

# Factors Affecting the Prognosis in Acute Insecticide Intoxications Containing Organic Phosphorus

Akut Organik Fosforlu İnektisit Zehirlenmelerinde Prognozaya Etki Eden Faktörler

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## Abstract

**Objective:** The goal of the study was to investigate the complications encountered during the follow up and treatment of the patients intoxicated with insecticides that contain organic phosphorus and assess the effects of these complications on the treatment periods of these patients.

**Material and Methods:** Patients who presented to the tertiary care emergency department with the diagnosis of intoxication with insecticides containing organic phosphorus (OPi) between March 2004-September 2005 were included into the study.

**Results:** Thirty four patients were included into the study. Seven of them underwent mechanical ventilation due to respiratory failure. The Glasgow Coma Scale (GCS) score was found to be <9 in patients with respiratory insufficiency. Eight of them had an initial serum amylase level of >300 U/L. The total dose of atropine used in these patients and the duration of hospital stay were found to be higher than in the other patients.

**Conclusion:** The clinical presentation and course of the patients especially with respiratory failure and hyperamylasemia are observed to be more serious, their atropine needs are greater and they have longer hospital stays. GCS is a useful parameter in determining the need for intubation.

(JAEM 2012; 11: 93-7)

**Key words:** Organic phosphorus, intoxication, complication

## Özet

**Amaç:** Bu çalışmanın amacı, organik fosforlu insektisitlerle zehirlenen hastaların takip ve tedavisi sırasında karşılaşılan komplikasyonlar ve bu komplikasyonların hastanın tedavi süresine etkisini araştırmaktır.

**Gereç ve Yöntemler:** Bu çalışmaya üçüncü basamak bir üniversite acil servisinde Mart 2004-Eylül 2005 tarihleri arasında organik fosforlu insektisit (OPi) zehirlenme tanısı konulan hastalar alındı.

**Bulgular:** Çalışmaya 34 hasta alındı. Hastalardan 7'sine solunum yetmezliği nedeni ile mekanik ventilasyon uygulandı. Solunum yetmezliği olan hastalarda glaskow koma skalası (GKS)<9 olarak belirlendi. Hastaların 8'inde geliş serum amilaz düzeyi >300 U/L (normal değer üst sınırının 3 kat fazlası) bulundu. Bu hastalarda toplam kullanılan atropin dozu ve hastanede kalış süreleri diğer hastalardan daha yüksek bulundu.

**Sonuç:** Özellikle solunum yetmezliği gelişen ve hiperamilazemisi olan hastaların klinik tabloları daha ağır, atropin ihtiyaçları daha yüksek ve hastanede kalış süreleri uzundur. Bu dönemde GKS entübasyon ihtiyacını saptamak için kullanışlı bir yöntemdir. (JAEM 2012; 11: 93-7)

**Anahtar kelimeler:** Organik fosfor, zehirlenme, komplikasyon

## Introduction

Organic phosphorus containing compounds are widely used in our country for agricultural purposes and as insecticides. The entry of the organic phosphorus containing insecticides (OPi) into the body can be by inhalation, gastrointestinal route, conjunctiva, skin, mucosal surfaces and via injection. It acts in the body by suppressing the activity of the carboxylic ester hydrolases such as acetylcholinesterase (AChE) and butyrylcholinesterase (BuChE). The suppression of AChE by the OPis leads to its accumulation at the neuronal junctions

therefore giving rise to the onset of muscarinic, nicotinic and central nervous system findings as a result of continuous stimulation of the receptors (1-3). The reflection of this situation in the clinical outcome is seen as cardiac conductive system problems, respiratory failure and altered mental status. Moreover, acute pancreatitis, renal failure and convulsions have also been reported.

The goal of the study was to investigate the complications encountered during the follow up and treatment of patients intoxicated with insecticides containing organic phosphorus and assess the effects of these complications on the treatment periods of these patients.

