The clinical effect of Bedside blood perfusion treatment of patients with severe acute organophosphorus pesticide poisoning and myocardial enzyme spectrum in patients

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Abstract
Objective: To observe the clinical effect of hemoperfusion in treatment of patients with severe acute organophosphorus pesticide poisoning, and to investigate its effect on myocardial enzyme spectrum in patients. Method clinical data of 84 cases of patients with severe acute organophosphorus pesticide poisoning from January 2008 to December 2015 in ICU were retrospectively analyzed, using conventional medical treatment of 40 patients as control group, routine therapy combined with bedside hemoperfusion of 44 cases of patients as the observation group, compared two groups of patients with clinical therapeutic effect and myocardial enzyme spectrum changes.

Results after the rescue and treatment, efficiency of the control group patients was 7.68%, efficiency of the observation group patients was 61.14%, the observation group was significantly higher than that in the control group, the two groups compared the difference is statistically significant (P < 0.05).

The observation group of patients with atropine and the total was less than that of the control group, the ChE activity recovery time, hospitalization time, coma duration was significantly shorter than that of the control group, the two groups were statistically significant (P < 0.05); the two groups of patients before treatment of myocardial enzyme spectrum of each index showed no statistical significance (P > 0.05).

The observation group after treatment of myocardial enzyme spectrum of each index was significantly lower than that of the control group, the two groups had statistical significance (P < 0.05). Bedside hemoperfusion application in conclusion early treatment of severe acute organophosphorus pesticide poisoning, which can effectively improve the success rate, and reduce myocardial injury.

Keywords: Hemoperfusion, severe acute organophosphorus pesticide poisoning, clinical effect, myocardial enzymes.

Introduction

Acute organophosphorus pesticide poisoning is a common urgent case in clinics, its life-threatening nature easily leading to considerably high mortality rate[1]. Organophosphorus pesticide damages the nerve, heart, liver, kidney and other functioning systems of human body rapidly after absorption by respiratory tract, digestive tract, skin, mucosa and other routes. Among all the impairment, liver bears the highest concentration and the relatively strong side effect on heart induces the commonly observed myocardial injury which can cause death of patients with organophosphorus pesticide poisoning[2]. Patients with severe acute organophorus pesticide poisoning suffer from rather poor prognosis without timely and effective treatment. Therefore, a timely and effective intervention therapy should be conducted at the early phase.

In recent years, the constant development of hemoperfusion technology has made it a key treatment in rescuing severe acute organophorus pesticide intoxication. The principle of hemoperfusion is to filter the blood extra-corporeally (outside the body) to remove the toxin, exogenous and endogenous through the hemoperfusioncartridge[3]. This study, through the measurement of the myocardial enzymes on 84 cases of patients with severe acute organophorus pesticide intoxication admitted by the ICU of our hospital during the period from January 2008 to December 2015, assessed the protective effect of bedside hemoperfusion on myocardium. Here the results are reported below.

Material and Methods

Case Selection: 84 cases of patients with severe acute organophorus pesticide intoxication admitted by the ICU of our hospital during the period of January 2008 to December 2015 were selected as the subjects, who conformed to the diagnostic criteria of severe acute organophorus pesticide intoxication in *Internal Medicine* (7th edition)[4] with major manifestations like nausea, vomit, dyspnea, different levels of coma, miosis, hyperhidrosis, muscle vibration, pulmonary edema and so forth. Patients with diseases in heart, liver, kidney, brain, lung and other organs and hypertension, diabetes, platelets and coagulation abnormalities were all excluded and so were patients with the period after taking poison to seeing a doctor exceeding 8 hours.

All the patients were cases of oral pesticide intoxication, including 29 cases of Dichlorvos, 22 cases of Methamidophos, 16 cases of dipterex, 13 cases of dimethoate and 4 cases of other pesticides. Among them, there were 45 male cases and 39 female cases at the age from 20 to 70 years and the mean age of 27.35 ± 8.56 years. The poison dose was 20～200 ml and the period from taking poison to seeing a doctor was 0.5～7hours. The patients were divided into 40 cases of control group and 44 cases of observation group on the basis of different treatments.

