Section: General Medicine

Original Research Article

TO DETERMINE THE PROGNOSTIC SIGNIFICANCE OF SERUM CREATINE PHOSPHOKINASE IN ORGANOPHOSPHORUS POISONING IN TERTIARY CARE HOSPITAL SETTING

G. Prakash[1], Stefy Joseph[2], J. Brinda[3], G. Arul Venkadesh[4]

[1]Assistant Surgeon, Department of General Medicine, Mayiladuthurai Government District Hospital, Tamilnadu, India
[2]Assistant Professor, Department of General Medicine, Dr. Somervell Memorial CSI Medical College Hospital, Karakonam, Kerala, India
[3]Associate Professor, Department of General Medicine, Government Medical College, Dindigul, Tamilnadu, India
[4]Assistant Professor, Department of General Medicine, Kanyakumari Government Medical College, Tamilnadu, India

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Corresponding Author:
Dr. G. Arul Venkadesh
Email: garuldr@gmail.com

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Abstract

Background: Organophosphorus poisoning is still a significant cause of deliberate damage. However, the prognosis was entirely dependent on clinical evaluation; the effect of CPK in predicting death and severity in OPC poisoning patients needs further exploration. To establish the prognostic significance of serum CPK levels in identifying the severity and mortality of OP poisoning. **Materials and Methods:** The prospective observational study was conducted from April 2020 to April 2021 at a tertiary care hospital in Tamil Nadu. Patients with ages >14 years presented with OP poisoning were included in the study, whereas patients with any other disease or illness were excluded. Patient data, including POP scores, CPK levels, and demographic details, were recorded. **Result:** A total of 95 patients were enrolled, out of which 55 were males and 40 were females, with the age group of 21-30 years with the most affected OP cases. 33.7% of students and 40% belonged below the poverty line. Chlorpyrifos was the most common poison reported, and monocrotophos with 63.2% of patients with POP <4 and 36.8% POP score >4. CPK levels were 443.3 (258.6) in individuals with a POP score less than 4 and 723.4 in those with a POP score greater than 4. (373.4) (Pearson value of 0.52), serum CPK levels were associated favourably with POP score. The sensitivity and specificity of serum CPK to predict mortality was 94% and 67%. **Conclusion:** Serum CPK levels can be used as a prognostic marker to predict the severity and mortality of OP poisoning cases with highly accurate and sensitive tests.

INTRODUCTION

The poisoning is caused due to chemical compounds comprising phosphoric, phosphonic, or phosphonic acids, referred to as "Organophosphorus poisoning" or "OP".[1] Several compounds with phosphorus, including pesticides and chemical warfare nerve agents, can result in poisoning due to inhalation, ingestion, and skin penetration with high absorption rates. The underlying mechanism involves acetylcholinesterase, which leads to a build-up of acetylcholine in the body.[2]

The OP manifests into three toxicity phases: acute cholinergic crisis, intermediate syndrome, and delayed OP-induced neuropathy. Patients with OP poisoning are mainly seen with weakness of proximal limb muscles, neck flexors, and respiratory muscles, which is attributed to muscle fibre necrosis.[3] The intermediate syndrome phase lasts 48 to 96 h after acute poisoning, resulting in OP-induced neuropathy.[4] Increased muscle enzymes have been reported, including lactate dehydrogenase, troponin, and creatine phosphokinase (CPK). Several studies have reported elevated serum CPK after muscle injury, which is prevalent for 5-6 days in patients.[5] OP poisoning is one of the most common poisonings in Asia, with an overall mortality rate of 22.6% among hospitalized patients.[6]

Patients presented with OP poisoning are usually monitored with serum acetylcholinesterase levels with an expectation of lowering levels.[7] The role of serum CPK has been demonstrated as a prognostic marker for the intermediate syndrome phase. However, only during admission or before discharge. The use of serum CRP has also been correlated with

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the clinical severity of the poisoning during admission.[8,9]

The current study aims to assess the effective use of serum CPK levels as a prognostic marker to determine the severity of OP poisoning and correlate it with the phase of poisoning in patients admitted to tertiary care hospitals.

MATERIALS AND METHODS

The prospective observational study was based on 12 months from April 2020 to April 2021 at a tertiary care hospital located at Asaripallam, Kanyakumari district, with hospital facilities of casualty, out-patient care, laboratory services, in-patient care, blood bank services, speciality, and super-speciality services.

Inclusion criteria

Patients aged >14 presented within 24 h consumption of organophosphorus poisoning, and patients with approved consent for the study were included.

Patients with the following criteria were excluded: Cases of mixed poisoning, autoimmune disorder, trauma, chronic liver disease, myopathy, malignancy, renal failure, coronary artery disease, and patients with chronic drug treatment with statins, fibrates, and steroids.

