

# Serum Amylase Level in Acute Organophosphorus Compound Poisoning in a Tertiary Level Hospital

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## Abstract

**Background:** Organophosphorus compound (OPC) poisoning is an important clinical problem in the developing world and kills an estimated 3,00,000 people every year. In spite of high case fatality rate early and proper management is crucial to save the lives and alleviate the sufferings. Amylase level is an important biochemical marker; which is closely related to severity of acute OPC poisoning. Therefore, to assess Serum amylase level in acute organophosphorus compound poisoning in a tertiary level hospital was the objective of the study.

**Methods:** This research was a hospital based descriptive cross-sectional study and was conducted at the inpatient department of Medicine in Dhaka Medical College. 50 Patient admitted in medicine department due to OPC poisoning and evidenced by history taking and physical examination were included in the study. Ethical issues were ensured properly. After written informed consent history and physical examination were done. Rest of the data were collected by interviewing each patient or from attendant of the patient by using a semi-structured questionnaire. Scoring of the severity were done by researcher himself by Peradeniya Organophosphorus Poisoning (POP) scale (Score range 0 to 11). Values of amylase level were collected from patient record file. All the Data was analysed by computer with the help of SPSS 16.

**Results:** Out of a total of 50 patients, 24 (48%) were males and 26 (52%) were females. OPC poisoning was most frequent (52%) in age group 21-30 years. Mean age was  $23.96 \pm 6.071$  SD. 96% (48) study population were Muslim and rest 4 % (2) were Hindus with diverse occupation. 86% population came from rural area whereas only 14% population reside in urban area. Among them suicidal attempts were seen significantly which was 96% and rest of them were accidental ingestion. Amylase level estimation were done in each case and 32 % (16) patient had elevated amylase level ( $>100$ U/L) and 68% (34) patient had amylase level within normal limit. Mean amylase concentration was  $62.2$ U/L ( $SD \pm 18.77$ ) and among the 16 patients who had elevated serum amylase level mean concentration was  $376.56$ U/L ( $SD \pm 266.124$ ). Mean amylase level differed significantly between these two groups ( $p$  value  $< 0.0001$ ) estimated by one way ANOVA. Spearman Correlation and One way ANOVA both showed significant association between severity (assessed by POP scale) and elevated level of serum amylase ( $p$  value  $< 0.0001$ ). Outcome analysis showed that 47 patients recovered and 3 patients died. Their mean hospital stay was  $3.87 (\pm 1.76)$  days and relationship between serum amylase level and duration of hospital stay and was found to be significant in chi-square analysis ( $p$  value-  $< 0.0001$ ).

**Conclusion:** Hyperamylasaemia in OPC poisoning can be used an important biomarker to assess the severity of the patient which may guide the clinicians for further management.



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## Introduction

Organophosphorus pesticides are commonly used chemical substances for agriculture, vector control, and domestic purposes. Despite the apparent benefits of these uses acute

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organophosphorus pesticide poisoning is an increasing worldwide problem, particularly in rural areas<sup>1</sup>. Far more than 1,000 active substances and in approximately 35,000 preparations of pesticides used in agriculture; organo-phosphate compounds (OPCs), are most commonly used pesticide<sup>2</sup>. Due to severe toxicity and death, it becomes the leading toxic agent among different chemicals used in domestic and industrial settings<sup>3-5</sup>. It is estimated that more than 300,000 deaths occurs every year due to OPC poisoning

and its complications and large portion share the Asia Pacific region<sup>6,7</sup>. Although the incidence of severe acute organophosphorus pesticide poisoning is much less in developed countries, many patients with low dose acute unintentional or occupational exposures present to health facilities<sup>8,9</sup>. On the contrary, OP compounds poisoning likely to have more adverse effects in developing countries like India mostly due to its easy availability and less awareness leading to high morbidity and mortality<sup>10,11</sup>.

