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Kaala Pathar (Paraphenylene Diamine) Poisoning and Angioedema in a Child: An Unusual Encounter

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Abstract

Hair dye ingestion is a rare cause of toxicity in Pakistan. Hair dyes contain paraphenylene-diamine (PPD) and a host of other chemicals that can cause rhabdomyolysis, laryngeal edema, severe metabolic acidosis and acute renal failure. Clinical outcomes rely on early recognition, prompt referral, and aggressive supportive treatment. Timely intervention has been shown to improve the outcome. There are many case reports of PPD poisoning in adults in which it was mainly used for deliberate self-harm purpose. However there is very little data regarding PPD poisoning in children. We report a case of a three year old boy who presented with severe respiratory distress and angioedema, who underwent emergent tracheostomy placement.

Introduction

Paraphenylenediamine (PPD) poisoning is amongst one of the emerging causes of poisoning in Asian countries. It is a constituent of hair dye formulation marked with the name of 'Kaala Pathar' and easily available in market at a low cost. It comes in grains or crystals like form, is crushed, mixed with henna and used as hair dye for enhancing its color.

PPD ingestion causes multiple organ dysfunctions. PPD is allergenic and tubulotoxic and causes angioneurotic edema and rhabdomyolysis, which lead to renal failure [1]. Common presenting features include development of edema of the face, neck, pharynx, tongue and larynx, sinus bradycardia, sinus tachycardia, hemodynamic instability and rhabdomyolysis followed by acute renal failure (ARF) as renal tubular necrosis occurs [2].

Paraphenylenediamine poisoning is reported globally, more so in the underdeveloped and developing countries. It was the number one of the leading cause of poisoning in Morocco during the 1990s [3], and an 11-year (1992-2002) retrospective study of 374 cases has been published from the Poison Control Center of Morocco [3]. A study of 150 cases over 10 years has been reported from Khartoum, Sudan [4]. An audit of tracheostomies in the adult patients after PPD ingestion has also been reported [5].

Numerous case reports have been reported from India and Pakistan. Several reports have been published in adult population from Pakistan, however, no cases of accidental ingestion in a child have been reported from the country and therefore a high degree of awareness and circumstantial evidence is required to make an early and a correct diagnosis.

Case

A 3 year old boy was brought to the emergency department with sudden onset of facial and tongue swelling and respiratory difficulty for the last 1-2 hours. History from the parents revealed that the child has ingested some "unknown liquid" 3-4 hours before the onset of these symptoms. However they were unaware of the exact time, quantity and nature of the substance ingested. There was no associated significant past medical history.

Physical examination revealed a sick looking child in severe respiratory distress. He was unable to speak and had an altered mentation. He weighed 15 kg (around 50th percentile) and was 90 cm in height (50th percentile). He was afebrile; having a respiratory rate of 75/minute and a heart rate of 140/minute and oxygen saturation was 70% on room air. There was evident oro-facial edema, with protrusion of the tongue. No associated rash or swelling on other part of the body observed.

Intubation was tried in emergency department; three failed attempts were made along with video-laryngoscopy and the child was subsequently rushed to the operating room, for an emergent tracheostomy tube placement. The child was shifted to Pediatric Intensive Care Unit for further management.

Initial lab results showed Hemoglobin of 9.2 gm/Dl, white blood counts of 16,000, platelet counts 422,000; serum glutamate-pyruvate transaminase (SGPT) 229 IU/L, Sodium 141 mmol/L, Potassium 3.4 mmol/L, Bicarbonate 24.2 mmol/L, creatinine 0.5 mg/Dl and lactic acid 0.8 mmol/L. Serum creatinine phosphokinase (CPK), and troponin I (cTnI) were within the normal range. Arterial blood gas analysis showed partial pressure of oxygen 121 mmHg, carbon dioxide 33.90 mmHg and pH of 7.41. Chest X ray done was unremarkable.

The child was managed along the lines of an anaphylactic reaction and angioneurotic edema. He was given organ supportive care along with steroids, H1, H2 blockers and nebulizations along with other organ specific supportive care.

Initially, repeated direct questioning from the parents did not reveal the true history of accidental ingestion of any toxic compound. It was not until the fourth day of admission in the PICU, that mother informed that the child had ingested a liquid (containing powder

named KAALA PATHAR used for hair-dying purposes) which earlier that day she had used to dye her hair. It was prepared in a water bottle and she had forgotten to throw the left over amount. Child had added more water to the bottle and drank it, as was witnessed by his elder brother. Relevant literature review was done following this history and to our surprise; literature revealed that Kaala Pathar contains paraphenylene-diamine (PPD) and its ingestion results in the characteristic triad of early angioneurotic edema with stridor, rhabdomyolysis with chocolate colored urine and acute renal failure. Whenever this combination occurs in poisoning, hair dye is a strong suspect.