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## Material and Methods

This prospective study was conducted in an ED of a tertiary care hospital with an annual census of approximate visits between March 2004-September 2005. The study was approved by the local ethics committee. Consecutive patients over 18 years old presented to the ED with Opi were included in the study. Patients who were poisoned with carbamate compounds or patients who had received treatment prior to arriving at our facility were not included. The diagnosis of intoxication was made by the history, seeing the poison box t, the presence of the characteristic clinical findings and establishing low levels of serum butyrylcholinesterase (BuChE). The demographic data of the patients such as age, sex, profession and intoxication related background like the route of intoxication, the type of poisoning Opi, time of intoxication and the times they were admitted to the hospital were recorded. Findings of general examinations and cholinergic outcomes, Glasgow Coma Scale (GCS), developed complications and therapy were all recorded throughout their clinical follow up periods. Biochemical parameters, complete blood count, serum amylase, creatine kinase (CK), BuChE and  $\beta$ HCG were measured after clinical assessment.

Patients with a GCS <9, an oxygen saturation <90% and patients whose oxygen saturations did not rise despite the oxygen therapy were intubated and connected to mechanical ventilation. All patients' clothes were removed and their skin and hair were washed with water and soap, gastric lavage was performed and active charcoal was given, an urinary catheter was placed and liquid therapy was

planned according to urinary output. Atropine and pralidoxime were initiated to all patients for antidote treatment. Seizures and delirium due to atropine have been controlled with diazepam. Patients who had undergone mechanical ventilation were followed up in the intensive care unit. Patients whose respiration was normal were followed up in the toxicology department.

Clinical follow up was performed and mortality of the study patients was assessed at one month periods after ED admission by using the hospital recording system and phone calls.

All the study data were analyzed by SPSS® 14.0 for Windows. The group data are expressed as mean±standard deviation. Mann-Whitney U test and Chi-square test were used for the evaluation of the data and establishment of statistical significance.  $p < 0.05$  was accepted to be statistically significant.

## Results

A total of 89 patients with opi were admitted to the ED during the study period. Thirty four patients were enrolled into the study. Fifty five patients were excluded as they had exclusion criteria.

The study subjects had a mean age of  $23.6 \pm 12.4$  years and 38% (n=13) of them were male. Eighty five percentage (n=29) of the patients were intoxicated as a result of attempted suicides while 15% (n=5) were poisoned accidentally. Thirty one patients (91%) received the poison orally, 1 (3%) with intravenous injection and 2 (6%) with inhalation. The distribution of the poisons intoxicating the patients were Diazinon in 17, Monokrotofos in 2, Dichlorvos in 8, Chlorpirifos in 2 and Parathion in 1 patient.

The GCS score was found to be <15 in 61% (n=21) of the patients. Among these 20% (n=7) had a GCS <9, with oxygen saturations being <90% and 4 were diagnosed to have aspiration of their gastric content. These were intubated and connected to mechanical ventilation (Table 1).

Cardiac arrest ensued in 1 patient. The patient had asystole which was treated with cardiopulmonary resuscitation for 10 minute. A sinus rhythm was observed in the monitor. Treatment for poisoning was also initiated (Table 1, 2).

One of the patients who underwent endotracheal intubation had a history of using antiepileptic drug therapy (valproic acid). The patient experienced generalized tonic-clonic convulsions under PAM therapy. The PAM therapy was interrupted and diazepam 20 mg was given for the convulsions and atropine therapy was continued. The convulsions did not recur throughout his follow up period (Table 1, 2).

Two of the female patients were diagnosed to be pregnant. The patient who was poisoned with Chlorpirifos was sent for consultation

**Table 1.** Problems encountered in intoxicated patients

Problem	No. of Patients	Reason for Intoxication
Cardiac arrest	1	Suicide attempt
Respiratory failure	7	Suicide attempt
Convulsion	1	Suicide attempt
Hyperamylasemia (>300U/L)	8	Suicide attempt
Creatin kinase elevation	14	Suicide attempt
Aspiration of the gastric content	4	Suicide attempt
Ileus	1	Suicide attempt
Cellulitis-Abscess	1	Suicide attempt
Pregnancies	2	Suicide attempt
Fetal death	1	Suicide attempt

**Table 2.** Properties of the patients who developed respiratory failure due to intoxication

	Duration of respiratory support (hours)	Duration of atropine therapy (hours)	Total atropine dose given	Active ingredient
1. patient*	312	258	2090	Diazinon
2. patient*	72	194	2375	Monokrotofos
3. patient	4	62	290	Metamidofos
4. patient	4	68	2650	Diazinon
5. patient <sup>®*</sup>	12	79	505	Monokrotofos
6. patient <sup>©*</sup>	48	102	180	Diklorvos
7. patient	120	216	1200	Diazinon

