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Role of Different Blood Purification Nursing Models in Uremic Patients: A Preliminary Report

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Data Collection B
Statistical Analysis C
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Background: Accumulation of uremic toxins is closely associated with chronic kidney disease (CKD)-related complications such as cerebrovascular accidents and cardiovascular diseases. Clinical nursing is accepted as a critical clinical prognosis factor for hospitalized patients. The present study was designed to compare the effects of different blood purification nursing models on clinical outcomes in patients with uremia.

Material/Methods: A total of 68 patients with uremia were selected and divided to control and intervention groups. The patients in the control group received traditional nursing model care, while the patients in intervention group received comprehensive high-quality nursing care for 6 months.

Results: After 6 months of treatment, the quality of life, anxiety, and depression were obviously ameliorated in both groups. The levels of blood urea nitrogen (BUN), parathyroid hormone (PTH), creatinine, β 2-microglobulin (β 2-MG), total cholesterol (TC), albumin (ALB), interleukin-1 β (IL-1 β), IL-6, tumor necrosis factor- α (TNF- α), C-reactive protein (CRP), 8-isoprostane, and malondialdehyde (MDA), as well as superoxide dismutase (SOD) and catalase (CAT) activities were all significantly improved in both groups of patients, but the intervention group exhibited better results than the control group.

Conclusions: Our results demonstrated that comprehensive high-quality nursing care rectified the metabolic disorders and inhibited systematic inflammatory factors, and oxidative stress, which may be responsible for better amelioration of quality of life in patients with uremia.

MeSH Keywords: **Anxiety, Separation • Depression • Inflammation • Quality of Life • Uremia**

Abbreviations: **ALB** – albumin; **β 2-MG** – β 2-microglobulin; **BUN** – blood urea nitrogen; **CAT** – catalase; **CKD** – chronic kidney disease; **CRP** – C-reactive protein; **ESRD** – end-stage renal disease; **IL-1 β** – interleukin-1 β ; **MDA** – malondialdehyde; **PTH** – parathyroid hormone; **SOD** – superoxide dismutase; **TC** – total cholesterol; **TNF- α** – tumor necrosis factor- α

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Background

The prevalence of chronic kidney disease (CKD) is increasing around the world and the prevalence of uremic patients with end-stage renal disease (ESRD) has continued to rise in recent years [1]. Hemodialysis, a kidney replacement therapy, is designed to eliminate blood toxins, which can improve the quality of life in uremic patients [2,3]. Medical resources are required for the treatment of uremia, especially in China [4]. Furthermore, the prognosis of hemodialysis in chronic uremia patients is not optimistic, almost half of the patients suffer from cardiovascular diseases such as ventricular arrhythmias, myocardial ischemia, atrial fibrillation tremor, heart failure, and CKD is an independent factor for cardiovascular diseases [5,6]. The cerebrovascular diseases and cardiovascular disorders are higher in peritoneal dialysis and hemodialysis patients [2,7]. These uremia-related cerebrovascular diseases and cardiovascular disorders exert life-threatening complications in uremic patients [8,9]. It is well recognized that hypertension, hyperlipidemia, malnutrition, poor histocompatibility of dialysis membrane, micro inflammatory state, and abnormal metabolism of calcium and phosphorus can cause cardiovascular and cerebrovascular diseases in the process of hemodialysis [10,11].

Dialysis patients are prone symptoms of depression and anxiety, which substantially affect their quality of life [10,12]. Excessive inflammatory response and oxidative stress are involved in the development of CKD, and abnormal systematic inflammatory response and oxidative stress accelerates renal injury progression; therapeutic targets against inflammation and oxidative stress may be beneficial for lowering uremic targeted organs toxicity [13–15]. It has been shown that hemodialysis can retard inflammation and oxidative stress, thus improving quality of life of patients with CKD [16]. Clinical nursing is an important part of hospital events, the application of nursing has been substantially evolving for chronic diseases in China [17,18]. Clinical nursing plays essential roles in the management of patients' self-management strategies [19]. A nurse's experience is helpful to achieve the goals of assisting a person to master the appropriate health behavior [20]. However, it is still uncertain whether clinical nursing can affect the quality of life and emotional state in uremic patients. Therefore, the present study was performed to examine the effect of clinical nursing on the effect of therapy for uremic patients.

Material and Methods

Study design

This study conformed to the rules of the Ethics Committee of the Second People Hospital of Nantong and was in compliance with the Helsinki Declaration. Written informed consents were

Table 1. Baseline clinical characteristics of the patients.

