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Original Research Article

Biochemical abnormalities in patients presenting with acute organo-phosphorus poisoning in a tertiary care hospital, and the prognostic significance

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ABSTRACT

Background: Organophosphate poisoning is a major cause of morbidity and mortality that poses public health problems in developing countries, including India. Clinical signs and symptoms of OP compound ingestion are often non-specific and clinical signs depend on the nature of the OP compound, the amount consumed the time lapse between exposure and admission to the hospital, and the severity
Methods: In this prospective cohort study, we reported the clinical presentation of 50 patients with OP poisoning, and studied the correlation of serum K+, Na+, creatinine, and BUN with the prognostic significance.
Result: Elevated serum creatinine along with hypokalemia was found to be strongly correlated with high mortality rates in patients with suicidal organophosphate poisoning. The correlation of clinical outcomes and low serum K+ was found to be statistically significant ($p<0.001$). Our study concludes that serum K+ (<3.6 mmol/l) and serum creatinine (>1.21 mg/dl) are poor prognostic indicators for patients presenting with suicidal OP poisoning
Conclusions: Our study concluded the association of hypokalemia and elevated serum creatinine levels with poor clinical outcomes in OP poisoning patients, and recommends regular monitoring of these prognostic indicators in effective management of these patients.

Keywords: Organophosphate, Hypokalemia, Poisoning

INTRODUCTION

Organophosphorus (OP) compounds are used as insecticides, pesticides, herbicides, and chemical warfare agents.[1-4] OP compound's easy availability is responsible for the increasing incidences of pesticide poisoning. World health organization estimates that one million serious unintentional poisoning cases occur every year and an additional two million people are hospitalized for suicide attempts with pesticides.[5] India is a predominantly agrarian country where pesticides are routinely used for farming. Hence, the number of cases of OP poisoning is relatively high.[6]

Recent data from the national crime bureau of India shows suicide by consumption of pesticides account for 19.4% and 19.7% of all cases of suicidal poisoning in the year 2006 and 2007 respectively.[7]

In such cases, early diagnosis and prompt treatment can play a significant role. Hence, a study and analysis of the prognostic factors in case of acute OP poisoning is of paramount importance. Our study was conducted to measure serum electrolyte levels and blood urea and creatinine levels to predict the severity and prognosis in case of OP poisoning.

Aims and objectives

The aim and objectives of the study were to find the correlation of deranged serum electrolyte (Na+/K+) levels and prognostic outcome in case of acute OP poisoning, to

study the correlation of deranged serum creatinine and serum urea with prognostic outcome in case of acute OP poisoning, to explore the relation of epidemiological variables like age, sex, educational background, geographical location, occupation, etc., with the prevalence of suicidal OP poisoning and to study the commonly observed symptoms and clinical features in OP poisoning.

METHODS

The present study was conducted in S.S.G. hospital and medical college Baroda, Gujarat, India.

The sample size was calculated by the department of preventive and social medicine of medical college Baroda. The sample size was based on average expected patient flow for organophosphate poisoning during the period of study in the hospital.

The study design was proposed to the institutional ethics committee for research and clinical trials of medical college Baroda and SSG hospital, and an approval was obtained before starting the study.

Study design

The stud design was of prospective cohort study.

All the patients presenting with a history of OP compound ingestion and admitted under the department of medicine were included in the study and interviewed. The patients or their relatives were explained the objectives of the study and written consent were taken before the interview. The sample size for this study was 50 patients presenting with acute OP poisoning. The patient's lab reports and their health condition were followed during their time in the hospital to determine the prognostic factors.

After taking patient history, subjects fulfilling the inclusion criteria were enrolled. Through the use of questionnaires-clinical, epidemiological, and demographic characteristics of patients presenting with acute OP poisoning were studied. In this study, pre-interventional clinical features were observed and noted with severity assessment as per Proudfoot classification, along with measurement of serum potassium ion (K+) concentration, serum sodium (Na+), blood urea, and serum creatinine levels.

All the data collected was analyzed using descriptive statistics (Frequency, percentage, mean, S.D) and an independent t-test was used to compare the result. Data was then entered in an excel sheet and analyzed by EPI-INFO software.

Study duration

The duration of the study was 6 months-from April 2020 to September 2020.

Inclusion criteria

All the patients presenting with a history of confirmed OP compound ingestion and admitted under the department of medicine were included in the study and interviewed.

Exclusion criteria

Patients or relatives not giving consent will not be included, patients with features of exposure to another compound not related to OP poison, patients with mixed poisoning; OP poisoning and any other poison, patients who have chronic alcoholism and patients with a history of renal disease were excluded from the study.

