Chemical Science International Journal

29(8): 31-36, 2020; Article no.CSIJ.63892
ISSN: 2456-706X
(Past name: American Chemical Science Journal, Past ISSN: 2249-0205)

Fatal Outcome of the Inappropriate Use of an Organophosphate Compound (Sniper) in a Resource-Limited Setting

Chioma Okechukwu[1*] and Ajibola Alabi[1]

[1]Department of Paediatrics and Child Health, Rivers State University Teaching Hospital, Port Harcourt, Rivers State, Nigeria.

Authors' contributions

This case report was written in collaboration between both authors. Author AA was involved in the patient management while author CO wrote the first draft of the manuscript. Author AA edited and added on the manuscript. Both authors managed the literature searches. Both authors read and approved the final manuscript.

Article Information

DOI: 10.9734/CSJI/2020/v29i830198
Editor(s):
(1) Dr. Thomas P. West, Texas A&M University-Commerce, USA.
Reviewers:
(1) Diego Sebastian Gomez, National University of Comahue, Argentina.
(2) Salvador Jose Penna Videau, Universidad de Oriente, Venezuela.
Complete Peer review History: http://www.sdiarticle4.com/review-history/63892

Case Study

Received 10 October 2020
Accepted 15 December 2020
Published 31 December 2020

ABSTRACT

This case of unintentional organophosphate poisoning in a 9-year-old girl highlights the fatal consequence of the inappropriate use of an organophosphate pesticide bearing the trade name *Sniper*. The child developed significant organophosphate (OP) toxicity from dermal absorption of the chemical agent applied to her scalp by her mother and hairdresser in an attempt to treat head lice. This case also outlines the management of organophosphate poisoning, identifies the constrains of management in a resource-limited setting and emphasizes the need for prevention through community education and enforcement of regulatory measures.

Keywords: Unintentional organophosphate poisoning; head lice; sniper; children.

**Corresponding author: E-mail: chiomaokechukwu412@gmail.com;*

1. INTRODUCTION

The product called *Sniper* has been in use in Nigeria as a pesticide for over two decades [1,2]. It has been proven to be an extremely effective chemical agent against common household insects as well as agricultural pests [3]. For this reason, it is a popular insecticide and is commonly found in many households in Nigeria [4]. The regulations regarding its procurement in Nigeria are also very weak [3].

There are reports of accidental poisoning and the intentional ingestion of this agent as a means of committing suicide or homicide, [5-7] however there is a paucity of reports regarding unintentional toxicity following the application of this chemical to the human body for treatment of head or body lice or skin rashes. Also, the use of this chemical without personal protective equipment like hand gloves or protective gowns has resulted in toxicity following dermal absorption [4]. With the increasing incidence of *Sniper*-assisted suicide attempts in Nigeria, the National Agency for Food and Drug Administration and Control declared a ban on its use in 2018 [8].

Sniper (Fig. 1) is marketed in Nigeria by a Swiss-Nigerian Chemical Company [4]. The product is labelled with a strong warning against domestic or non-professional use, however, the warnings are often over-looked and the regulations restricting the sale of this agent in Nigeria ~~is~~ are not enforced. Hence it is readily available for purchase in the daily markets and shops and it is also quite affordable by many Nigerian residents [4,6] *Sniper* contains a synthetic organophosphorus, (DDVP) 2,2-Dichlorovinyl dimethyl phosphate compound, (Fig. 2) [4] which binds to an enzyme, acetylcholinesterase that is responsible for the breakdown of acetylcholine. This results in the accumulation of acetylcholine at neuronal synapses and the neuromuscular junction causing excessive stimulation of nicotinic and muscarinic receptors [9,10].

This is a report of the fatal outcome of ~~OP~~ organophosphate (OP) poisoning in a 9-year-old girl following the inappropriate use of *Sniper* to treat head lice. This article also outlines the management of OP poisoning, identifies the constrains of management in a resource-limited setting and emphasizes the need for prevention through community education and enforcement of regulatory measures.

