

The prognostic value of the Glasgow coma scale, serum acetylcholinesterase and leukocyte levels in acute organophosphorus poisoning

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BACKGROUND AND OBJECTIVES: Organophosphate poisoning (OP) is a serious clinical condition that may sometimes be fatal. The aim of this study was to determine whether the Glasgow coma scale (GCS), and serum acetylcholinesterase and leukocyte levels have prognostic value in acute OP poisoning.

DESIGN AND SETTING: Retrospective review of records of patients admitted to the intensive care unit of Selcuk University, Meram Medical Faculty, Emergency Department, Konya, Turkey, between January 2006 and January 2009.

METHODS: We studied acutely OP-poisoned patients admitted within 24 hours after OP exposure.

RESULTS: The mean age of the 25 patients was 37 years (range, 20-80 years). Three (12%) of the 25 patients (male-female ratio, 12:13) died. The mean GCS values of the patients who died were significantly lower compared to those of the group that survived (4 vs 11.7, respectively $P < .05$). While the mean serum acetylcholinesterase levels were lower in the patients who died, the difference in the mean serum acetylcholinesterase levels between the patients who died and the ones who survived was not statistically significant (3841 IU/L vs. 1768 IU/L, respectively).

CONCLUSION: Although serum cholinesterase values can be used in the quick diagnosis, their efficiency at predicting outcome in patients with OP poisoning has not been established. It has also been determined that serum leukocyte values have no prognostic value in OP poisoning, but GCS values have been found to be effective in predicting the outcome.

Organophosphate (OP) compounds are frequently used as pesticides in countries that have a great deal of agricultural activities. OP poisonings are often encountered in Turkey as it is an agricultural country.¹ It has been reported in a statistical assessment conducted in the USA in 2003 that 18 out of every 100 000 agricultural laborers are exposed to pesticide-associated poisoning, and a total of 7500 OP poisonings occur annually.²

OP compounds increase the accumulation of acetylcholine in the synaptic gap through inhibition of acetylcholinesterase and decrease in the degradation of acetylcholine, thus leading to excessively increased cholinergic activity and the appearance of cholinergic symptoms. Oximes like pralidoxime cause acetylcholin-

esterases to reactivate by binding to OP and carbamates that have been bound to acetylcholinesterases.³ Since penetration of oximes into the central nervous system is limited, the actual effect is on the peripheral nervous system. OPs are quickly absorbed through the respiratory system, gastrointestinal system and mucosa, and they can be absorbed quickly from the skin as they are lipophilic compounds. The severity of OP poisoning differs depending upon the compound and its quantity, the way the exposure has occurred and the time at which treatment is initiated. Pesticide poisonings have a low mortality rate (0.04% to 1%) as long as they are treated appropriately; and the major reason for death is respiratory insufficiency.^{4,5} OPs lead to undesired effects on the central nervous system, cardiovascular system, respira-

tory system, urogenital system, neuromuscular junction, and metabolic and endocrine systems. Muscarinic symptoms like miosis, bradycardia, bronchospasm, urine and fecal incontinence; and nicotinic symptoms like muscle weakness, muscle fasciculations, tachycardia, loss of consciousness and globe vesicale occur.^{6,7}

In the present study, patients with OP poisoning who had been followed up in the intensive care unit were examined. Demographic data and the effects of serum acetylcholinesterase leukocyte values and admission Glasgow coma scale (GCS) values on the length of stay and mortality due to OP poisoning were investigated.

METHODS

Patients with OP poisoning who had been followed up in the intensive care unit of SUMMF (Selcuk University, Meram Medical Faculty), Emergency Department, from the beginning of January 2006 to the end of December 2008 were retrospectively examined. Computer records of patients with OP poisoning who had presented between these dates were examined. Leukocyte levels, acetylcholinesterase levels and GCS levels on admission; and length of stay of these patients were recorded, and the correlation between the obtained outcomes was investigated. The obtained outcomes were evaluated with the help of the Spearman rank correlation test and the Mann-Whitney U test by using SPSS 13.0 software. The outcomes with *P* values <.05 were considered significant.

RESULTS

Twenty-five patients (male-female ratio, 12:13) were included in this study. The mean age of the patients was 37.8 years with a median of 35 years; the youngest patient was 20 years of age and the eldest was 80 years old. Six (24%) patients were farmers, and they had been accidentally exposed to OP poisoning. One

(16.6%) patient in this group died. A total of 3 patients (12%) among the 25 died, 4 (16%) were transferred to other clinics and 18 (72%) were discharged from the intensive care unit. The mean and median lengths of stay of these patients were found to be as follows (**Table 1**): 1.33 days and 1 day for patients who had died, 4.1 days and 2.5 days for discharged patients, and 8.3 days and 7.0 days for patients who had been transferred to other clinics, respectively. The patients that died did so on the first or second day. The lowest mean cholinesterase level was 1768 IU/L and the highest leukocyte value was 18.6 K/uL among the patients who died, whereas the mean acetylcholinesterase level was 3841 IU/L and the mean leukocyte level 13.4 K/uL among the patients who had been discharged from the intensive care unit. The outcomes were not statistically significant (*P*>.05). The mean and median GCS values were found to be as follows: 4 and 3 for patients who had died, 13.4 and 15 for discharged patients, 9.7 and 10.5 for patients who had been transferred to the other clinics, respectively. The correlation between mortality and GCS values was statistically significant (*P*<.05), but it was not significant between the GCS values and the length of stay (*P*>.05).

