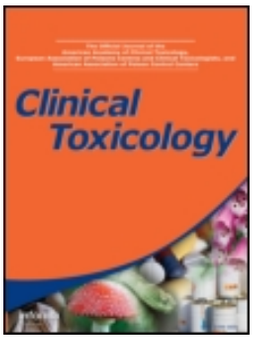

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CASE REPORT

Mass ethion poisoning with high mortality

ARUNA DEWAN, M.D.[1], ASHWIN B. PATEL, M.Sc.[1], RAMAVATI R. PAL, M.Sc.[1], UMESH J. JANI, M.D.[2], VINU C. SINGEL, M.D.[2], and MAULIK D. PANCHAL, MBBS[2]

[1]*Poison Information Centre, National Institute of Occupational Health, Meghaninagar, Ahmedabad, India*
[2]*Department of Medicine, B. J. Medical College, Civil Hospital, Ahmedabad, India*

Introduction. Fifteen people who consumed a meal during a social ceremony at a remote farm developed symptoms and signs of organophosphate poisoning. *Methods*. Information was gathered from villagers and doctors at the primary health center and district hospital. Serial measurements of plasma and red blood cell cholinesterase activity levels were carried out and the organophosphate compound was identified in blood samples. *Results*. Clinical toxicity included abdominal pain, vomiting, diarrhea, excessive secretions, and respiratory distress. The victims were taken to a community health center about 30 km away where three people died. The others were taken to the district level hospital at Palanpur where five died. Of the seven remaining victims who were transferred to a tertiary care hospital at Ahmedabad, one died during transport and another succumbed within a few hours. The remaining five people were hospitalized. Three recovered within a week but two developed complications: one had a lung infection and the other had cerebral anoxia following cardiorespiratory arrest. The person with cerebral anoxia died after eight and a half months. Red blood cell cholinesterase levels on the day of admission correlated well with clinical severity and outcome of the patients. The pesticide was identified as ethion. *Conclusions*. Pesticide poisonings in developing countries have high morbidity and mortality rates, as facilities for immediate treatment are not readily available. Such incidents should sensitize clinical toxicologists, health authorities, and policy makers to the problems of pesticide poisoning in third world countries.

Keywords Organophosphate; Pesticide; Mass poisoning; Ethion; Plasma cholinesterase; RBC cholinesterase; High mortality; Developing countries

Introduction

Organophosphate (OP) pesticides continue to be the most common type of pesticides involved in acute poisoning in countries like India and Sri Lanka (1–3). A large number of them, including ethion, are registered for use in India. Despite structural differences, the mechanism by which they elicit their toxicity is identical and is associated with the inhibition of the nervous tissue acetylcholinesterase. Morbidity and mortality from OPs remains especially high in rural settings where facilities for intensive care are either absent or very limited. The World Health Organization (WHO) has estimated that each year more than 200,000 people in the world die from pesticide poisoning (4); most of them occur in Asia and at least 50% of them are of OP-poisoning (1,4). Episodes of mass poisoning due to OP pesticides have been reported from developing countries like Pakistan and India (5,6); the first from India was reported in 1958 and occurred following the consumption of parathion-contaminated wheat, killing more than 100 people (7).

In India, there are very few established Poison Information Centers (PIC) and one such center at the National Institute of Occupational Health (NIOH) in Ahmedabad provides laboratory support in acute poisoning cases. Plasma and red blood cell (RBC) cholinesterase measurements are routinely carried out; in severe OP poisoning cases that remain hospitalized for long durations, serial measurements are also done.

In the past five years, three episodes of mass poisoning have been reported to the PIC. One was due to endosulfan (8) and the other was due to phorate (unpublished). In the episode due to phorate, 14 children aged 7–14 years were poisoned while washing empty plastic bags in which phorate granules had been packed; one child died. The third episode is the subject of this report.

The present report describes a mass poisoning involving ethion in which 10 out of 15 affected people died within 24 hours and the remaining five people had to be hospitalized for varied durations. There are very few reports in the literature on human ethion poisonings. There is one report of acute poisoning in a six-month-old child who accidentally ingested 15.7 mg/kg of ethion from a contaminated milk bottle (9). There are no data in the literature regarding deaths in humans after oral exposure to ethion (10).