Characteristics	Control group (n=34)	Intervention group (n=34)
Age, years	55.4±11.5	54.9±12.5
Sex (male/female)	21/13	13/11
BMI, kg/m ²	21.3±2.4	21.4±1.8
Dialysis duration (months)	32.1±5.8	32.4±4.9
SBP (mm Hg)	142.3±16.3	140.9±15.8
Kt/Vurea	1.62±0.14	1.65±0.12
Education level		
≤ Middle school	9	11
High school	22	19
≥ College	3	4
Primary disease diagnosis		
Diabetic nephropathy	3	4
Chronic glomerulonephritis	9	11
Hypertensive nephropathy	5	5
End-stage kidney disease	14	12
Other primary diseases	3	2
Mean urine volume		
<100 ml/24 h	13	14
>100 ml/24 h	11	10

The baseline biochemical parameters in the intervention and control groups before treatment were analyzed by using paired t tests for normally distributed and signed rank test for skewed parameters. The comparison with categorical variables was analyzed using the Chi square test or paired T test.

collected from the candidate patients or their guardians. At the end point of the study, we compared the effects of conventional and clinical nursing pathways on the quality and emotional symptoms in uremic patients. Participants, between January 2014 and March 2015, were selected in accordance with the following inclusion criteria: ages between 18 and 70 years, voluntary participation; signed consent form. Patients with acute infection, cardiac dysfunction, severe anemia, or cardiopulmonary diseases or psychiatric diseases were excluded from this study. A total of 68 cases with uremia were eligible for the current study, and they were randomly assigned to 2 groups, with 34 cases in each group. There was no significant difference in basic characteristics including gender, age, blood pressure, education level, body mass index (BMI), primary disease diagnosis, and mean urine volume between the 2 groups as shown in Table 1.

Treatment method

All patients underwent high flux hemodialysis treatment as described in a previous report [3]. The patients in the 2 groups were treated with alimentary control, ferralia, erythropoietin (EPO), folic acid, calcium carbonate, and other basic treatment drugs [21]. The patients in the control group received conventional nursing: 1) ensure hemodialysis was conducted according to the doctor's advice to prevent and optimize possible complications; 2) provide health guidance and psychological care; 3) explain hemodialysis related knowledge; 4) observe complications during treatment; 4) meticulously answer questions raised by the patient. On the basis of the control group, the intervention group received comprehensive high-quality nursing. 1) A new social support system was established, and nurses conducted positive guidance to relax pressure or stress and ensure good mental status of patients in the intervention group by providing patients with relevant information support and information feedback. Health guidance and psychological intervention was carried out once a week. During the dialysis process, music therapy and sleep therapy was used to help patients maintain a more comfortable mood and relieve tension and anxiety. Any current problems in the family and the patient's mental state and psychological state were better understood by communicating with family members. In the area of health education, nurses taught patients' family members how to care for the patients and how to prevent potential complications. 2) Nutritional intervention was strictly implemented; bland diet and an appropriate nutrition package were formulated according to the patient's specific circumstances. Fish, eggs, lean meat, milk and other high protein foods and adequate carbohydrates are selected; vitamins and minerals are appropriately added; and any vegetable protein food was prohibited. The patients were told to use a graduated glass to drink less water during dialysis to avoid cardiovascular and water intoxication. If a patient had less urine, the patient's intake of trace elements, such as sodium, phosphorus and calcium, should be controlled during dialysis. For each dialysis, the nurse analyzed the body mass and diet of the patient to prevent improper diet and water intake. 3) Individual aerobic exercise was instructed for each patient to improve cardiovascular function. The patients were guided to regularly work and rest without staying up all night. Calisthenics, walking, and stretching were performed 10 minutes before dialysis, and patients were instructed to walk for 30 minutes 2 hours after dialysis. Our hospital's prescription included walking, relaxing gymnastics, Taijiquan, and health gymnastics. 4) Patients and their families were informed of the purpose and details of the administration of the treatment and the possible complications before dialysis. During the course of dialysis, the indexes of each patient were closely observed. Once adverse reactions occurred, appropriate control measures were taken to reduce the possibility of complications. 5) Patients and their families

were informed about family care and self-care for uremia, and the nurse guided the patients and their families to help them master the necessary health knowledge. At the same time, nurses educated patients to help form a correct understanding of their disease, and remain optimistic, emotional stability, engage in correct lifestyle and eating habits, avoid poor nutrition, prevent excessive fatigue, and understand prescribed medication. In addition, the nurse asked the patient to pay attention to cold, warm temperatures, and adhere to moderate exercise, in order to improve their immunity.

