Acute Organophosphate Poisoning in University Hospital Emergency Room Patients

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Abstract

Objects In the present study, we evaluated patients who were admitted to our emergency department with a diagnosis of organophosphate poisoning and discussed clinical, social and demographic features.

Methods A retrospective study was conducted with organophosphate poisoning patients admitted to our emergency department between January 1995 and December 2004. Data regarding the age, sex, occupation, type of agent, route of poisoning, clinical effects of cholinergic overactivity, laboratory findings, and mortality rate were obtained from the patient files.

Results During the study period, 220 patients who had organophosphate poisoning with a known agent were admitted to the ED. The estimated mean admission time to the ED after the exposure was 3.9 ± 3.1 (1-14) hours. There were 131 (59.5%) female and 89 (40.5%) male patients. The most affected age group was 15-24 years (40.5%), in both sexes. Oral ingestion (86.5%) was found to be the most common route of poisoning. The most frequent reason for poisoning was attempted suicide (75.9%). The most common organophosphate compounds exposed were dichlorvos, diazinon and parathion-methyl. The most frequent clinical signs were miosis, respiratory system findings, tachycardia, loss of consciousness, and hypertension. Twenty patients (9.1%) died due to sudden respiratory and cardiac arrest (45%), respiratory failure (25%), CNS depression (5%) and septic shock (25%).

Conclusion We think that the appropriate use of these compounds, instruction of the public about their harmful effects and restriction of their uncontrolled sales by legal regulations can reduce the incidence of organophosphate poisoning.

Key words: organophosphates, poisoning, medicine, emergency

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Introduction

Organophosphate compounds (OPCs), used commonly in agriculture, are a gradually increasing cause of accidental and suicidal poisoning, with high morbidity and mortality rates, especially in developing countries. OPCs may be taken via the oral, respiratory, or transdermal routes (1, 2). Globally, poisoning due to OPCs is responsible for approximately 3 million episodes, which result in nearly 200,000 deaths every year (3).

The mechanism of action of OPCs is related to inhibition of acetylcholine esterase (AChE), and inhibition of this en-

zyme leads to accumulation of acetylcholine at nerve synapses and neuromuscular junctions, resulting in overstimulation of acetylcholine receptors. The initial overstimulation is followed by paralysis of cholinergic synaptic transmission in the central nervous system (CNS), in autonomic ganglia, at parasympathetic and some sympathetic nerve endings (e.g., sweat glands), and in somatic nerves (4, 5).

Signs of organophosphate poisoning (OPP) may be classified into effects secondary to muscarinic, nicotinic, and central nervous system receptor overstimulation. Muscarinic overstimulation is manifested as hyperactivity of the parasympathetic system, including miosis, bradycardia, and bronchial glands. Nicotinic effects include muscle fascicula-

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Table 1. Distribution of Patients According to Age and Sex

Age groups	Male		Female		Total	
	n	%	n	%	n	%
15-24	29	13.2	60	27.3	89	40.5
25-34	17	7.7	32	14.5	49	22.3
35-44	16	7.3	16	7.3	32	14.5
55-64	11	5	10	4.5	21	9.5
65-74	10	4.5	5	2.3	15	6.8
>75	6	2.7	8	3.6	14	6.4
Total	89	40.4	131	59.6	220	100

Table 2. The Route of Poisoning According to Age

Age groups	Inhalation		Skin		Ingestion		Intravenous		Total	
	n	%	n	%	n	%	n	%	n	%
15-24	5	2.3	2	0.9	80	36.3	2	0.9	89	40.4
25-34	3	1.4	3	1.4	43	19.4			49	22.2
35-44	3	1.4	1	0.5	28	12.7			32	14.6
55-64	3	1.4			18	8.2			21	9.6
65-74	3	1.4			12	5.4			15	6.8
>75	3	1.4	1	0.5	10	4.5			14	6.4
Total	20	9.3	7	3.3	191	86.5	2	0.9	220	100

tion, cramping, and weakness while respiratory depression, seizures, and unconsciousness are the consequence of central nervous system effects (6).