Patients admitted to the hospital with a diagnosis of OP poisoning from April 2020 to April 2021 were included in the study with sample size estimation and measurement of serum CPK levels. To assume the alpha error of 5%,

The study calculated sample size with an absolute precision of 100 U/L and a standard deviation of 485 U/L (serum CPK levels reported by Sen R et al., in the moderate severity group of the POP scale) for to assume the alpha error of 5%. A minimum required estimated sample size was estimated to be 91 subjects.

The study tool was pre-tested with a semi-structured questionnaire comprising socio-demographic variables, types of poisoning, route of dose of the OP, intention for consumption, clinical characteristics, serum CPK levels, POP score, need for mechanical ventilation, and clinical outcome of the patients.

The Peradeniya organophosphorus Poisoning (PoP) scale, [Table 1], includes five common clinical manifestations of OP intoxication and represents both muscarinic and nicotinic effects and the central effects of Cholinesterase inhibition. The score is computed as soon as the patient presents to the emergency department before any medical intervention is instituted.

The data was included in Microsoft Excel and analyzed using Statistical Package for Social Science (SPSS) standard version 20.0. All continuous variables were summarised using Mean (SD) or Median (IQR) depending on the normality of distribution, and categorical variables were summarized using proportions.

Study disposition

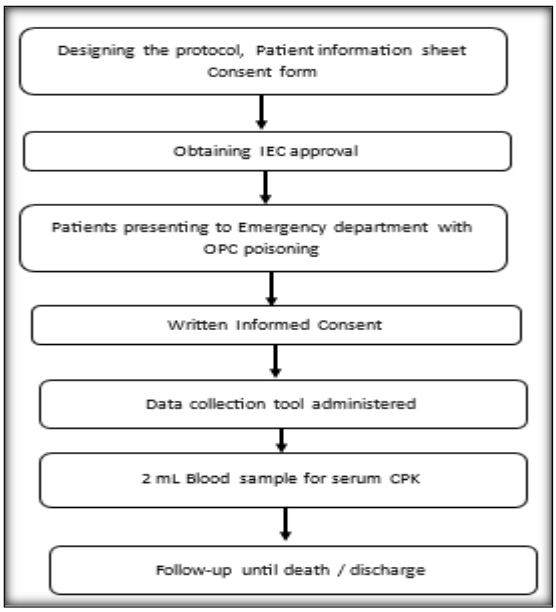

Figure 1: Depiction of the study procedure

RESULTS

[Table 2] describes the participants based on their age and gender distribution. One-fourth of the participants were under the age of 20. The majority of the patients were between the ages of 21 and 30. About 58% of the patients were men, and the remaining 42% were women.

Table 1: Peradeniya Organophosphorus Poisoning Scoring System-distribution of symptoms

PARAMETER SCORE	SCORE
MIOSIS	
Pupil size	
> 2mm	0
< 2mm	1
Pinpoint	2
FASCICULATIONS	
None	0
Present but not generalized	1
Generalized and continuous with central cyanosis	2
RESPIRATION RR	
< 20/min RR	0
> 20/min RR	1
> 20/min with central cyanosis	2
BRADYCARDIA	

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PR > 60/min PR 41-60/min PR < 40/min	0 1 2
LEVEL OF CONSCIOUSNESS Conscious and rational Impaired and responds to oral commands Impaired and no response to oral commands (If fits present, add 1)	 0 1 2
Total	11

Table 2: Distribution of study participants according to age and gender distribution (n = 95)

Age categories	Males (n=55)	Female (n=40)	Total (n=95)
15 – 20 years	11 (20.0%)	14 (35.0%)	25 (26.3%)
21 – 30 years	27 (49.1%)	15 (37.5%)	42 (44.2%)
31 – 40 years	10 (18.2%)	7 (17.5%)	17 (17.9%)
41 – 50 years	4 (7.3%)	2 (5.0%)	6 (6.3%)
51 – 60 years	3 (5.4%)	2 (5.0%)	5 (5.3%)
Total	55 (100%)	40 (100%)	95 (100%)

The distribution of the study participants by age group is not significantly different between males and females (chi-square value=2.88; p-value=0.577).

[Table 3] demonstrates the occupation distribution of the study participants. One-third of the patients were students, with the remaining 20% being employed. Housewives, agricultural workers, labourers, and unemployed patients made up around 10% of the total.

Table 3: Distribution of study participants based on occupation (n = 95)

Occupation categories	Frequency (%)
Agricultural worker	11 (11.6%)
Employed	19 (20.0%)
Student	32 (33.7%)
Housewife	12 (12.6%)
Labourer	11 (11.6%)
Unemployed/ retired	10 (10.5%)
Total	95 (100%)

A majority of the patients presented with OP poisoning due to chlorpyrifos (53.7%), followed by monocrotophos (24.0%) and methyl parathion (10.0%) [Table 4].