Renal function tests were followed along with detailed liver function tests including a coagulation profile, that were unremarkable, except a rising SGPT level, 474 IU/L as of now. Magnesium levels were 2.2 mg/dl and creatinine phosphokinase (CPK) was 3700. No myoglobinuria was observed. Echocardiogram done revealed normal cardiac function and Ejection fraction (~70%).

The child improved clinically over the next few days, was weaned off the ventilator and discharged home with the tracheostomy tube. Parents were taught tracheostomy care. Over the next two to four weeks, he was decannulated and the tracheostomy removed successfully after four weeks.

Discussion

Paraphenylene diamine *(PPD)* is one of the most common constituent of hair dye formulations. It is a coal-tar derivative, which on oxidation produces Bondrowski's base, which is allergenic, mutagenic and highly toxic. This is first case report of accidental PPD in ingestion in children from Pakistan. The aim is to create awareness about the adverse effects of the hair dye, its poisoning, outcome, and possible preventive measures.

Poisoning with PPD presents with the characteristic features of severe angioneurotic edema, rhabdomyolysis and intravascular hemolysis with hemoglobinuria culminating in acute renal failure. Various case reports on PPD poisoning in adults have been published, this is the first case report of accidental ingestion in a child from Pakistan. Abdel Raheem et al. from the Middle East have reported a suicide of a twenty-seven year old mother, who also tried to poison her four children with PPD. One child died, one recovered after dialysis for acute kidney injury [6].

Chandran et al. have reported PPD ingestion with suicidal intent in a 13 year old female, who presented with cervicofacial edema, respiratory distress, rhabdomyolysis, and myocarditis [7].

Paraphenylene diamine is basically a coal tar derivative. When mixed with ammonia and hydrogen peroxide it becomes hair dying agent. It is also added to Henna (*Lawsonia Alba*) and used in the popular tattooing for its darkening effect [8,9]. Hair dyes contain PPD at various concentrations ranging from 0.2% to 3.75%. It is worth mentioning that the amount of PPD that can cause systemic poisoning is only three grams, while the lethal dose is 7-10 grams [10]. Hair dyes are available in stone, powder, or liquid forms. While the liquid forms are more often ingested with suicidal intentions, mortality is higher with the stone forms [11].

Permanent hair colors are the most popular hair dye products. They may be further divided into oxidation hair dyes and progressive hair dyes. Oxidation hair dye products consist of a solution of dye intermediates, e.g., PPD, which is a good hydrogen donor and is metabolized by electron oxidation to an active radical by cytochrome P450 peroxidase to form a reactive benzoquinone diamine. Free ammonia is present to promote the oxidation reaction. Complex reaction takes place, and numerous intermediates are produced on oxidation of PPD. However, the major product formed is Bondrowski's base which is a well-known allergenic, mutagenic and highly toxic [12].

Organ damage caused by PPD poisoning may be assessed by appropriate tests for rhabdomyolysis, and kidney and liver involvement. The onset of effects is usually within four to six hours after ingestion. The more severe the poisoning, the earlier the onset of effects. Laryngeal edema, cervico orofacial edema and respiratory distress occur due to direct toxic effect of PPD on mucous membranes within the first four to six hours of ingestion. Methemoglobinemia, rhabdomyolysis, acute tubular necrosis, arrhythmias, intra vascular hemolysis, gastritis, vertigo, tremors and convulsions develop over days to weeks [13]. Myocardial damage and myocarditis are reported less frequently in hair dye poisoning but associated with higher mortality [14].

The most consistent predictor of mortality is the amount of hair dye ingested, hyperkalemia, hypocalcemia and hyperphosphatemia and mortality rates vary between 0.03% and 60% [15]. Deamination and formation of analine are claimed to be responsible in part for the toxic symptoms. Suliman et al. [16] noted angioneurotic edema in 68% and emergency tracheostomy had to be done in 15.8% of the patients. Senthilkumaran et al. [16] had reported alveolar rupture possibly secondary to trapping of large volume of air maybe due to intense inspiratory effort resulting to laryngeal edema.

Published literature mentions the characteristic triad of features encountered is early angioneurotic edema of face and neck with stridor, rhabdomyolysis with chocolate colored urine and acute renal failure (ARF) could be a confirmative evidence of PPD poisoning even in the absence of laboratory facilities and when history is lacking in case of emergency [16,17]. The most marked presentation as has been described of cervicofacial edema was evident in our patient at presentation. Many a times it can be severe enough to cause respiratory distress, hypoxia, and necessitate an early and emergency intubation or tracheostomy, as a lifesaving measure. Upper airway tracheostomy secondary to 'kaala pathar' ingestion is in fact becoming the new emerging indication for emergency tracheostomy.

