

Evaluation of Cases with Acute Organophosphate Pesticide Poisoning Presenting at a Tertiary Training Hospital Emergency Department: Intoxication or Suicide?

Bir Üçüncü Basamak Hastanesi Acil Servisine Başvuran Akut Organofosfat Zehirlenmesi Vakalarının Değerlendirilmesi

Dilek Soysal¹, Volkan Karakuş¹, Ahmet Soysal², Erhan Tatar¹, Bayram Yıldız¹, Hatice Şimşek²

¹Department of 1st Internal Medicine, Atatürk Research and Training Hospital, İzmir, Turkey

²Department of Community Health, Faculty of Medicine, Dokuz Eylül University, İzmir, Turkey

Abstract

Objective: The aim of this study was to evaluate cases of acute poisoning by organophosphate pesticides, mainly used for suicidal purposes.

Materials and Methods: In this retrospective, cross-sectional study, twenty three cases who presented with acute organophosphate pesticide poisoning between January 2005 and December 2006 were evaluated. The diagnosis "acute poisoning" included only acute intoxications and excluded symptomatic poisoning due to chronic intoxication.

Results: Of the 23 cases, 13 were women and mean age was 31.3±11.9 years. Poisoning was common in Summer. Nineteen cases (82.6%) were admitted to the emergency between 17.00 PM and 08.00 AM. Of the 23 cases, 15 (65.2%) were farmers, 5 (21.7%) were unemployed, 2 (8.7%) were students and 1 (4.3%) was a worker. Fourteen cases (59.8%) had no social security. Eighteen cases (78.3%) were residing in the rural area or outside İzmir. Three cases took the toxic substance accidentally and 20 (87.0%) for suicidal purposes. The most common symptom on admission was bronchial hypersecretion (91.3%). Eight patients (34.8%) with respiratory failure required mechanical ventilation. Median duration of hospital stay was 5 days. Overall mortality was 13.0%. Atropine was used in all the cases. Pralidoxime was used in 20 cases with a total amount ranging between 2 and 42g at a median of 6 days.

Conclusion: Poisoning with organophosphate pesticides is more common among farmers and the major cause is the suicide.

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Key words: Organophosphates, pesticides, poisoning, suicide

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Özet

Amaç: Bu çalışmanın amacı temelde organofosfatlı pestisidleri intihar amaçlı kullanarak akut zehirlenme tablosu ile başvuran olguların değerlendirilmesidir.

Gereç ve Yöntemler: Bu çalışma retrospektif ve kesitsel olup, Ocak 2005 ve Aralık 2006 yılları arasında akut organofosfat zehirlenmesi nedeniyle acil servise başvuran 23 olgu değerlendirilmiştir. Sadece akut zehirlenme olgularını içeren çalışmaya kronik zehirlenmeye maruz kalan semptomatik olgular dahil edilmemiştir.

Bulgular: Yirmi üç olgunun 13'ü kadındı ve ortalama yaş 31.3±11.9 yılı. Zehirlenmeler yaz mevsiminde yaygındı. On dokuz olgu (%82.6) hastaneye akşam 17.00 ile sabah 08.00 saatleri arasında başvurmuştu. Tüm olgulardan 15'i çiftçi (%65.2), beşi işsiz (%21.7), ikisi öğrenci (%8.7) ve bir olgu da işçiydi (%4.3). On dört olgunun (%59.8) sosyal güvencesi yoktu. Olgulardan 18'i (%78.3) kırsal alanda veya İzmir dışında ikamet etmekteydi. Olguların üçü yanlışlıkla, 20'si (%87.0) intihar amaçlı toksik maddeyi kullanmıştı. En sık semptom bronşiyal hipersekresyondur (%91.3). Sekiz olgu (%34.8) solunum yetmezliği nedeniyle mekanik ventilatöre bağlandı. Hastanede kalış süresi ortalama beş gündü. Olguların yüzde 13'ü kaybedildi. Olguların tümünde tedavide atropin kullanıldı. Pralidoksim 20 olguda kullanıldı. Kullanılan toplam doz 2-42 gram arasındaydı, ortalama kullanma süresi altı gündü.

Sonuç: Organofosfatlı pestisitlerle zehirlenme çiftçiler arasında sık görülmektedir ve büyük çoğunluğu intihar amaçlıdır.

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Anahtar kelimeler: Organik fosforlu bileşikler, pestisidler, zehirlenme, intihar

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Introduction

Insects, rodents, wild herbs and fungus live on human or animal body as well as on or around plants, and decrease or detriment nutritional values of food sources during their production, storage and

consumption. Pesticides are chemical materials and used to minimize these detrimental effects (1).

