

## A Rare Type of Suicide Attempt in East Turkey: Acute Zinc Phosphide Poisoning

Türkiye'nin Doğusunda Nadir Bir Özkıyım Girişim Şekli: Akut Çinko Fosfid Zehirlenmesi

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### Abstract

**Objective:** The purpose of this study was to predict the clinic and demographic profile of patients who attempt suicide by poisoning with zinc phosphide.

**Material and Methods:** All cases presenting to the ED from January 1<sup>st</sup> 2009 to April 30<sup>th</sup> 2011 due to Acute Zinc Phosphide Poisoning were retrospectively reviewed.

**Results:** All cases had taken the pharmaceutical product in an attempt to commit suicide. The average age of the cases was 25.4 years. Sixteen of the cases were female (76%), and five (24%) were male; all of the cases who died were female. In terms of marital status, 4 (19%) of the cases were single or unmarried. A total of 8 (38%) cases were unconscious and had low pH levels (<7.35), and 9 (43%) cases had signs of shock, such as hypotension and tachycardia. The average level of bicarbonate in the arterial blood gas of the cases was 23.20 mmol/L and the average amount of time (admission time) taken to bring the patients from the place where they were poisoned to the ED was 2.40 hours. According to the autopsy results of the dead patients, there were findings of liver congestion, liver necrosis, pancreatic edema and hemorrhagic points together with inflammation in the kidneys.

**Conclusion:** Although it is a rare form of suicide attempt, the mortality rate for patients with zinc phosphide poisoning is high. Early resuscitation can have positive effects on morbidity and mortality. Patients who suffer from zinc phosphide poisoning must be monitored under intensive care conditions.

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**Key words:** Suicide attempt, zinc phosphide, poisoning, emergency department

### Özet

**Amaç:** Bu çalışmada amaç, çinko fosfid zehirlenmesi ile özkıyım girişiminde bulunan olguların klinik ve demografik özelliklerini belirlemektir.

**Gereç ve Yöntemler:** Acil Servise 1 Ocak 2009-30 Nisan 2011 tarihleri arasında çinko fosfid zehirlenmesi nedeni ile başvuran hastalar geriye dönük olarak araştırıldı.

**Bulgular:** Tüm olgular çinko fosfid olarak özkıyım girişiminde bulunmuşlardı. Olguların yaş ortalaması 25,4 yıl idi. Olguların 16'sı (%76) bayan ve 5'i (%24) erkek idi; ölen olguların hepsi bayan idi. Dört (%19) olgu bekar veya yalnızdı. Sekiz (%38) olguda şuur kaybı ve düşük pH (<7,35) düzeyi ve 9 (%43) olguda hipotansiyon ve taşikardi gibi şok bulguları vardı. Ortalama bikarbonat düzeyi 23,20 mmol/L ve zehirlenmenin olduğu yer ile acil servise kabul edilinceye kadar geçen zaman ortalaması 2,40 saat idi. Otopsi sonuçlarına göre ölen olgularda, karaciğer konjesyonu, karaciğer nekrozu, pankreas ödemi ve böbreklerde kanama odakları ile beraber enflamasyon vardı.

**Sonuç:** Nadir bir özkıyım şekli olmasına rağmen, çinko fosfid zehirlenmesi olan hastalar için mortalite oranı yüksektir. Erken müdahale mortalite ve morbiditeye olumlu etki yapabilir. Çinko fosfid zehirlenmesine maruz kalan hastaların yoğun bakım şartlarında takibi yapılmalıdır.

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**Anahtar kelimeler:** Özkıyım girişimi, çinko fosfid, zehirlenme, acil servis

### Introduction

Zinc phosphide is a dark-grey, crystalline compound that is used as a rodenticide to control rats, mice, voles, ground squirrels, prairie dogs, nutria, muskrats, feral rabbits, and gophers (1-3). The absence of a specific antidote results in very high mortality, and the key to treatment lies in rapid decontamination and institution of resuscitative measures. People residing in the rural areas of our

region spend most of their time on agricultural land. Many accidental or suicide-related poisonings are linked to this pharmaceutical product being scattered on open land; as a result, a significant number of poisoning cases are brought to the Emergency Department (ED) of the hospital, which is located in the city center. The purpose of this study was to predict the clinical and demographic profile of patients who attempt suicide by poisoning with zinc phosphide.



