ACUTE KIDNEY INJURY IN CASE OF PARAQUAT POISONING WITH PROGRESSIVE PULMONARY FIBROSIS

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ABSTRACT

Paraquat (PQ)-induced acute kidney injury (AKI) is rare and is often misdiagnosed due a lack of general awareness. We report a case of unsuspected paraquat poisonings presenting as Acute kidney injury and progressive pulmonary fibrosis. This rare case reports, A 16-year-old girl with gastrointestinal symptoms was admitted to hospital after attempting to commit suicide by ingesting 20 ml of paraquat solution. With progression of the disease, damage to the respiratory, hepatic and renal organs occurred. With highly active therapy, renal function progressively improved, manifesting as a reversible phase of paraquat-induced acute kidney injury. Unfortunately, because of rapidly progressive severe pulmonary fibrosis, the patient succumbed to respiratory failure. Our findings suggest that the multi-disciplinary collaborative networks and biochemical indicators of improving clinical outcomes should be considered in early diagnosis and prognostic evaluation of patients with AKI.

Keywords: Paraquat poisoning, acute kidney injury, progressive pulmonary fibrosis

INTRODUCTION

Paraquat (N,N’-dimethyl-4,4’-bipyridinium dichloride) has been widely used as a herbicide in many countries since the 1960s. When ingested, it can cause intense local irritation of the mouth, oropharynx and esophagus, and multiple organ (renal, cardiac, respiratory and hepatic) failure. Paraquat toxicity mechanisms produce free radicals and oxidative stress which induce cellular toxicity. Numerous cases of acute poisoning and death have been reported over the past few decades. Studies have determined survival and prognostic factors after acute paraquat poisoning, which were associated with suicidal intent and ingestion of paraquat, as poison dosage and time, age, hypotension, severe hypoxia, acidosis and the number of organ dysfunctions. Many treatments...
have been proposed, including immunosuppressants, antioxidants, renal replacement therapy, hemodialysis and hemoperfusion. However, the mortality rate remains high. This report presents a suicide attempt case of occult paraquat poisoning complicated by the development of acute kidney injury, and in which there was progressive pulmonary fibrosis. Unfortunately, the patient succumbed to respiratory and circulatory failure.

**CASE REPORT**

A 16-year-old girl voluntarily ingested more than 20 ml of paraquat in a suicide attempt 7 days prior to hospitalization. Upon admission, the patient reported nausea and vomiting accompanied with fever and weakness. Her vital signs were: body temperature, 37.5°C; pulse rate, 88 beats/min regular; blood pressure, 120/80 mmHg; respiratory rate, 21 breaths/min; and arterial oxygen saturation on air of 93%. Physical examination revealed nothing abnormal. She was catheterized and started on intravenous fluids to maintain diuresis. Antiemetic and gastric-mucosal membrane protection drugs were administered. Initial laboratory results were all within normal limits. Electrocardiograms were normal and chest radiographs were clear. Her urine output on the first day was less than 400 ml/24 h with no detection of proteinuria or hematuria. Urine output the following day dramatically reduced (<100 ml/24 h), and proteinuria and hematuria were detected. On day 3, she reported nausea and was vomiting, which was accompanied with bloody mucus, but did not complain of chest tightness, shortness of breath or palpitations. Renal function deteriorated despite adequate fluid replacement therapy and urine output. On day 4, chest computed tomography scans revealed multiple irregular flakes, high-density shadows with obscure edges and ground-glass-like cloudy shadowing in the lungs, and she had bilateral pleural effusion (Figure 1). The patient subsequently received immunosuppressive therapy (methylprednisolone 1 g/d), and strong diuretics, calcium, potassium, antibiotics and antioxidants were administered through the venous channel. From day 5 to day 10, the patient’s urine output gradually increased, up to 3400 ml/24 h. Renal and liver function showed continued improvement. Vital signs showed a pulse rate of 80–90 beats/min regular, blood pressure of 100–90/80–65 mmHg, respiratory rate of 17–19 breaths/min, and arterial oxygen saturation on air of 90–92%. From day 15, the patient’s condition suddenly progressively deteriorated. Despite the best efforts of medical staff, the patient died 20 days after hospitalization from respiratory failure caused by severe pulmonary fibrosis.
Figure 1. Evolution of chest HRCT scans. (A-D) HRCT scan obtained 1 week after paraquat ingestion shows diffuse ground-glass opacity, severe interstitial lung changes in both lungs.
Paraquat poisoning is still a challenging clinical diagnosis. It should be considered when a patient presents with skin and mucosal membrane burns, gastrointestinal symptoms, acute kidney injury and respiratory failure. Kidney injury caused by paraquat poisoning is reversible and renal function gradually improves provided that there is early nephrology consultation and referral before specialized treatment begins. The timing of nephrology consultation and referral in acute renal injury has been associated with mortality and outcome. A series of clinical characteristics and biomarkers for the early diagnosis and prognosis of paraquat poisoning have been suggested; however, the current clinical indicators used have poor sensitivity and specificity. When these are abnormal, serious organ complications can present and can be irreversible. Unfortunately, there are no early warning indicators to evaluate the severity, prognosis or efficacy of the condition. Paraquat induces acute tubular necrosis, especially in the proximal tubule. Acute kidney injury is a prominent manifestation of acute paraquat poisoning, which has prompted research into renal biomarkers. Generally, acute kidney injury is diagnosed on the basis of changes in creatinine concentration or urine output. However, some studies suggest that the levels of serum Cys C, uNGAL and baseline serum uric acid might serve as indicators...
for the risk of mortality and as an early diagnostic marker for acute kidney injury induced by paraquat poisoning.\textsuperscript{1,9-10}

