

# Case Report: Hemoperfusion Efficiency in Paraquat Toxicity



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## ABSTRACT

The present study was conducted on paraquat poisoning cases, from January 2017 to January 2018, a total of 9 patients of paraquat poisoning transferred to our referral Toxicology center. Six of them survived. Paraquat is one of the most used herbicides, a non-selective, killing green plants on contact. It is very toxic for human. We used immunosuppressant and antioxidant drugs in most cases. In addition, many patients were given gastrointestinal decontamination and activated charcoal at a local hospital before transferring to our center. According to our treatments, early management and hemoperfusion after ingestion can increase the rate of survival.

## 1. Introduction

**P**araquat is used widely in agro-based areas of Iran, especially north-west of Iran. Most of the paraquat intoxicants are farmers who have access to poison. Most of paraquat poisoning patients ingest intentionally and in a suicidal attempt. Paraquat is a highly toxic poison; cation radicals are released during the first few hours after ingestion and mostly concentrate on alveolar cells that causes direct lung damage [1, 2]. Various species of oxygen radicals lead to inflammatory cell infiltration and renal and liver damages [3, 4]. Hemoperfusion (HP) is an extracorporeal method which can remove Paraquat (PQ) from the blood, and can survive

patients [5]. Le Quang Thuan et al. reported that resin hemoperfusion is better than activated charcoal hemoperfusion [6]. This study aimed at studying hemoperfusion in these patients and its effectiveness in improvement and survival of PQ poisoning.

## 2. Patients and Methods

We presented a case series of 9 patients of paraquat poisoning admitted from January 2017 to January 2018 in Toxicology Center of Sina Hospital of Tabriz University of Medical Sciences. The diagnosis of Pq poisoning was made because of their living in an agricultural area, widespread access to PQ, and also history and the labels on the bottles in cases they brought them. In addition, all cases

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were confirmed by urine sodium dithionite test. Gastrointestinal (GI) decontamination and lavage with charcoal were given for most of the patients at the local hospital before referring to our center. One case received fuller's earth.

They were treated with Hemoperfusion (HA230 cartilage). The time needed for starting hemoperfusion was different from patient to patient. Firstly, they were taken to a local hospital for 4 hours on average. After initial treatments, they were referred to our hospital. Because of their first admittance in the emergency ward, it takes different times to start HP for them in our center. Patients after initial stabilization, i.e. receiving intravenous fluid therapy, antiemetic and H<sub>2</sub> blocker in the emergency ward, were taken to Toxicology ward.

Besides the time difference of HP administration for each case, five cases received immunosuppressant, i.e. methyl prednisone 1 g/d up to 3 days and then prednisone 60 mg/d until their discharge. In addition, all of the cases received antioxidant, i.e. N-acetylcysteine, 30-50 g/d. We did not administer oxygen therapy except for case 5 who had cyanosis and low O<sub>2</sub> saturation. Therefore, we had to intubate him in advance. Despite HP treatment, he died after about 15 hours. All of the patient's renal functions were monitored with measurement of creatinine and urine output and also liver enzymes and bilirubin

and coagulation tests were measured and CXR was taken from them. After discharge, they were followed up until July 20 (Table 1).

### 3. Case Presentations

The patients' ages ranged between 14 and 45 years; 3 were females and 6 were males. None of them had history of attempting to suicide. Out of 9 patients, 8 cases swallowed PQ intentionally and one case ingested one teaspoon of PQ unintentionally and during the spraying, but didn't swallow it. He spat it immediately and his sodium dithionite test was negative. He was discharged 2 days later with no organ failure without HP therapy. Case one and seven ingested about one mouthful of PQ and both of them had positive (+1) sodium dithionite test. The rest of them ingested about 30-50 mL PQ and their sodium dithionite test was 3+ positive. The time of performing HP took 2.5-15 hours.