Organophosphate (OP) compounds are the largest chemical group found in pesticides. In Turkey, they are widely used in agriculture industry (1). Parathion, an organophosphate pesticide, is respon-

sible for most of the occupational poisonings and deaths throughout the world. Other highly toxic pesticides in this chemical class are mevinphos (Phosdrin), methamidophos (Monitor, Taron), azinphosmethyl (Guthion), etc. N-Methyl carbamates, chlorinated hydrocarbons, phenolic and cresolic pesticides, phenoxyaliphatic acid herbicides, fumigants and bipyridylherbicides are chemicals used as pesticides other than organophosphate compounds (2). Pesticides concerning organophosphate compounds are a common cause of poisoning in developing countries but less so in developed countries (3).

The increased use of pesticides, especially organophosphates, to improve the quality of agricultural products in Turkey and also worldwide raised the concern on accidental poisoning and suicides with these compounds. The mode of exposure to organophosphate compounds varies, including dermal, gastrointestinal, respiratory and intravenous routes (4, 5).

Organophosphate compounds inhibit both cholinesterase (ChE) and pseudocholinesterase activities, as they are irreversible cholinesterase inhibitors. The inhibition of cholinesterase activity leads to accumulation of acetylcholine at synapses, causing overstimulation and disruption of neurotransmission in both central and peripheral nervous systems (1-6).

In the present study, we evaluated cases with acute poisoning of organophosphate pesticides from urban and rural areas of Izmir and the entire region between January 2005 and December 2006.

Material and Methods

In this retrospective, cross-sectional study conducted in patients with acute organophosphate pesticide poisoning between January 2005 and December 2006, twenty three cases were examined and data on descriptive qualities including age, sex, residential area, occupation, social insurance of patients, responsible toxic agent, season of poisoning, route of exposure, clinical and laboratory findings, length of stay in the hospital and clinical outcome were analyzed. The diagnosis "acute poisoning" included only acute intoxications and excluded symptomatic poisoning due to chronic intoxication. Information about the type of the exposed toxic agent and route of exposure was obtained from hospital records and case files. The average dose and contact time with the chemical were lacking in the case files. Laboratory investigations included arterial blood gases, electrocardiogram, chest radiograph, whole blood count and biochemistry of the patients. Diagnosis was confirmed by measuring red blood cell cholinesterase levels in the toxicology laboratory of Eylul University, in Izmir.

Treatment was started as soon as the patient was admitted to the emergency service and the diagnosis of organophosphate pesticide poisoning was suspected. After monitoring for cardiac and respiratory functions, continuous infusion of atropine sulfate in saline at rate of 0.02-0.08 mg/kg/h was administered with additional 1 to 5 mg boluses if needed to dry the secretions and clear the lungs (7). Pralidoxime chloride was administered as 1 to 2g in saline in 10 minutes. The dose was repeated every 6 hours until fasciculations were absent and muscle strength returned normal (7). In addition, general supportive measures were applied by trained nurses such as dermal decontamination by removing clothes and cleansing of all affected areas, gastrointestinal decontamination by administration of activated charcoal, ocular decontamination by irrigation of eyes with

0.9% saline for 10 minutes. Diazepam was given to patients who suffered from seizures.

For statistical evaluation, SPSS 11.0 for Windows was used. Data are presented as mean and standard deviation for estimation of age, as median in estimation of duration of hospital stay, mechanical ventilation, atropine and pralidoxime administration, and as number and percentages in estimation of descriptive variables.

Results

Of the 23 cases, 12 cases (52.1%) were enrolled in 2005 and 11 (47.9%) in 2006. Thirteen patients (56.5%) were women, 10 (43.5%) were men, 20 (87.0%) were 20 years or older, and mean age was 31.3 ± 11.9 (15-68) years. Children under 15 years-old were beyond the scope of this study. All children with poisoning were transferred to the children's hospital. Of the 23 cases, 15 (65.2%) were farmers, 5 (21.7%) were unemployed, 2 (8.7%) were students and 1 (4.3%) was a worker. Cases in the unemployed group were all young women, four of them were unmarried and one was a housewife. The two students were girls aged 15 and 16 years old. Five cases (21.7%) were residing in the urban area, 12 (52.2%) in the rural area and 6 (26.1%) outside of Izmir. Nine cases (39.1%) had social security, 13 cases (56.5%) had no social security and one case had a green card which was valid only in government hospitals for being free of charge. Table 1 presents the distribution of socio-demographic characteristics of the study population.