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## Material and Methods

### Study design and patients

All cases of acute zinc phosphide poisoning presented to our ED in East Turkey. Over a two-year period from January 1<sup>st</sup> 2009 to April 30<sup>th</sup> 2011, the cases were retrospectively reviewed. The clinical and laboratory data for 21 patients who were affected by rat poison containing zinc phosphide and were brought to the ED of Harran University Medical Faculty and Sanliurfa Training and Research Hospital were investigated. Patient files, computer records, forensic records, and records from the psychosocial support unit of the ED were used to gather data. The cases were diagnosed as zinc phosphide poisoning based on anamnesis and clinical and laboratory findings. All patients were transferred to the Intensive Care Unit (ICU) after initial resuscitation and gastric lavage in our ED. Blood samples for biochemical, hematologic, and arterial blood gas determinations were sent from the ED within 1 hour of presentation to the hospital laboratory. We collected information on age, gender, dosage, and any delay in presentation to the hospital. The severity of poisoning was assessed from laboratory and clinical parameters, which included hepatic enzyme levels (aspartate aminotransferase [AST, normal range: 0-38 U/dL] and alanine aminotransferase [ALT, normal range: 0-41 U/dL]), findings of shock, such as hypotension (middle arterial pressure [MAP], normal range: 70-100 mm Hg), neurologic status (Glasgow Coma Scale; GCS), serum bicarbonate levels on admission (normal range: 22-26 mmol/L), pH level (normal range: 7.35-7.45), and pancreatic amylase level (11-54 U/L).

### Exclusion criteria

Instances in which patients who under 18 years age and patients who had not received clear information about zinc phosphide poisoning were excluded from the study. Furthermore, patients who were poisoned with a mixed substance were excluded from the study, as were individuals who were poisoned accidentally.

## Results

All patients had taken the pharmaceutical product in an attempt to commit suicide. The patients ranged in age from 18 to 34 years. The average age of the patients was 25.4 (Table 2). Sixteen of the cases were female (76%), and five (24%) were male. All of the patients who died were female. In terms of marital status, 17 (81%) married, and 4 (19%) of the patients were single or unmarried (Table 1). 13 (62%) of the cases were brought to the ED in a conscious state (GCS=15) and 8 (38%) cases were brought to the ED in an unconscious state (Table 2).

Comparisons of patients with respect to employment status, previous suicide attempts, and antidepressant usage are given in Table 1.

Comparisons of patients with respect to the average length of stay in the ICU (hospitalization) and average dose of the pharmaceutical product consumed are given in Table 2.

The average amount of time (admission time) taken to bring the patients from the place where they were poisoned to the ED was 2.40 hours (Table 2).

A total of nine (43%) patients had signs of shock such as hypotension and tachycardia and 5 (55.5%) of these patients sub-

**Table 1.** The demographic profile of patients presenting with Acute Zinc Phosphide poisoning

Characteristic	Total [n]	[%]
Sex		
Male	5	24
Female	16	76
Marital Status		
Married	17	81
Single	4	19
Employment Status		
Housewife	6	28.6
Works in Agriculture	15	71.4
Previous suicide Attempts		
Yes	16	76
No	5	24
Antidepressant Use		
Yes	13	62
No	8	38

**Table 2.** The clinical profile of patients presenting with Acute Zinc Phosphide poisoning

Characteristic	Value [n or means]
Age (years)	25.4
Admission time (hours)	2.40
Dose consumed (grams)	14.5
Length of stay in the ICU±(days)	12.5
Shock signs (hypotension and/tachycardia)	9
Unconscious (*GCS<13)	8
ICU±: Intensive care unit, *GCS: Glasgow Coma Scale	

**Table 3.** The laboratory profile of patients presenting with Acute Zinc Phosphide poisoning

Characteristic	Value [n or means]
Acidosis [pH <7.35]	8
High Liver function test	13
High Pancreatic amylase level	4
Bicarbonate level [mmol/L]	23.20

sequently died. A total of eight patients (38%) had low pH levels (<7.35) on admission (Table 3). The average level of bicarbonate in the arterial blood gas of the patients was 23.20 mmol/L.

