

# Therapeutic efficacies of different hemoperfusion frequencies in patients with organophosphate poisoning

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**Abstract. – OBJECTIVE:** We tested therapeutic efficacies of different hemoperfusion frequencies in patients with acute severe organophosphate poisoning (ASOP).

**PATIENTS AND METHODS:** 36 patients with ASOP were enrolled in this study and divided into two groups. Patients in the repeated hemoperfusion group (n = 20) received 3-4 hemoperfusions within 48 hours after poisoning, while other patients (n = 16) received 1 hemoperfusion. The therapeutic efficacies were compared using the following outcomes: dosage of atropine, time to awake from coma, time for normalization of cholinesterase levels, appearance of intermediate myasthenia syndrome, and survival rates.

**RESULTS:** Compared with patients who receive one hemoperfusion, patients with repeated hemoperfusion had a significantly less atropine use, shorter time of awakening from coma, higher cure rates, shorter time until normalization of cholinesterase levels, lower appearance of intermediate myasthenia syndrome, and higher survival rates.

**CONCLUSIONS:** Early repeated hemoperfusion is more efficient than single hemoperfusion in treating organophosphate poisoning.

*Key Words:*

Hemoperfusion, Acute severe organophosphate poisoning, Rescue.

## Introduction

There are over 100,000 reported pesticide poisonings in China each year, and the case-fatality rate reaches 20%. Among these poisonings, 28% are acute organophosphate poisonings (ASOP). Therefore, organophosphate poisoning is one of the most common clinical emergencies associated with pesticides. In addition, the case-fatality rate in ASOP remains nearly 22%<sup>1</sup>. Acute organic phosphorus pesticide poisoning can cause the occurrence of intermediate syndrome, but the mortality rate of intermediate syndrome with respiratory

muscle paralysis, clinical has no effective treatment and positive, with the development of science and technology, hemoperfusion began<sup>2</sup>. clinical treatment was applied to the patients with acute organic phosphorus pesticide poisoning can cause the intermediate syndrome in In the present study, we evaluated the efficacies of different hemoperfusion frequencies in the treatment of ASOP. We utilized hemoperfusion to treat 36 patients with ASOP, admitted from May 2010 to August 2011. Twenty patients received repeated<sup>3-4</sup> hemoperfusions, while 16 patients received 1 hemoperfusion.

## Patients and Methods

### *Patients*

All poisonings were due to oral exposures. The 36 enrolled patients included 13 men and 23 women, aged 17-67 ([mean ± SD] 38 ± 5.6) years. The pesticides included phorate, dimethoate, 1605, dichlorvos, 1059, parathion, and phoxim. The exposure doses ranged from 20 to 280 ml. All cases were ASOP. The patients were divided to receive single (n = 16) or repeated (n = 20) hemoperfusion, with patients in the latter group receiving 3-4 hemoperfusion sessions within 48 hours after poisoning. The two study groups did not significantly differ in terms of age, gender, types and doses of pesticides, degree of poisoning, cholinesterase activity, and interval between poisoning and admission.

### *Hemoperfusion*

The treatment was performed using a hemodialysis machine (Campbell, Switzerland) and HA230 blood perfusion apparatus (Jafron Biomedical Co., Ltd, Zhuhai, China).

### *Other Treatment*

All patients underwent gastric lavage, received cathartics, atropine and cholinesterase reactiva-

tors, rehydration, prophylaxis and/or treatment of stress ulcer, and symptomatic treatment (including ventilator-assisted breathing in some patients).

### Main Outcomes

The main outcomes included atropine atropine, time to awakening from coma, time for cholinesterase to return to normal levels, incidence of intermediate myasthenia syndrome (IMS), and survival rates.

### Statistical Analysis

Data are presented as mean  $\pm$  SD. The distribution differences were compared using the chi square test, while means were compared using the *t*-test for unpaired samples. The *p* value of  $< 0.05$  was considered as statistically significant.

## Results

Compared with the single treatment group, the repeated treatment group had significantly less atropine use, shorter time to awake from coma, higher survival rates, shorter interval for cholinesterase to return to normal levels, and lower incidence of IMS (all  $p < 0.05$ ; Table I).

## Discussion

Organophosphorus pesticides are fat-soluble macromolecular substances. They can easily bind to proteins. Once ingested, they rapidly distribute across organs and tissues. By inhibiting cholinesterase, these pesticides cause massive accumulation of acetylcholine. The resulting cholinergic hyperactivity causes nicotinic and muscarinic signs, as well as central nervous system signs and symptoms. After absorption, organophosphorus pesticides can be stored in

adipose tissues, brain, liver, kidney, lung, and gastrointestinal wall, forming gut-blood-gut circulation, which allows organophosphorus pesticides to be stored in the fat and other tissues, and be released into back into blood. Patients with severe ASOP often die of respiratory failure<sup>3</sup>.

The main treatment includes gastric lavage, cathartics, cleansing of residual pesticide from the gastrointestinal tract, atropine, and cholinesterase reactivators. Atropine can only counter muscarinic effects but does not eliminate residual organophosphorus pesticides. The cholinesterase reactivator can only act on the newly formed phosphorylated cholinesterase. A few hours after the poisoning, as phosphorylated cholinesterase "ages", its activity cannot be easily restored. Without hemoperfusion, the rate of residual organophosphorus pesticide elimination from the body is very slow. The hemoperfusion therapy is highly effective in clearing lipid soluble or plasma protein-bound poisons. Thereby, hemoperfusion can rapidly attenuate the poisoning symptoms and minimize complications<sup>4</sup>. Clinical studies showed that early hemoperfusion reduces the occurrence of IMS and decreases mortality<sup>4</sup>. It has been proposed that multiple hemoperfusion should be performed before the occurrence of respiratory muscle paralysis<sup>5</sup>. So, the rescue with IMS poisoning were the primary key in addition to mechanical ventilation is good, but also the use of hemoperfusion in patients with poison removal will be clean<sup>6</sup>. Blood perfusion for the treatment of IMS can significantly increase the survival rate and shorten the duration of IMS<sup>7</sup>.

