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Mini Review

A Trial of Therapeutic Plasma Exchange in Intramuscular Ricin Poisoning

Bhavya Sharma[1], Jay Patel[1], Timothy Schaub[2], Joseph Myers[2], Rupesh Raina[1,2,3*]

[1]Department of Medicine, Northeast Ohio Medical University, Rootstown, Ohio, United States; [2]Department of Medicine, Summa Akron City Hospital, Akron, Ohio, United States; [3]Department of Medicine, Cleveland Clinic Akron General Hospital, Akron, Ohio, United States

ABSTRACT

Ricin poisoning is an exceedingly rare clinical scenario encountered in the field of toxicology. Potential routes of exposure consist of injection, inhalation, or ingestion. The ricin toxin's mechanism of action involves inhibition of protein synthesis, and the corresponding clinical findings can include nausea, vomiting, shortness of breath, pulmonary edema, cutaneous and visceral necrosis, multi-organ failure, and sepsis. Renal failure is often encountered, and the appropriate management is not currently established in the literature. We report a fatal case of intramuscular ricin injection leading to renal failure in a 37-year-old male. To our knowledge, there has been only one prior confirmed lethal case of intramuscular poisoning. Our case is also the first to evaluate the efficacy of Plasma Exchange (PLEX) in adult ricin poisoning. Although treatment remains supportive, we believe our case provides valuable insight and highlights the need for further investigation.

Keywords: Ricin poisoning; Toxicology; Renal failure; Hepatitis C

INTRODUCTION

Ricin, a glycoprotein contained within the castor bean, is one of the deadliest naturally occurring toxins available [1]. Specifically, the Castor bean plant (Ricin us communist) produces brown seeds from which castor oil is extracted under high heat. The corresponding toxin inhibits protein synthesis and inactivates eukaryotic ribosomes. Ricin may be ingested orally via castor beans or can be extracted as a concentrate, then inhaled or injected. A case fatality rate of 83% has been reported in patients with intentional ricin injection and as little as five to 10 micrograms per kilogram can be lethal [2,3]. Although the effects of orally ingesting ricin have been more commonly reported, exposure through inhalation or injection is limited in current literature. We report a patient who committed suicide by intramuscular injection of ricin from mashed castor beans obtained over the internet.

DESCRIPTION

A 37-year-old male with past medical history of IV drug use, hepatitis C, bipolar disorder and multiple suicide attempts came to emergency department 24 hours after injecting his left antecubital area with 4 cc of supernatant fluid of mashed castor beans, acetone, and water. He was resting in public with the intent of dying comfortably; however, he awoke the next morning with dyspnea, chest tightness, chills, myalgia's, fatigue and back pain. Vitals in the ED demonstrated a temperature of 99.7°F, blood pressure of 127/51 mm/Hg, pulse of 100/min, respiratory rate of 20 per min, and SpO_2 97% on RA. On examination, the patient was awake, alert, and oriented in mild distress. A small circle of erythema was noted on his left arm just proximal to antecubital fossa without necrosis. The remainder of the exam was benign. CBC demonstrated a WBC count of 10.2 and platelets at 161. Urine drug screen was positive for methadone and amphetamines. Serum drug screen did not detect methanol. Comprehensive Metabolic Panel (CMP) demonstrated creatinine of 0.60, Alanine Transaminase (ALT) of 98, and Aspartate Aminotransferase (AST) of 156. CK was elevated at 1198. Troponin was WNL. Chest X-Ray (CXR) was normal. The patient was diagnosed with acute ricin poisoning. On day two, his transaminases worsened. Based upon published success in children, Plasma Exchange (PLEX) was initiated with albumin 1:1, blood flow at 120 ml/min, PLEX rate of 2500

Correspondence to: Rupesh Raina, Department of Medicine, Northeast Ohio Medical University, Rootstown, Ohio, United States, Tel: 330-543-8950; E-mail: rraina@akronchildrens.org

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ml/h, and a volume of exchange of 3.5 liters. Median time from ingestion to PLEX was approximately 96 hours. Repeated blood work highlighted declining serum liver enzymes after second PLEX therapy. He received a total of five PLEX treatments. On hospital day four, he developed acute hypoxic respiratory failure. CXR demonstrated bilateral pulmonary vascular congestion and bilateral pleural effusion. Empiric vancomycin and piperacillin-tazobactam were initiated. On hospital day five, he required endotracheal intubation. Infectious workup was negative. Over the course of next few days, he developed acute renal failure with progression to Multi Organ System Dysfunction (MOSD). On hospital day 10, the family declined to pursue further treatment. As a result, the patient was extubated and transferred to hospice care where he died on day 11.

RESULTS AND DISCUSSION

When inhaled, ingested, or injected, ricin inhibits protein synthesis by irreversibly inactivating eukaryotic ribosomes. This disrupts the apoptosis pathways, causing cell membrane damage, cell death and release of cytokine inflammatory mediators [1]. The route of exposure determines the prevailing symptoms. When inhaled, patients can experience coughing, wheezing, dyspnea, congestion, and may subsequently develop pulmonary edema. When ingested, patients typically experience nausea, vomiting, diarrhea, hematemesis, melena, and may go on to develop necrosis of the spleen, liver, and kidney. When injected, symptoms may include erythema, blisters, induration, capillary leak syndrome and localized necrosis with potential progression to shock, multi-organ failure and respiratory failure [2].

There is a paucity of published reports on attempted or completed suicide by ricin injection. To our knowledge, there have been only three documented incidents of sub lethal poisoning after intramuscular ricin injection [4-6] notably, the use of intramuscular ricin injection with homicidal intent has been publicly recognized in the assassination of injected with ricin extract in the thigh via a modified umbrella and he ultimately succumbed to the poisoning [7]. Accidental ricin poisoning by ingestion of castor beans is unusual but more commonly reported [8-12]. Renal failure has been observed in ricin poisoning, however there is a lack of documented evidence on appropriate management [13,14].

We report a trial of PLEX in an individual who subcutaneously injected castor bean extract. Current tenets of management for ricin poisoning include the correction fluid imbalances, monitoring liver and renal function, correcting coagulopathies, and providing respiratory support. This case represents the first documented example of PLEX used for intramuscular ricin poisoning. PLEX was indicated due to previous documentation of successful treatment of oral ricin poisoning in children [15-17].

CONCLUSION

Our case demonstrates a reduction in hepatic serum biomarkers, suggesting PLEX may be effective upon early initiation. Though our course of treatment did not prevent the ultimate outcome for this patient, this may be due to the route of ricin administration, the amount injected, or the time to initiation of PLEX. While previous studies have explored the possibility of an antidote or vaccine-mediated immunity, there is currently no targeted management available. We believe our report provides valuable insight in the management of acute ricin poisoning and highlights the need for further investigation.

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