Though the organophosphate intoxication can occur by suicidal and accidental means<sup>12</sup>, but deaths from unintentional organophosphorus poisoning are less common than those from intentional poisoning<sup>12,13</sup>. The effects of OPC on human physiology are multiple and complex<sup>6</sup>. It usually inhibits numerous enzymes, of which esterase seem to be the most clinically important. Inhibition of acetylcholinesterase leads to the accumulation of acetylcholine at cholinergic synapses, interfering with normal function of the autonomic somatic, and central nervous systems and have three distinct toxic effects on human body<sup>15</sup>. It potentiates postganglionic parasympathetic activity and causes muscarinic like effect like bronchoconstriction, increase salivation, sweating, lacrimation, constriction of pupil, blurred vision, urinary incontinence, bradycardia, hypotension, etc. Nicotinic effect like paralysis of preganglionic and somatic motor nerves, resulting in twitching of facial muscles, eyelids, tongue, neuro muscular blockage are also seen. Most important Central nervous system are restlessness, headache, tremor, drowsiness, ataxia, confusion, convulsion, respiratory depression, coma, death<sup>6,15-18</sup>.

Worldwide mortality studies report showed 3-25% mortality rates arises from organophosphate poisoning<sup>3</sup>. Besides other causes of acute pancreatitis it is a well-known complication of OPC poisoning. Elevated serum amylase (hyperamylasemia) secondary to pancreatic injury because of parasympathetic overstimulation and hypersecretion has been noted in human beings and found both of this are closely related in different studies. Studies have also shown that serum amylase above the normal range on the day of admission was related to the development of respiratory failure and the elevation of amylase level and predictive of subsequent respiratory failure<sup>19-20</sup>. Moreover, the elevated level of enzyme (hyperamylasaemia) is closely related to clinical severity and the presence of shock<sup>21-23</sup>.

In adults the frequency of acute pancreatitis related to OPC poisoning is 12.7%<sup>21</sup>. In 1979, Dressel described the first case report of pancreatitis following OPC poisoning. But neither do commonly used surgical and medical textbooks describe acute pancreatitis as a presenting feature of organophosphorus poisoning nor is organophosphorus poisoning listed as one of the aetiological factors of acute pancreatitis and its complications<sup>24</sup>.

Therefore, the study aimed to assesses serum amylase level in acute organophosphorus compound poisoning in a tertiary level hospital which may help to reduce mortality and hospital stay by its early detection.

### Materials and Methods

Our study was descriptive cross-sectional study. 50 patients from in-patient department of department of medicine of Dhaka Medical College Hospital (DMCH) were selected by purposive convenient sampling. Patients of age above 12 years with history of ingestion of organophosphorus compound within previous 24 hours as indicated by patient or relatives or the referring doctor, with characteristic clinical manifestations of organophosphorus compound poison were included in the study. Informed written consent was taken from patient or his relatives. Patients with OP poisoning and mixed with any other poison, who have history of taking alcohol, with a history of pancreatitis were excluded from the study.

**Peradeniya OP poisoning scale**<sup>23</sup> was used to assess severity of organophosphorus (OP) intoxication. Five common clinical manifestations of OP poisoning have been selected as parameters, each to be assessed on a 3-point scale varying from 0-2. Poisoning can then be graded as mild (score 0-3), moderate (score 4-7) or severe (score 8-11) when the patient first presents.

Miosis -

- Pupil > 2mm – 0 point
- Pupil ≤ 2mm – 1 point
- Pupils pin point – 2 points

Fasciculations -

- None – 0 point
- Present but not generalized or continuous – 1 point
- Generalized and continuous with central cyanosis – 2 points

Respiration -

- Respiratory rate ≤ 20/min – 0 point
- Respiratory rate > 20/min – 1 point
- Respiratory rate > 20/min with central cyanosis – 2 points

Bradycardia -

- Pulse rate > 60/min – 0 point
- Pulse rate 41-60/min – 1 point
- Pulse rate ≤ 40/min – 2 points

Level of consciousness -

- Conscious and rational – 0 point
- Impaired, responds to verbal commands – 1 point
- Impaired, no response to verbal commands (if convulsion present add 1) – 2 points

Serum amylase level was regarded as normal level, if <100 U/L<sup>24</sup>.