RESULTS

In this study, 50 patients of acute organo-phosphorus poisoning were studied, that included 32 men and 18 females. The median age of the patients presented was 29.7 years. Of these 50 cases, 31 were suicidal, 14 were accidental, and 5 were due to occupational OP compound exposure.

Most commonly observed symptoms were nausea and vomiting, followed by cough, and convulsions.

The most common clinical manifestation on presentation was congested conjunctiva (82%) followed by miosis (78%), bronchospasm/bronchorrhea (78%) and vomiting (74%). A total of 21 cases presented with one or more severe clinical features according to Proudfoot classification

Hypokalemia was observed in 69% of the severe cases (34 out of 50). The 34% of the patients (17 cases) had muscle weakness or fasciculation with mean serum (K+) of 3.31±0.11, indicating that when the serum (K+) level decreases below 3.5 mmol/l, these alarming signs can be recognized. The development of muscle weakness or fasciculation was in association with a steady decrease in oxygen saturation level. This gradually progressed to respiratory distress to such a level that ventilatory support was required at the mean serum (K+) of 3.27±0.10 mmol/L. Fatality was noted when the mean serum (K+) reduced to 2.90±0.06 mmol/l. For these conditions, the correlation of the clinical effects and serum (K+) was significant ($p<0.001$).

Serum creatinine was observed to be elevated in 37% of cases. As the serum creatinine level increases, the general condition of the patient in case of OP poisoning deteriorates rapidly. Elevation of serum creatinine level was observed in correlation with hypokalemia in 67% of cases. Mortality was observed to be very high (71%) in case of acute OP poisoning with acute kidney injury.

No direct correlation between serum sodium level and treatment outcome was observed in the study. Hyponatremia was observed in 27% of the cases and

hypernatremia was observed in 13% of cases. However, 63% of patients with hypernatremia also had hypokalemia.

Table 1: Sample size correlation with biochemical abnormalities.

Number of patients with following parameters	N (%)
K+ <3.6 mmol/l ref. range (3.6 to 5.2 mmol/l)	34 out of 50 (69)
Critically ill patients with serum K+ <3.6 mmol/l	17 cases (34)
Serum creatinine >1.21 mg/dl*	18 out of 50 (37)

*First measured value at patient presentation

Table 2: Correlation of clinical effects on patients and serum (K+) levels (p<0.001).

Serum (K+) value (in mmol/l)	Clinical manifestations in OP poisoning patients
3.31±0.11	Muscle weakness and fasciculations
3.27±0.10	Respiratory distress requiring ventilatory support
2.90±0.06	Clinically fatal outcomes

DISCUSSION

On ingestion of organo-phosphorus compounds, they bind to the acetylcholine esterase (AchE) receptors and thereby prevent the hydrolysis of acetylcholine (Ach). This results in accumulation of Ach in the synaptic cleft, leading to all the cholinergic effects.[8] From our study, we learned that significant reduction in serum [K+] is directly related to OP toxicity induced muscle weakness, paralysis and ultimately death. These findings may suggest that alteration in serum [K+] may alter neuro-muscular junction activity and contribute to overall morbidity and mortality of OP poisoning. In our study, significant signs and symptoms were observed in patients with reduced serum potassium.

Potassium ion is highly balanced in the body. The urinary potassium excretion (1-1.5 mmol/kg/day) is directly proportional to the total body potassium and is a good marker of total body potassium.[9]

The resting membrane potential and functional activity of electrically excitable cells undergo significant alteration even due to minute changes in extracellular potassium concentration.[10]

In acute cases of OP poisoning, due to hypokalemia, respiratory distress, muscle weakness and paralysis sets in. In such stressful conditions, hypokalemia can be established as an add-on to the clinical burden and these signs and symptoms can be aggravated in the presence of associated clinical conditions.[11-13]

Limitations

The study was conducted in a regional tertiary care hospital, and the patient demographics and clinical severity may not be representative of the population in general. The study results are only applicable for patients with confirmed organophosphate compound poisoning, as patients with mixed or unknown compound ingestion were excluded from the study.

CONCLUSION

Elevated serum creatinine along with hypokalemia was found to be strongly correlated with high mortality rates in patients with suicidal organophosphate poisoning. The correlation of clinical outcomes and low serum K+ was found to be statistically significant (p<0.001). Our study concludes that serum K+ (<3.6 mmol/l) and serum creatinine (>1.21 mg/dl) are poor prognostic indicators for patients presenting with suicidal OP poisoning. These lab values are correlated to increased artificial ventilation requirements as well as increased mortality in case of OP poisoning. Hence, special attention must be paid for the patients with serum K+ (<3.6 mmol/l) and serum creatinine (>1.21 mg/dl), and regular monitoring of these prognostic indicators is recommended in a critical care setting.

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