In the control group, there were 22 male cases and 18 female cases (including 14 cases of Dichlorvos, 11 cases of Methamidophos, 7 cases of dipterex, 6 cases of dimethoate and 2 cases of other pesticides) with the age ranging from 20 to 68 years and the mean age of 26.89 ± 8.37 years, whose poison dose was 20～190 ml and the period from taking poison to seeing a doctor was 0.5～7hours. In the observation group, there were 23 male cases and 21 female cases(including 15 cases of Dichlorvos, 11 cases of Methamidophos, 9 cases of dipterex, 7 cases of dimethoate and 2 cases of other pesticides） with the age ranging from 21 to 70 years and the mean age of 27.40 ± 8.61 years, whose poison dose was 20～200 ml and the period from taking poison to seeing a doctor was 0.5～7hours. Since there is no statistical difference（P > 0.05）in gender, age, poison dose, poisoning and other general information between the two groups, the comparability exists.

Method

Patients in control group were given conventional medical treatment, in particular to gastric lavage, catharsis, diuresis, oxygen inhalation and maintaining homeostasis and being given atropine, pralidoxime chloride or other organophosphate antidotes as a bolus in the minimum period. The infusion of atropine was repeated constantly with the initial dose of intravenous access being 10～20 mg and the following doses varied in accordance with patients' tolerance, which were kept with as long interval as possible with the minimum dose. The initial dose of pralidoxime chloride through intravenous access was 1500～2500 mg which was repeated when necessary.

Patients of the observation group were treated with hemoperfusion (with the device provided byLivzon Pharmaceutical Group Co., Ltd.) within 3 hours after admission to this hospital in addition to conventional medical treatment received by patients of the control group. Vascular access was constructed on femoral or subclavian vein with single needle double lumen central venous catheter. A dose of 1.0mg / kg of heparin was given intravenously for anticoagulant therapy which was redone at a dose of 6～8 mg/kg every hour till the end of the treatment. The blood flow volume was maintained at 120～160 ml/min. The whole hemoperfusion lasted for 2 hours, which was repeated after 24 hours and 48 hours based on poison severity.

Observation Indexes: Following the treatment, an assessment of treatment outcome, the total amount of atropine, the recovery time of serum cholinesterase activity, hospitalization time, comatose duration and the change of myocardial enzyme between the two groups were carried out.

Efficacy standard[5]**:** Efficacy: after the treatment, patients' clinical symptoms and signs completely vanished without the reemergence of disease if stopping taking anticholinergic drugs. Inefficacy: patients died after the treatment.

Data analysis: All the data analysis was conducted on the basis of SPSS17.0. software. T-test stands for the comparison between two groups, $\bar{x} \pm s$ for measurement data and Chi-square test for enumeration data. When P <0.05, the difference is statistically significant.

Results

Efficacy comparison between the two groups: After rescue and treatment, effective rate in control group is 7.68%, while in observation group it's 61.14%, the latter remarkably larger than that of the former. Therefore, the difference between the two groups has statistical significance（P ＜0.05). See table 1.

The total amount of atropine, the recovery time of serum cholinesterase activity, hospitalization time, comatose duration and the total amount of atropine in the observation group are observably smaller than that in the control group; the recovery time of serum cholinesterase activity, hospitalization time and comatose duration in observation group are notably shorter than those in the control group, which is statistically significant in the difference (P < 0.05). See table 2.

The change of myocardial enzyme between two groups before and after the treatment

There is no statistical significance (P >0.05) in the index difference of myocardial enzyme between the two groups before the treatment, while after the treatment, myocardial enzyme indexes of observation group are remarkably lower than those of the control group, which is statistically significant in the difference (P < 0.05). See table 3.

Discussion

Organophosphorus pesticide poisoning refers to clinical symptoms of the central nervous system caused by accidental ingestion and inhalation of organophosphorus pesticides. Patients with severe acute organophosphorus pesticide poisoning typically present with coma, toxic myocarditis, pulmonary edema, even fatality as well as comparatively poor prognosis[6].