Before the commencement of the study, the protocol for the following study was approved by Institutional ethical review committee of Dhaka Medical College Hospital (DMCH). All the data were checked and edited after collection in SPSS 16.

**Result**

Out of a total of 50 patients, overall age range was from 15 to 40 years and most of them (52%) were aged in between 21 to 30 years. Mean age of the population was 23.96 ± 6.071 SD (Table 1) . Among the study population 26 patients (52%) were female and 24 patients (48%) patients were male. Most of them were from rural area (86%) and were married (70%). 48 patients (96%) were Muslims and the remaining two were Hindu. Majority of the patients were housewives (32%), although service holders and students contributed 20% each (Table II).

**Table I.** Age group of the patients (n=50)

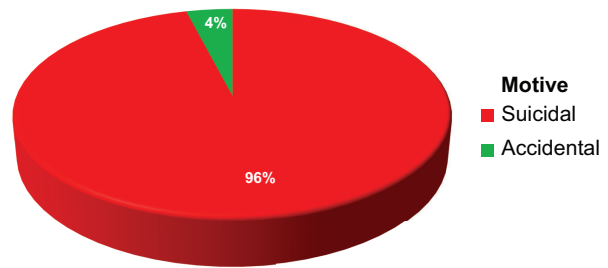
Age Group (years)	Frequency	Percentage (%)
≤20	17	34
21-30	26	52
≥30	7	14
Mean age 23.96 ± 6.67 SD	50	100

When patients were asked for motive of OPC ingestion 48 patients (96%) revealed they had the intention of suicide and remaining 2 patients (4%) ingested accidentally. (Figure - 1)

Serum amylase concentration of 50 patients was measured and was considered ‘elevated’ if its concentration exceeds 100 unit per liter. Otherwise, it was considered ‘normal’. In this study 34 patients (68%) had normal serum amylase level and 16 (32%) had elevated concentration of amylase in serum. Among the 34 patients who had normal serum amylase level

**Table-II.** Demographic characteristics of the patients (n=50)

Variables	Categories	Number of Patients with percentage
Sex	Female	26 (52%)
	Male	24 (48%)
Residence	Rural	43 (86%)
	Urban	7 (14%)
Religion	Muslim	48 (96%)
	Hindu	2 (4%)
Marital status	Married	35 (70%)
	Unmarried	15 (30%)
Occupation	Housewife	16 (32%)
	Service-holder	10 (20%)
	Student	10 (20%)
	Businessman	7 (14%)
	Rickshaw-puller	5 (10%)
	Farmer	2 (4%)



**Figure 1:** Motive of OPC ingestion (n=50)

mean concentration was 62.2U/L (SD±18.77) and among the 16 patients who had elevated serum amylase level mean concentration was 376.56U/L (SD±266.124). Mean amylase level differed significantly between these two groups (p value < 0.0001) (Table III)

**Table-III.** Serum amylase level among admitted patients (n=50)

Serum amylase level	Frequency (Percentage %)	Mean serum amylase concentration as U/L (±SD)	p value*
Normal	34 (78%)	62.2 (±18.77)	<0.0001
Elevated	16 (32%)	376.56 (±266.124)	

\* Between group analysis of variance done by one way ANOVA

Mean serum amylase concentration was found high in patients of age more than 31 years. Nevertheless, there was no statistically significant difference between different age groups. Mean serum amylase was found more in male group but no statistically significant difference found between male and female patients. (Table-IV)

Severity of poisoning were assessed clinically by Peradeniya Organophosphorus Poisoning (POP) scale (Score range 0 to 11). Patients were grouped into three categories: mild (POP: 0 - 3), moderate (POP: 4-7) and severe (POP 8-11). Variation of serum amylase concentration in between different groups was analyzed and statistically significant difference was seen.