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Address correspondence to Dr. Aruna Dewan, Poison Information Centre, National Institute of Occupational Health, Meghaninagar, Ahmedabad, India. E-mail: dewanaruna@yahoo.com

Materials and methods

This episode of mass poisoning happened on April 14, 2005 in Magrawa, a village about 235 km north of Ahmedabad. Fifteen people (nine adults and six children) were affected. Within 24 hours, a Poison Center team visited the site of the incident and collected information from the relatives and neighbors. Information was also obtained by telephone from the medical personnel who treated the victims at the primary health center in Dhanera (about 30 km from the site) and the District hospital in Palanpur (about 95 km from the site). Five survivors were admitted to the intensive care unit of the new civil hospital in Ahmedabad on the morning of April 15, 2005 where they were treated for OP poisoning. Routine laboratory investigations were carried out in the hospital but serial plasma cholinesterase and RBC cholinesterase estimations were carried out at the Poison Information Center (PIC) laboratory. Samples of food and buttermilk consumed by the victims were not available for our analysis, as the same had already been collected by forensic teams. The results of the forensic analysis was not available to the researchers.

For cholinesterase estimations, 2–3 ml blood was collected in EDTA tubes and the blood samples were brought to the PIC laboratory within half an hour. Plasma cholinesterase and RBC cholinesterase were determined by spectrophotometry on a RA-50 chemistry analyzer by modified Ellman's method using acetyl thiocholine (Sigma chemicals) as substrate (11). Normal values standardized in the PIC laboratory range from 2900–5800 U/L and 1700–2300 U/L for plasma cholinesterase and RBC cholinesterase, respectively.

For identification of the OP pesticide, serum samples collected on day one were stored at −20° C and were airlifted in dry ice to Vimta laboratories, a private accredited analytical laboratory in Hyderabad. The Human Research Ethics committee of NIOH approved the study.

Case report

The mass poisoning occurred at a farm during a social ceremony in which a meal consisting of cereals, potatoes, and buttermilk was served during mid-morning hours on April 14, 2005. Children and male members were the first to take the food. Within 2–3 hours, all nine adult males and six children who had taken the meal along with buttermilk started complaining of severe abdominal pain, difficulty in respiration and many had diarrhea and vomiting. These effects were not observed among the people who did not consume this food. The affected people were transported to the Primary Health Center in Dhanera. According to the attending doctors, all cases had diarrhea, and some had vomiting, abdominal pain, and excessive perspiration. They were initially treated for food poisoning and were given intravenous (IV) fluids and antibiotics. However, three of the cases developed respiratory distress and died within a few hours of admission. Thereafter, the survivors were transferred to the District hospital in Palanpur. Doctors at this hospital also described a similar clinical picture and, in addition, reported pulmonary edema in one case. Five more people died but the exact times of their deaths are not known. During the night, the remaining seven victims were transferred to the New Civil hospital in Ahmedabad where they arrived at about 0200 hours on April 15, 2005. In the emergency room, one person was found dead before he could be treated and another person, a 6-year-old child, died at 0900 hours.

The important data of five cases is given in Table 1. Three patients (Patients 1, 2, and 3) were fully conscious on admission but had clinical evidence of OP poisoning. They were kept in the intensive care unit for two days but were later shifted to the ward, as they did not need ventilatory support. They were given 30–50 mg atropine intravenously (IV) over a period of 2 to 3 hours. Thereafter, a dose of 40–50 mg was given daily for a week and then gradually tapered off. All three patients were also given pralidoxime (2-PAM) IV; the total dose given over a period of four days was 12 to 15 g per person. Though the victims recovered after a week, they were kept under observation in the hospital due to slow recovery of cholinesterase levels and were discharged after 25 to 27 days. The remaining two surviving patients were critically ill.

Patient 4 was immediately intubated and put on assisted ventilation in the Synchronized Intermittent Mandatory Ventilation (SIMV) mode with 15 breaths per minute along with pressure support of 10 cm water. Intravenous atropine was given in doses of 2.4 mg every 15 minutes (50 mg of atropine were given on days one and two in divided doses). On the first day, pralidoxime was given in a dose of 1 g every six hours and then gradually reduced and discontinued on the fourth day. The RBC cholinesterase activity level was zero on days 1, 4, and 8 and then started increasing very gradually; plasma cholinesterase levels were reduced by more than 90% (Figs. 1 & 2). Due to the need for continuous ventilatory support, a tracheostomy was done on day seven. Until the ninth day, the patient remained stable and laboratory investigations carried out periodically were within the normal range. On day 10, the patient developed bilateral mid-zone consolidations and Klebsiella species was isolated from endotracheal tube swab cultures for which antibiotics were given. Patient responded to intensive drug therapy and chest physiotherapy. He was weaned from the ventilator on day 20 and the tracheostomy was closed on day 25.