Outcome measurement

During the 6 months of treatment, sleep disorders, appetite, pruritus, arthralgia, feeling thirsty, and the incidence of cardiovascular and cerebrovascular complications in both groups were recorded.

Quality of life

Sleep disorders, pruritus, arthralgia, appetite, feeling thirsty, and the incidence of cardiocerebrovascular complications in both groups were recorded. An internationally standard assessment indicator of the Medical Outcomes Study 36-Item Short Form Health Survey (SF-36) was used for elevation of the quality of life as previously described in other studies [5,6]. The scores for physical functioning, general health perceptions, mental health, bodily pain, vitality, social role functioning, and emotional role functioning were quantified for analysis. The quality of sleep was measured with the Pittsburgh Sleep Quality Index (PSQI) and the Mental Component Summary (MCS) scale from the 12-item short-form (SF-12; version 2) was applied to evaluate the quality of life in enrolled patients before and after treatment. as described in a previous report [3].

Anxiety and depression

Emotional symptoms, including anxiety and depression, in all patients before and after treatment were assessed by the Zung Self-rating Anxiety Scale (SAS) and the Zung Self-rating Depression Scale (SDS) as previously described [22]. Lower SAS and SDS scores suggested the more mitigated levels of anxiety and depressive symptoms.

Laboratory data

The collected samples were stored at -80°C prior to use. The levels of $\beta 2$ -microglobulin ($\beta 2$ -MG), blood urea nitrogen (BUN), creatinine, parathyroid hormone (PTH), total cholesterol (TC), and albumin (ALB) were determined in our hospital using standard techniques as described in a previous report [3]. The commercial kits for interleukin- 1β (IL- 1β), IL-6, C-reactive protein (CRP), and tumor necrosis factor- α (TNF- α) were purchased

from BOSTER (Wuhan, China) following the manufacturer's protocols as previously described [23,24].

Oxidative stress related factors

Superoxide dismutase (SOD) and catalase (CAT) activities were examined using the xanthine oxidase method following the manufacturer's instructions (Nanjing Institute of Biological Engineering, Nanjing, China) [25]. Malondialdehyde (MDA) content was determined using the thiobarbituric acid method (Nanjing Institute of Biological Engineering, Nanjing, China) as previous report [25–27]. The serum level of 8-isoprostane was measured using a commercial enzyme-linked immunosorbent assay (ELISA) kit according to manufacturer's protocols (Detroit R&D Inc., Detroit, MI, USA) [28].

Statistical analysis

All data were analyzed using SPSS 15.0 for Windows. Data were defined as mean \pm standard deviation (SD) or percentage. Wilcoxon tests were used when the independent nonnormally distributed groups were compared. Two groups of quantitative data were compared with independent *t*-test. Intragroup comparison before and after treatment was conducted with paired *t*-test. Qualitative data was performed with chi-square test or rank-sum test. $P < 0.05$ was considered statistically significant.

Results

Clinical features

A total of 68 screened dialysis patients were selected for this study; 34 patients were divided in a control and an intervention group, respectively. No significant difference was observed regarding the socio-demographic characteristics, dialysis, and primary disease diagnosis between the 2 groups (Table 1).

Quality of life and improvement of complications

At the initiation stage of treatment, the scores for general health, physical functioning, bodily pain, vitality, mental health, social role functioning, emotional role functioning, PSQI, and SF-12 were not significantly different between the 2 groups before treatment, but the scores for quality of life indicators in the intervention group after treatment showed a better improvement (Table 2). After treatment of 6 months, in comparison with the control group, sleep disorders, pruritus, arthralgia, appetite, and feeling thirsty were more significantly improved in the intervention group (Table 3). In addition, the incidence of cardiocerebrovascular complications in the intervention group was significantly lower compared to the control group (Table 4).

Table 2. Changes in the quality of life in two groups.