Table 4: Distribution of poison among study participants

Type of poison	Frequency (%)
Chlorpyrifos	51 (53.7%)
Monocrotophos	23 (24.2%)
2% Methyl parathion	10 (10.5%)
Dimethoate	3 (3.2%)
Profenophos	3 (3.2%)
Quinolphos	3 (3.2%)
Triazophos	2 (2.1%)

In addition, our study reports a high incidence of suicidal poisoning among 90 patients (94.74%), and five patients presented with accidental/unintentional poisoning (5.26%). The marital status of patients revealed that 50 were unmarried (52.6%) and 45 were married (47.4%). Furthermore, one-fifth of the patients were degree holders or enrolled in tertiary education. However, about 20% of patients had no formal education, and 8% of patients presented with less than a primary level of education. Of the participants, 31% had an education status between class 6 to class 10 and 38 patients were below the poverty line (40.0%), and 57 patients were reported above the poverty line (60.0%). The data regarding the distribution of marital status, educational status, and socio-economic status are presented in the supplementary data.

Approximately 80% of the subjects had a loss of consciousness and miosis, but 70% did not have fasciculation. In 56% of them, the respiratory rate was normal, while bradycardia and seizures were absent in 65% and 90%, respectively. The POP score was less than or equal to 3 in 63% of the subjects and greater than or equal to 4 in 37% [Table 5].

Table 5: Distribution of POP score in OP poisoning patients

Domains	Frequency (%)
Loss of consciousness 0 1 2	 18 (18.9%) 63 (66.3%) 14 (14.7%)

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Miosis	
0	14 (14.7%)
1	66 (69.5%)
2	15 (15.8%)
Fasciculation	
0	68 (71.6%)
1	23 (24.2%)
2	4 (4.2%)
Respiratory rate	
0	53 (55.8%)
1	37 (38.9%)
2	5 (5.3%)
Bradycardia	
0	62 (65.3%)
1	31 (32.6%)
2	2 (2.1%)
Seizure	
0	86 (90.5%)
1	9 (9.5%)
POP score	
Less than or equal to 3	60 (63.2%)
More than or equal to 4	35 (36.8%)

Based on the outcome, 21 patients (22.1%) required ventilatory support, whereas 74 patients (77.9%) did not require ventilatory support. However, mortality and deaths were seen in 19 patients (20.0%), and 76 survived the poisoning state.

Table 6: Comparison of occupational characteristics and patient mortality

Occupation	Died (n=19)	Survived (n=76)	Total (n=95)
Agricultural worker	1 (9.1%)	10 (90.9%)	11 (100%)
Student	5 (15.6%)	27 (84.4%)	32 (100%)
Employed	5 (26.3%)	14 (73.7%)	19 (100%)
Labourer	6 (54.5%)	5 (45.5%)	11 (100%)
Housewife	1 (8.3%)	11 (91.7%)	12 (100%)
Unemployed	1 (10.0%)	9 (90.0%)	10 (100%)

Table 7: Comparison of POP score between patient mortality

POP domains		Died (n=19)	Survived (n=76)	p-value (Chi-square value)
Loss of consciousness	0	4 (22.2%)	14 (77.8%)	0.621
	1	11 (17.5%)	52 (82.5%)	(0.952)
	2	4 (28.6%)	10 (71.4%)	
Miosis	0	3 (21.4%)	11 (78.6%)	0.015
	1	9 (13.6%)	57 (86.4%)	(8.355)
	2	7 (46.7%)	8 (53.3%)	
Fasciculation	0	5 (7.4%)	63 (92.6%)	<0.001
	1	11 (47.8%)	12 (52.2%)	(25.491)
	2	3 (75.0%)	1 (25.0%)	
Respiratory rate	0	0	53 (100%)	<0.001
	1	14 (37.8%)	23 (62.2%)	(40.608)
	2	5 (100%)	0	
Bradycardia	0	5 (8.1%)	57 (91.9%)	<0.001
	1	12 (38.7%)	19 (61.3%)	(20.302)
	2	2 (100%)	0	
Seizure	0	15 (17.6%)	70 (82.4%)	0.255
	1	3 (33.3%)	6 (66.7%)	(1.293)
POP score	Less than or equal to 3	2 (3.3%)	58 (96.7%)	<0.001
	More than or equal to 4	17 (48.6%)	18 (51.4)	(28.273)

Table 8: Patients requiring mechanical ventilation comparison with POP scores

POP domains		Mechanical ventilation (n=21)	Not intubated (n=74)	p-value (Chi-square value)
Loss of consciousness	0	6 (33.3%)	12 (66.7%)	0.294
	1	11 (17.5%)	52 (82.5%)	(2.447)
	2	4 (28.6%)	10 (71.4%)	
Miosis	0	3 (21.4%)	11 (78.6%)	0.184
	1	12 (18.2%)	54 (81.8%)	(3.383)
	2	6 (40.0%)	9 (60.0%)	
Fasciculation	0	8 (11.8%)	60 (88.2%)	<0.001
	1	11 (47.8%)	12 (52.2%)	(14.867)
	2	2 (50.0%)	2 (50.0%)	
Respiratory rate	0	3 (5.7%)	50 (94.3%)	<0.001

