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Therapeutic efficacy of a resin sorbent-based hemoperfusion cartridge in treating acute poisoning cases caused by lipophilic and paraquat poisons typically found in an Indian tertiary care centre

[1]Alok Kumar Mohaptra, [2]Shashi Bhusan Rout, [3]Sarat Kumar Parida

[1]Senior Resident, Department of Medicine, Srirama Chandra Bhanja Medical College and Hospital, Cuttack, Odisha, India

[2]Professor & HOD, [3]Assistant Professor, Department of Nephrology, Srirama Chandra Bhanja Medical College and Hospital, Cuttack, Odisha, India

Correspondence:

Sarat Kumar Parida

Assistant Professor, Department of Nephrology, Srirama Chandra Bhanja Medical College and Hospital, Cuttack, Odisha, India

ABSTRACT

Paraquat (PQ) is a frequently used herbicide that is cheap and easy to obtain for individuals living in rural regions. A small amount of PQ intake could be fatal, although the best treatment is still being debated. Extracorporeal treatments (ECTR) have been used in the treatment of PQ poisoning, although there is insufficient evidence to demonstrate that they are superior to conservative therapy. The most prevalent treatments are haemodialysis (HD) and haemoperfusion (HP), while some institutions now use HP–HD concurrent therapy. The goal of this study is to see if haemopurification therapy can reduce mortality when compared to standard care. This one-year hospital-based study was conducted at a tertiary care center's P.G. department of Nephrology and renal transplant. A total of 20 patients were recruited for the study after evaluating exclusion and inclusion criteria.Despite the intervention with hemoperfusion, paraquat patients had the worst clinical outcome in this trial, with a survival rate of 5% (n = 20).

INTRODUCTION

The ability of an extracorporeal approach to improve toxin clearance is largely dictated by its physicochemical and pharmacokinetic features [1, 2, 3]. Water-soluble toxins are removed by the most frequent extracorporeal treatments, such as Hemodialysis (HD) and Hemofiltration. Lipophilic poisons, on the other hand, are removed to a lower amount by hemodialysis or hemofiltration, due in part to their strong protein binding [4, 5, 6, 7]. Because only the free toxin is readily available to be cleaned by these modalities, clearance is lowered [8]. As a result, different extracorporeal methods for lipophilic poisons are required.Even though some of these lipophilic toxins have antidotes, combining effective extracorporeal modalities with normal therapy may improve clinical outcomes [9, 10]. Furthermore, alternate extracorporeal modalities are required for toxins for which no antidotes are available, and extracorporeal elimination by Hemodialysis is less efficient. Paraquat is a classic example of a poison in this group [11].

Because it is widely used as an herbicide in India, paraquat toxicity is of considerable toxicological significance. Paraquat poisoning has a significant fatality rate. Clearance of lipophilic substances is favoured by Hemoperfusion (HP), particularly with resin adsorbent

comprising columns [12, 13, 14]. Neutral resins contain a macroreticular aromatic structure with a unique surface affinity for nonpolar chemicals, making them more suitable for liposoluble toxins than ionic resins or charcoal [15].It is widely known that Hemoperfusion is more efficient than HD for paraquat poisoning. The clearance rate of HP is approximately 5-7 times that of HD, and HP remains efficacious after blood levels of paraquat are reduced to [16, 17]. The study's goal is to use a Resin Sorbent Based Hemoperfusion Cartridge to investigate the clinical results of individuals suffering from acute poisoning.

MATERIALS AND METHODS

This one-year hospital-based study was carried out at the P.G. department of Nephrology and renal transplant in a selected tertiary care centre. After considering exclusion and inclusion criteria, a total of 20 patients were chosen for the study. The patient underwent a baseline study (CBC, RFT, LFT, ECG, USG, X-RAY CHEST, CT THORAX, PT, INR) and clinical evaluation. Patients were given normal poisoning treatment as well as Hemoperfusion.

METHOD OF TREATMENT

The steps were as follows: Hemoperfusion in addition to standard treatment 1st session immediately after admission; 2nd session 8 hours later; 3rd session on day 2; and 4th session on day 3 (N=20). The standard treatment consists of emetics, gastric lavage, catharsis, fluid infusion and diuresis to promote paraquat excretion, and antioxidant. When necessary, organ function supportive therapy comprised oxygen supply, mechanical breathing, blood volume expansion, and the administration of vasoactive medications to maintain normal tissue perfusion and cell metabolism. Hemoperfusion is carried out using the HA 230 cartridge (Jafron Biomedical Co. China, Marketed in India by Delvin). Hemoperfusion cartridges are offered through the BSKY plan at our department.

SAMPLE SELECTION

INCLUSION CRITERIA

- ✓ Aged > 18 year
- ✓ Paraquat poisoning by oral intake
- ✓ Ingestion volume, up to 50 ml
- ✓ Admission within 24hrs of Paraquat poisoning
- ✓ *Exclusion criteria:*
- ✓ Ingestion volume of > 50ml
- ✓ Time to admission from poison ingestion >24 hours
- ✓ Significant bleeding tendency
- ✓ Combined with the other poisonings
- ✓ History of severe diseases of the heart, lung, liver, kidney, or haematological system

STATISTICAL ANALYSIS

SAS® system for Windows Version 9.4 or higher will be used to do statistical analysis on PK data (SAS Institute Inc., USA). The data from the CRF will be entered into the computer using an EXCEL spreadsheet. Data will be reviewed and sanitised before being sent to SAS/SPSS. SAS/SPSS software will be used for all data analysis.

