

Original Article

Early enteral nutrition combined with PSS-based nursing in the treatment of organophosphorus pesticide poisoning

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Abstract: Objective: To investigate the administration of early enteral nutrition combined with poisoning severity score (PSS)-based nursing in the treatment of organophosphorus pesticide poisoning (OPP). Methods: A total of 99 OPP patients treated in our hospital between June 2019 and June 2020 were enrolled in this study and were divided into the conventional group (n=46, early enteral nutrition support + routine care) and the combined group (n=53, PSS-based nursing + early enteral nutrition support + routine care). The nutritional status indicators, the hemoglobin (Hb) and blood glucose levels, the Glasgow coma scale (GCS) scores, and the complications were compared between the two groups. Results: The total protein (TP), albumin (ALB), and prealbumin (PAB) levels were reduced in the conventional group after the intervention ($P<0.05$) but were significantly lower than they were in the combined group ($P<0.05$). The Hb and blood glucose levels were decreased in the conventional group after the intervention ($P<0.05$) and were significantly higher than they were in the combined group ($P<0.05$). The GCS scores increased significantly as the treatment progressed ($P<0.05$), and the GCS scores in the combined group were significantly higher than the GCS scores in the conventional group at 3 and 5 days after the treatment ($P<0.05$). The time to the recovery of 60% cholinesterase (CHE) activity, the durations of the mechanical ventilation, the lengths of the hospital stays, and the hospital costs in the combined group were significantly lower than they were in the conventional group ($P<0.05$). The complication rate in the combined group (9.43%) was significantly lower than the complication rate in the conventional group (32.61%) ($P<0.05$). Conclusion: Early enteral nutrition combined with PSS-based nursing can effectively control the blood glucose, improve the nutritional disorders, promote recovery, and reduce complications in OPP patients.

Keywords: Early enteral nutrition, PSS, nursing, organophosphorus pesticide poisoning

Introduction

Organophosphorus pesticides are powerful insecticides that may lead to poisoning through unsafe use, accidental drinking, or suicide attempts in farming areas. The toxicity of organophosphorus pesticides is manifested by the inhibition of cholinesterase (CHE), leading to a large accumulation of acetylcholine, causing nerve stimulation followed by inhibition [1]. The clinical symptoms of organophosphorus pesticide poisoning (OPP) include pulmonary

edema, coma, and respiratory paralysis. The CHE activity is less than 30%. The condition is very dangerous. The onset of symptoms often occurs within minutes to hours, but some symptoms can take weeks to appear. OPP has a high mortality rate [2].

OPP results in muscle tremors and convulsions, and adequate and continuous atropine administered during resuscitation causes an increase in the body temperature and an increase in metabolism, consuming a large amount of

nutrients, while inadequate nutrition can adversely affect the functions as well as the morphology of the organs and tissues of the organisms [3]. Therefore, nutritional support is the key to the success of the resuscitation. Enteral nutrition support can prevent damage to the intestinal origin, maintain the integrity of the intestinal mucosal structure and the intestinal barrier, and effectively supplement nutrition and improve nutritional disorders as well as the quality of life. It has been found that that when nutritional support is given in combination with effective nursing interventions, the risk of complications can be decreased [4].

The poisoning severity score (PSS) is a quantitative, objective index in the assessment of a patient's condition as well as the prognosis, and different nursing instructions will be given according to the severity of the condition [5]. There are few studies on the exploration of the role of PSS-based nursing in the treatment of OPP, which is the focus of the present study.