This difference implies that the more severe a patient's condition is according to POP scale the more statistically significant rise of amylase concentration will be found in the patient's blood. Details are given in table V.

Among the patients who were considered 'mild' according to POP scale 29 patients had normal serum amylase level and no patient had elevated serum amylase level. Among 'moderate' severity patients 5 had elevated serum amylase and 14 patients' serum amylase was elevated. Both of the 'severe' patients had elevated serum amylase. Significant correlation was found between POP level of severity and serum amylase level (Table VI).

**Table-IV.** Relationship of Serum amylase concentration with age and sex of patient (n=50)

	Frequency (n=50)	Mean serum amylase concentration as U/L (±SE)	p value*
Age (in years)			0.053
≤20	17	169.47 (±65.43)	
21 – 30	26	114.12 (±21.87)	
≥31	7	327.71 (±100.07)	
Sex			0.496
Female	26	143.19 (±45.77)	
Male	24	184.13 (±37.25)	

\* Between group analysis of variance done by one way ANOVA

\* Analysis done by one way ANOVA

**Table-V.** Distribution of patients according level of clinical severity and serum amylase concentration (n=50)

Level of Severity	Frequency (Percentage %)	Mean Serum Amylase (±SD)	p value*
Mild	29 (58%)	59.45 (±18.78)	<0.0001
Moderate	19 (38%)	246.84 (±172.798)	
Severe	2 (4%)	864.00 (±162.84)	

\* Analysis done by one way ANOVA

**Table-VI.** Relationship between POP level of severity and serum amylase level (n=50)

POP level of severity	Amylase level		p-value*
	Normal	Elevated	
Mild	29	0	<0.0001
Moderate	5	14	
Severe	0	2	

\* p-value determined by Spearman Correlation

Out of 50 patients, 47 patients recovered. Their mean hospital stay was 3.87 ( $\pm 1.76$ ) days. Majority of the patient stayed for less than 3 days (53.2%). 36.2% patients stayed for 4 to 6 days, 8.5% for 7 to 9 days and one patient (2.1%) stayed for 10 days. Cross tabulation was done to see any relationship between serum amylase level and duration of hospital stay and was found to be significant (p value- <0.0001) which means patient with elevated serum amylase level have increased chance of staying more than 3 days in the hospital. (Table-VII).

Among 16 patients who had raised serum amylase level 4 patients (25%) required ventilator support and two of them

died. All of them had raised serum amylase above 400 IU/L (Elevated). Statistically significant relationship was seen between raised amylase level and ventilator requirement. (Table VIII)

Total 47 patients (94%) survived and 3 patients (6%) deceased. 34 of the 47 survived patients had normal amylase level and 13 patients had elevated amylase level. All the deceased patients had elevated amylase level. High serum amylase concentration of >100U/L was significantly associated with increased chance of mortality. (p-value <0.05). (Table IX)

**Table-VII.** Relationship between duration of hospital stay and serum amylase level (n=47)

Duration of hospital stay	Amylase level			p-value*
	Normal	Elevated	Row N (%)	
≤3 days	24	1	25 (53.2%)	
4 to 6 days	9	8	17 (36.2%)	
7 to 9 days	0	4	4 (8.5%)	<0.0001
10 to 12 days	0	1	1 (2.1%)	

\* p-value determined by Spearman Correlation

**Table-VIII.** Relationship between serum amylase level and ventilator requirement (n=50)

Serum Amylase Level	Ventilator required				p value*
	No		Yes		
	Frequency	Row N %	Frequency	Row N %	
Normal	34	100	0	0	0.008
Elevated	16	75	4	25	(<0.05)

\* Test done by Fisher’s Exact Test as some of the cells had expected count less than 5

