

**A Case of Homicidal Paraquat Poisoning in a 4 Year Child**Tresa James<sup>1</sup>, Akhilesh Pathak<sup>2</sup><sup>1</sup>Junior Resident Doctor, Department of Forensic Medicine and Toxicology, All India Institute of Medical Science, Bathinda<sup>2</sup>Professor and Head, Department of Forensic Medicine and Toxicology, All India Institute of Medical Science, Bathinda

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**Abstract:**

Paraquat, a widely used synthetic herbicide in agriculture, poses a grave threat to human health. Ingesting toxic amounts of paraquat can lead to fatal consequences, causing severe damage to vital organs. World Health Organization categorizes paraquat as a 'class II moderately toxic pesticide.' Unfortunately, there is no specific antidote or effective treatment to save lives in cases of paraquat poisoning, resulting in a dismal prognosis worldwide. A 4-year male child was brought to the emergency department with alleged history of ingestion of paraquat poison at home. On detailed enquiry with his grandfather, it was found that the boy was given poison by his grandmother. Grandfather noticed the deteriorating condition of child at home and rushed the child to a nearby Primary Health Centre where gastric lavage and initial treatment was done and subsequently, he was referred to our Emergency Department for further management. Upon conducting laboratory investigations, the results revealed abnormal levels of urea and creatinine in the patient's blood, along with the presence of haematuria, indicating the development of acute kidney injury. The child was treated in paediatric department for 7 days and finally discharged uneventfully. The case is rare of its kind with regard to the manner of homicidal poisoning by a close relative within home, which was also confirmed during the police investigation.

**Keywords:** Paraquat, Poisoning, Child, Homicide.

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**Introduction**

Paraquat, chemically called as N, N'-dimethyl-4,4'-bipyridinium dichloride, was originally synthesized in 1882 and started being used in herbicide applications from 1955. Discovered in the 1950s, it was introduced into agricultural practices by 1962 as a liquid herbicide mainly for controlling weeds and grasses. [1] Due to its highly toxic nature, it was soon classified as a "restricted-use" herbicide. Despite this, its affordability and effectiveness have led to widespread, often unregulated, usage in developing countries, including India. [2]

Ingestion of paraquat is extremely dangerous, leading to severe health issues such as acute respiratory distress syndrome, renal failure, hepatotoxicity, and pulmonary fibrosis. The mortality rate from paraquat poisoning is alarmingly high, reaching up to 70%, and there is no known antidote. [3] A small amount, approximately 10-20 mL of a 20% solution, can be fatal if ingested, and it's corrosive to metals like mild steel and aluminium. Poisoning typically occurs through ingestion, either accidental or intentional, rather than through inhalation or direct skin contact. [4] Paraquat has been responsible for

numerous deaths worldwide due to accidental or deliberate ingestion, as well as skin exposure, making it a common agent in suicide attempts. The toxic effects are caused by the generation of superoxide anions, which result in damaging reactive oxygen species that interfere with essential cellular functions. [5]

Paraquat's long-term soil persistence and non-selectivity in killing a wide range of grasses have made it a favoured choice among farmers. In India, while organophosphate compounds are often responsible for fatal poisonings, paraquat is also a significant contributor to acute poisoning cases. The herbicide affects various organ systems, potentially leading to multiple organ dysfunction syndromes in serious cases.

Paraquat primarily targets the kidneys, with about 90% being excreted in its unchanged form within the first day. Its induced acute kidney injury is characterized by oxidative stress, inflammation and changes in renal hemodynamics. In some cases, renal function may normalize within three weeks after the peak of the injury. [2,7,9]

### Case-History:

A four-year-old boy was brought to the emergency department with complaints of 3 episodes of vomiting and nausea, after a reported incident of ingesting paraquat poison at his home. Further inquiry with his grandfather revealed that the poison was administered by the boy's grandmother. Observing the child's worsening condition, the grandfather quickly took him to a nearby Primary Health Centre for treatment, from where he was transferred to the emergency department of AIIMS Bathinda for further management. Upon arrival in emergency, his vital signs were stable, with a heart rate of 98 beats per minute, a respiratory rate of 26 cycles/min, SpO<sub>2</sub> at 100% on room air, and blood pressure of 104/68 mmHg. He was afebrile and alert, cooperative, and showed no abnormalities in respiratory and cardiovascular examinations. His abdomen was soft and non-tender.

