treatment with valsartan amlodipine combined with α-lipoic acid on of T-AOC, IL-6 and β2-MG levels treatment is more efficacious, cost-effective, and part of the armamentarium in patients with DN and HTN.

DISCUSSION

This study was conducted to systematically understand the difference in the clinical value of treatment with valsartan amlodipine tablets alone and treatment with valsartan amlodipine tablet combined with α-lipoic acid in DN. The patients were randomly divided into the control group and the experimental group, and the corresponding therapeutic interventions were adopted. As shown in Table 1 and Table 2, the blood pressure

indices and renal function indices in the experimental group were closer to the normal range after treatment and effectively remained stable, and the combined regimen was significantly more effective than the single treatment regimen, suggesting a good synergistic effect of the combined treatment. T-AOC is an indicator of the antioxidant capacity of the body, and IL-6 is an important pro-inflammatory cytokine that responds rapidly in the acute disease phase and is most closely related to inflammatory injury in glomerular disease. It has been shown that valsartan reduces MDA and 8-hydroxydeoxyguanosine levels, inhibits cyclosporin-A-induced oxidative stress and attenuates renal damage. α-Lipoic acid, an antioxidant, reduces oxidative stress and also has significant therapeutic effects in CVD, DM and its complications and neurodegenerative diseases. In alloxan-induced diabetic rabbits, low doses of lipoic acid significantly reduced urinary albumin concentrations and improved oxidative stress and renal damage, thus proving this drug to be effective in the treatment of diabetes and DN.

In our study, the results showed that the combination of alpha-lipoic acid significantly increased T-AOC levels. We thus inferred that valsartan and amlodipine tablets combined with α-lipoic acid treatment inhibited oxidative stress, reduced the body's inflammatory response and enhanced antioxidant capacity.

β2-MG is a large polypeptide that is toxic, undergoes degradation and reabsorption in the kidneys, and is capable of causing dialysis-related amyloidosis, which can result in death. β2-MG is mainly produced by lymphocytes and platelets, and under normal physiological conditions, 99.9% of β2-MG is absorbed by the proximal tubule and destroyed in the endothelial cells of the renal tubule, so the serum level of β2-MG is low. When the proximal tubule is dysfunctional, serum β2-MG levels increase. In our study, serum β2-MG in both groups decreased after treatment compared with before treatment, and levels in the experimental group were significantly lower than in control group. Therefore, it is suggested that α-lipoic acid can improve renal proximal tubular function and thus reduce serum β2-MG.

According to our study data, treatment with valsartan and amlodipine tablets combined with α-lipoic acid was outstanding for the control of HTN, with a low incidence of related adverse events and without serious consequences that would make the treatment course difficult. When AEs caused by the 2 treatment regimens were compared during the follow-up period, the number of events such as nausea, palpitations, drowsiness and loss of appetite in the experimental group did not differ significantly from the control group, and valsartan and amlodipine tablets combined with alpha-lipoic acid treatment did not increase AEs.

Study Limitations

This study was limited by the small sample size. Subsequent studies are needed that expand the sample size and provide more in-depth research.

CONCLUSION

Based on our study findings, one may draw the conclusion that therapy with valsartan + amlodipine tablets coupled with α-lipoic acid has a substantial influence on T-AOC, IL-6 and 2β-MG in patients with DN. It adds to beneficial health advantages by reducing AEs, and achieves the alternative aims of care in DN. An effective and safe treatment alternative is available in the form of a fixed-dose combination of a valsartan and amlodopine with α-lipoic acid on T-AOC, IL-6 and 2β-MG levels in patients with HTN and diabetes who are not meeting their blood pressure objectives. This combination not only reduces the danger of AEs but also brings the cost of treatment down, making it more appealing to patients. On the other hand, given that the majority of preparations are only available in 1 or 2 presentations, it has the drawback of being less adaptable when the doses need to be adjusted.

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