RESULTS

The mean age of the paraquat poisoned patients was 26.86 years, with a median age of 23 years, as shown in Table.1. With paraquat poisoning, approximately 35% of patients were males and 65% were females. The mean hospitalisation time for paraquat poisoning was 17.9 4.20 hours,

with a median of 19.5 hours. The total number of patients with paraquat poisoning included in this study was 20. Nineteen patients died (95 percent) and one patient survived (5 percent).

Table 1: Baseline laboratory parameters

Statistics	Paraquat
Age	20
Mean	26.0
Sex	
Male	7
Female	13
TB	1.15
DB	0.60
AST	32.3
ALT	29.2
Hb	10.4
TLC	6600.0
TPC	2.06
Spo2	1 (Abnormal) 19 (Normal)
CT Scan	1 (Abnormal) 18 (Normal)
Sr. Urea	30.1
Sr. Cr	1.02
Sr Na^+	136.1
Sr. K^+	4.21

DISCUSSION

We investigated the effect of a resin sorbent-based hemoperfusion cartridge on the clinical outcome of paraquat poisoning in a tertiary care institute in this observational study. Despite the intervention with hemoperfusion, the patients had the worst clinical outcome, with a survival rate of 5% (n = 20). In the Indian Studies on Paraquat Poison done by Raghavendra Rao et al. [9], Harshavardhan L et al. [10] and Ravichandran R et al. [11], the survival rates were 65 percent, 61 percent, and 72.5 percent, respectively. The current study's high fatality rate of 95% may be related to late hospitalisation and late beginning of both Standard of Care therapy and hemoperfusion.The mean time spent in the hospital for paraquat was 17.94± .20 hours, with a median of 19.5 hours, while the mean time spent starting Hemoperfusion was 22.4± 1.69 hours, with a median of 23.0 hours. The toll of paraquat poisoning is very high. Early in the course of disease, multi organ failure with circulatory collapse is associated with 100 percent death, although late pulmonary fibrosis with respiratory failure is also a significant cause of mortality [18, 19, 20, 21].

The apparent distribution volume of paraquat is 1 liter/kg. It is a water-soluble organic heterocyclic herbicide. Paraquat is extremely harmful to both humans and animals and has no recognised antidote. The lethal dose for humans is 1-6 g, and the deadly concentration is 3 g/ml. The toxicity of paraquat may be attributed to its buildup in alveolar cells, which causes lipid oxidation of cell membranes in the lung, kidney, and liver, leading in pulmonary bleeding, edoema, fibrosis, and liver and kidney damage. Some studies concluded that hemoperfusion was ineffective, possibly due to potentially fatal concentrations of paraquat accumulating in highly vascular tissues of important organs and pneumocytes prior to hemoperfusion commencement.

The peak time of plasma paraquat is 1-3 hours, the peak time of lung cells is 4-5 hours, and about 9% of the paraquat in the plasma vanishes 5- 6 hours after consumption. As a result, individuals who receive early hemoperfusion are likely to benefit from large elimination of paraquat from the blood. This indirectly reduces the quantity of paraquat that accumulates in lung cells, enhancing the outcome. Hemoperfusion has been demonstrated to be the most effective method of removing paraquat and detoxifying the poison.

The survival percentage in the group that did not undergo hemoperfusion was roughly 8%, compared to 57 percent in the group that did, demonstrating that hemoperfusion enhances the survival rate in paraquat poisoned patients. According to Cavalli RD et al., the survival rate in patients without active treatment was only 13% even with non-fatal dose ingestion of paraquat poison, but it climbed to more than 50% in patients with fatal dose intake when active treatment mode such as hemoperfusion was used.

According to one study [12], combining hemoperfusion with Continuous VenoVenous Hemofiltration (CVVH) enhanced survival length in patients with acute paraquat poisoning. According to a recent study [13], CVVH as a stand-alone therapy was found to be useful in lowering mortality. Raghavendra Rao et al. [9] discovered that early hemoperfusion (6 hours) enhanced survival rates compared to those who got late hemoperfusion (>6 hours).

Early hemoperfusion enhanced survival outcomes in paraquat-poisoned patients, according to a study conducted by Hsu CW et al. [21]. Even with immunosuppressive medication, the mortality rate in paraquat poisoned patients approaches 50%, indicating that it is insufficient. Hemoperfusion quadrupled the systemic clearance of paraquat, implying that it could be used as a therapy method in individuals suffering from paraquat poisoning.

CONCLUSION

The current study found that despite the intervention with hemoperfusion, paraquat patients had bad clinical outcome, with a survival rate of 5% (n = 20). Early hemoperfusion (6 hours) enhanced survival rates in paraquat poison patients compared to late hemoperfusion (>6 hours). More prospective randomised controlled trials are needed to evaluate the findings of this observational investigation on the effect of resin sorbent-based hemoperfusion cartridges in Paraquat.

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