Laboratory tests indicated abnormal urea and creatinine levels (Urea: 68 mg/dl, Creatinine: 1.90 mg/dl), along with haematuria, pointing to acute kidney injury. The child received conservative management, including IV fluids, and was monitored for symptoms of paraquat poisoning. A chest X-ray was performed and found normal. Follow-up blood tests showed improved renal function tests (RFT), and after a week of treatment in the paediatric department, he was discharged without any complications. This case is notable not only for the medical aspects of paraquat poisoning but also because it involved a rare instance of homicidal poisoning by a close relative within the home circumstances, a fact later confirmed during the police investigations. We followed the case by telephonic contact to know that where the boy is living at present and found that he was living with his mother not with grandparents.

### Discussion

Paraquat, a widely used synthetic herbicide in agriculture, poses a grave threat to human health. Ingesting toxic amounts of paraquat can lead to fatal consequences, causing severe damage to vital organs.

The study by Hsieh et al. [1] focused on paraquat poisoning outcomes in Taiwanese children, analyzing data from Chang Gung Memorial Hospital between 2000 and 2010. The average age of these children was about 8.85 years, with younger ones typically ingesting paraquat accidentally and older ones intentionally. The research indicated that paraquat poisoning in children led to critical health complications, such as acute respiratory distress syndrome and failure of multiple organs. The study emphasized the importance of quick diagnosis and immediate detoxification to improve outcomes whereas in the case reported here is about a 4 year old child who

was deliberately given paraquat trying to intentionally poison the child by his own grandmother and eventually resulted in deranged urea and creatinine parameters leading to acute kidney injury.

The study by Qiu L et al. [3] was a retrospective analysis of pediatric paraquat poisoning cases from January 2012 to December 2017. Data from 123 pediatric cases were analyzed, revealing that there were more accidental exposures compared to deliberate paraquat poisoning cases. Most affected were children aged 0 to 2.9 years, comprising 30% of the cases. A positive outcome was that 81.3% (100 out of 123) of the children were discharged with improved health, though two had died upon admission due to respiratory failure. The study underscored, stressing the need for preventive interventions and policies though in our case also child was presented with vomiting and nausea with deranged renal function initially and then child slowly started improving and was discharged on the seventh day of admission

Yang CC et al. [6] did a study in Taiwan, focusing on poison exposures in individuals under 19 years old between July 1985 and December 1993. A total of 5,812 cases of child poisoning exposures were recorded. Findings revealed that boys were more frequently affected than girls. Most incidents were accidental, predominantly through oral ingestion. The most commonly ingested substances were household products, benzodiazepines, and pesticides, with a mortality rate of 1.4%. The data particularly emphasized the issue of accidental poisonings from household products and medications among children under 6 years old. To address this, the study suggested the need for increased educational efforts aimed at parents and caregivers, as well as the implementation of child-resistant packaging. Also in the case presented here it was a case of deliberate poisoning we followed up the case by telephonic contact to know that where the boy is living at present and found that he was living with his mother not with grandparents.

The research conducted by Song Y et al. [7] focused on the clinical features and risk factors related to acute kidney injury (AKI) in pediatric cases of acute paraquat poisoning. The study examined 110 children who were treated for acute paraquat intoxication and found that 42 of these children developed AKI. The findings highlighted a significant occurrence and mortality rate associated with paraquat-induced AKI in the pediatric population and also the case reported here the child also developed acute kidney injury initially which upon treatment child improved and was discharged uneventfully.

Dhochak et al. [8] discussed a case involving a young boy who ingested paraquat. Initially, the boy

showed signs of responding to treatment, but his condition deteriorated, leading to severe and unmanageable hypoxemia, which ultimately resulted in his death. This case highlighted a critical aspect of paraquat poisoning: its early stages can appear mild, creating a false sense of security about the patient's condition. The authors stressed the importance of recognizing this initial mild phase, the need for prompt treatment, and the urgency of early referral to specialized care.

They pointed out that many cases of paraquat poisoning progress to Acute Respiratory Distress Syndrome (ARDS) and often prove fatal. Given this progression, the authors suggested that early intervention with immunosuppressive therapy might be essential in changing the disease's trajectory and potentially improving survival outcomes whereas in case mentioned here child was initially taken to a nearby hospital received initial treatment and was immediately referred to the emergency department because of early intervention child's health improved gradually and was discharged uneventfully.

Diane et al. [15] suggested that the emergency physicians need to be well-versed not only in the essential management strategies for poisoned patients, but also in the distinct aspects of pediatric poisoning. This included understanding the differences in epidemiology, toxicology, and the most effective treatments for children compared to adults. Pediatric poisoning cases involve unique factors such as the context of exposure, its effects on the child and their family, the child's physiological response to the poison, and specific evaluation and management considerations. These factors demand a tailored approach. This article serves as a guide for this specialized practice and emphasizes the importance of continuous awareness and updating of knowledge in light of new pediatric risks, as well as advancements in diagnosis, treatment, and prevention of poisoning in children

In India, where family dynamics and caregiving structures are diverse, this issue is particularly pressing. The establishment of robust systems for monitoring and supporting both caregivers and children is crucial. This includes enhancing the capabilities of foster care systems and ensuring they are equipped with the necessary resources and training to identify and prevent potential harm to children in their care. Legal frameworks and child welfare policies must be strengthened to protect children from such harms. This includes stringent background checks for foster parents and caregivers, regular home visits by child welfare professionals, and accessible reporting mechanisms for suspected abuse or negligence.