\*aspiration of the gastric contents, <sup>®</sup>cardiopulmonary resuscitation, <sup>©</sup>convulsion

to the obstetrical department in order to assess the physical status of her gestation and the fetus. Obstetrical ultrasound revealed no heart beat in the fetus. The gestation period was estimated to be 18 weeks and 5 days. 200 mg misoprostol was applied via the vagina with the recommendation of the obstetrician. Normal vaginal delivery occurred after 12 h. 264 ppb Chlorprifos was found to be present in the blood sample taken from the fetus. This patient received a sum of 60 mg atropine in 4 days and was discharged from the hospital on the 7<sup>th</sup> day after admittance (Table 1). The second patient who was poisoned with Diazinone had a gestation concordant with 30 weeks. The obstetrical ultrasonography revealed a healthy fetus. The patient received a total of 40 mg of atropine during 3 days and was discharged on the 5<sup>th</sup> day after her admittance to the hospital. She gave birth to a healthy baby girl on the 39<sup>th</sup> week of gestation via the normal vaginal route. The examination of the baby was normal (Table 1).

One of the patients had an intravenous injection of Chlorpyrifos on the interior of the left forearm following an attempted suicide. The patient was diagnosed to have cellulitis on the forearm. Later, an abscess formed at the injection site. The abscess was drained following consultation with the orthopedic surgery department (Table 1).

Vomiting and abdominal distension was observed in one of our patients during atropine therapy. She received a total of 190 mg of atropine in 5 days. The absence of intestinal sounds and the presence of widened gut flexures and air-liquid levels observed in the direct

abdominal x-ray led to the diagnosis of paralytic ileus. This problem recovered rapidly after cessation of atropine (Table 1).

The body temperatures of all our patients rose during atropine therapy and all experienced a state of delirium. Application of cold, fluid replacement and diazepam was used for treatment.

Serum CK levels was high in 14 patients (Table 4). They were found to be highest especially on the 2<sup>nd</sup> day of treatment. The urine output of these patients was closely followed up and fluid therapies were adjusted accordingly. The CK levels were followed daily and the CK levels were observed to regress.

Serum amylase level was increased in fifteen patients (44%). In 8 of these the initial serum amylase levels were >300 U/L (3 times higher than the normal upper limit). The total dose of atropine used, atropine therapy periods, time needed for the commencement of oral feeding and durations of their hospital stay were found to be higher in this group when compared with the other patients (Table 5).

Mechanical ventilation following endotracheal intubation was performed in 7 patients. Follow ups of these patients were made in the intensive care unit. Patients whose spontaneous respiration recovered were transferred to the toxicology unit after weaning from mechanical ventilation (Table 2).

All the patients were discharged from the hospital with full recovery.

**Table 3.** Comparison of the patients who developed respiratory failure due to intoxication with the other patients

	<b>Patients with respiratory failure Mean±SD</b>	<b>Patients without respiratory failure mean±SD</b>	<b>p</b>
Atropinisation dose (mg)	461±429.63	51.85±44.49	0.001
Total dose of atropine used (mg)	1327±1041.92	98.7±65.66	0.001
Duration of Atropine therapy (hours)	139.86±80.67	58.52±31.8	0.006
Duration until the commencement of oral feeding (hours)	166.14±95.48	81.67±32.93	0.008
Duration of hospital stay (hours)	203.86±122.47	103.81±38.10	0.019