Parathion was used in 8 cases (34.8%), dichlorvos (DDVP) in (34.8), methamidophos (Taron) in 5 (21.7%) and diazinon (Basudin) in (8.7%). Exposure was predominantly by ingestion (91.3%). Two cases (8.7%) inhaled the pesticides accidentally. Except for one case (4.3%), all ingestions (87.0%) were for suicidal purposes. Suicide was more common among women (56.5%) compared to men (30.4%). All females (100%) and 7 males (70%) attempted suicide. Organophosphate pesticide poisoning was most common in summer (47.8%). Figure 1 presents the distribution of cases according to seasonal variation. Of the 23 cases, 11 cases (47.8%) were admitted between 17.00 and 24.00 PM, 8 (34.8%) between 00.01 and 08.00 AM and four (17.4%) between 08.00 AM and 17.00 PM. The duration of hospital stay ranged from 24 hours to 22 days (median 5 days). Six cases (26.1%) stayed between 24 hours and 4 days, and 17 (73.9%) stayed between 5 and 22 days in the hospital. Of those attempting suicide, 8 patients (34.8%) required intubation and mechanical ventilation. The median duration of mechanical ventilation was 7 days (range, 4-22 days). Three patients with assisted ventilation died of multi organ failure on 5, 8 and 22 days, respectively. The overall mortality rate was 13.0%.

Table 2 shows the most common symptoms and biochemical abnormalities in patients with acute organophosphate pesticide poisoning. Complications like melena (8.7%) and hematuria (4.3%) were observed (data not shown). Melena was detected in two and hematuria was detected in one of the patients who died. Changes in the electrocardiography (ECG) were evident on admission and after treatment: bradycardia in 18 cases (78.3%), tachycardia in 12 (52.1%) and ST-T wave changes in 15 (65.2%).

Low levels of red blood cell cholinesterase roughly correlated with the incidence of symptoms and signs. Of the 23 cases, red blood cell cholinesterase level was <3714 U/L in 16 cases (69.6%), between

Table 1. Distribution of cases with acute organophosphate pesticide poisoning according to their socio-demographic characteristics

Socio-demographic characteristics	(N:23)	(%)
Age, y		
10-19	3	13.0
20-29	9	39.1
30-39	7	30.4
40-49	2	8.7
50-59	1	4.3
60-69	1	4.3
Gender		
Female	13	56.5
Male	10	43.5
Occupation		
Farmer	15	65.2
Unemployed	5	21.7
Student	2	8.7
Worker	1	4.3
Residence		
Izmir, urban area	5	21.7
Izmir, rural area	12	52.2
Outside of Izmir	6	26.1
Social security		
Absent*	14	59.8
Present	9	39.1

*13 cases had none of the social securities and one had a green card valid only in hospitals, in Turkey.
N: total number of the study population, y: year, %: percentages

3714 and 4000 U/L in 4 (17.4%) and above 4000U/L in 3 (13%). The normal limits for red blood cell cholinesterase level in the toxicology laboratory ranged from 3714 to 11.513 U/L. Other abnormal laboratory findings were leukocytosis in 15 cases (65.2%), hyperglycemia in 8 (34.8%), hypokalemia in 6 (26.1%), raised INR in 4 (17.4%), elevated alanine aminotransferase in 5 (21.7%) and aspartate aminotransferase in 7 (30.4%), elevated creatine kinase (CK) in 4 (17.4%) and elevated serum creatinine in 3 (13.0%).

All cases with symptoms of muscarinic effects received atropine. The total amount of atropine given ranged from 1-168 mg. Median duration of atropine treatment was 5.5 days (range, 1-20 days). Twenty cases (86.9%) received pralidoxime. Total amount of pralidoxime given ranged from 2-42g. Median duration of pralidoxime treatment was 6 days (range, 1-11 days). In the cases of intentional poisoning, patients received psychiatric consultation before discharge.