In addition, community-based support systems can play a pivotal role. By fostering a culture of shared responsibility for child welfare, communities can help identify at-risk children and intervene appropriately. Training community leaders and members in child safety and protection can significantly contribute to creating safer environments for children. Ultimately, protecting children from poisoning, whether accidental or intentional, requires a collective effort from families, communities, and the government. Building a network of support and safety around each child, especially in more vulnerable areas such as foster homes, is imperative to ensure their well-being and security in what should be their safest environment - their home.

### Conclusion

In conclusion, the safety of children, even within their own homes, necessitates vigilant oversight, particularly in light of the distressing reality that poisoning incidents can sometimes involve close relatives. This unsettling fact underscores the need for comprehensive child protection measures, extending beyond immediate family members to include relatives and caregivers. The vulnerability of children to such dangers in their home environment calls for a multi-faceted approach to ensure their safety. Moreover, awareness campaigns targeting parents, relatives, and caregivers about the risks of poisoning and preventive measures are essential. These campaigns should emphasize the importance of safe storage of hazardous substances and the vigilance required in households with children.

### References

1. Hsieh YW, Lin JL, Lee SY, Weng CH, Yang HY, Liu SH, Wang IK, Liang CC, Chang CT, Yen TH. Paraquat poisoning in pediatric patients. *Pediatric emergency care*. 2013 Apr 1; 29(4):487-91.
2. Sukumar CA, Shanbhag V, Shastry AB. Paraquat: the poison potion. *Indian Journal of Critical Care Medicine: Peer-reviewed, Official Publication of Indian Society of Critical Care Medicine*. 2019 Dec; 23(Suppl 4):S263.
3. Qiu L, Deng Y. Paraquat poisoning in children: a 5-year review. *Pediatric emergency care*. 2021 Dec 1; 37(12):e846-9.
4. McDonagh BJ, Martin J. Paraquat poisoning in children. *Archives of disease in childhood*. 1970 Jun 1; 45(241):425-7.
5. Shadnia S, Ebadollahi-Natanzi A, Ahmadzadeh S, Karami-Mohajeri S, Pourshojaei Y, Rahimi HR. Delayed death following paraquat poisoning: three case reports and a literature review. *Toxicology Research*. 2018 Sep 1; 7(5):745-53.

6. Yang CC, Wu JF, Ong HC, Kuo YP, Deng JF, Ger J. Children poisoning in Taiwan. *The Indian Journal of Pediatrics*. 1997 Jul; 64: 469-83.
7. Song Y, Li C, Luo F, Tao Y. Clinical features and risk factors of acute kidney injury in children with acute paraquat intoxication. *Journal of international medical research*. 2019 Sep; 47(9):4194-203.
8. Dhochak N, Sankar J, Lodha R. Paraquat poisoning: unusual lung toxicity. *J Pediatr Crit Care*. 2019 Jan 1; 6(1):51-3.
9. Kanchan T, Bakkannavar SM, Acharya PR. Paraquat poisoning: analysis of an uncommon cause of fatal poisoning from Manipal, South India. *Toxicology international*. 2015 Jan; 22(1):30.
10. Wesseling C, De Joode BV, Ruepert C, León C, Monge P, Hermosillo H, Partanen LJ. Paraquat in developing countries. *International journal of occupational and environmental health*. 2001 Oct 1; 7(4):275-86.
11. Sittipunt C. Paraquat poisoning. *Respiratory Care*. 2005 Mar 1; 50(3):383-5.
12. Cavalli RD, Fletcher KE. An effective treatment for paraquat poisoning. In *Biochemical mechanisms of paraquat toxicity 1977* Jan 1 (pp. 213-230). Academic Press New York.
13. Kumar RR, PUNITHA DR. Deliberate self-harm by paraquat poisoning. *Anil Aggrawal's Internet Journal of Forensic Medicine & Toxicology*. 2016 Jul 1; 17(2).
14. Navneet A, Wadhera S, Dhibar PD. Paraquat Poisoning: What we do and do not know.?. *J Clin Toxicol. S*. 2021; 19.
15. Calello DP, Henretig FM. Pediatric toxicology: specialized approach to the poisoned child. *Emergency Medicine Clinics*. 2014 Feb 1; 32(1):29-52.