Materials and methods

General data

Ninety-nine OPP patients admitted to our hospital between June 2019 and June 2020 were recruited as the study cohort and divided into the conventional group (n=46, early enteral nutrition support + routine care) and the combined group (n=53, PSS-based nursing + early enteral nutrition support + routine care). Inclusion criteria: All the patients were diagnosed with OPP and met the relevant diagnostic criteria [6]: ① patients with a clear exposure to organophosphorus pesticides or oral administration, ② patients with typical manifestations of cholinergic and muscarinic poisoning, in a coma, and with pulmonary edema and respiratory failure, ③ patients with a serum CHE activity <30%, ④ and patients with normal gastrointestinal function and in need of nutritional support. Exclusion criteria: ① patients with a history of pesticide poisoning, ② patients who died within 24 hours of admission, ③ patients with uncontrolled diabetes mellitus, ④ patients with serious liver and kidney insufficiency, ⑤ patients with serious diseases of the vital organs, ⑥ patients with unstable vital signs for more than 24 hours, ⑦ overweight or underweight patients, ⑧ and patients with poor communication abilities,

cognitive impairment, or mental illness. This study was approved by the Ethics Committee of Qingdao Women and Children's Hospital. The patients and their families were informed of the study, and they signed the informed consent forms.

Methods

In the conventional group, early enteral nutrition and routine care were provided. Intubation was performed first, and if no abnormalities were observed, the enteral nutrition preparation was infused at a dose of 500 mL on the first day, and the dose was gradually increased to 1500-2000 mL from the second day of treatment according to each patient's condition, and routine care was administered, such as blood glucose control. The patients' blood glucose levels were tested every two hours when the enteral nutrition was infused, and the appropriate amount of insulin was administered according to the test results.

The combined group was administered PSS-based nursing in addition to the nursing care administered to the control group. The PSS scores were determined by two experienced physicians and two nurses within 24 hours after admission. The highest score was recorded. A PSS score of 10-20 was considered severe and one specialist nurse was assigned for this patient. A PSS score of 21-35 was considered critical, and 1.5 specialist nurses were assigned (i.e. 3 specialist nurses for 2 patients). A PSS score of 35 or more was considered very critical and 2 specialist nurses were assigned for this patient [7]. The nursing intervention was carried out by professional nurses. Early enteral nutrition was performed within 48 h after surgery. Before the injection of nutrition solution, it was necessary to shake the nutrition solution well to avoid blockage in the tube, and it was also necessary to ensure gastric emptying before the infusion, and to stop the infusion when the patient had retention or diarrhea. When the patient experienced dyspnea, cyanosis, or other adverse symptoms due to the intubation, nasal feeding tube care was given in a timely manner, such as elevating the patient's head to lower the intracranial pressure and prevent gastric reflux. During the infusion, it was also necessary to supplement water in a timely manner to avoid water-electrolyte disorders.

Outcome measurement

① Four mL of venous blood was drawn from the patients at admission (before the intervention) and at two weeks (after the intervention), and the total protein (TP), albumin (ALB), prealbumin (PAB), hemoglobin (Hb), and blood glucose levels were measured using a Vi-CELL XR automatic cell counter (Beckman Coulter, USA). ② The clinical indicators were recorded, including the times to recovery of 60% CHE activity, the times spent on the ventilator, the lengths of the hospital stays, and the hospital costs. ③ The Glasgow coma scale (GCS) [8] was used to assess the degree of coma in the patients, with a GCS score of 3 to 8 indicating severe coma, a GCS score of 9 to 12 indicating moderate coma, and a GCS score of 13 to 14 indicating mild coma. ④ The incidences of complications, including arrhythmias, myocarditis, and toxic encephalopathy, were recorded.

Statistical methods

All the data were processed using SPSS 22.0. The count data were expressed as (*n*, %) and compared using χ^2 tests. The measurement data were expressed as ($\bar{x} \pm s$) with paired t-tests for the within-group comparisons and independent samples t-tests for the between-group comparisons. Comparisons at multiple time points were made using repeated measures ANOVA with post hoc LSD-t tests. $P < 0.05$ indicated a significant difference.

Results

Baseline data

The baseline data regarding age, sex, duration of the illness, type of poisoning, and the intake amount were compared between the two groups, and the differences were insignificant ($P > 0.05$) (Table 1).