**Table 4.** Daily serum CK level follow up of patients with high CK values due to intoxication-U/L

	<b>Initial U/L</b>	<b>1. day U/L</b>	<b>2. day U/L</b>	<b>3. day U/L</b>	<b>4. day U/L</b>	<b>While Discharged U/L</b>
1 <sup>st</sup> patient	236	351	452	947	597	170
2 <sup>nd</sup> patient	787	2961	3067	1989	1809	1156
3 <sup>rd</sup> patient	186	503	940	521	521	521
4 <sup>th</sup> patient	579	2126	2117	1423	851	506
5 <sup>th</sup> patient	255	1393	1337	2146	1090	100
6 <sup>th</sup> patient	411	2759	1557	114	501	157
7 <sup>th</sup> patient	328	639	1434	722	567	567
8 <sup>th</sup> patient	71	75	1654	798	1374	568
9 <sup>th</sup> patient	313	533	1547	899	899	432
10 <sup>th</sup> patient	175	1198	3510	2573	1104	503
11 <sup>th</sup> patient	150	3095	2726	1891	1063	355
12 <sup>th</sup> patient	119	543	3051	1491	76	308
13 <sup>th</sup> patient	1297	1330	754	472	115	115
14 <sup>th</sup> patient	963	702	1462	812	568	53
Normal value for CK≤170 U/L						

**Table 5.** Comparison of patients who had initial serum amylase values >300 U/L with patients having amylase levels ≤ 300 U/L

	<b>Amylase &gt;300U/L mean±SD</b>	<b>Amylase ≤300U/L mean±SD</b>	<b>p</b>
Total atropine dose used (mg)	532.50±730.14	295.96±661.52	0.020
Duration of atropine therapy (hours)	123.88±73.76	60.31±39.66	0.004
Duration for the commencement of oral feeding (hours)	146.75±92.32	84.38±39.55	0.031
Duration of hospital stay (saat)	190.13±115.52	104.19±42.32	0.010
Normal value for amylase 28-100 U/L			

## Discussion

We investigated the complications encountered during the follow up and treatment of patients intoxicated with insecticides that contain organic phosphorus, and assessed the effects of these complications on the treatment periods of these patients. We found that clinical presentation and course of the patients with respiratory failure and hyperamylasemia especially are observed to be more serious, their atropine needs are greater and they have longer hospital stays. GCS is a useful parameter in determining the need for intubation. Intoxication with OPi can occur during pest control in the agricultural areas, in industry, during transportation of these poisons and accidentally in houses. Attempted suicide, however, takes first place among adults and this is especially an important issue in developing countries. In a regional study conducted in our country, the suicide ratio was found to be 75.9% and in another regional study, this was reported to be 68% (4, 5). In our study 29 patients (85%) were intoxicated as a result of attempted suicide. The reason for such high rates in our country may be due to widespread use of these poisons and their uncontrolled sale. The clinical findings in suicidal attempts are much more serious than the findings in accidental intoxications. A study has documented 75% deaths due to suicide attempts (4). In our study, all the patients who developed complications were patients with attempted suicides (Table 1). This may be associated with higher dose intakes.

All systems of the body are affected by OPi intoxications. Altered mental status, respiratory failure, abdominal aches and conductive disturbances of the heart are the most commonly accompanying problems of the characteristic clinical findings (1, 3-5).

Studies reported that respiratory failure is seen between 21.2%-40.2%. Furthermore, atropine doses in patients with respiratory failure are found to be very high, their duration of hospital stays are longer and mortality among these patients are higher. Death was usually found to be due to cardiopulmonary arrest, pneumonia and ARDS (5-8). In our study, 20% (7 patients) were diagnosed to have respiratory failure. Four of them had aspirated their gastric contents. The total atropine doses administered and their atropine therapy durations were much higher than the patients without respiratory failure, in accordance with the literature. The longer therapy periods also lengthened their periods for commencement of oral feeding and duration of hospital stay (Table 2, 3).

Mortality may ensue due to cardiac rhythm disturbances during acute OPi intoxications. High doses of atropine administration may worsen the ongoing arrhythmias. Hypoxia, metabolic acidosis and electrolyte imbalance aggravates the cardiovascular burden (9-11). In our series, one patient experienced cardiac arrest which was seen to accompany asystole on the monitor. The reason for this clinical outcome could be long lasting hypoxia and direct cardiac effect of OPi.

The neurological disturbances can be due to direct impact of OPi or hypoxia on the central nervous system (CNS). The degree of altered mental status can range between confusion and a deep coma state. A study revealed that altered mental status is present in 76% of intoxicated patients. Studies propose that GCS is a useful method for the evaluation of consciousness both in the field and in the emergency services and it helps to prevent patients from the risks of aspiration by guiding the appropriate timing of endotracheal intubation (12-14). We also used GCS in order to evaluate the problems during consciousness. The GCS was <15 in 21 (61%) of the patients and in 7 (20%) of them this was found to be <9. The pO<sub>2</sub> values in patients with GCS <9 was measured to be <90. Four of them had aspirated the gastric contents before they reached the hospital. Endotracheal intubation according to the GCS protected other patients from aspiration.