	Control group	Intervention group
General health		
Baseline	25.1 \pm 3.2	26.5 \pm 4.1
6 month after treatment	34.9 \pm 5.1*	49.1 \pm 5.1**
Physical functioning		
Baseline	43.2 \pm 3.5	42.9 \pm 3.7
6 month after treatment	56.1 \pm 5.4*	68.1 \pm 7.4**
Bodily pain		
Baseline	51.2 \pm 6.2	52.1 \pm 6.3
6 month after treatment	61.2 \pm 7.2*	74.1 \pm 8.5**
Vitality		
Baseline	28.6 \pm 4.1	29.6 \pm 4.2
6 month after treatment	38.2 \pm 4.2*	49.1 \pm 5.9**
Mental health		
Baseline	45.3 \pm 3.7	44.6 \pm 3.3
6 month after treatment	57.3 \pm 5.6*	65.4 \pm 5.8**
Social role functioning		
Baseline	32.1 \pm 2.9	33.1 \pm 3.6
6 month after treatment	41.6 \pm 4.2*	49.7 \pm 4.5**
Emotional role functioning		
Baseline	48.6 \pm 3.8	47.7 \pm 4.1
6 month after treatment	59.9 \pm 4.6*	68.1 \pm 5.7**
PSQI		
Baseline	12.8 \pm 2.9	13.1 \pm 3.8
6 month after treatment	7.1 \pm 2.3*	2.4 \pm 1.2**
SF-12		
Baseline	40.3 \pm 5.1	39.8 \pm 4.9
6 month after treatment	49.7 \pm 5.6*	63.2 \pm 7.9**

* $P < 0.05$ compared with that before treatment in each group;
$P < 0.05$ compared to control group by covariance analysis at the same period. The baseline biochemical parameters in the intervention and control groups before treatment were analyzed by using paired *t* tests for normally distributed and signed rank test for skewed parameters. Independent *t* tests were applied to detect the differences in measurement data between two groups after treatment.

Table 3. Improvement of complications in two groups after treatment.

	Control group	Intervention group	χ^2	P
Sleep Improvement	23.5% (8/34)	61.7% (21/34)*	10.161	0.001
Appetite Improvement	26.5% (9/34)	52.9% (18/34)*	4.976	0.026
Pruritus Improvement	32.4% (11/34)	61.8% (21/34)*	5.903	0.015
Arthralgia Improvement	35.3% (12/34)	73.5% (25/34)*	10.019	0.002
Thirsty Improvement	29.4% (10/34)	70.6% (24/34)*	11.529	0.001

* $P < 0.05$ compared with control group. The comparison with categorical variables was analyzed using the Chi square test.

Table 4. Comparison of the incidence of cardio cerebral vascular complications in two groups.

	Control group	Intervention group
Cerebral hemorrhage	4	1
Cerebral infarction	3	1
Angina	6	2
Miocardial infarction	5	1
Hypotension	5	2
Arrhythmia	7	2
Total	30	9*

* $P < 0.05$ compared with control group. The comparison with categorical variables was analyzed using the Chi square test.

Anxiety and depression

There was no statistical significance in the SAS and SDS scores between the control group and the intervention group before treatment. After treatment, the SAS and SDS scores in the intervention group exhibited more improvement (Figure 1).

Laboratory data and cytokine levels

Before treatment, the levels of BUN, creatinine, PTH, TC, β 2-MG, and ALB were not significantly different between the control group and the intervention group. After treatment, these indices were all obviously improved in both groups within 6-month follow-up. In comparison with the control groups, there was greater improvement in these changes from baseline in the intervention group (Figure 2). The baseline TNF- α , IL-1 β , CRP, and IL-6 levels did not differ significantly between the intervention group and the control groups before treatment. Both groups showed the obvious reductions in TNF- α , IL-1 β , CRP, and IL-6 levels after treatment. The levels of TNF- α , IL-1 β , CRP, and IL-6 were significantly decreased in the intervention group (Figure 3).

Oxidative stress related factors in the 2 groups before and after treatment

The levels of 8-isoprostane and MDA, as well as SOD and CAT activities were similar to the 2 groups at baseline. Both groups showed obvious improvement in 8-isoprostane and MDA, as well as SOD and CAT activities after 6 months of treatment. However, the oxidative stress related factors within 6-month