Discussion

The use of pesticides and the incidence of side effects vary considerably among regions and farming systems. The severity of any health effect from exposure to pesticides depends on the dose, the route of exposure, the type profile of pesticide, the absorption of the pesticide, and the profile health of the affected individual. Pesticide

Table 2. Distribution of symptoms, signs and laboratory findings in cases with acute organophosphate pesticide poisoning

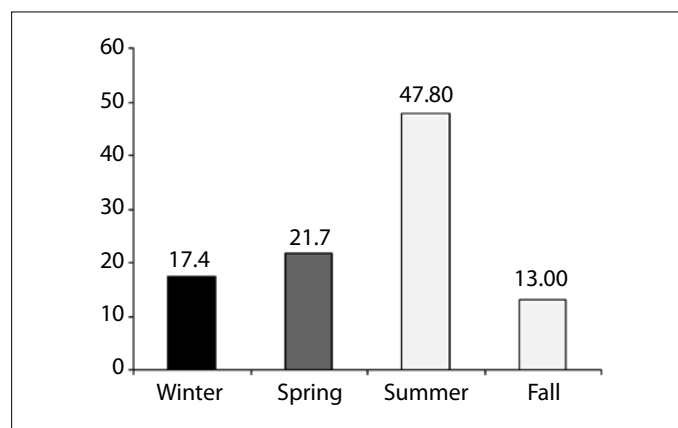
Symptoms and Signs	Number	%*
Hypersecretion	21	91.3
Nausea	19	82.6
Bradycardia	18	78.3
Sweating	18	78.3
Miosis	18	78.3
Headache	18	78.3
Hypotension	17	73.9
Confusion/lethargy	13	56.5
Vomiting	10	43.5
Respiratory insufficiency	10	43.5
Muscle fasciculation	9	39.1
Abdominal pain	8	34.8
Tachycardia	5	21.7
Diarrhea	3	13.0
Seizure	3	13.0
Laboratory Findings	**	
Cholinesterase level, U/L †		
<3714	16	69.6
≥3714	7	30.4
Elevated WBC, $\geq 10 \times 10^9$ /L	15	65.2
Hyperglycemia, ≥ 110 mg/dl	8	34.8
Hypokalemia, < 3.5 mEq/L	6	26.1
INR, ≥ 1.2	4	17.4
Elevated ALT, > 55 U/L	5	21.7
Elevated AST, > 34 U/L	7	30.4
Elevated CK, > 168 U/L	4	17.4
Serum creatinine, > 1.1 mg/dl	3	13.3

*As one person shows more than one symptom, the sum exceeds 100%

** represents the number of patients with laboratory findings above the range of the kits used in the laboratory

† represents red blood cell cholinesterase level

WBC: white blood cell, INR: International normalized ratio, ALT: alanine aminotransferase, AST: aspartate aminotransferase, CK: creatine kinase

**Figure 1.** The ROC Curve for the Score 199 of Threshold Value of the NEDOCS Scale for the Adult ED of Gazi University Hospital

use in agriculture puts farmers and their families at risk for exposure. About 60% to 70% of all cases of unintentional, acute pesticide poisoning are the result of occupational exposure (8). Organophosphate and carbamate compounds are the most common cause of acute pesticide intoxication (1-8), and share a common mechanism of toxicity-cholinesterase inhibition (1, 2, 7, 8). In our study, information about the type of the exposed agent and the route of exposure was obtained from hospital records and case files which had already been provided by either patients or their relatives on admission. Data to estimate the quantity of pesticide consumed and the contact time with the chemical were lacking. The commercial forms of the pesticides evaluated in the study were Parathion, DDVP (dichlorvos), Taron (methanidophos) and Basudin (diazinon). These forms of organophosphate pesticides are known to be widely used in the West Anatolian Region of Turkey. In our sample, 52.2% of the cases were residing in the country side, and 65.2% of them were farmers. In this region of Turkey, many farmers keep pesticides in their homes or gardens and they are quite accessible by the households. Exposure to the pesticides was accidental in three cases (13%). Two farmers inhaled, one ingested through consuming contaminated food. Twenty cases (87%) used it in an attempt to commit suicide. Suicide was more common among women compared to men (13 females vs 7 males). In all the 20 cases who attempted suicide, organophosphate compounds were taken orally. The main reasons for suicide were; being hopeless for the future as 59.8% of our cases had no social security, losing his/her hope of finding a satisfactory job, love affairs and failure in exams. It has been reported that, in the last 10 years, between 60-90% of suicides due to pesticide ingestion were from the Asian countries. Recently, WHO has received reports of growing number of suicides by pesticide ingestion in Central and South American countries and this clearly makes pesticide ingestion the most common method of suicide on a worldwide basis (9). The preventive value of controlling access to pesticides, which often are easily accessible and stored without any precautions in most rural households in many of the countries and in Turkey, has to be considered (9). Although, children were beyond the scope of this study, 13% of the cases were teenagers (aged 15, 16 and 18 years old, respectively), and were in the attempted suicide group. They used parathion and one of them died in spite of all taken treatment measures. In our study, 20-20 years old group constituted the majority of cases (39.1%) and all of them took organophosphate compounds for suicidal purposes. In the studies from South-East (6, 10) and North of Turkey (1), the majority of the cases were below 20 years old and attempted suicide with organophosphate compounds (79.1%, 94.5% and 40.0%, respectively). In a study from Middle Anatolia (4), suicide attempts with organophosphate compounds were observed in 68% of the cases at a mean age of 30 ± 15 years. In India and Zimbabwe (11, 12), 21-30 years old group were more prone to poisoning with organophosphate compounds (67.4% and 75% of committed suicides). In Southern Taiwan (13), 81.3% of cases with a mean age of 45 ± 17 years attempted suicide. However, in Western Australia (3), cases in the attempted suicide group were about 36% of the whole group; mainly of men and a mean age of 40 years old. A recent survey from America (14) showed that some people illegally used methyl parathion in their homes and a high percentage of them agreed that pesticides bought for use in the home were safe if used as directed. Our data and the reported information in this survey denoted to undertake several preventive measures to enhance public awareness of the dangers of pesticides (14).