As poisoning with OPCs is seen in many countries and sometimes causes mass poisoning (7, 8), it is also one of the most common causes of poisoning in Turkey (9). In the present study, we evaluated 220 patients who were admitted to our emergency department (ED) with diagnosis of OPP and discussed clinical, social and demographic features.

Patients and Methods

A retrospective study was conducted on patients with OPP admitted to our ED between January 1995 and December 2004. Two hundred twenty patients were included in the study. Patients were assessed at the time of admission. A detailed history had been taken from the patient or patient's family.

The diagnosis of acute OPP was based on the following criteria: 1) history of exposure to or contact with insecticide; 2) characteristic clinical signs and symptoms of OPP; 3) improvement of signs and symptoms with atropine and oximes, and 4) decreased serum cholinesterase (sChE) activity.

Biochemical parameters, complete blood count, serum amylase, sChE level, and troponin levels were measured with Konelab 60I autoanalyzer (Thermo Clinical Labsystem, Vantaa, Finland), after clinical assessment.

Admissions were always through the ED where initial decontamination procedures were carried out. These included skin decontamination by removal of all clothing, washing skin and hair with soap and water, and gastrointestinal decontamination by gastric lavage, cathartics and activated charcoal. All cases were treated with repeated doses of intravenous atropine and some patients were treated with oximes. Data regarding the age, sex, occupation, type of agent, route of poisoning, clinical effects of cholinergic overactivity, laboratory findings, and mortality rate were obtained from the patient files. These were recorded using standardized data collection forms and were analyzed with SPSS soft-

ware.

Results

During the study period, 220 patients who had OPP with a known agent were admitted to the ED. In this period of time approximately 305,000 patients were admitted to the ED. The estimated mean admission time to the ED after the exposure was 3.9 ± 3.1 hours (Min: 1, Max: 14 hours: 4 ± 1.9 hours in dead cases and 3.9 ± 3.2 hours in discharged patients).

Table 1 presents the distribution of patients according to age and sex. There were 131 (59.5%) female and 89 (40.5%) male patients and the female/male ratio was 1.47. The most frequently affected age group was 15-24 years in both sexes (40.5%) and in discharged patients (42%), but it was 15-24 years and above 75 years in dead cases (25% each). One hundred forty-one (67.3%) of the patients were married and the majority of them were housewives (47.3%). Residency distribution patterns showed that 44.5% of the patients came from rural areas, while 55.5% were from urban areas.

Routes of intake were inhalation, transdermal, oral ingestion, and intravenous injection. Oral ingestion (86.5%) was found to be the most common route of poisoning (19 of dead cases and 172 of discharged patients) (Table 2). A total of 45 (20.5%) patients were exposed to the agent accidentally and 8 patients (3.6%) had occupational exposure. But, the most frequent reason for poisoning was attempted suicide (75.9%) (Table 3). The suicide attempt rate was 75% in dead cases and 76% in discharged patients. The most common OPCs exposed were dichlorvos, diazinon and parathion-methyl. The average volume of exposed OPCs was 48.9 ± 52.5 mL (Min: 1 mL, Max: 500 mL; 69 ± 33 mL in dead cases and 47 ± 53 mL in discharged patients).

The clinical findings on admission are summarized in Table 4. The most frequent clinical signs were miosis, respiratory system findings, tachycardia, loss of consciousness, and hypertension. There was an increase in serum liver enzymes, lactate dehydrogenase, glucose, amylase and troponin levels,

Table 3. The Route of Poisoning According to Reason

Reason	Inhalation		Skin		Ingestion		Intravenous		Total	
	n	%	n	%	n	%	n	%	n	%
Suicidal	1	0.5			164	74.5	2	0.9	167	75.9
Accidental	12	5.4	6	2.7	27	12.3			46	20.5
Occupational	7	3.2	1	0.5					8	3.6
Total	20	9.1	7	3.2	191	86.8	2	0.9	220	100