Comparisons of patients with respect to liver enzyme levels and amylase enzyme levels are given in Table 3.

As shown in Table 4, According to the autopsy results of the dead patient, there were findings of liver congestion, liver necrosis, pancreatic edema and hemorrhagic points together with inflammation in the kidneys.

**Table 4.** Results of autopsies of the dead cases

Died patients	LC	LN	PE	HP+ KI
1	+	+	+	+
2	+	+	+	+
3	+		+	+
4			+	+
5	+			

LC: liver congestion, LN: liver necrosis, PE: pancreatic edema, HP: hemorrhagic points, KI: kidneys inflammation

## Discussion

Phosphide is commonly used in suicide attempts by individuals in the younger, productive age group of society (4). In one study, most of the suicides by poisoning occurred in persons who were in their third decade of life; the mean ages of the males and females in that study were 40.5 and 34.4 years, respectively (5). Another study reported that the majority of the patients were young (mean age, 27 years) (6). In this study, the mean age was similar to the earlier literature

In reports in the literature, it is mainly males who suffer from aluminum phosphide and zinc phosphide intoxication (5-7). However, in the present study, the number of women was higher than that of men, and the women were affected more by the poison. The five patients who died were female. We believe that the reason why 75% of the cases were female pertains to the cultural structure of the region. In developing countries, where the industrial revolution has yet to happen, the life pattern of women is the home and agricultural land. Exposure to pharmaceutical products used for different purposes in these areas is very common. In our study, the majority of our patients (N=15, 71.4%) were agricultural workers who were uninsured and were being paid a daily rate. The rate of suicide attempts of women who were housewives (6%) was less than among women who worked in agriculture (10%). Although this is seen as a contradiction, the challenges of work in agriculture may be partly behind attempts at suicide in women. Furthermore, women who work in agriculture have easier access to pesticides.

Individuals who are not married or have no family are more susceptible to suicide-related poisoning. In one study, it was reported that the total number of poisonings was 88, of whom 35% were housewives, while marital or family conflicts were noted in 52 (59%) of the patients (7). Another study reported that the common causative factors that led to self-poisoning were marital disharmony, economic hardship, and disagreements with other family members (6). In line with the literature, in the present study, patients who attempted suicide had a significantly higher proportion of those who were living alone or divorced.

Adaptation issues related to social life and financial difficulties increase the possibility of depression. According to one study, 30 (34%) patients suffered from depression, 28 (32%) were alcoholics, and 23 (26%) suffered from neurosis (7). In the present study, the number of patients using antidepressants (n=13, 62%) was higher than the number not using antidepressants and also the majority of patients (16/21) exposed to zinc phosphide poisoning had a history of previous suicide attempts.

The major lethal consequence of phosphide ingestion, i.e., profound circulatory collapse, is reportedly secondary to the toxins

generated, which have direct effects on cardiac myocytes, fluid loss, and adrenal gland damage (8). Hemodynamic disturbance and hypotension (MAP <70 mmHg) have been reported in some studies (8-10). In the present study, nine (43%) of the patients had signs of shock such as hypotension and tachycardia and five (55.5%) of these patients subsequently died. Damage to the central nervous system may arise due to circulatory disorders (8-11). As a result, patients may become unconscious due to zinc phosphide intoxication, either at the time of admission or at a subsequent time-point. In their study, Louriz et al. (12) reported that mortality in acute phosphine poisoning (APP) correlated with shock and altered consciousness. In our study, eight of the patients were unconscious when they were admitted to the ED and four (50%) of these patients subsequently died. The state of shock most probably progressed in those patients who were admitted in an unconscious state, which may explain the high mortality rate.