Females were more prone to poisoning with organophosphorus compounds in Turkey. We found the male/female ratio 1/1.3. In studies from different regions of Turkey (1, 4, 6, 10), male/female ratios were 1/1.4, 1/1.1, 1/3.8, and 1/15.5, respectively. However, male/female ratios from India (11), Southern Taiwan (13), and Trinidad and Tobago (15) were 2.1/1, 2/1 and 2.7/1, respectively. In Western Australia (3), 96% of the attempted suicides with organophosphorus compounds were men.

The onset, intensity, and duration of organophosphate poisoning are determined largely by the nature of the particular compound and whether it exhibits reversible or irreversible acetylcholinesterase binding (13). Of the 23 cases, muscarinic symptoms and signs with hypersecretion were present in 21 cases (91%), nausea in 19 (83%) and bradycardia, sweating and miosis in 18 (78%). The most common central nervous system symptom was headache (78%). In this study, we did not grade the severity of poisoning as Bardin et al. (16) did, instead we arranged symptoms and signs in order of their incidence from the most common to the least. Some studies, but not all (5, 13, 16), found increased symptom prevalence associated with inhibition of erythrocyte acetylcholinesterase activity, a biomarker of recent organophosphate exposure (17). In our study; of the 23 cases, 16 (69.6%) had red blood cell cholinesterase levels beyond the lower range of the laboratory, and these low levels of red blood cell cholinesterase roughly correlated with the incidence of symptoms and signs. Compared to previous studies (1, 3-6, 10, 11, 13, 16, 18), a variety of biochemical abnormalities were evaluated in acute organophosphate poisoning in our study. Changes in the electrocardiography (ECG), bradycardia in 18 cases, tachycardia in 12 and ST-T wave changes in 15, were more prominent compared to some other studies (6, 10, 11, 19). In one study, a relationship between decreased plasma cholinesterase activity and early ECG changes such as ventricular and sinus arrhythmias were shown (19).

Although, Pawar et al. (20) reported that, higher dose regimen of pralidoxime than the standard regimen reduced the need of atropine within 24 hours of admission and the severity of respiratory failure, we started with oximes in a dose of 1-2g every 6 hours similar to Asian district hospitals applying a standard regimen with oximes in a dose of 1g every 4-6h (20). In our study, the most common complications were respiratory failure and multi-system failure, and the incidence of complications were higher in the attempted suicide group than in the accidental group. Eight cases required assisted mechanical ventilation and three of them died in spite of all treatment measures. Although the need for assisted ventilation is usually considered as an indicator of illness severity in patients with organophosphate poisoning, the mainstays of respiratory failure treatment is supportive and to control the subsequent infection, such as aspiration pneumonia (13). Treatment failure, that results with increase in complications, may be due to inadequate dosing of pralidoxime and atropine (3, 20).

Conclusion

To conclude, there is a correlation between the severity of poisoning and clinical signs and symptoms. Poisoning is more common among farmers and the major cause is suicide. Considering that the mortality rate is as high as 13%, our data urges to undertake preventive measures to enhance awareness of the dangers of pesticides. Studies indicate that interventions to control access to pesticides are effective and work better when integrated into more comprehensive

community education programs as well as into pesticide management programs.

Limitations

The retrospective and cross-sectional method is the limitation of the study itself due to the probability of obtaining inadequate or inappropriate information from case files and hospital records. Another limitation is the small sample size which is not convenient for further statistical analysis. Finally, we don't have enough data about the amount ingested and the time interval between contact with the poison and hospitalization.

Conflict of Interest

No conflict of interest was declared by the authors.

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