Early enteral nutrition and PSS-based nursing reduced nutritional indicators

The TP, ALB, and PAB levels were not significantly different between the two groups before intervention ($P > 0.05$). After the intervention, the TP, ALB, and PAB levels were reduced in the combined group ($P < 0.05$) and were significantly higher in the combined group compared with the conventional group ($P < 0.05$) (Table 2).

PSS-based nursing decreased Hb and controlled blood glucose

Before the intervention, the Hb and glucose levels were (123.73 ± 10.94) g/L and (19.36 ± 5.31) mmol/L, respectively in the combined group, and (124.12 ± 11.18) g/L and (19.47 ± 5.81) mmol/L, respectively in the conventional group ($P > 0.05$). The Hb and glucose levels were decreased in both groups after the intervention ($P < 0.05$), and were (20.42 ± 6.43) g/L and (7.28 ± 1.55) mmol/L, respectively in the combined group, which were significantly lower than the values of (25.66 ± 7.47) g/L and (0.53 ± 3.08) mmol/L, respectively in the conventional group ($P < 0.05$) (Figures 1, 2).

PSS-based nursing improved the degree of coma

The GCS scores were statistically significant at multiple time points, between groups, and time vs. group interaction ($P < 0.05$). The post hoc LSD-t showed that the GCS scores on the fifth day of treatment were higher than they were on the first and third days of treatment ($P < 0.05$). The GCS scores in the combined group were significantly higher than they were in the conventional group on the first and third days ($P < 0.05$) (Figure 3).

The PSS-based nursing improved the OPP symptoms

The times to the recovery of 60% of the CHE activity, the ventilator durations, the lengths of the hospital stays, and the hospital costs in the combined group were significantly less than they were in the conventional group ($P < 0.05$) (Figure 4).

The PSS-based nursing reduced the complications

The complication rate in the combined group was 9.43%, which was significantly lower than the rate of 32.61% in the conventional group ($P < 0.05$) (Table 3).

Discussion

Most OPP patients are in a coma and are unable to eat, resulting in nutritional deficiencies, low immunity, and the aggravation of the patient's condition. When OPP patients are in a coma, the autonomic regulation of the central

Early enteral nutrition and PSS-based nursing

Table 1. Comparison of the baseline data ($\bar{x} \pm s$; n , %)

Groups	Number of cases	Age (years)	Gender		Duration of illness (h)	Type of poisoning				Intake amount of poison (mL)
			Male	Female		Trichlorfon	Dimethoate	Thiophanate-methyl	Dichlorvos	
Combined group	53	38.92±9.38	21 (39.62)	32 (60.38)	4.51±1.43	5 (9.43)	11 (20.75)	13 (24.53)	24 (45.28)	106.75±30.13
Conventional group	46	38.58±9.17	17 (36.96)	29 (63.04)	4.44±1.35	5 (10.87)	9 (19.57)	10 (21.74)	22 (47.83)	117.42±35.84
<i>t</i>		0.182		0.074	0.249			0.025		1.609
<i>P</i>		0.856		0.786	0.804			0.875		0.111

Early enteral nutrition and PSS-based nursing

Table 2. Comparison of nutritional indicators before and after the intervention (n, %)

Groups	Time points	TP (g/L)	ALB (g/L)	PAB (g/L)
Combined group (n=53)	Before intervention	71.06±6.44	42.33±3.49	214.58±56.06
	After intervention	70.13±3.89	42.92±5.54	208.32±34.37
t_a		0.874	0.607	0.672
P_a		0.385	0.545	0.503
Conventional group (n=46)	Before intervention	71.57±5.52	42.25±4.19	216.31±34.57
	After intervention	66.36±7.11	37.87±5.43	179.39±51.31
t_a		3.926	4.331	4.047
P_a		<0.001	<0.001	<0.001
t_b		0.402	0.098	0.176
P_b		0.689	0.923	0.860
t_c		3.330	4.565	3.334
P_c		0.001	<0.001	0.001

Note: t_a , P_a indicates within-group comparisons, t_b , P_b indicates pre-intervention comparisons, and t_c , P_c indicates post-intervention comparisons.