Table 4. Clinical Manifestations of Patients

Clinical Manifestations	Affected patients	
	N	%
Miosis	175	74.5
Respiratory tract findings	120	54.6
Tachycardia	78	35.4
Emesis	72	32.7
Loss of consciousness	67	30.4
Hyperhydrosis	63	28.6
Hypertension	32	14.5
Fasciculation	18	8.2
Bradycardia	11	5
Fever	10	4.5
Diarrhea or urinary incontinence	6	2.7
Convulsion	4	1.8
Hypotension	4	1.8

and also leukocyte count (Table 5).

Twenty patients (9.1%) died due to sudden respiratory and cardiac arrest (45%), respiratory failure (25%), septic shock (25%) and CNS depression (5%) (Table 6). Two hundred patients (90.9%) were discharged with no symptoms.

Discussion

OPCs have largely been used as pesticides in many parts of the world (10). They are readily available because of inadequate regulations controlling their sale (11). This easy availability of the compounds has resulted in a gradual increase in accidental and suicidal poisoning (9).

Table 5. Abnormal Laboratory Findings of Patients

Findings	Normal values	Patient values
Leukocyte count	4000-10000	13.465±5.78
Blood glucose (mg/dL)	70-110	145±68
Lactate dehydrogenase (U/L)	225-450	458.2±377.8
Aspartate aminotransferase (U/L)	0-32	37.5±72.1
Amylase (U/L)	28-100	150.6±197.3
Troponin I (U/L)	<0.1	1.3±0.2
Serum AChE (U/L) Female	5600-17600	1592.6±1735
Serum AChE (U/L) Male	4000-12000	1918.5±2155.4

Table 6. The Causes for Mortality of Patients

	Affected patients	
	n	%
Sudden respiratory and cardiac arrest	9	45
Respiratory failure	5	25
Septic Shock	5	25
CNS depression	1	5
Total	20	100

Poisoning with OPCs may occur at all ages (7, 8). The most commonly affected age group in our study was 15-24 years, with the female to male ratio being 1.47. From this aspect, the present results are in agreement with those of the literature (11-14).

In contrast to the findings of Saadeh et al (11) and Kara et al (14), in our study, there were more married patients (67.3%) than unmarried (31.8%). But, the marriage rate of our patients was similar to that of Agarwal et al, and Chharba et al (15, 16). This may be related to the socio-cultural structure of the exposed population in our country.

Ingestion of OPCs in an attempt to commit suicide is a major problem especially for developing countries (9), and severe cases are mostly due to suicidal use (17-19). Accidental exposure is the main cause of mild poisoning (20-22). OPP due to suicidal attempt accounts for at least 40-60% of all cases in some African countries (9). In the present study, the rate of suicidal poisoning was 75.9%, and the major route of intake of OPCs was ingestion (86.8%). These high ratios of suicidal poisoning and intake by oral means are similar to those of Sungur and Guven (9) and Saadeh et al (11). These high ratios may be due to uncontrolled sales

and the wide use of these agents all over the country.

The type of OPCs as the agent of poisoning was noted to be varied in different studies. For instance, fenitrothion was reported by Yamashita et al, dichlorvos by Sungur and Guven and Saadeh et al, and mevinphos by Nouria et al as the most common causative agent (6, 9, 11, 23). We also found dichlorvos to be the most common OPC as the agent of poisoning. We think that this may be due to the fact that dichlorvos is one of the most commonly sold insecticides in Turkey.