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	1 2	13 (35.1%) 5 (100%)	24 (64.9%) 0	(29.591)
Bradycardia	0 1 2	7 (11.3%) 12 (38.7%) 2 (100%)	55 (88.7%) 19 (61.3%) 0	<0.001 (16.222)
Seizure	0 1	18 (21.2%) 2 (22.2%)	67 (78.8%) 7 (77.8%)	0.942 (0.005)
POP score	Less than or equal to 3 More than or equal to 4	5 (8.3%) 16 (45.7%)	55 (91.7%) 19 (54.3)	<0.001 (17.938)

Supplementary Data

Table 1: Distribution of the study participants according to the Educational status of the patients (n=95)

Education categories	Frequency (%)
No formal education	19 (20.0%)
Primary level (class 1 – 5)	8 (8.4%)
High school (class 6 - 10)	30 (31.6%)
Higher secondary (class 11 – 12)	16 (16.5%)
Bachelor / PG Degree	22 (23.2%)
Total	95 (100%)

Table 2: Distribution of the study participants according to the socio-economic status of the patients (n=95)

Socio-economic status categories	Frequency (%)
Above poverty line	57 (60.0%)
Below poverty line	38 (40.0%)

Table 3: Distribution of the study participants according to the marital status of the patients (n=95)

Marital status categories	Frequency (%)
Married	45 (47.4%)
Unmarried	50 (52.6%)

Table 4: Comparison of age characteristics between patients who died vs those who survived

Characteristics			
Age groups	**Died (n=19)**	**Survived (n=76)**	**Total (n=95)**
15 – 20 years	5 (20.0%)	20 (80.0%)	25 (100%)
21 – 30 years	7 (16.7%)	35 (83.3%)	42 (100%)
31 – 40 years	4 (23.5%)	13 (76.5%)	17 (100%)
41 – 50 years	2 (33.3%)	4 (66.7%)	6 (100%)
51 – 60 years	1 (20.0%)	4 (80.0%)	5 (100%)
Total	19 (20.0%)	76 (80.0%)	95 (100%)

Chi-square value=1.090; p-value=0.896

Table 5: Comparison of gender characteristics between patients who died vs those who survived

Characteristics	Died (n=19)	Survived (n=76)	Total (n=95)
Gender			
Male	12 (21.8%)	43 (78.2%)	55 (100%)
Female	7 (16.7%)	33 (82.5%)	40 (100%)
Total	19 (20.0%)	76 (80.0%)	95 (100%)

Chi-square value=0.269; p-value=0.603

Table 6: Comparison of Educational characteristics between patients who died vs those who survived

Education	Died (n=19)	Survived (n=76)	Total (n=95)
No formal education	4 (21.0%)	15 (79.0%)	19 (100%)
Primary level	3 (37.5%)	5 (62.5%)	8 (100%)
High school level	4 (13.3%)	26 (86.7%)	30 (100%)
Higher secondary level	3 (18.7%)	13 (81.3%)	16 (100%)
Degree and above	5 (22.7%)	17 (77.3%)	22 (100%)

Chi-square value=2.495; p-value=0.645

Table 7: Comparison of occupational characteristics between patients who died vs those who survived

Occupation	Died (n=19)	Survived (n=76)	Total (n=95)
Agricultural worker	1 (9.1%)	10 (90.9%)	11 (100%)
Student	5 (15.6%)	27 (84.4%)	32 (100%)
Employed	5 (26.3%)	14 (73.7%)	19 (100%)
Labourer	6 (54.5%)	5 (45.5%)	11 (100%)
Housewife	1 (8.3%)	11 (91.7%)	12 (100%)
Unemployed	1 (10.0%)	9 (90.0%)	10 (100%)

Chi-square value=11.5; p-value=0.042

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Table 8: Comparison of marital status and socio-economic status between patients who died vs those who survived

Characteristics	Died (n=19)	Survived (n=76)	Total (n=95)
Marital status			
Ever Married	9 (20.0%)	36 (80.0%)	45 (100%)
Never Married	10 (20.0%)	40 (80.0%)	50 (100%)
Chi-square value=0.0; p-value=1.000			
Socio-economic status			
APL	13 (22.8%)	44 (77.2%)	57 (100%)
BPL	6 (15.8%)	32 (84.2%)	38 (100%)
Chi-square value=0.701; p-value=0.402			

About 28.6% of patients with grade 2 loss of consciousness died, compared to only 22.2% of those who did not have a loss of consciousness. The distribution of Loss of consciousness was not significantly different between those who died and those who survived (p-value=0.621). About 75% of patients with grade 2 fasciculations, 47.8% with grade 1 fasciculations, and 7.4% without fasciculations died. The difference in mortality between those with fasciculations and those without was statistically significant, with a p-value of 0.001. None of the patients with normal respiratory rates had died. The mortality rate among those without bradycardia was 8% compared to 38% among those with bradycardia, and the difference was statistically significant [Table 7].