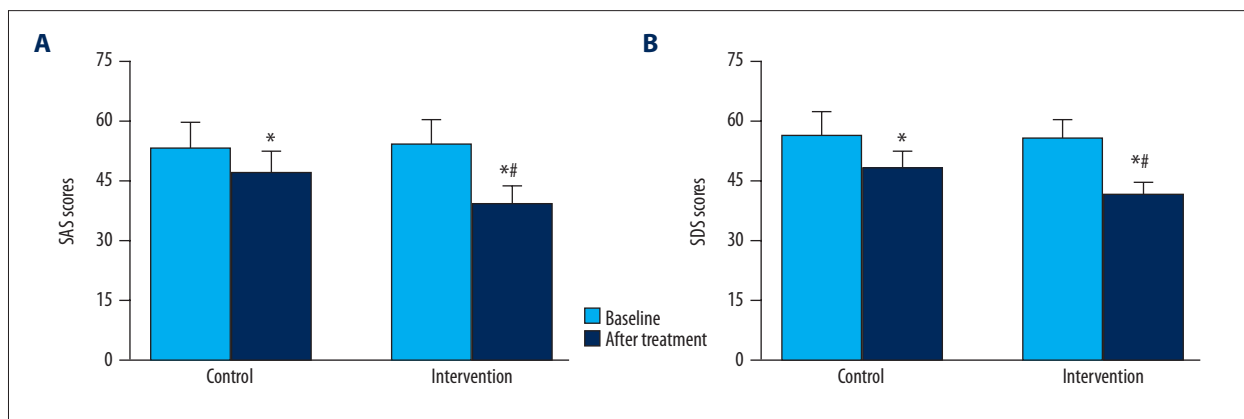


Figure 1. Comparisons of scores for SAS and SDS: (A) comparison of SAS scores; (B) comparison of SDS scores. SAS, Zung Self-rating Anxiety Scale; SDS, Zung Self-rating Depression Scale. * $P < 0.05$ vs. baseline, # $P < 0.05$ vs. control; $n = 34$ for each group.