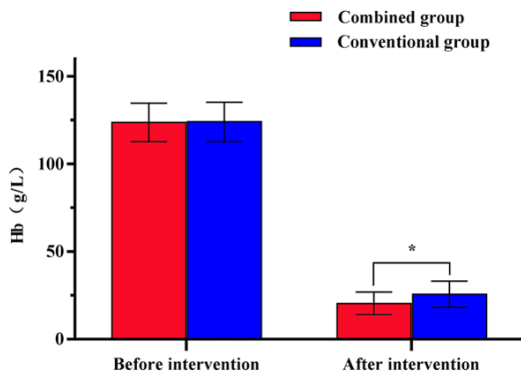


Figure 1. Comparison of the Hb levels before and after intervention. Significant difference was observed in Hb levels between the two groups before the intervention ($P>0.05$). After the intervention, the Hb levels in the combined group were significantly lower than they were in the conventional group ($P<0.05$). *Compared with the conventional group, $P<0.05$.

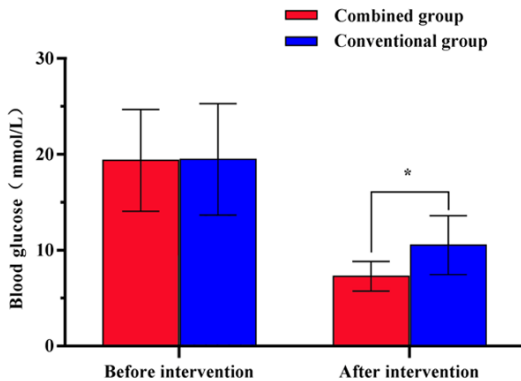


Figure 2. Comparison of the blood glucose levels in the two groups. No significant difference was ob-

served in the blood glucose levels between the two groups before the intervention ($P>0.05$). After the intervention, the combined group had significantly lower blood glucose levels than the conventional group ($P<0.05$). *Compared with the conventional group, $P<0.05$.

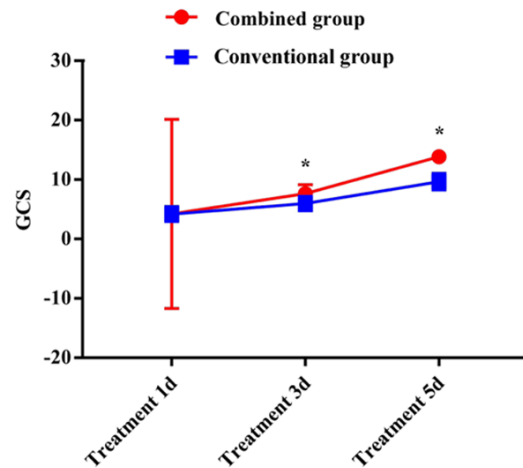


Figure 3. Comparison of the GCS scores between the two groups at different time points. The GCS scores were significantly higher in the combined group on the third and fifth days of treatment compared with the conventional group ($P<0.05$). *indicates a comparison between the two groups at the same time points, $P<0.05$.

nervous system is impaired, which will reduce insulin secretions and lead to an increase in blood glucose, aggravating their malnutrition and even leading to the death of patients [9, 10]. Early enteral nutrition can help reduce the