The comparison of serum CPK patients and morality revealed a significant difference (p-value <0.001), including a mean serum CPK level of 953.8 (56.2) among patients who died and a mean level of 546.5 (332.) among patients with no mortality. [Table 7]

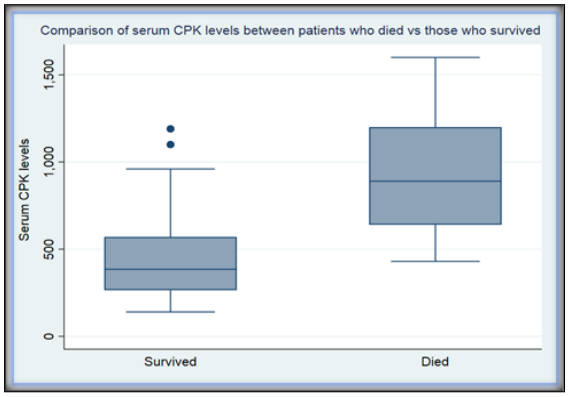

Figure 3: Comparison of mean serum CPK levels in patients

Comparing POP scores with patients requiring mechanical ventilation revealed a significant difference in patients with muscle fasciculations, tachypnoea, and bradycardia who required mechanical ventilation (p-value <0.001), respectively.

In addition, comparing serum CPK levels with the need for mechanical ventilation also revealed a significant difference between patients with high serum CPK levels. The mean (SD) CPK levels among patients who required mechanical ventilation were 848.1 (322) and 460.9 (281.0) among those who did not, and the difference was statistically significant (p-value <0.001). [Table 8]

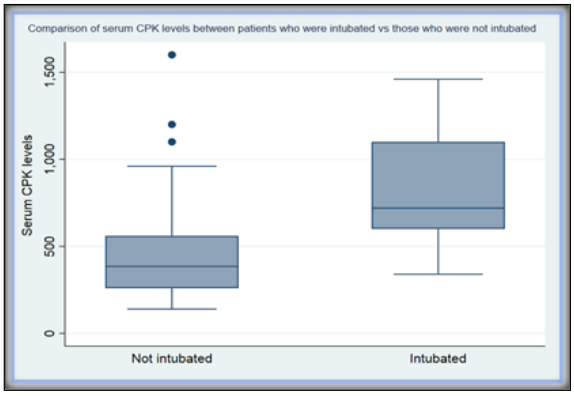

Figure 4: Comparison of serum CPK levels with a need for mechanical ventilation

The area under the curve for predicting mortality based on serum CPK levels was 0.878, with a standard error of 0.037. The 95% confidence interval ranged from 0.804 to 0.951. The table below shows the individual cut-offs with sensitivity and specificity for predicting mortality. A serum Creatine Phosphokinase level of more than 500 IU has a sensitivity of approximately 94.1% and a specificity of approximately 67.1%. This cut-off can be used in clinical settings to identify patients at risk of death.

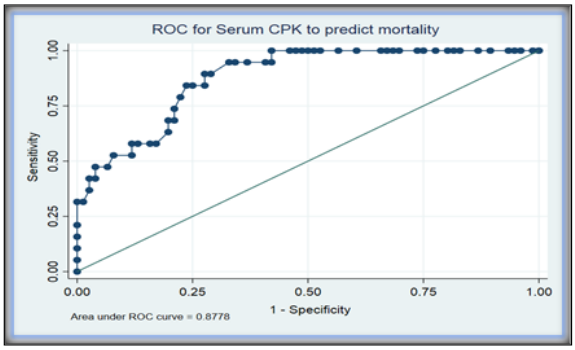

Figure 5: ROC curve for determining cut-off for CPK levels to predict mortality

Note: The complete set of data points is included in the supplementary data

The assessment of the ROC curve for predicting the need for mechanical ventilation by using serum CPK levels revealed a cut-off value of 0.832 with a standard error of 0.044. The 95% CI ranged from 0.746 to 0.917. A serum Creatine Phosphokinase level greater than 500 IU has a sensitivity of approximately 90.5% and a specificity of approximately 67.6%. This cut-off can be used

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clinically to identify patients requiring mechanical ventilation.

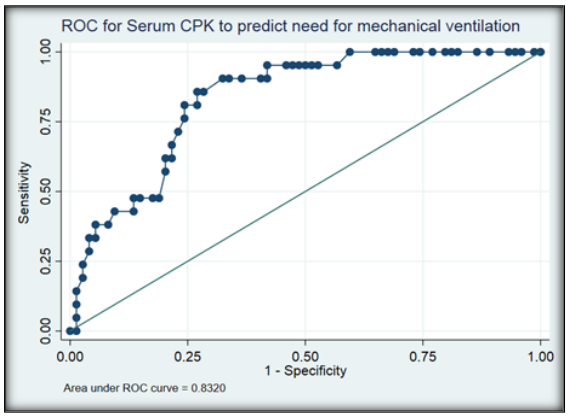

Figure 6: ROC curve for determining the cut-off value of CPK levels for predicting the need for mechanical ventilation

Note: The complete data point set is represented in supplementary data.