Fig. 1. A sample of the product, *Sniper*

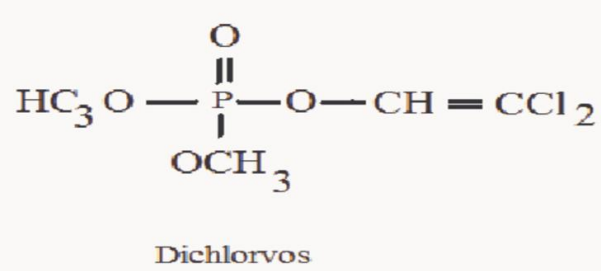

Fig. 2. The chemical structure of 2,2-Dichlorovinyl dimethyl phosphate compound

2. CASE PRESENTATION

A 9-year old female presented to the Children emergency room (CHER) of the Rivers State University Teaching Hospital (RSUTH) with a 5-hour history of worsening restlessness, difficulty in breathing, drooling of saliva, darkening of the lips, fever, vomiting, convulsions and loss of consciousness. Two days earlier, a pesticide (*Sniper*) had been applied to her scalp by her mother and hairdresser in an attempt to treat head lice.

Olive oil was applied to her skin, nose and mouth by her mother, following which she was rushed to a secondary health facility, where the seizure was aborted with benzodiazepine before she was referred to RSUTH for expert care.

She was the 1st child of two children. Her 6 –year old sister also had a smaller quantity of the substance applied to her scalp by their mother who carried out both applications with her bare hands. The mother is a 39-year-old single mother with a secondary level of education, and she is a petty trader who takes sole financial responsibility for children. Her psychologic evaluation did not reveal any concerns. The family lives in a one-bedroom apartment and is of low socioeconomic class. A review of systems and the patient past medical history was not contributory.

On physical examination, the patient was found to be unconscious with a Glasgow Coma Scale of 9/15 (E_4 V_3 M_2), in severe respiratory distress, centrally cyanosed, drooling saliva from the mouth and febrile (temperature- 38.5°C). Her oxygen saturation was 72% in room air. The respiratory rate was 50 cycles/minute with widespread coarse crepitations heard on auscultation of the lung fields. The heart rate was 120 beats/minute and the blood pressure 140/100 mmhg. She had pinpoint pupils and hypotonia in all limbs. Random blood sugar done was 8.3 mmol/l.

The airway was cleared, she was positioned to allow drainage of bronchorrhoea and intranasal oxygen commenced. The whole body was washed with soap and water to decontaminate the scalp and skin. She received boluses of intravenous atropine at 0.02 mg/kg (0.5 mg) at intervals of 30 minutes and intravenous infusion of Ringer's lactate 500 mls 8 hourly. Intravenous hydrocortisone and ceftriaxone (2 grams) were also given. Pralidoxime was prescribed but unavailable till child's demise. The measurement of erythrocyte acetylcholinesterase (E-AChE) and serum cholinesterase (S-ChE) activities were not done as the laboratory at our facility is unable to perform these tests. With no improvement in the clinical condition, arrangements were ~~being~~ made to move the child into the intensive care unit for possible intubation and ventilation. She, however, developed gasping respiration and stopped breathing after 18 hours on admission.

It is important to note that the patient's sister and mother also showed features of OP toxicity. The sister presented with body weakness, dizziness, and convulsions for which she was admitted and discharged after one week, while the mother complained of dizziness and severe body weakness which resolved without treatment.

3. DISCUSSION

Organophosphate poisoning has become a common occurrence in many developing countries like Nigeria, especially due to its availability and poor regulations regarding purchase [1,11,12].

Human exposure to organophosphate pesticide could occur through ingestion, inhalation, dermal absorption or ocular contact [3]. For most agents

oral or respiratory exposures result in features of toxicity within three hours while symptoms of dermal absorption can be delayed for up to twelve hours. Our patient got poisoned mainly through dermal absorption, with a possibility of some ingestion or inhalation.

As is the situation, in this case, the occurrence of pesticide poisoning has been reported to be significantly associated with low socioeconomic class [13-16]. This can be explained as an unfortunate interplay between ignorance and poverty [16,17]. Given that low-income families may also have a low level of education hence they are less likely to be knowledgeable of the harmful effects of a cheap alternative pesticide.

The excessive stimulation of nicotinic and muscarinic receptors causes symptoms such as headache, dizziness, weakness, vomiting, diarrhoea, bradycardia, dyspnoea, ataxia, and paralysis [9,10]. Other possible symptoms of OP poisoning listed by the Centre for Disease Control include irritation of eyes, skin; miosis; rhinorrhea, wheezing, laryngeal spasm, salivation; cyanosis; anorexia; sweating; muscle fasciculation; convulsions; hypertension, and cardiac irregularity [18]. Anxiety, emotional liability, stupor, delirium, confusion, slurred speech, tremors and coma are central nervous system effects that could also occur [19]. Non-ketotic hyperglycaemia has also been reported [20].