Early enteral nutrition and PSS-based nursing

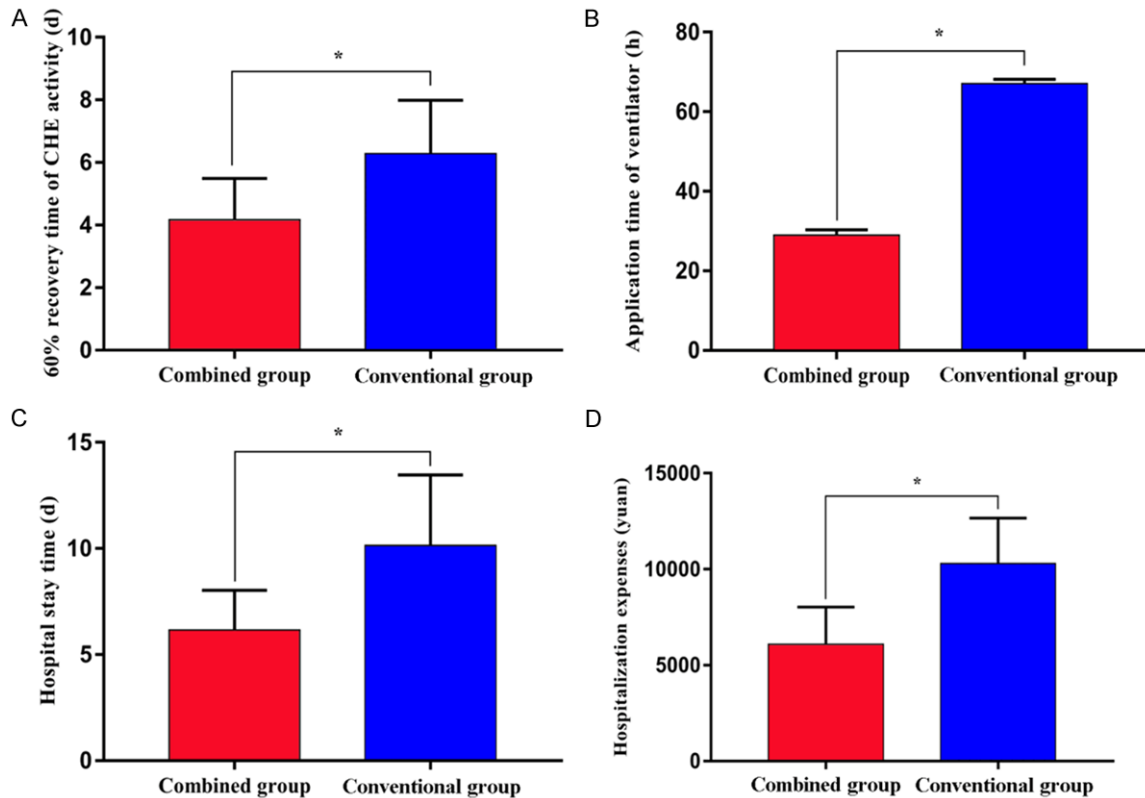


Figure 4. Comparison of the clinical indicators. The times to recovery of 60% of the CHE activity (A), durations of the time spend on the ventilator (B), lengths of the hospital stays (C), and the hospital costs (D) in the combined group were significantly less than they were in the conventional group ($P < 0.05$). *Compared with the conventional group, $P < 0.05$.

Table 3. The complication incidence rates (n , %)

Groups	Number of cases	Arrhythmia	Myocarditis	Toxic encephalopathy	Complications
Combined group	53	1 (1.89)	3 (5.66)	1 (1.89)	5 (9.43)
Conventional group	46	3 (6.52)	5 (10.87)	7 (15.22)	15 (32.61)
χ^2		1.365	0.900	5.892	8.204
P		0.243	0.343	0.015	0.004

cardiopulmonary burden and decrease the risk of developing pulmonary edema. Enteral nutrition can ensure the integrity of the intestinal structure as well as function and can correct metabolism disorders, a negative nitrogen balance, and promote the restoration of neurological function [11]. Meanwhile, hemodialysis during the treatment can reduce the blood glucose levels, promote recovery, and reduce the occurrence of complications [12]. The nursing strategy for OPP patients is mainly determined by the doctor. However, it is the nurse who has spent more time with the patient, so there is a limitation of nursing only according to the doctor's decision. The PSS is assessed by experi-

enced doctors and nurses, which is more objective and can more accurately reflect the condition and contributes to effective nursing guidance [13, 14]. In this study, early enteral nutrition combined with PSS-based nursing care was applied to OPP patients, yielding good nursing results.