Table 1
Efficacy comparison between the two groups [n (%)]

Groups	Efficacy	Inefficacy	Effective rate
control group(n=40)	34	6	85.00
Observation group(n=44)	41	1	97.62

Table 2
The total amount of atropine, the recovery time of serum cholinesterase activity, hospitalization time, comatose duration($\bar{x} \pm s$)

Groups	Amount of atropine(mg)	the recovery time of CHE activity(d)	hospitalization time(d)	comatose duration(d)
Control group(n=40)	417.58±40.63	9.76±4.59	15.28±5.75	11.87±4.57
Observation group (n=44)	298.45±39.28	6.43±2.16	10.54±3.33	6.57±2.76

Table 3
The change of myocardial enzyme between two groups before and after the treatment

-	Pre-treatment			Posttreatment		
	LDH	CK	CK-MB	LDH	CK	CK-MB
Control group (n=40)	369.27±34.53	279.42±20.56	41.27±3.56	231.25±21.09	158.34±15.45	36.87±2.46
Observation (n=44)	370.44±35.28	282.05±19.59	40.08±3.67	169.42±19.48	112.87±12.55	25.67±2.35

Hence, the emphasis of the clinical therapy lies in timely rescue and effective control on the basis of patients' poisoning severity. Numerous studies on clinical treatment of organophosphorus pesticide poisoning have been seen at home and abroad. The rescue scheme is relatively mature and the specific method includes gastric lavage, catharsis, diuresis, oxygen inhalation and maintaining homeostasis and being given atropine, pralidoxime chloride or other organophosphate antidotes as a bolus ASAP.

Atropine infusion along with other conventional medical treatment should be maintained[7]. Atropine and pralidoxime chloride are common clinical therapeutic drug, of which atropine is categorized as a common clinical rescue medication. Atropine extracted from belladonna and other Solanaceae plant can effectively block acetylcholine working on muscarinic receptors of the parasympathetic nerve and the central nervous system, and help ease muscarinic symptoms and inhibit respiratory center[8].

Pralidoxime chloride can recover cholinesterase activity to relieve nicotine poisoning symptoms. Nevertheless, atropine and pralidoxime chloride cannot eliminate effectively the organophosphorus compound in the blood[9]. Convention medical treatment is rather beneficial to patients with organophosphorus pesticide intoxication at mild and moderate level while for patients with severe acute organophosphorus pesticide intoxication it manifests limited effect.

Furthermore, the research of experts at home and overseas[10] indicates that organophosphorus pesticide intoxication harms patients' heart, causing elevated myocardial enzyme. Thus, monitoring myocardial enzyme was taken as an item of evaluating the effectiveness of treatment on organophosphorus pesticide intoxication.

Hemoperfusion refers to adopting the hemoperfusion cartridge to decontaminate patients' blood. The blood flows through the arterial catheter into an adsorbent device with wide spectrum and high efficiency, which decontaminates pathogenic substances, endogenous or exogenous, in the blood directly and rapidly to relieve the continued damage of organic phosphorus on patients for the achievement of blood decontamination[11]. Relevant information[12] reveals that hemoperfusion clears away various water-soluble and fat-soluble poison with remarkable effect, in particular to organic phosphorus, the clearance rate up to100 %, becoming one of the common methods for rescuing poisoned patients.

Moreover, hemoperfusion can remain relatively stable internal environment, which protects vital organs and reduces multiple organ failure, improving the success rate and survival rate of rescue. However, hemoperfusion should

proceed as early as possible (a duration of 3 hours is preferred). This is simply because within 3 hours, most poison is absorbed into the bloodstream, which peaked within 3～6 hours in concentration, which is the best timing for hemoperfusion[13].

The absorption effectiveness of activated carbon is closely related to the time of its combination with poisons, drugs and proteins since its absorption effectiveness is saturated within 2～3 hours, while after 2～3 hours its absorption, the effectiveness is lowered. In such case, the duration for hemoperfusion should be controlled within 2～3 hours in case that patients' condition is worsened, leading to secondary intoxication[14].

This study indicates that the total amount of atropine, the recovery time of serum cholinesterase activity, hospitalization time and comatose duration in observation group is less than those in control group, which is consistent with relevant literature[15]. Reduction of the total amount of atropine has certain relationship with the decrease of damage on serum cholinesterase by organic phosphorus after clearance from the body. Reducing the total amount of atropine prevents the risk of aggravated cerebral edema[16]. Myocardial enzyme of observation group decreased notably in comparison with that of control group, which shows that hemoperfusion effectively removes the organophosphorus absorbed into the blood stream, which reduces the immediate myocardial injury caused by organophosphorus, indirectly protecting the heart, thus improving patients ' prognosis and patient survival rate. In summary, early application of bedside hemoperfusion to rescue severe acute organophosphorus pesticide poisoning effectively raises the success rate and decrease myocardial injury.

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