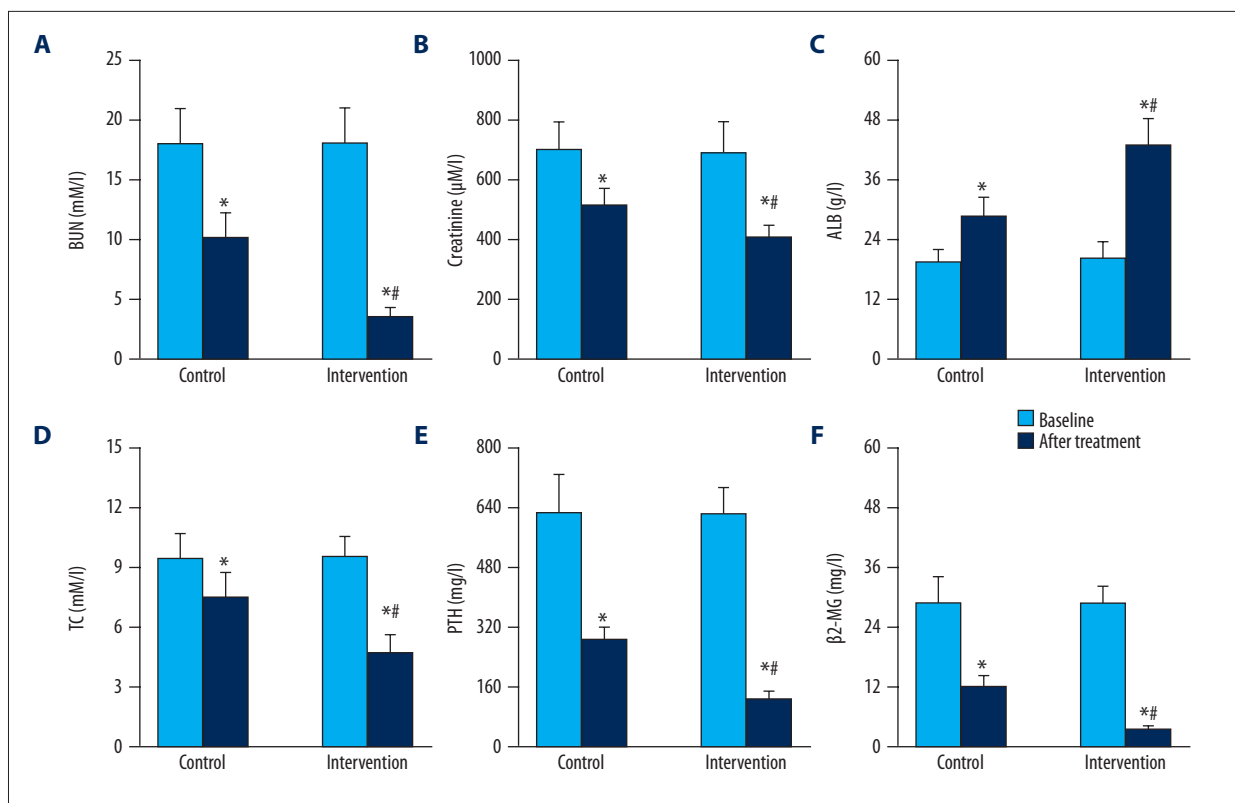


Figure 2. Comparisons of BUN, creatinine, PTH, TC, β2-MG, and ALB levels: (A) comparison of BUN; (B) comparison of creatinine; (C) comparison of ALB; (D) comparison of TC; (E) comparison of PTH; (F) comparison of β2-MG. BUN – blood urea nitrogen; PTH – parathyroid hormone; ALB – albumin; TC – total cholesterol; β2-MG – β2-microglobulin. * $P < 0.05$ vs. baseline, # $P < 0.05$ vs. control; $n = 34$ for each group.

follow-up revealed significantly greater improvement in the intervention group compared to the control group (Figure 4).

Discussion

Nursing in China is increasingly recognized as a profession clinical skill and nursing quality has enormously improved in recent years [20]. Clinical nursing is necessary for relieving disease symptoms and accelerating the rehabilitation of the hospitalized patient [17]. In this present study, our results demonstrated the beneficial effects of comprehensive high-quality nursing on quality of life, anxiety, and depression in uremic patients. In comparison with conventional nursing, the comprehensive high-quality nursing was more effective in terms of quality of life and alleviation of clinical presentations. The beneficial actions of comprehensive high-quality nursing may be associated with inhibition of inflammatory response and oxidative stress. The limitations in this present study included small sample size and short follow-up time. Consequently, multicenter, large sample clinical trials are required for measurement of long-term efficacy, safety, and tolerability of comprehensive high-quality nursing for uremic individuals.

Extreme hyperkalemia, pulmonary edema, ventricular arrhythmia, and uremic autonomic neuropathy are overwhelming and life-threatening complications in progressively developed uremic symptoms [8]. There is an enormously increased incidence of cardiocerebrovascular complications in patients with hemodialysis, which contributes to the high risk of cardiovascular morbidity and mortality [29]. A global cross-sectional study found that uremia patients had lower quality of life accompanied with anxiety, depression, poor sleep, and increased mortality [3]. Anxiety and depression are common psychiatric symptom in ESRD patients treated with hemodialysis [30,31]. An internationally standard assessment indicator of SF-36 was used for assessment of quality of life [5,6]. Furthermore, the sleep quality was quantified with the PSQI and SF-12 [3]. It has been recommended that hemodialysis can be used to improve the survival rate and quality of life of patients with ESRD [3,21]. In recent years, Chinese nurses have formed a professional discipline, the nursing model has been broadened from hospital care to community care, from care concerning sustaining life to care concerning quality of life and health status [20]. In this study, our results showed that for basic treatment of uremic patients with regular hemodialysis, comprehensive high-quality nursing care exhibited a better