By establishing the cardiopulmonary bypass, hemoperfusion drains the blood into a hemoperfusion apparatus containing resin adsorbents and absorbs toxic substances from blood, thus achieving blood purification<sup>8</sup>. In case of ASOP, hemoperfusion should be arranged in an early, appropriate, and adequate manner<sup>9</sup>, and if possi-

**Table I.** Treatment efficacies of single and repeated hemoperfusions.

	Patient number	Atropine usage (mg)	Time to awakening from coma	Time to normalization of cholinesterase levels	IMS	Survival rate
Single hemoperfusion	16	622.16 $\pm$ 42.5	28.62 $\pm$ 2.12	14.21 $\pm$ 4.28	4 (25%)	81.25%
Repeated hemoperfusion	20	251.30 $\pm$ 30.1*	9.52 $\pm$ 1.62*	6.12 $\pm$ 3.76*	1 (5%) <sup>#</sup>	100%

Patients in the repeated hemoperfusion group received 3-4 sessions of hemoperfusion. Data are shown as mean  $\pm$  SD. \* $p < 0.05$ , <sup>#</sup> $p < 0.01$ , both vs. single hemoperfusion group.

ble, within 6 hours after the poisoning. The pesticide concentration in blood reaches the peak at 3-6 hours after ingestion. Hemoperfusion usually lasts for 3-6 hours. The plasma clearance rate of the poison dramatically declines 2-3 hours after the initiation of hemoperfusion due to adsorbent saturation. Therefore, hemoperfusion should not last excessively long<sup>10</sup>. Furthermore, long hemoperfusion may cause complications, such as blood coagulation and shock.

During hemoperfusion, blood pressure can drop. To prevent this, blood pressure and pulse rates should be closely monitored, and if necessary, measures should be undertaken to maintain the blood pressure stable. However, it is not necessary to stop hemoperfusion<sup>11</sup>. Hemoperfusion should be immediately initiated in patients with moderate or severe poisoning. A timely replacement of the filters is required for repeated hemoperfusion<sup>12</sup>.

### Conclusions

In our study, we treated 36 patients with ASOP and found that patients who received 3-4 hemoperfusions had significantly less atropine usage, shorter time to awakening from coma, higher cure rates, shorter interval for cholinesterase returning to normal level, lower incidence of IMS, and higher survival rates. Therefore, repeated hemoperfusion should be arranged for patients with ASOP, if economic conditions allow. As this regimen reduces the occurrence of IMS and respiratory failure, shortens disease course, increases the survival rates, it may even lower the hospitalization cost due to a shortened course of treatment.

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### Conflict of Interest

The Authors declare that they have no conflict of interests.

### References

- 1) PENG A, SUN LZ, LI L. [Observation on the hemoperfusion in treating acute severe dichlorvos poisoning]. *Chin J Internal Med* 2000; 39: 699-700. in Chinese.
- 2) SENANAYAKE N, KARALLIEDDE L. Neurotoxic effect of organophosphorus insecticides: an intermediate syndrome. *N Engl J Med* 1987; 316: 761-763.
- 3) LU ZY, ZHONG NS. Internal medicine. People's Medical Publishing House, Beijing, 2008. in Chinese.
- 4) HU SD, LI B, LI YQ. [Blood purification for treating acute poisoning: Analysis of 32 cases]. *Chongqing Med* 2002; 31: 605. in Chinese.
- 5) WANG ZG. Blood purification. Beijing Science and Technology Press, Beijing, 2003. in Chinese.
- 6) HE F, XU H, QIN F, XU L, HUANG J, HE X. Intermediate myasthenia syndrome following acute organophosphates poisoning—an analysis of 21 cases. *Human Exp Toxicol* 1998; 17: 40-45.
- 7) YANG PY, LIN JL, HALL AH, TSAO TC, CHERN MS. Acute ingestion poisoning with insecticide formulations containing the pyrethroid permethrin, xylene, and surfactant: a review of 48 cases. *J Toxicol Clin Toxicol* 2002; 40: 107-113.
- 8) YUAN X, HE YZ. [Application of hemoperfusion in treating acute severe organophosphorus pesticide poisoning]. *J Milit Med Acad* 2005; 29: 393-395. in Chinese.
- 9) QIU WQ, LIN XH, LI MJ. [Clinical observation on the hemoperfusion in combination with hemodialysis in treating acute severe drug poisoning]. *Chin J Primary Med Pharm* 2003; 10: 3-4. in Chinese.
- 10) SUN XL, HUO PF, XIN XD. [Effectiveness of hemoperfusion in treating acute organophosphorus pesticide poisoning]. *Chin J Industrial Med* 2002; 15: 342-343. in Chinese.
- 11) QIU WQ, ZHOU LL, ZHANG CH. [Hemoperfusion in combination with hemodialysis in treating acute severe organophosphorus poisoning]. *Appl J General Practice* 2005; 3: 336-337. in Chinese.
- 12) QIU HB. [Manual for ICU residents]. Jiangsu Science & Technology Press, Nanjing, 2007. in Chinese.