#### Case one

She was a 14-year-old female who received 2.5 hours of HP treatment, 2.5 hours after taking a mouthful PQ. She showed no sign and symptoms of renal and liver damages, and her CXR was normal during the hospitalization. She was discharged 5 days later and did not

**Table 1.** Case series characteristics, time to treatment, laboratory results and outcome

Case	Age, y	Gender	Amount of PQ	Time to Get to Local Hospital	Time to Administer HP	Duration of Hp	Dithionite Test	AST ALT	CR	Bill T, D	PT, INR, PTT	Outcome
1	14	F	One mouthful	2.5 h	2.5 h	2.5 h	+	NL	NL	NL	NL	Survival
2	16	F	50 mL	2.5 h	5 h	5 h	+	NL	^	^^	^^^	Survival
3	45	M	50 mL	4 h	8 h	5 h	+	^^	^^^	^	^^	Death
4	35	F	50 mL	3.40 h	15 h	2.5 h	+	^^	^^	^^	NL	Death
5	23	M	One tea spoon	7.40 h	---	---	-	NL	NL	NL	NL	Survival
6	23	M	40-50cc	7 h	14 h	3 h	+	^^	^	NL	^	Death
7	26	M	One mouthful	2 h	6 h	2.5 h	+	^	^	NL	NL	Survival
8	39	M	30 mL	0.5 h	12 h	5 h	+	NL	NL	^	^^	Survival
9	30	M	40-50 mL	0.5 h	4.5 h	5 h	+	NL	NL	NL	NL	Survival

complained of dyspnea and other problems in the next followings days.

#### Case two

She was a 16-year-old female who received 5 hours of HP treatment, 5 hours after taking 50 mL of PQ. She did not develop renal and liver dysfunction such as CR rising or oliguria and liver enzymes rising, but she showed higher PT, PTT, INR and Disseminated Intravascular Coagulation (DIC) immediately after HP. She was given fresh frozen plasma and packed cell and platelet. Finally, she recovered and discharged after 2 weeks. In the next visit, she reported some dyspnea during exercise but her CXR was normal. She did not have any problems in subsequent visits during 6 months and lung CT scan was normal.

#### Case three

He was a 45-year-old male who received 5 hours of HP treatment (each day 2.5 hours), 8 hours after ingestion of 50 mL PQ. He showed CR rising up to 8 mg/dL and renal failure. He intubated and died after 4 days as a result of acute respiratory distress syndrome and renal failure.

#### Case four

She was a 35-year-old female who received 2.5 hours of HP treatment, 15 hours after swallowing 50 mL PQ. His Urea and CR increased gradually, and became oliguric and then anuric. Oxygen saturation was more than 96% at first, but she suffered from dyspnea on the next few days and oxygen saturation decreased despite giving oxygen therapy with nasal cannula and face mask. We had to intubate her. Unfortunately, she died 12 days later due to respiratory and renal failure.

#### Case five

He was a 23-year-old male who ingested a teaspoon PQ unintentionally and during the spraying but spat it out before swallowing. He showed no signs of organ failure without doing HP. His sodium dithionite test result was negative. He was discharged after 4 days, and he did not have any problems in the next followings days.

#### Case six

He was a 23-year-old male who received 3 hours of HP, 14 hours after taking an unknown amount of PQ. He developed cyanosis and low oxygen saturation, therefore he was intubated in advance. He showed severe hypotension during HP that did not respond to norepi-

nephine and we had to discontinue HP treatment. After stopping HP, he had bloody foam from trachea. His PT, PTT, INR rose, and he received fresh frozen plasma. Unfortunately, he died of acute respiratory distress syndrome and respiratory failure after 15 hours of admission.

#### Case seven

He was a 26-year-old male who received 2.5 hours of HP treatment, 6 hours after ingestion of a mouthful of PQ. He showed Cr rising and oliguria. CR rose up to 2.5 mg/dL, liver transaminases increased up to about 180. He did not show respiratory problems and finally recovered without renal dysfunction; his CR returned to normal range. He was discharged 10 days later; he did not have any problems in the next visits.

#### Case eight

He was a 39-year-old male who received 5 hours (each day 2.5) of HP treatment, 12 hours after taking of 30 mL PQ; his renal function was normal during hospitalization. He showed coagulation dysfunction; his PT, PTT, INR values rose and platelets became less than 80000, and indirect bilirubin increased up to 3. He did not have bleeding and hemodynamic instability. He left the hospital 5 days later without permission. However, he is still alive without renal and lung problems in the next visits after 2 months. His lung CT scan was normal.

#### Case nine

He was a 30-year-old male who received 5 hours (each day 2.5) of HP treatment, 4.5 hours after ingestion of 50 mL PQ; his renal and liver function tests were normal. He did not have dyspnea or CXR abnormality. He was discharged without any organ failure after 10 days. He is still being followed up without any problems during 3 months.