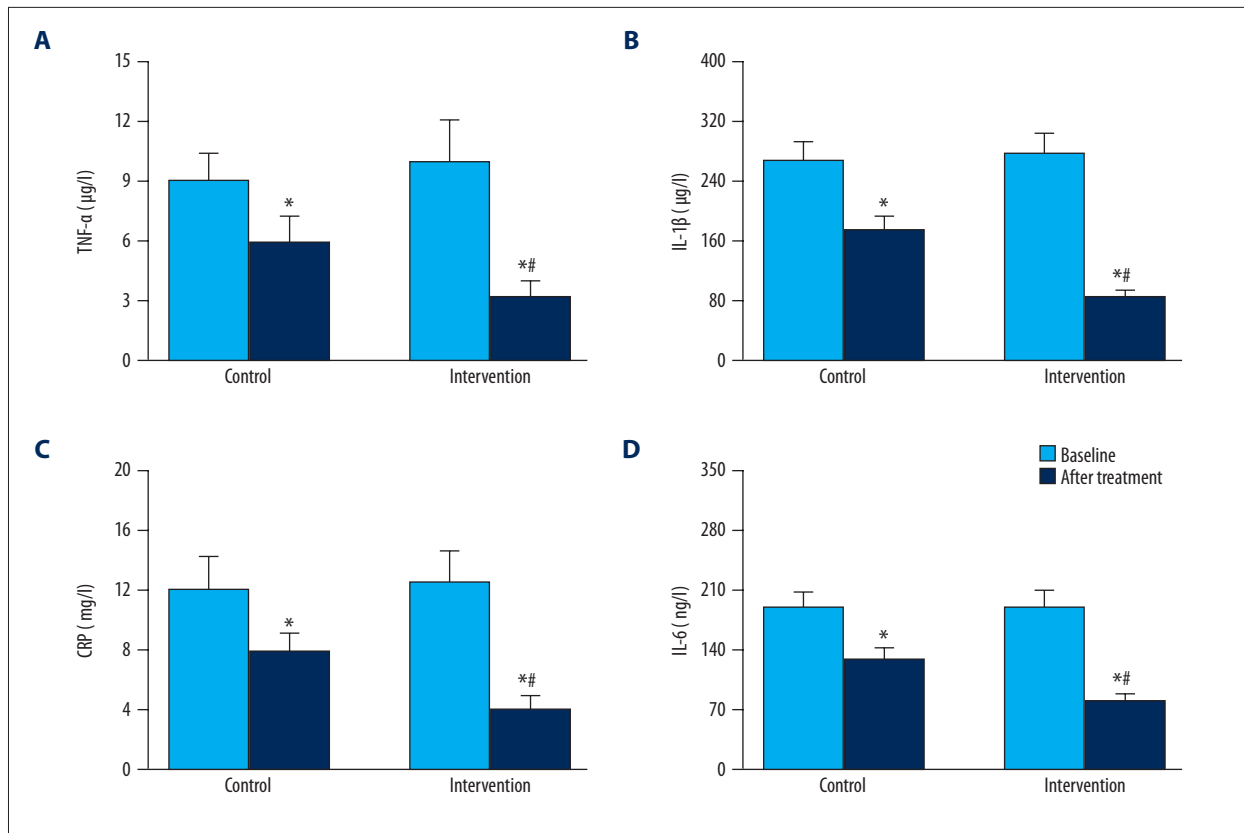


Figure 3. Comparisons of TNF- α , IL-1 β , CRP and IL-6 levels: (A) comparison of TNF- α ; (B) comparison of IL-1 β ; (C) comparison of CRP; (D) comparison of IL-6. TNF- α – tumor necrosis factor- α ; IL-1 β – interleukin-1 β ; CRP – C-reactive protein; IL-6 – interleukin-6. * $P < 0.05$ vs. baseline, # $P < 0.05$ vs. control; $n = 34$ for each group.

improvement in quality of life, scores for SAS and SDS, sleep disorders, pruritus, arthralgia, appetite, and feeling thirsty, as well as incidence of cardiocerebrovascular complications compared to the control group. These results suggest that comprehensive high-quality nursing represents a good strategy for amelioration of the decreased quality of life, sleep, emotional symptoms, and cardiocerebrovascular complications during the process of hemodialysis in uremic patients.

Renal transplantation may be the most effective method for treatment of uremia [32]. Hemodialysis is developed to remove both small and middle molecules with advantageous effects on hemodynamic stability [3]. Dialysis patients can have calcium and phosphorus disorders, parathyroid gland hyperthyroidism, and lipid metabolism dysfunction [3,16,32]. The accumulation of PTH and β 2-MG contribute to vascular calcification and renal osteodystrophy [33]. Our results showed that the levels of BUN, creatinine, PTH, TC, β 2-MG, and ALB were all remarkably improved in the 2 study groups. In addition, there was more improvement in these changes in the intervention group. These results suggest that comprehensive high-quality nursing may modulate metabolism disorders to improve renal function in the process of hemodialysis in uremic patients.

Inflammatory response and oxidative stress participate in the pathophysiology of uremia, and uremia toxins induce systematic inflammatory reaction and oxidative stress, which may accelerate the renal injury progression [7,10,34]. Hemodialysis has been found to minimize inflammation and oxidative stress in patients with CKD [29]. In comparison with healthy controls, the levels of IL-1 β , IL-6, and TNF- α were found to be significantly higher in hemodialysis patients [10]. Our data showed that the baseline TNF- α , IL-1 β , CRP, and IL-6 levels, as well as the expressions of 8-isoprostane and MDA, SOD, and CAT activities did not differ significantly between our 2 groups before treatment. However, the inflammation and oxidative stress related factors within 6-month follow-up revealed significantly greater improvement in the intervention group compared to the control group. These results suggested that comprehensive high-quality nursing may relieve uremic symptoms and improve quality of life, anxiety, and depression via inhibition of systematic inflammation response and oxidative stress in the process of dialysis.