The symptoms of OPP are related to subsequent accumulation of acetylcholine, which is usually termed cholinergic crisis. The signs of OPP may be classified as effects secondary to muscarinic, nicotinic, and central nervous system receptor overstimulation (6). Clinical presentation depends on the specific agent involved, the quantity absorbed, and the type of exposure (4). The most frequent sign in OPP is miosis (12). Miosis was also the most significant sign in the present patient (74.5%). This finding is similar in several studies (11, 12). Other frequent signs were respiratory system findings, tachycardia, emesis, loss of consciousness, hyperhydrosis, hypertension, fasciculation, bradycardia, fever, diarrhea, urinary incontinence, convulsion, and hypotension. Loss of consciousness was seen in 30.4% of patients. Ozturk et al reported this ratio to be 25.27% (12). In our study, tachycardia and bradycardia were seen in 35.4% and 5% of the patients, respectively. This result was similar to results of Ozturk et al and Saadeh et al (11). While tachycardia is due to nicotinic effects on adrenal medulla and sympathetic ganglia, bradycardia occurs because of muscarinic effects (12).

Serum glucose changes in OPP are usually clinically significant (12), as hyperglycemia has been reported many times in the literature (9). Here, we observed hyperglycemia in 67.7% of patients. The increase in serum glucose is believed to be due to the secondary release of catecholamines from the adrenal medulla (9).

Additional laboratory abnormalities include leukocytosis with a left shift (common) (24), impaired liver function tests and increased serum amylase levels (12, 25, 26). In our study, we saw leukocytosis and increased serum amylase in 68.7% and 36.1% of the patients, respectively, and these findings were in accordance with literature (9, 25).

We observed increased aspartate aminotransferase levels in 33% of the patients, which is reported to be very rare (27). This may be due to various organic solvents found in OPCs. High lactate dehydrogenase levels may be associated with oxidative tissue damage induced by OPCs (28), and this level was also high in 29.8% of our patients.

The diagnosis of acute OPP is based on a history of exposure and a blood test of red cell and plasma choline-

sterase (29). Red blood cell cholinesterase is a true cholinesterase, but cannot be easily measured quickly and routinely. Although sChE is a pseudocholinesterase, it can be measured quickly in emergencies. Clinical manifestations of OPP generally appear after more than 50% of sChE is inhibited and are very severe when sChE inhibition is 90% or more (23). We detected in our study that on admission to the ED, 69.6% of the male patients and 74.1% of the female patients had depressed sChE levels by 50% or more.

Current therapy for OPP includes decontamination, reversal of muscarinic symptoms using atropine, regeneration of acetylcholinesterases using oxime compounds such as pralidoxime (2-PAM), and supportive pulmonary care (30). Atropine antagonizes the effect of Ach reversing the excessive parasympathetic stimulation by competing for identical binding sites at muscarinic receptors (29). Treatment guidelines recommend frequent atropine boluses or infusion therapy until pulmonary secretions are minimized, with endotracheal intubation as needed (30). The most common cause of treatment failure is inadequate atropinization (4). Inadequate atropinization may contribute to high rates of both aspiration pneumonia and death (7). Pralidoxime is a biochemical antidote for OPP; its beneficial effects include reactivation of cholinesterase by cleavage of phosphorylated active sites, direct reaction and detoxification of unbounded OPCs, and an endogenous anticholinergic effect (5). This therapy for OPP also applies to the emergency treatment for sarin, a typical drug of chemical weapons of mass destruction (31). In the present study, atropine and pralidoxime treatment was given in the ED to 58.6% and 43.6% of the patients, respectively. The rest of the patient treatments were given in the intensive care unit.

The mortality rate from acute OPP varies between 10-20%, and is generally due to respiratory failure (6). The initial respiratory symptoms as described above and RF consistently develop during the period of cholinergic crisis, usually during the first 24 hours after exposure to OPCs (5). The causes of death and mortality rates of the present patients (9.1%) were also in accordance with the literature. Because patients above 75 years of age composed 25% of dead cases in our study, we think that advanced age may be one of the important factors affecting mortality. This may be explained by the decreased physiological reserves in elderly.

In conclusion, it is obvious that OPP is still an important health problem in Turkey as in other countries and it primarily affects the reproductive age group. In these poisonings, suicidal purposes are in the foreground. We think that the appropriate use of these compounds, instruction of the public about their harmful effects and restriction of their uncontrolled sales by legal regulations can reduce OPP incidence.

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