**Table-IX.** Relationship between serum amylase level and treatment outcome of patients with OPC poisoning (n=50)

Serum Amylase Level	Treatment Outcome Frequency (Percentage%)		p value*
	Survived	Deceased	
Normal	34 (68%)	0	0.029
Elevated	13 (26%)	3 (6%)	(<0.05)

\* Test done by Fisher’s Exact Test as some of the cells had expected count less than 5

## Discussion

Acute OPC poisoning often presents as a medical emergency requiring close monitoring and ventilator support. Management of poisoning depends on clinical severity and is assessed by clinical signs and symptoms as well as laboratory evaluation. Various scales were developed based on clinical signs and symptoms of OPC poisoning to assess the severity and take necessary steps. Different laboratory markers are also being used to assess severity.

Serum amylase level is an important marker of severity in OPC poisoning.<sup>25-28</sup> Peradeniya Organophosphorus Poisoning (POP) scale has been used in different studies to assess the prognostic value of this scale in OPC poisoning.<sup>19-20</sup> Very few studies were done on OPC poisoning patients in Bangladesh using serum amylase level and POP scale. This study estimated the level of serum amylase in 50 cases of OPC poisoning admitted in Dhaka Medical College Hospital and assessed the severity using Peradeniya OP scale.

Majority of the patient (52%) were aged between 21 to 30 years. This is consistent with the analysis on recent situation of OPC poisoning in Bangladesh done by Dewan G.<sup>33</sup> Thunga G et al<sup>2</sup>, Badiger S et al<sup>26</sup> and Kora S et al<sup>32</sup> found similar picture in their studies. Female and male comprised 52% and 48% percent of cases in this study. This shows that there was no significant difference in between two sexes in case of OPC poisoning. Kora S et al<sup>32</sup> found slightly different percentage: 56.08% and 43.98% for female and male, respectively.

83% of the patients came from rural area and rest (17%) of them from came from urban area. This is because organophosphorus compounds are readily available over the counter in village shops as pesticides. Although an overview written by Ahmad M et al<sup>15</sup> on the OPC poisoning situation in Bangladesh reports from a study performed at Dhaka Medical College in 2004 a different proportion of 56% from rural area and 44% from urban area. But, this report also shows higher number of patients are from rural area.

70% of the cases were married showing a prevalence of suicidal tendency in married individual. This is probably due to familial disharmony found as the main reason of pesticide poisoning in the study done by Shadequl-Islam AHM et al.<sup>34</sup>

In this study, 32% were housewives followed by 20% student, 20% service holder, 14% businessman, 10% rickshaw-puller and 4% farmer. Whereas, occupation was reported in a small series in DMCH that 18.3% of patients were student, 16.7% housewife, 11.7% businessman, 11.6% farmer, 1.7% government employee and 40% other

occupations<sup>34</sup>. In another study performed in Dinajpur Medical College Hospital, 47% of patients were farmer, 16% student and 13% housewife<sup>7</sup>.

96% (48) of this study population had the intention of suicide while self-ingesting OPC and remaining 4% (2) took OPC accidentally. In the study entitled "Study of Serum Amylase and Serum Cholinesterase in Organophosphorus Poisoning" conducted by Badiger S et al<sup>26</sup> they found nearly similar percentage of people (93.4%) had suicidal motive. But Sahin I et al<sup>35</sup> reported a different result that 33 of 47 patients (70.2%) intended to commit suicide and 14 (29.8%) patients were exposed to OPC due to an accidental event in their study conducted in Turkey.<sup>35</sup>

In this study serum amylase level less than 100 U/L was considered normal and more than 100 U/L was considered elevated. 34 patients (68%) had normal serum amylase level and 16 (32%) had elevated serum amylase in blood (hyperamylasemia). Among the 34 patients who had normal serum amylase level mean concentration was 62.2U/L (SD±18.77) and 'among the 16 patients who had hyperamylasemia mean concentration was 376.56U/L (SD±266.124). This is consistent with findings of Chaturvedi AN et al.<sup>29</sup> They reported hyperamylasemia in 31%.