## 4. Discussion

Paraquat is a very toxic poison that leads to releasing oxygen free radicals and superoxide and causes cell membranes damage resulting in alveolar cell damage, bleeding, edema, and finally lung fibrosis if not death. PQ causes tubular necrosis of renal and hepatocyte and myocardial cell damages; it also causes corrosive damage in gastrointestinal track. Some of our cases had burning and sore in the mouth and upper GI that was revealed by endoscopy (case 2 and 8). There is no effective way to prevent poison absorption from GI after

having taken. Researches reported that GI decontamination, fuller's earth and charcoal had not been completely effective and should not be given to all patients [7]. On the other hand, most of the patients usually go to a hospital late and after absorption period [8].

All patients in our study went to a local hospital with an average of 4 hours delay after ingestion; they were given lavage, charcoal and fuller's earth in one case. Oxygen therapy in patients with PQ poisoning increase  $O_2$  reception and aggravates toxicity [9, 10]. None of our patients except case 6 who was cyanotic, received oxygen in advance. Using antioxidant or immunosuppressant alone does not have significant effects on improvement and survival of patients [11].

All patients except cases 5 and 6 were given methyl prednisone 1 g/d for 3 days and then prednisone 60 mg/d until being discharged. Also, they received NAC 30-50 g/d. Some researches reported that patients with severe PQ poisoning despite receiving methylprednisolone and cyclophosphamide had not shown appropriate improvement and surviving [12, 13]. On the other hand, there is no antidote for PQ. However extracorporeal ways carried out in many studies. Hemodialysis could be considered in patients who have developed acute renal failure due to PQ poisoning [14] and probably volume overload which do not respond to supportive cares.

Koo JR et al. performed HP within 24 hours of ingestion and then randomly assigned patients to the HP-alone or HP-CVVH group. There was no difference in mortality rates between the two groups. Actually, the mortality rate was still over 50% in centers that performed hemoperfusion/hemodialysis [15]. HP treatment especially in early hours after ingestion can remove PQ from blood; different studies emphasize on early HP administration [16, 17].

Hau-Ru Wang et al. reported that the effectiveness of HP therapy was time-dependent and the best results were gained when Hp was done within 4 hours after ingestion [18]. We performed Hp even 12 hours after swallowing more than three mouthfuls of PQ, and the patient survived. Of course, he was given GI decontamination very soon after ingestion. Some researches recommended continuous Hp for 6-8 hours and as soon as possible after ingestion [17, 19]. Le Quang Thuan et al. compared efficacy of charcoal Hp to resin Hp in patients of PQ poisoning and reported that resin Hp had resulted in less mortality and side effects than charcoal Hp in the same time period. Platelet count in the charcoal group was less than resin group [6].

All of our patients were treated with resin Hp except case 5. The longest time for doing Hp after ingestion was about 15 hours (case 4) that received 2.5 hours of Hp treatment and she died because of Cr rising, oliguria and respiratory failure 12 days later. Lung opacity and heart enlargement were reported on CXR. The other case who died received 2.5 hours of resin Hp treatment 8 hours after ingestion of PQ. Both of them went to a local hospital with an average of 4 hours delay. Third death (case 6) intubated initially and received 3 hours of Hp treatment, 14 hours after ingestion of PQ and died 15 hours after admission. It seems that early management besides resin Hp were more effective in our study. Meanwhile, all of our patients who had ingested more than 20 mL of PQ and could survive, received 5 hours Hp treatment (constantly or 2.5 hours per day). Therefore, Hp duration is also important in severe cases.

All of our patients received antioxidant and immunosuppressant, then the influence of these treatments was equal for all patients and cannot be assessed. Four cases in our study (case 2, 3, 6 and 8) developed coagulation dysfunction and thrombocytopenia after HQ. It seems that this disorder has not had any role in mortality. The most severe case (case 2) survived after resuscitation and receiving fresh frozen plasma, platelet, packed cell, despite DIC and severe bleeding from all sites of access veins and having hematoma at a central vein insertion site.

## 5. Conclusion

Early management after taking paraquat, including lavage, giving charcoal [20] and the most important of them doing hemoperfusion, especially resin hemoperfusion (which we did in this study as soon as possible after ingestion and in the first 5-6 hours) is crucial in surviving moderate to severe PQ poisoning.

## Ethical Considerations

### Compliance with ethical guidelines

All ethical principles were considered in this article. The participants were informed about the purpose of the research and its implementation stages; they were also assured about the confidentiality of their information; Moreover, They were allowed to leave the study whenever they wish, and if desired, the results of the research would be available to them.

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## Authors contributions

All authors contributed in preparing this article.

## Conflict of interest

The authors declared no conflict of interest.

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