There is no specific antidote for PPD poisoning and treatment is supportive. In our case also, the child was managed as a case of angioedema and anaphylactic shock, before the toxic substance was identified. Paediatricians need to be aware about the clinical manifestations and emergency airway management of this condition, since misdiagnosis is not an uncommon entity as already discussed.

The child was managed as a case of angioedema and anaphylactic shock, before the toxic substance was identified. We therefore stress the need for a detailed history of any child who presents with acute poisoning. The aim of the study is to create awareness about the adverse effects of the hair dye, its poisoning outcomes, and possible preventive measures.

Conclusion

Hair dye poisoning is a rare cause of toxicity in Pakistan, especially in children. The initial presentation may be confusing and most deaths occur within hours of admission. Diagnosis therefore requires a high index of suspicion, as the clinical features are quite distinctive. There is

no specific antidote for PPD and treatment is supportive. Early recognition and treatment is vital for the management with special emphasis on airway control and prevention/treatment of renal failure. Clinical outcomes rely on early recognition, prompt referral, and aggressive supportive treatment. Health authorities should call for the prevention of the use and trade of PPD in the market. Awareness programs about its toxicity should be implemented at different levels. In view of the increasing incidence of poisoning with this toxin, primary care physicians, intensive care physicians and nephrologists need to be aware about the various manifestations and management strategies of this condition. In addition to the awareness, we recommend strict regulation and restriction of sale of PPD. More such findings should be published in peer reviewed journals, so they could influence the authorities and policy makers to come up with recommendations.

Conflict of Interest

The authors declare no conflict of interest.

References

1. Ram R, Swarnalatha G, Prasad N, Dakshinamurty KV (2007) Paraphenylene diamine ingestion: an uncommon cause of acute renal failure. J Postgrad Med 53: 181-182.
2. Akbar MA (2010) Kala pathar (paraphenylene diamine) intoxication; a study at Nishtar Hospital Multan.
3. Benslama A, Moutaouakkil S, Mjahed K, el Moknia M, Lahbil D, et al. (1998) Intermediary syndrome in acute malathion poisoning. Presse Med 27: 713-715.
4. SH Qadri, I Haq, E Haq, S Hassan (2014) An audit of the emergency tracheostomies in a tertiary care hospital. JSZMC 5: 615-618.
5. Soni SS, Nagarik AP, Dinaker M, Adikey GK, Raman A (2009) Systemic toxicity of paraphenylenediamine. Indian J Med Sci 63: 164-166.
6. Sampathkumar K, Yesudas S (2009) Hair dye poisoning and the developing world. J Emerg Trauma Shock 2: 129-131.
7. Raheem MA, Hamdouk M, Zijlstra EE (2010) Paraphenylene Diamine (Hair Dye) Poisoning in Children. Arab Journal of Nephrology and Transplantation 3: 39-43.
8. Bokutz M, Nasir N, Mahmood F, Sajid S (2015) Hair dye poisoning and rhabdomyolysis. J Pak Med Assoc 65: 425-426.
9. Chandran J, Manners R, Agarwal I, Ebenezer K (2012) Hair dye poisoning in a paediatric patient. Case Rep Pediatr 2012: 931463.
10. Jain PK, Agarwal N, Kumar P, Sengar NS, Agarwal N, et al. (2011) Hair dye poisoning in bundelkhand region (Prospective analysis of hair dye poisoning cases presented in department of Medicine, Mlb medical college, Jhansi). J Assoc Physicians of India 59: 415-419.
11. Abdelraheem MB, Elbushra M, Ali el-T, Ellidir RA, Bushara AI, et al. (2014) Filicide and suicide in a family by paraphenylene diamine poisoning: a mother who committed suicide and poisoned her four children of which one died. Toxicol Ind Health 30: 679-682.
12. Sir Hashim M, Hamza YO, Yahia B, Khogali FM, Sulieman GI (1992) Poisoning from henna dye and para-phenylenediamine mixtures in children in Khartoum. Ann Trop Paediatr 12: 3-6.
13. White JM, Kullavanijaya P, Duangdeeden I, Zazzeroni R, Gilmour NJ, et al. (2006) p-Phenylenediamine allergy: the role of Bandrowski's base. Clin Exp Allergy 36: 1289-1293.
14. Prabhakar Y, Kamalakar K (2012) Hair dye poisoning: A report of three cases. J NTR Univ Health Sci 1: 46-48.
15. Senthilkumaran S, Thirumalaikolundusubramanian P (2015) Acute hair dye poisoning: Lurking dangers. J Mahatma Gandhi Inst Med Sci 20: 33-37.
16. Chrispal A, Begum A, Ramya I, Zachariah A (2010) Hair dye poisoning--an emerging problem in the tropics: an experience from a tertiary care hospital in South India. Trop Doct 40: 100-103.
17. Singh AP, Jatav OP, Dudani M (2009) Myocarditis in hair dye poisoning. Indian Heart J 61: 306-307.