A study done in Mamata General Hospital, Khammam by Ganiger IB et al.<sup>31</sup> showed there was no significant relationship between serum amylase concentration and age and sex of the patients. No significant relationship was found in this study either. This implies that age and sex is not a determining factor of concentration of serum amylase found in OPC poisoning patients.

Present study assessed the severity of poisoning clinically by Peradeniya Organophosphorus Poisoning (POP) scale (Score range 0 to 11). Patients were grouped into three categories: mild (POP: 0 - 3), moderate (POP: 4-7) and severe (POP 8-11). 58% patients were graded mild, 38% moderate and 4% severe in POP scale. This is consistent with study done by Dubey T et al<sup>19</sup>. Their study entitled "Correlation of Severity of Organophosphorus Poisoning as Assessed by Peradeniya Organophosphorus Poisoning Scale with Serum Amylase and CPK Level" done in 100 patients in 2016 had found 68% mild, 27% moderate and 5% severe in POP scale. In present study, patients who ranked mild, moderate and severe in POP scale had mean serum amylase concentration of 59.45 (±18.78), 246.84 (±172.798) and 864.00 (±162.84) respectively. An analysis of variance (ANOVA) showed statistically highly significant relationship (p value < 0.0001) between POP level of severity and serum amylase concentration. This finding also conforms to the finding of Dubey T et al.<sup>19</sup> This implies that patients who scored more

in POP score are going to have a higher mean amylase concentration in their blood. Serum amylase concentration was graded into 'normal' and 'elevated' category and was correlated with POP scale of mild, moderate and severe. All of the mild cases had normal amylase level and all of the severe cases had elevated serum amylase. Majority of the moderate cases (14 out of 19) had elevated serum amylase. Spearman correlation again showed significant association between POP level of severity and serum amylase level.

Elevated serum amylase level was statistically significantly associated with increased hospital stay. Current study shows 24 out of 25 patients who stayed in the hospital for less than 3 days had normal serum amylase level. All the patients (5) who stayed more than 7 days had elevated serum amylase level. This is a newer finding as no previous study was done which correlates serum amylase level with duration of hospital stay. Although a similar study conducted in Western India by Mulay A. and his colleagues<sup>30</sup> showed a correlation between decreased serum acetylcholinesterase and increased hospital stay of more than 7 days.

None of the 34 patients who had normal serum amylase level (<100u/l) needed ventilator support (i.e., ICU transfer). But, out of 16 patients who had elevated amylase level (>100u/l) 4 patients required ventilator support (25%). Subhash L. Patil and Praveen Vasepalli<sup>20</sup> in their study found out of 18 patients who had elevated serum amylase (>88u/l) 12 patients (66.7%) required ventilator support. This is different than present study. But this study showed concordance with their finding of association between serum amylase levels and need for ventilator support which they showed was highly significant (p value <0.001). Fisher's Exact Test done in the present study showed a significant p value of <0.008.

In this study 47 cases (94%) survived and 3 cases (6%) deceased. A slightly different statistic was found in Ganiger I et al's<sup>31</sup> study that 45 patients (90%) was alive and 5 patients (10%) died. They reported a statistically significant difference between amylase level of alive and dead patients. In accord with their finding present study also show a statistically significant difference between serum amylase level of patients who survived and who deceased.

### Conclusion

Acute OPC poisoning can present with different stage in clinical setting but no widely practiced grading system are available to asses and evaluate the severity. Moreover, uniform and distinct pattern of biomarker or lab test are not found yet. But serum amylase level can be considered as a marker of Organophosphorus intoxication, since it enables the early recognition of severity and also helps to identify

those at risk of developing the complications of organophosphorus poisoning. But in limited cases it may not represent the actual scenario.

**Conflict of interest:** None

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