Serum CPK detailed report of data points (ROC curve)

Detailed report of sensitivity and specificity

Cutpoint	Sensitivity	Specificity	Correctly Classified	LR+	LR-
(>= 140)	100.00%	0.00%	20.00%	1.0000	
(>= 150)	100.00%	1.32%	21.05%	1.0133	0.0000
(>= 160)	100.00%	3.95%	23.16%	1.0411	0.0000
(>= 170)	100.00%	5.26%	24.21%	1.0556	0.0000
(>= 180)	100.00%	6.58%	25.26%	1.0704	0.0000
(>= 190)	100.00%	10.53%	28.42%	1.1176	0.0000
(>= 210)	100.00%	13.16%	30.53%	1.1515	0.0000
(>= 220)	100.00%	17.11%	33.68%	1.2063	0.0000
(>= 240)	100.00%	18.42%	34.74%	1.2258	0.0000
(>= 250)	100.00%	19.74%	35.79%	1.2459	0.0000
(>= 260)	100.00%	22.37%	37.89%	1.2881	0.0000
(>= 270)	100.00%	25.00%	40.00%	1.3333	0.0000
(>= 280)	100.00%	26.32%	41.05%	1.3571	0.0000
(>= 290)	100.00%	30.26%	44.21%	1.4340	0.0000
(>= 300)	100.00%	31.58%	45.26%	1.4615	0.0000
(>= 310)	100.00%	32.89%	46.32%	1.4902	0.0000
(>= 320)	100.00%	34.21%	47.37%	1.5200	0.0000
(>= 340)	100.00%	39.47%	51.58%	1.6522	0.0000
(>= 350)	100.00%	43.42%	54.74%	1.7674	0.0000
(>= 360)	100.00%	47.37%	57.89%	1.9000	0.0000
(>= 380)	100.00%	48.68%	58.95%	1.9487	0.0000
(>= 390)	100.00%	50.00%	60.00%	2.0000	0.0000
(>= 400)	100.00%	51.32%	61.05%	2.0541	0.0000
(>= 410)	100.00%	52.63%	62.11%	2.1111	0.0000
(>= 420)	100.00%	53.95%	63.16%	2.1714	0.0000
(>= 430)	100.00%	57.89%	66.32%	2.3750	0.0000
(>= 440)	94.74%	57.89%	65.26%	2.2500	0.0909
(>= 450)	94.74%	59.21%	66.32%	2.3226	0.0889
(>= 460)	94.74%	63.16%	69.47%	2.5714	0.0833
(>= 480)	94.74%	65.79%	71.58%	2.7692	0.0800
(>= 500)	94.74%	67.11%	72.63%	2.8800	0.0784
(>= 540)	89.47%	71.05%	74.74%	3.0909	0.1481
(>= 550)	89.47%	72.37%	75.79%	3.2381	0.1455
(>= 560)	84.21%	72.37%	74.74%	3.0476	0.2182
(>= 580)	84.21%	75.00%	76.84%	3.3684	0.2105
(>= 600)	84.21%	76.32%	77.89%	3.5556	0.2069
(>= 640)	78.95%	77.63%	77.89%	3.5294	0.2712
(>= 650)	73.68%	78.95%	77.89%	3.5000	0.3333
(>= 670)	68.42%	78.95%	76.84%	3.2500	0.4000
(>= 700)	68.42%	80.26%	77.89%	3.4667	0.3934
(>= 720)	63.16%	80.26%	76.84%	3.2000	0.4590
(>= 740)	57.89%	82.89%	77.89%	3.3846	0.5079
(>= 760)	57.89%	84.21%	78.95%	3.6667	0.5000
(>= 780)	57.89%	86.84%	81.05%	4.4000	0.4848
(>= 790)	57.89%	88.16%	82.11%	4.8889	0.4776
(>= 840)	52.63%	88.16%	81.05%	4.4444	0.5373
(>= 890)	52.63%	92.11%	84.21%	6.6667	0.5143
(>= 900)	47.37%	93.42%	84.21%	7.2000	0.5634
(>= 950)	47.37%	96.05%	86.32%	12.0000	0.5479
(>= 960)	42.11%	96.05%	85.26%	10.6667	0.6027
(>= 1050)	42.11%	97.37%	86.32%	16.0000	0.5946
(>= 1100)	36.84%	97.37%	85.26%	14.0000	0.6486
(>= 1190)	31.58%	98.68%	85.26%	24.0000	0.6933
(>= 1200)	31.58%	100.00%	86.32%		0.6842
(>= 1350)	21.05%	100.00%	84.21%		0.7895
(>= 1400)	15.79%	100.00%	83.16%		0.8421
(>= 1460)	10.53%	100.00%	82.11%		0.8947
(>= 1600)	5.26%	100.00%	81.05%		0.9474
(> 1600)	0.00%	100.00%	80.00%		1.0000