Convulsions due to OPi intoxication may be seen and progress to status epilepticus. Neurological damage and mortality increase in the presence of such a situation (15, 16). The convulsion of our patient may be related with the lowered threshold due to the stress induced by intoxication, direct impact of OPi, to PAM therapy given or due to hypoxia. The seizures were treated with diazepam and the patient was sequel free.

High amylase levels in patients with OPi are closely related with the presence of shock severity of the clinical course. Therefore hyperamylasemia is generally seen in severe OPi intoxications. Two studies reported hyperamylasemia to be present in 36% and 46.95% of the poisoned patients (17, 18). Nevertheless, some studies have reported plasma amylase levels to be significantly high in patients with respiratory failure and thus denoted that the elevation of plasma amylase values could be used as a predictive value for intubation (7, 19). The amylase level was high in fifteen (44%) patients in our study. The serum amylase levels especially in 8 (23.5%) were >300 u/L (3 times more than the upper limit of the normal values). Moreover the total atropine dose used, atropine treatment interval, time elapsed until the commencement of oral feeding and duration of hospital stay in patients with amylase levels >300 U/L were higher than other patients. The possible reason for these outcomes may be increased secretions in the gastrointestinal system in parallel to the severity of intoxication.

OPis are known to give rise to rhabdomyolysis. Some studies have revealed necrosis in the diaphragmatic and intercostal muscles in the autopsies of some cases, together with greatly elevated CK levels due to rhabdomyolysis. Some intoxication cases with acute renal failure due to rhabdomyolysis requiring hemodialysis have also been forwarded (20-23). Fourteen (41%) patients were observed to have elevated CK levels in our study. These levels reached their maximal levels by the second day of their follow up periods. None of our patients developed acute renal failure. This may be associated with administration of adequate hydration and close follow up of urine outputs.

Cases with suicide attempts by OPi injections have been recorded. Cellulitis at the injection sites, compartment syndrome and necrosis in the subcutaneous tissues are the basic complications observed in such patients (24, 25). We observed the development of cellulitis and abscess formation in our case and drained the abscess at the earliest possible time.

OPis are known to pass through the placenta and they might affect the fetus. Mortality in the fetuses of the pregnant women who were intoxicated with somon gas in Sadasht and Halapjah during the Iran -Iraq war was higher, with the fetuses being lost within hours or days (1). However, healthy deliveries were also reported (26). An intrauterine fetal death was seen in a 18 weeks pregnant suicide patient using Chlorpirifos in our study. Chlorpirifos level was established to be 264 ppb in the blood sample of the fetus. The direct cardiac toxic effect of the OPi on the fetus heart or placental insufficiency result in intrauterine fetal death in OPi intoxication. Another pregnant patient in our study had been delivered of a healthy baby 9 weeks after her treatment, because of the advanced gestation age and less severe toxicity. Atropine was used as an antidote treatment in OPi intoxications with high dosage and long periods. Tachycardia, tachypnea, paralytic ileus and fever were seen in high dose atropine usage in the emergency or intensive care settings. Confusion, psychotic reactions, delirium or even convulsions may ensue due to CNS stimulation (27-29). We observed delirium and increased body temperatures in our patients during atropine therapy. All patients responded well to cold application and diazepam administration. The absence of severe side effects in our patients may be related to the titration of the administered doses according to the cholinergic findings during their therapies. One patient developed ileus which may be seen during application of atropine for a long term.

## Conclusion

Intoxications due to suicide attempts with OPi are still an important problem in our country. The clinical findings and encountered complications are much more severe in subjects who attempt suicide rather than the patients who are accidentally exposed to OPis. The clinical condition of the patients who have hyperamylasemia and develop respiratory failure is more severe than the others, requiring more atropine, thus staying longer in hospital. GCS is a handy method for the evaluation of the need for intubation which should be instituted to patients with a score of <9.

## Conflict of Interest

No conflict of interest was declared by the authors.

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