The index patient manifested most of the life-threatening symptoms of OP poisoning like loss of consciousness, continuous excessive drooling of saliva and convulsions 48 hours after application of pesticide to the scalp. She had muscarinic symptoms (miosis, vomiting, drooling saliva, catarrh, tearing) as well as nicotinic symptoms (tachycardia, hypertension). Using the WHO classification of Acute pesticide poisoning (APP), this patient can be classified as a probable case of APP [3]. Acute pesticide poisoning refers to any illness or health effect that resulted from suspected or confirmed exposure to a pesticide within 48 hours [3].

The long duration of 48 hours from exposure to first intervention in this patient also contributed to the fatal outcome. Research has shown that intervention within a few hours of exposure is associated with a better outcome as patient decontamination is more effective and the total quantity of substance ingested or absorbed in the body is minimized [21].

The diagnosis of OP toxicity is most often clinical. Our patient gave a history of exposure to an organophosphate compound. The history coupled with the presence of symptoms and signs resulting from excessive stimulation of the nicotinic and muscarinic receptors indicated a diagnosis of OP poisoning. The diagnosis can also be confirmed by checking for erythrocyte acetylcholinesterase (E-AChE) and serum cholinesterase (S-ChE) activities [22]. This is not available in most health facilities in resource-limited settings.

Acute pesticide poisoning or exposure to organophosphate chemicals is a medical emergency and the ideal treatment response is to give priority to airway and fluid management. Patients who present with severe toxicity, like our patient, should be admitted directly into an Intensive Care Unit, intubated and ventilated, however, there are a limited number of health facilities that have an Intensive care unit in resource-limited countries. The chances of survival are better for patients with features of severe toxicity who present early for medical care [1].

Following the initial assessment and cardiorespiratory stabilization, our patient was decontaminated by washing her body thoroughly with soap and water. Gastric lavage is discouraged if the patient is unconscious and its effectiveness depends on the time since ingestion of the agent.

Atropine is the mainstay of therapy in organophosphate poisoning worldwide [23]. Atropine is a competitive antagonist of muscarinic acetylcholine receptor [23]. It can be given as a bolus and as an infusion. Its use is especially beneficial when instituted promptly and rapidly [23]. Incremental doses are given at intervals and care is taken to ensure atropine toxicity is avoided. In severe cases (such as the index case), Pralidoxime should be given to give the child a better chance at survival. Pralidoxime is also an antidote for organophosphate poisoning as it reactivates acetylcholinesterase by binding to the phosphorus atom to form oxime-phosphonate [24]. This splits away from the acetylcholinesterase molecule [24]. Pralidoxime though effective, may not be readily available in resource-limited settings [10].

In any case of accidental or non-accidental organophosphate poisoning, proper counselling of the patient and relatives is crucial. Social

workers should be assigned to do periodic home visits of survivors and their families to ensure that the environmental triggers for acute poisoning have been dealt with. For this index case, in addition to family education and counselling, community health education and sensitization was done for the index community.

4. CONCLUSION

The consequence of the inappropriate use of organophosphate pesticides like *Sniper* can be fatal. More public enlightenment should be done to discourage the inappropriate use of this agent and communicate its harmful effects to the public. Extreme caution must be applied while handling these agents and, as much as possible, any contact with human body parts should be avoided.

5. RECOMMENDATIONS

1. Strict regulations to enforce the ban on the use of the pesticide called *sniper*.
2. Extensive health education and enlightenment campaigns on the detrimental effects of applying pesticide chemicals on the hair or body.
3. Education of medical personnel on the management and care of children with acute pesticide poisoning.
4. Equipment of hospitals with necessary facilities and resources needed in the management of OP poisoning.

DISCLAIMER

The products used for this research are commonly and predominantly used products in our area of research and country. There is absolutely no conflict of interest between the authors and producers of the products because we do not intend to use these products as an avenue for any litigation but for the advancement of knowledge. Also, the research was not funded by the producing company rather it was funded by personal efforts of the authors.

CONSENT

Authors declare that consent was obtained from the mother of the children for publication of this case report about the clinical presentation and outcome of the children. She was assured of strict confidentiality as the patients' names will not be disclosed at any point in the publication.

ETHICAL APPROVAL

As per international standard, written and informed ethical approval has been collected and preserved by the authors.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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Peer-review history:
The peer review history for this paper can be accessed here:
http://www.sdiarticle4.com/review-history/63892