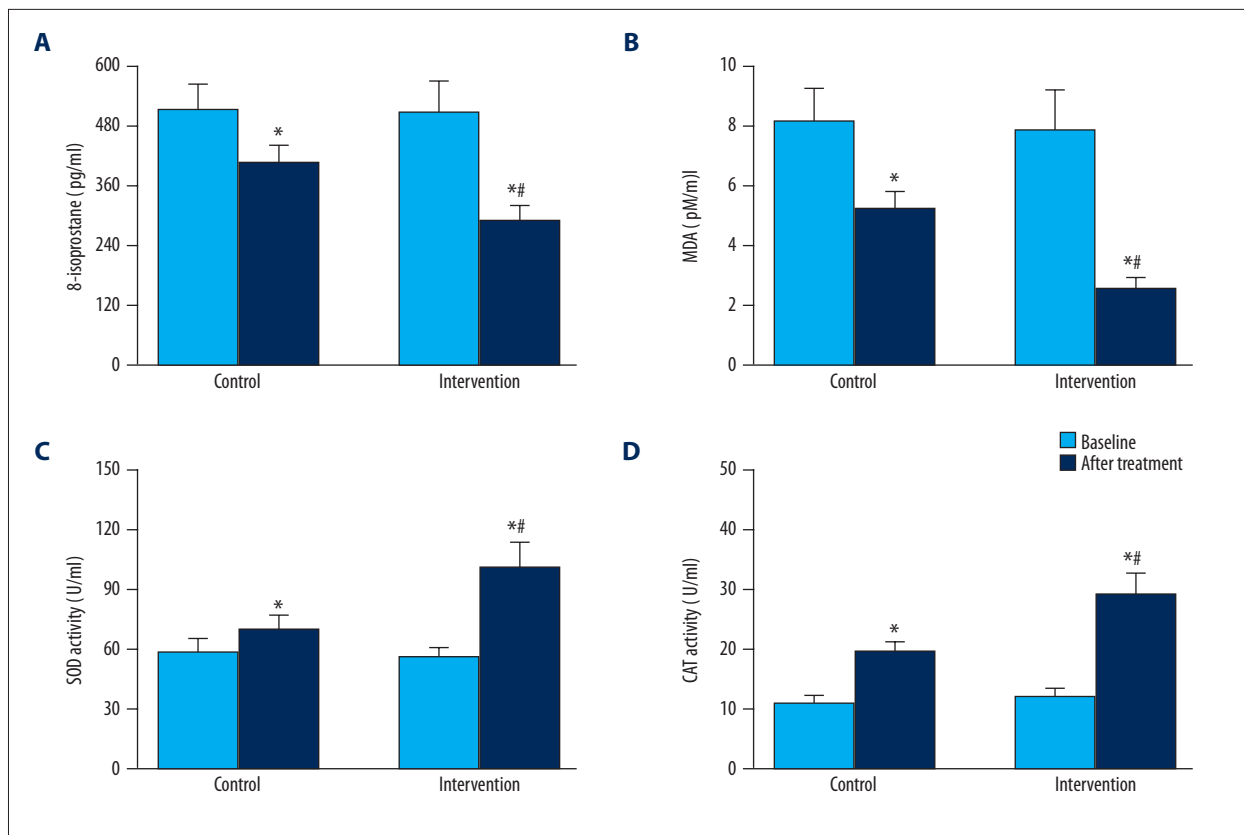


Figure 4. Comparisons of 8-isoprostane and MDA, as well as SOD and CAT activities: **(A)** comparison of 8-isoprostane; **(B)** comparison of MDA; **(C)** comparison of SOD activity; **(D)** comparison of CAT activity. MDA – malondialdehyde; SOD – superoxide dismutase; CAT – catalase. * $P < 0.05$ vs. baseline, # $P < 0.05$ vs. control; $n = 34$ for each group.

Conclusions

In conclusion, comprehensive high-quality nursing was shown to be an important auxiliary approach for treatment of uremia, and it is worthy of clinical application. However, a larger sample of prospective research with long-term follow-up is needed to determine the effects of comprehensive high-quality nursing on uremic patients.

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