Patient 5 had a cardiorespiratory arrest three hours after admission to the hospital. Though he was resuscitated and put on ventilatory support, he remained unconscious. He also had a tracheostomy done. Routine investigations done periodically remained within normal range. RBC cholinesterase done on day 1 and 4 were zero and started increasing slowly from day 8 onwards (Figs. 1 & 2). An MRI of the brain showed bilateral lentiform nucleus ischemia. Aspirin, atorvastatin and clopidogrel were added to treatment. There was not much improvement in the level of consciousness and the relatives took him home after two months of hospital stay though he was permanently disabled with power grade 3/5,

Table 1. Patient data

Parameter	Patient 1 male, 55 yrs	Patient 2 male, 14 yrs	Patient 3 male, 55 yrs	Patient 4 male, 28 yrs	Patient 5 male, 35 yrs
Level of consciousness at the time of admission	Conscious	Conscious	Conscious	Stupor Glasgow coma scale $E_2V_3M_4$	Comatose coma scale $E_1V_1M_3$
Plasma cholinesterase (U/L) *	2899	234	265	116	173
RBC cholinesterase (U/L) **	1404	716	610	0	0
Routine biochemical, hematological, and other investigations ***	Normal	Normal	Normal	Respiratory acidosis on admission; Leucocytosis and anemia on day 15	Normal
Dose for atropinization (mg)	30	50	30	50	85
Total dose of Atropine given (mg)	336	618	206	432	1000
Total dose of PAM given (g)	15	12	12	15	20
Duration of Hospitalization (days)	25	25	27	54	60
Stay in ICU (days)	2	2	2	28	45
Need of ventilatory support (days)	No	No	No	Yes (19)	Yes (40)
Whether tracheostomy done	No	No	No	Yes	Yes
Complications	Nil	Nil	Nil	Bilateral mid-zone pulmonary consolidation	Cardio-respiratory arrest, hypoxic brain damage
Outcome	Complete recovery	Complete recovery	Complete recovery	Complete recovery	Died after 8.5 months

*Normal value 2900–5800 U/L.
**Normal value 1700–2300 U/L.
***Include routine hematology and urine analysis, random blood sugar, liver and renal function tests, arterial blood gases, chest X-rays, and ECG.

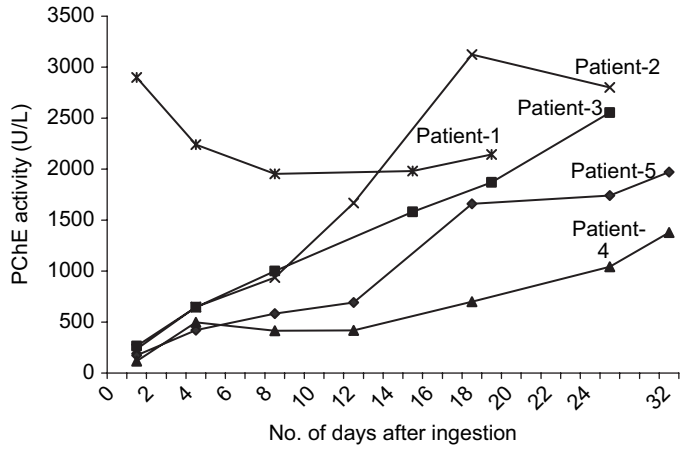

Fig. 1. Serial plasma cholinesterase levels in ethion poisoning cases.

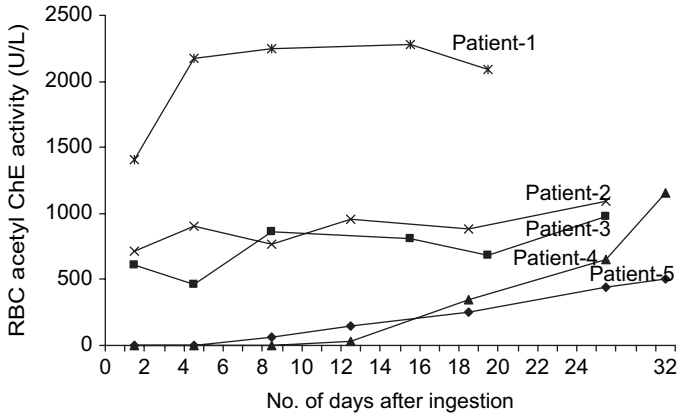

Fig. 2. Serial RBC acetylcholinesterase levels in ethion poisoning cases.

incontinence, and Ryle's tube in situ. His condition did not improve and he died after eight and a half months.

Analysis of blood samples by gas chromatography—mass spectroscopy (GC-MS) showed the presence of ethion in Patient 3. In this patient, ethion concentration was 1.3 mg/L 24 hours after the exposure.

