

Association of Serum Butyrylcholinesterase Activity Level and 25 (Oh) D Level in Outcome of Organophosphorus Poisoning

Deepak Kumar Dewat¹, Anil Samaria², Anil Kumar Ranwa³, Meenakshi Samaria⁴, Monika Chowdhary⁵, Sourabh Soni⁶

¹Resident Doctor, JLN Medical College, Ajmer, Rajasthan

²Senior Professor, JLN Medical College, Ajmer, Rajasthan

³Assistant Professor, GMC, Pali, Rajasthan

⁴Associate Professor, JLN Medical College, Ajmer, Rajasthan

⁵Assistant Professor, JLN Medical College, Ajmer, Rajasthan

⁶Resident Doctor, JLNMC, Ajmer, Rajasthan

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Corresponding author: Dr. Meenakshi Samaria

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Abstract

Background: We do not find any study regarding status of vitamin D3 level and its role in outcome of organophosphorus poisoning in the world literature. Therefore, this prospective observational cross-sectional analytic study was planned to evaluate status of vitamin D3 level in organophosphorus poisoning and its correlation with outcome of such patients.

Methods: This cross-sectional study was conducted among 340 patients acute organophosphorus poisoning admitted in Casualty ward, MICU and attending the medical ward of JLN hospital, Ajmer during September 2021 to September 2022. Diagnosis of OP poisoning shall be made by history of poisoning including container of the poison brought by patient's relative, clinical examination and measurement of serum butyrylcholinesterase activity.

Results: Mean vitamin D3 in expired patients was 16.4 ± 5.69 ng/ml and in recovered cases it was 52.97 ± 49.97 ng/ml and this difference was also found statistically highly significant ($p < 0.001$).

Conclusion: We observed that vitamin D3 deficiency is highly prevalent, and it is also associated with suicidal tendency. Vitamin D3 level is having linear correlation with length of hospital stay. Severe D3 deficiency is associated with more requirement for ventilator support, development of serious complication like ARDS, IMS and poor outcome.

Keywords: Vitamin D, Poisoning, Organophosphorus.

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Introduction

Organophosphate pesticide poisoning is a major challenging public-health problem in developing countries [1-3]. Organophosphorus (OP) compounds are principally used as pesticides, and their exposure is highly prevalent in developing countries. Toxic effects of

organophosphorus compound are associated with significant morbidity and mortality making it a major global health problem. Their ease of access and socio-cultural factors play important role in the choice of organophosphorus compound as a self-poison. The incidence is higher in young, economically active group with a

case fatality ratio of 4-30% [4-6]. Deaths from unintentional OP poisoning are less common than those from intentional poisoning [7] and seem to be more common in region where highly toxic OP pesticides (WHO class I toxicity) are available [8,9].

Organophosphorus poisoning is associated with early and late neurological manifestation and severe systemic inflammatory response syndrome like ARDS. Vitamin D3 deficiency have been reported to be clinically correlated with psychiatric illness and manifestation of severe systemic inflammatory response syndrome like ARDS. Thus vitamin D3 deficiency may affect clinical course and outcome in cases of organophosphorus poisoning. We do not find any study regarding status of vitamin D3 level and its role in outcome of organophosphorus poisoning in the world literature. Therefore this prospective observational cross-sectional analytic study was planned to evaluate status of vitamin D3 level in organophosphorus poisoning and its correlation with outcome of such patients.

Materials and Methods

This study was conducted among 340 patients acute organophosphorus poisoning admitted in Casualty ward, MICU and attending Medical ward of JLN hospital, Ajmer during September 2021 to September 2022. Diagnosis of OP poisoning shall be made by history of poisoning including container of the poison brought by patient's relative, clinical examination and measurement of serum butyrylcholinesterase activity.

Study Design : Cross-sectional study

Sample Size:- From previous studies prevalence of low level of vitamin D was 66.7% in Organophosphorus poisoning patients.

The sample size was estimated based on prevalence of disease and using formula, n

= z^2pq / d^2 , where; n=sample size, z=1.96(considering 0.05 alpha, 95% confidence limits and 80% beta), p = assumed probability of occurrence or concordance of results, q = 1 – p and d = marginal error (precession).

Study Period: September 2021 to September 2022.

Inclusion Criteria:

- Patients suffering from OP poisoning.
- Patients given consent to participate in the study.

Exclusion Criteria:

- Patient admitted with multiple poisoning.
- Patient suffering from any co-morbid conditions like diabetes mellitus, ischemic heart disease, and other chronic conditions like CKD, CLD, Malnutrition, Severe burns, Cancer and pregnancy.
- Patient already on vitamin D therapy.
- Patients who are not giving consent for the study.
- Muslim females (Who giving history of low sun exposure)

Methodology

All patients were evaluated thoroughly by clinical history and physical examination as per Performa. Laboratory investigations was done in all patients at the time of admission including Complete blood count, Renal function test, Liver function test, Butyrylcholinesterase level, Acid Base Gas analysis, Serum 25-hydroxyvitamin D, Serum electrolytes (Na⁺, K⁺, Ca⁺⁺). Other necessary special investigations like X-ray Chest PA view, Ultrasonography, ECG, CT scan, MRI scan etc was done as per requirement.