Serum CPK level correlation with the need for mechanical ventilation data points (ROC curve)

Detailed report of sensitivity and specificity

Cutpoint	Sensitivity	Specificity	Correctly Classified	LR+	LR-
(>= 140)	100.00%	0.00%	22.11%	1.0000	
(>= 150)	100.00%	1.35%	23.16%	1.0137	0.0000
(>= 160)	100.00%	4.05%	25.26%	1.0423	0.0000
(>= 170)	100.00%	5.41%	26.32%	1.0571	0.0000
(>= 180)	100.00%	6.76%	27.37%	1.0725	0.0000
(>= 190)	100.00%	10.81%	30.53%	1.1212	0.0000
(>= 210)	100.00%	13.51%	32.63%	1.1562	0.0000
(>= 220)	100.00%	17.57%	35.79%	1.2131	0.0000
(>= 240)	100.00%	18.92%	36.84%	1.2333	0.0000
(>= 250)	100.00%	20.27%	37.89%	1.2542	0.0000
(>= 260)	100.00%	22.97%	40.00%	1.2982	0.0000
(>= 270)	100.00%	25.68%	42.11%	1.3455	0.0000
(>= 280)	100.00%	27.03%	43.16%	1.3704	0.0000
(>= 290)	100.00%	31.08%	46.32%	1.4510	0.0000
(>= 300)	100.00%	32.43%	47.37%	1.4800	0.0000
(>= 310)	100.00%	33.78%	48.42%	1.5102	0.0000
(>= 320)	100.00%	35.14%	49.47%	1.5417	0.0000
(>= 340)	100.00%	40.54%	53.68%	1.6818	0.0000
(>= 350)	95.24%	43.24%	54.74%	1.6780	0.1101
(>= 360)	95.24%	47.30%	57.89%	1.8071	0.1007
(>= 380)	95.24%	48.65%	58.95%	1.8546	0.0979
(>= 390)	95.24%	50.00%	60.00%	1.9048	0.0952
(>= 400)	95.24%	51.35%	61.05%	1.9577	0.0927
(>= 410)	95.24%	52.70%	62.11%	2.0136	0.0904
(>= 420)	95.24%	54.05%	63.16%	2.0728	0.0881
(>= 430)	95.24%	58.11%	66.32%	2.2734	0.0819
(>= 440)	90.48%	58.11%	65.26%	2.1598	0.1639
(>= 450)	90.48%	59.46%	66.32%	2.2317	0.1602
(>= 460)	90.48%	63.51%	69.47%	2.4797	0.1499
(>= 480)	90.48%	66.22%	71.58%	2.6781	0.1438
(>= 500)	90.48%	67.57%	72.63%	2.7897	0.1410
(>= 540)	85.71%	71.62%	74.74%	3.0204	0.1995
(>= 550)	85.71%	72.97%	75.79%	3.1714	0.1958
(>= 560)	80.95%	72.97%	74.74%	2.9952	0.2610
(>= 580)	80.95%	75.68%	76.84%	3.3280	0.2517
(>= 600)	76.19%	75.68%	75.79%	3.1323	0.3146
(>= 640)	71.43%	77.03%	75.79%	3.1092	0.3709
(>= 650)	66.67%	78.38%	75.79%	3.0833	0.4253
(>= 670)	61.90%	78.38%	74.74%	2.8631	0.4860
(>= 700)	61.90%	79.73%	75.79%	3.0540	0.4778
(>= 720)	57.14%	79.73%	74.74%	2.8190	0.5375
(>= 740)	47.62%	81.08%	73.68%	2.5170	0.6460
(>= 760)	47.62%	82.43%	74.74%	2.7106	0.6354
(>= 780)	47.62%	85.14%	76.84%	3.2035	0.6153
(>= 790)	47.62%	86.49%	77.89%	3.5238	0.6057
(>= 840)	42.86%	86.49%	76.84%	3.1714	0.6607
(>= 890)	42.86%	90.54%	80.00%	4.5306	0.6311
(>= 900)	38.10%	91.89%	80.00%	4.6984	0.6737
(>= 950)	38.10%	94.59%	82.11%	7.0476	0.6544
(>= 960)	33.33%	94.59%	81.05%	6.1667	0.7048
(>= 1050)	33.33%	95.95%	82.11%	8.2222	0.6948
(>= 1100)	28.57%	95.95%	81.05%	7.0476	0.7445
(>= 1190)	23.81%	97.30%	81.05%	8.8095	0.7831
(>= 1200)	19.05%	97.30%	80.00%	7.0476	0.8320
(>= 1350)	14.29%	98.65%	80.00%	10.5714	0.8689
(>= 1400)	9.52%	98.65%	78.95%	7.0476	0.9172
(>= 1460)	4.76%	98.65%	77.89%	3.5238	0.9654
(>= 1600)	0.00%	98.65%	76.84%	0.0000	1.0137
(> 1600)	0.00%	100.00%	77.89%		1.0000

DISCUSSION

The cross-sectional study conducted among 95 patients with the causality of OP poisoning was evaluated for the correlation of serum CPK levels in predicting mortality and severity of the disease. Our study findings reported a significant correlation between the serum CPK levels in predicting the severity of the disease and mortality.