Plasma cholinesterase was very low on day one in four of the five cases (Fig. 1). In Patient 1, the plasma cholinesterase was within the normal range and the RBC cholinesterase was only slightly inhibited (it returned to normal range within 4 days post-exposure). Patients 2 and 3 did not require ventilatory support even though plasma cholinesterase levels were almost 90% inhibited on day one; their RBC cholinesterase levels on day one were not as low as the two critically ill patients (Patients 4 and 5). However, recovery of RBC cholinesterase in these two patients was also very slow and even on the day of discharge, their levels were almost 50% inhibited while they were clinically normal. In Patients 4 and 5, plasma cholinesterase values were more than 90% inhibited on day one whereas RBC cholinesterase remained zero for

4 to 8 days after which there was a very gradual rise in the levels (Figs. 1 & 2).

Discussion

To the best of our knowledge, this is first study reporting mass poisoning due to ethion. Ethion is a moderately toxic OP pesticide belonging to class II category by hazard, and approximately 3000–4000 metric tons of this pesticide is used annually in India. It is a small (MW 384), lipid-soluble molecule that can be absorbed by passive diffusion through the lungs, gastrointestinal tract, or skin. Absorption appears to be rapid by the oral and dermal routes. In one report, the rapid absorption of ethion is inferred from the onset of clinical signs within one hour after accidental ingestion of ethion in a 6-month-old boy (9). In an experimental study, deaths were recorded within 3–6 hours in dermally-exposed Sherman rats (12). Except for these two reports, there is limited information on the toxicity of ethion. The time course of events in the present report leading to severe toxicity within a few hours points towards rapid absorption of the pesticide. Ethion was detected only in one of the blood samples collected 24 hours after the episode. It is possible that ethion was not detected in four samples because it had been converted to ethion monoxon, the active metabolite. Quick absorption of the pesticide and delay in treatment seems to the main factors responsible for very high mortality and morbidity observed in this episode. Interestingly, all six children died within 24 hours of the poisoning episode; whether this was due to a larger exposure or increased sensitivity is unclear. In the five survivors, cholinesterase levels, especially RBC cholinesterase, correlated well with the clinical picture on the day of admission. The three patients who had higher levels of RBC cholinesterase on day one did not need ventilatory support, were hospitalized for shorter durations, and did not develop any complications.

Another important issue is the use of toxic pesticides by illiterate farmers in remote villages where poisonings are most likely to occur. In this particular episode, the exact reason for poisoning could not be determined, but it was most probably unintentional because the incident happened on a farm.

The economic cost of managing OP poisoning is high. Treatment of OP poisoning cases in developing countries taxes the hospital resources that have to be diverted to the treatment of a preventable condition. In the present study two out of six ventilators in the medical ICU were used for OP poisoning cases for more than a month. OP poisoning continues to be a serious problem in developing countries and there is an urgent need for reviewing policy decisions related to their availability, safe use, and treatment facilities.

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References

1. Eddleston M. Patterns and problems of deliberate self poisoning in the developing world countries. Q J Med 2000; 93:715–731.
2. Karalliedde L, Eddleston M, Murray V. The global picture of OP insecticide poisoning. In: OPs and Health. Karalliedde L, Feldmen F, Henry J, Marrs T, eds., London: Imperial College Press, 2001:431–471.
3. Peedicaryil J, Emset K, Thomas M, Kanagasabapathy AS, Stephen PM. The effect of organophosphorous compounds on serum pseudocholinesterase levels in a group of industrial workers. Hum Exp Toxicol 1991; 10:275–278.
4. WHO in collaboration with the United Nations Environment Programme. Public health impact of pesticides used in agriculture. Geneva: World Health Organization, 1990.
5. Baker EL Jr, Warren M, Zack M, Dobbin RD, Miles JW, Miller S, Alderman L, Teeters WR. Epdemic malathion poisoning in Pakistan malaria workers. Lancet 1978; 1:31–34.
6. Chaudhari R, Lall S, Mishra B, Dhawan B. Food born outbreak of organophosphorous poisoning. Brit Med J 1998; 317:268–269.
7. Karunakaran CO. The Kerala food poisoning. J Ind Med Assoc 1958; 31:204.
8. Dewan A, Bhatnagar VK, Mathur ML, Chakma T, Kashyap R, Sadhu HG, Sinha SN, Saiyed HN. Repeated episodes of endosulfan poisoning. J Toxicol Clin Toxicol 2004; 42: 363–369.
9. Comstock EG, Bickel L, McCormik RA Jr Acute ethion poisoning Tex Med 1962; 63:71–75.
10. ATSDR/CDC Toxicological profile for Ethion. Agency for Toxic Substances and Disease Registry, Centres for Disease Control and Prevention, Atlanta, GA, 2002:1–218.
11. Ellman GL, Courtney KD, Andres V Jr, Featherstone RH. A new and rapid colorimetric determination of acetylcholinesterase activity. Biochem Pharmacol. 1961; 7:88–95.
12. Gaines TB. Acute poisoning of pesticides. Toxicol Appl Pharmacol 1969; 14:515–534.