DISCUSSION

OP and carbamate compounds are used commonly in agricultural countries, and they have been used for military purposes (including terrorist attacks) and for treatment of diseases like myasthenia gravis. OP poisonings can present to the emergency services with several clinical symptoms, and although they progress quickly and can be mortal, many are of a moderate exposure and symptoms generally disappear quickly. OP exposure can occur as a suicide attempt or as an accident. The absorption of OP compounds differs according to the route of exposure. While the symptoms after oral intake begin in hours, they develop more quickly when exposure occurs through inhalation.⁶

In a study related to OP poisoning that was similar to ours, the mean age of the patients was stated as 21 years, and 75% of the patients were under 25 years of age. In the present study, the mean age was 37.8 years.⁸ This difference can be explained by the difference in socioeconomic status of the study populations, in addition to the fact that the present study included only those patients who had been treated at the intensive care unit.

Defining the factors that affect the prediction of mortality and prognosis in OP poisoning will help guide follow-up and treatment in the intensive care unit. GCS is a scoring system developed by Jennett and Teasdale to evaluate the neurological condition of the patient,

Table 1. Outcomes of 25 organophosphate-poisoned patients.

	Died (n=3)	Discharged (n=18)	Transferred (n=4)
Length of stay			
Mean (days)	1.3	4.1	8.3
Median (days)	1.0	2.5	7.0
Glasgow coma scale			
Mean	4	13.4	9.7
Median	3	15	10.5

particularly in patients with head trauma, but it was reported in 1978 that it can also be used to define prognosis in nontrauma patients.⁹ Hypoperfusion occurring in the central nervous system as a result of neuropathy and the added hemodynamic abnormalities in OP poisoning cause the GCS value to decrease, and low values of GCS indicate the potential for development of respiratory insufficiency and prognosis.¹⁰ Davies et al stated that patients with a GCS value under 13 need intensive monitoring and treatment and that half of the patients who had died because of OP were those with mild symptoms on admission. Therefore, they suggested that patients presenting with OP poisoning must be closely monitored and treated even if they are asymptomatic on admission.¹¹ In the present study we also found a statistical correlation between GCS values and mortality, while there was no statistically significant correlation between the GCS values and length of stay.

OP compounds cause irreversible inhibition of acetylcholinesterase and create several symptoms, collectively referred to as a cholinergic crisis, by causing acetylcholine to accumulate at the synapse and overstimulate the central and peripheral nervous systems. The resulting muscarinic and nicotinic symptoms may continue for days or months until the acetylcholinesterase enzyme forms again.¹² In studies similar to ours, the relationship between acetylcholinesterase level and the severity of OP poisoning has been examined, but there has been no common conclusion. Goswamy et al have stated that measurement of the acetylcholinesterase level is useful in predicting the prognosis in OP poisoning,¹³ but the dominant view is that there is no relationship. In a study conducted by Aygun et al on patients with OP poisoning, acetylcholinesterase levels on admission were evaluated, and low levels of serum acetylcholinesterase

were reported to support the diagnosis of acute OP poisoning, but acetylcholinesterase levels were not related to clinical severity.¹⁴ In the study conducted by Chorian et al on 21 patients with OP poisoning, no significant difference was found in serum acetylcholinesterase levels between the group treated with pralidoxime and the group that received placebo.¹⁵ In our study, serum acetylcholinesterase level did not correlate statistically with mortality and length of stay. Some authors suggest that the reduction of serum acetylcholinesterase level and the corresponding clinical manifestation should be evaluated together, which would further benefit treatment planning.¹⁶ It should be noted that in the present study, mean serum acetylcholinesterase levels were also lower in patients who died.

Laboratory data has been reported in several cases of OP poisonings. In three similar but separate studies, the leukocytosis rates were determined to be between 30% and 44%,^{17,18} whereas the leukocytosis rate was found to be 76% in our study. However, a statistically significant correlation was not found between leukocyte levels and length of stay or mortality, although there were higher leukocyte levels in patients who died.

OP poisonings are frequent, but if treated appropriately and in time, are rarely fatal. Of the parameters we used to predict prognosis, a statistical correlation was found only between GCS values and mortality; there was no correlation between GCS values and length of stay. Furthermore, a statistically significant correlation between serum acetylcholinesterase and leukocyte levels on the one hand and length of stay and mortality on the other could not be determined. The outcomes are in line with the fact that serum acetylcholinesterase and leukocyte values can be used in the diagnosis, but they do not have a value in the prognosis.

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