In this study, the patients' TP, ALB, and PAB levels were decreased in the conventional group after the intervention, but the levels were significantly higher in the combined group. The Hb and blood glucose levels were reduced in the conventional group after the intervention and were significantly lower in the combined group

than in the conventional group. The results of the study showed that early enteral nutrition combined with PSS-based nursing was more effective at improving the nutritional disorders and reducing the toxicity, achieving better glycaemic control. The reason may be that the early enteral nutrition and the PSS-based nursing provide nutritional supplementation at the appropriate times, which can more effectively reduce the adverse reactions, bring on a supplementary nutritional effect, and then enhance the immunity and improve the intoxication symptoms [15, 16]. In this study, the severity of the comas was also studied, and the results showed that the GCS scores in the combined group were significantly higher at the third and fifth days of treatment compared with the conventional group, which showed that early enteral nutrition and PSS-based nursing can more effectively improve the coma level and improve the degree of poisoning.

The inhibition of CHE activity leads to the accumulation of CHE, and high concentrations of CHE can lead to disorders of the central nervous system, resulting in respiratory failure and coma [17]. Evidence has shown that the degree of inhibition of CHE activity can reflect the severity of OPP [18]. In this study, the times to recovery of the 60% CHE activity, the durations of the ventilator use, the lengths of the hospital stays, and the hospital costs in the combined group were significantly shorter or lower than they were in the conventional group. The findings suggest that early enteral nutrition and PSS-based nursing can improve OPP symptoms. A previous study showed that early enteral nutrition can significantly improve the OPP level [19]. Another study on PSS scores indicated that PSS scores can be used to evaluate the prognoses of OPP patients [20]. Therefore, the possible reasons for the results of this study are as follows: Nutritional support provides the body with energy, corrects metabolic disorders, improves immunity and resistance, and increases the body's ability to remove toxins, thus improving the condition. The PSS-based nursing shows that the PSS score can be used to provide targeted care according to the patients' degree of poisoning, and at the same time, sufficient nursing staff can deal immediately with the changes in the patients' condition to avoid any deterioration in

the condition, in order to achieve the effect of improving the condition.

After organophosphorus pesticide poisoning, high levels of CHE inhibit the myocardium activity and the myocardial conduction system and cause damage to the heart, inducing myocardial damage. It has been found that the severity of a myocardial injury is related to the severity of the organophosphorus pesticide poisoning [21]. It has been shown that the more severe the organophosphorus pesticide poisoning, the more severe the arrhythmia and myocarditis will be. OPP patients can experience brain hypoxia due to coma, resulting in the swelling of the brain parenchyma, coupled with nutritional disorders and dehydration, which contributes to the occurrence of toxic encephalopathy [22]. In this study, the complication rate in the combined group (9.43%) was significantly lower than it was in the conventional group (32.61%), suggesting that early enteral nutrition and PSS-based care can lower the risk of complications. The reason may be that early enteral nutrition and PSS-based nursing can effectively improve the degree of coma and the nutritional disorders, and thus can effectively reduce the risk of complications.

In conclusion, early enteral nutrition and PSS-based nursing are components of different specialized care according to the severity of the condition using OPP. Early nutritional support at the right time can effectively control the blood glucose levels, reduce the serum Hb levels, shorten the recovery times of 60% CHE activity, improve the nutritional disorders and the coma, reduce the time spent on the ventilator and the length of the hospitalization times, reduce the risk of complications, and promote patient recovery with lower hospitalization costs. However, this is a retrospective analysis and the study cohort was small, so further studies with larger cohorts are needed.

Disclosure of conflict of interest

None.

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