The current study reports a male predominance of OP poisoning with 58% and 42% of females, which was also similar to the study conducted by Bhattacharya et al. with a female ratio of 2:1 and Chauhan et al. with 62% of males and 38% of females.[9,10]

The most common type of OP poisoning was chlorpyrifos with 53.7% of patients, followed by monocrotophos (24.2%) which was also reported by Sen R et al. and Amit Kumar et al.[11,12]

In our study, 85.3% of the patients had miosis, and 82.1% had altered sensorium. Tachypnoea affected 44% of the patients, bradycardia affected 35%, and muscle fasciculations affected 28.4%. This is consistent with the findings of other studies. According to Bhattacharya et al., approximately 80%

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had miosis, 69.8% had bradycardia, 36.5% had tachypnoea, and 25.4% had fasciculations. In the study by Chauhan et al., 35% of the patients had bradycardia.[10] As per Sen R et al., bradycardia was found in 69% of the patients, miosis in 64%, and tachypnea in 56%, whereas Das et al., a higher proportion of patients (62%) had bradycardia.[11,13] Furthermore, Chauhan et al. reported a mortality rate of 22% (44 out of 200 patients).[10] Our study's death rate was 20%, and 21 of the 95 individuals (22.1%) required mechanical breathing. This proportion was similar to what others had reported. Sen R et al. reported that 22 out of 100 patients died, for a 22% mortality rate.[11]

The current study findings report that approximately 63.2% had a POP score of less than 4 and approximately 36.8% had a POP score greater than 4. This proportion is comparable to that reported by Chauhan et al., who found that 61% of patients had a low POP score (less than 4), 30% had a moderate POP score, and 9% had a severe POP score.[10] In addition, Sen R et al. reported 29% of POP scores less than 4, and 45% had a score between 4 to 7, respectively, whereas Amit Kumar et al. reported 72% with mild POP score, 20% with a moderate score, and 8% with severe POP score.[11,12] In the study conducted by Wali et al., 51% of the participants had a mild POP score.[14] In contrast, Bhattacharya et al. report a POP score of more than four among 73% of patients.[9] This disparity could be because the time required to reach a healthcare institution was significantly longer in their study.

In our investigation, the mean (SD) CPK levels at admission were 546.5 (332.9) in those who survived and 935.8 (356.2) in those who died, and the difference was statistically significant. This conclusion is consistent with earlier research on CPK in OPC poisoning with Sen R et al., who found that the mean (SD) CPK levels in those who survived were 698.5 (486) and 1277.8 (645) in those who died.[11] Das et al. (1340±466.5 among non-survivors and 373.8±234.5 among survivors). Wali et al. (1312±411 among non-survivors and 321.1±179.1 among survivors)) found similar results.[13,14]

In our investigation, the association involving CPK levels and POP score was determined to be r =0.52. This finding is similar to that of Bhattacharya et al., who discovered a correlation coefficient of 0.874. Sen R et al. found a 0.625 association coefficient between serum CPK levels and POP score.[9] Kumar et al. found that serum CPK levels had a 74% sensitivity and an 81% specificity for predicting clinical severity. In our investigation, a cut-off of 500IU was used to predict mortality, with a sensitivity of 94% and a specificity of 67%.[12]

The study revealed the beneficial use of serum CPK levels in patients with OP poisoning with accurate and sensitive analysis, which can enable early detection of mortality and severity of the poisoning state. However, our study had a few limitations, which include a low sample size (n = 95) which requires further exploration and subgroup analysis in a higher number of patients. Secondly, we did not assess the serial CPK levels in poisoned patients and the changes occurring over time with disease outcomes. Third, the quantity of the poison consumed was not estimated precisely and the time interval between the consumed poison and hospital admission duration.

CONCLUSION

Estimating serum CPK levels in individuals with organophosphorus poisoning is possible in emergencies. The necrosis of muscle fibers causes increased CPK levels in both acute and intermediate poisoning. CPK elevation indicates the severity of muscular necrosis. The serum CPK level was a reliable biomarker for predicting mortality and severity in cases with acute OP poisoning. The use of serum CPK levels is highly effective due to its low cost, non-invasive methods, and accurate correlation with the disease.

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