Such markers are manifested much earlier than blood urea nitrogen and serum creatinine. Studies have reported that serum TNF-alpha, IL-2 and IL-6 significantly increased early in acute kidney injury rats with paraquat poisoning. However, the biomarkers which were used to evaluate the benefit from treatment and prognosis have not been adequately validated. Prospective, larger cohort studies are required to confirm the findings and to determine more precisely the biomarkers.

Paraquat mainly accumulates in the lung and generation redox cycling and intracellular oxidative stress which result in pulmonary edema, infiltration of inflammatory cells and damage to alveolar epithelium, finally progressing to severe pulmonary fibrosis.\textsuperscript{2,11} Clinical features include obstructive and restrictive ventilatory abnormalities, progressive worsening in gas exchange efficiency and rapidly progressive pulmonary fibrosis. Patients eventually die from refractory hypoxia or respiratory failure. Studies have reported that paraquat-induced pulmonary fibrosis in rats began at an early stage of inflammation and increased expression of HIF-1α. Pentraxin 3, arterial blood gas analysis and the area of ground-glass opacities of the lung may be a reliable index during early evaluation as a predictor of prognosis in paraquat poisoning.\textsuperscript{12-13} Pneumoproteins are probably markers of paraquat lung injury.\textsuperscript{14} An enhanced understanding of the radiological changes from computed tomography of the lung could detect early lung fibrosis.\textsuperscript{2} Having a sound understanding of the above factors could be valuable for early diagnosis, prognosis assessment and the development of treatment programs.

During recent decades there have been many fatalities from paraquat poisoning. It is still an extremely frustrating condition to manage clinically. However, a number of studies have considered that a successful outcome requires initial aggressive treatment to control serum paraquat concentrations. Aggressive measures, such as hemodialysis or hemoperfusion, high dose antioxidants (vitamin A, vitamin E, N-acetylcysteine) and immunosuppressants (methylprednisolone, cyclophosphamide, dexamethasone), might prevent the development and progression of fibrosis.\textsuperscript{15} Treatment of paraquat poisoning will benefit from future cases which are able to report on early treatment strategies based on diagnostic biomarkers that provide a good outcome, to evaluate and categorize reliable biomarkers. Timely diagnosis and treatment of PQ-induced AKI is often hampered by the atypical presentations and lack of reliable indicators. Although, The multi-disciplinary collaborations must be kept in mind, and the biochemical indicators for early diagnosis and prognostic evaluation if feasible to improve clinical outcomes.

**CONSENT**

The authors obtained written, informed consent from the patient for the publication of this article.

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COMPETING INTERESTS

There is no conflict of interest.

REFERENCES