The amount of poison reported in poisoning cases differs among publications. Chugh et al. (13) reported that serum phosphine levels correlated positively with the severity of poisoning, and levels equal to or less than  $1.067 \pm 0.16$  mg % appeared to be at the limit of phosphine toxicity. Another study indicated that zinc phosphide is lethal at dosages of between 4000 mg and 5000 mg (9). Wahab et al. (14) reported the specified fatal aluminum phosphine dosage as 150-500 mg. In the present study, the average amount of poison consumed by the patients was 14.5 grams.

Phosphine is a nucleophile and acts as a strong reducing agent that is capable of inhibiting cellular enzymes involved in several metabolic processes (15-17). The reactions that phosphine causes at the cellular level give rise to various disorders and failures in organs and systems. Laboratory evaluation is mainly done to assess the prognosis. Metabolic acidosis indicates moderate to severe ingested poisoning (8). Metabolic acidosis or mixed acid base imbalance accompanying metabolic acidosis, together with respiratory alkalosis, is very common (18). In one study, it was reported that the mean pH on admission was  $7.20 \pm 0.14$  and the mean bicarbonate concentration was  $12.32 \pm 5.45$  mmol/L (4). In the present study, eight patients (38%) had low pH levels at admission; four of them died. A low pH was a causative factor in the deaths of our patients. The average level of bicarbonate in the arterial blood gas of the patients was 23.20 mmol/L. Patients who died had a lower average value of the serum bicarbonate (13.8 mmol/L). The mean serum bicarbonate level on admission may be a good indicator of prognosis.

The onset of clinical signs following ingestion of poison is variable but often occurs within 4 h (1). Proudfoot has reported that there is usually only a short interval between the ingestion of phosphides and the appearance of systemic toxicity (8). Zinc phosphide is generally used in the rural areas of our region. A certain amount of time elapses before persons who are exposed to the poison reach fully equipped hospitals in the city center. The average amount of time taken to bring the patients from the place where they were poisoned to the ED was 2.40 hours. We believe that this duration is important in terms of patient prognosis.

Some studies have indicated that phosphine poisoning can lead to liver damage. Abnormal liver function tests in non-fatal cases of poisoning also suggest the presence of a type of pathology in the liver (19-23). Nevertheless, the morphologic findings in the liver in cases of phosphine poisoning have only been examined in very limited studies with small sample sizes (22, 24, 25). A study conducted

in Iran on liver biopsies from 37 patients who had died from zinc phosphide intoxication found that in all cases there were injury symptoms, which ranged from congestion to necrosis in the liver at different stages (26). Thirteen of our patients had high levels of liver enzymes. The rate of mortality was twice as high in patients with high levels of liver enzymes as in patients with normal liver enzyme levels. According to the autopsy reports, congestion in the liver was identified in 3/5 of the dead patients and 2/5 of these patients had both congestion and necrotic spots in the liver.

Sarma et al. (27) have reported that zinc phosphide ingestion leads to acute pancreatitis. In our study, four of our patients had higher than average amylase values. In the autopsies, 4/5 cases showed edema and swelling of the pancreas, as well as lesions in the liver.

There is no antidote for poisoning with metal phosphides, such as aluminum phosphide and zinc phosphide. Some patients may die even after being treated in intensive care units (8). The reported mortality rates for aluminum phosphine and zinc phosphine vary across different studies, although they are generally high (1, 14, 28). The mortality rate in the present study was 23.8%.

### Study Limitation

A limitation of the present study is that it was retrospectively designed. Our patient numbers may be considered as inadequate for this research. Therefore, larger prospective studies need to be performed to confirm our results.

### Conclusion

While it is a rare type of suicide attempt, the mortality rate for patients with zinc phosphide poisoning is high. Metabolic acidosis and shock are commonly seen in zinc phosphide. Early resuscitation can have positive effects on morbidity and mortality. Patients who suffer from zinc phosphide poisoning must be monitored under intensive care conditions.

### Conflict of Interest / Çıkar Çatışması

No conflict of interest was declared by the authors.  
*Yazarlar herhangi bir çıkar çatışması bildirmemişlerdir.*

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### Author Contributions / Yazar Katkıları

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