Measurement of serum butyrylcholinesterase will be done by spectrophotometry

	Butyrylcholinesterase activity of normal
Mild OP poisoning	20%-50%
Moderate OP poisoning	10%-20%
Severe OP poisoning	<10%

All patients was treated and follow up during hospital stay as per protocol. 25-hydroxyvitamin D estimation will be done by electro-chemiluminescent Assay using Elecsys 25(OH)D Assay (k060755) manufactured by Roche Diagnostics, Germany.

Levels of 25(OH)D will be classified into three categories as per US Endocrine Society (2011) criteria that is:

- (1) Deficient :- ≤ 20 ng/ml,
- (2) Insufficient :- 21-30 ng/ml and
- (3) Sufficient :- > 30 ng/ml.

In our study low level of 25(OH)D means levels ≤ 30 ng/ml and severe deficiency defined as levels ≤ 10 ng/ml. Severity and outcome of OP poisoning was also assessed at the time of admission by Peradeniya organophosphorus poisoning (POP) scale and by GCS score.

Statistical analysis

Statistical analysis was performed using SPSS 20 software and the analyzed data was expressed in percentages. P-value equal to or less than 0.05 was considered to be significant.

Results

In present series, out of total 340 cases, 178(52.4%) patients had their vitamin D3 level ≤ 20 ng/ml while 30(8.8%) had 21-30

and 132(38.8%) had their vitamin D3 level > 30 ng/ml. Mean vitamin D3 was 50.82 ± 49.25 and it ranges from 9-201 ng/ml. According to salt of poisoning used by patients, Chlorpyrifos was used by 110 patients and out of them 44(40%), 12(10.9%) and 54(49.1%) had their vitamin D3 levels ≤ 20 , 21-30 and > 30 respectively and out of them 8 was expired, Profenofos was used by 90 patients and out of them 44(48.9%), 16(17.8%) and 30(33.3%) had their vitamin D3 levels ≤ 20 , 21-30 and > 30 respectively and out of them 6 was expired, Monocrotophos was used by 50 patients and out of them 36(72%) and 14(28%) had their vitamin D3 levels ≤ 20 and > 30 respectively, Diazinon was used by 48 patients and out of them 24(50%) and 24(24%) had their vitamin D3 levels ≤ 20 and > 30 respectively, Dimethoate was used by 42 patients and out of them 30(71.4%), 2(4.8%) and 10(23.8%) had their vitamin D3 levels ≤ 20 , 21-30 and > 30 respectively and out of them 6 was expired. Out of total 340 cases 20 patients were expired and out of them 18(90%) and only 2(10%) belonged to vitamin D3 level ≤ 20 ng/ml and 21-30 ng/ml. while all other (n=320) were recovered and discharged from hospital. Mean vitamin D3 in expired patients was 16.4 ± 5.69 ng/ml and in recovered cases it was 52.97 ± 49.97 ng/ml and this difference was also found statistically highly significant ($p < 0.001$).

Table 1 Statistical analysis of different parameters in relation to outcome

Parameters	Outcome				P value
	Expired		Recovered		
	Mean \pm SD	Range	Mean \pm SD	Range	
Age	29.7 \pm 5.85	23-42	32.54 \pm 6.67	20-45	0.06
Hospital Stay	7.5 \pm 1.39	5-10	7.24 \pm 1.38	4-12	0.41
Amount of Atropine Used	275.6 \pm 100.56	150-413	263.37 \pm 100.04	50-614	0.59

Hemoglobin	12.6±2.56	9-16	14.82±13.85	9-156	0.47
TLC (Thousands)	14.2±2.23	11-19	13.59±2.17	1-20	0.22
Platelet Count (lacs)	3.1±1.48	1-5	3.11±3.01	1-39	0.99
Blood Urea	35.7±8.65	29-57	41.73±11.59	8-80	0.02 (S)
Serum Creatinine	1±0	1	1.12±0.67	0-7	0.43
Sodium	137.7±5.93	130-146	138.08±5.803	119-160	0.78
Potassium	4±0.91	3-6	4.19±1.005	3-14	0.4
Vitamin D3	16.4±5.69	9-30	52.97±49.97	9-201	0.001 (S)

When we compared different parameters with outcome like age, hospital stay, amount of atropine used, Hb, TLC, Platelet Count, BU, SC, Sodium, potassium, vitamin D3 statistically highly significant difference was found in amount of Blood Urea and vitamin D3 ($p < 0.05$), while all other parameters had not significant change ($p > 0.05$).

Table: 2

Parameter	No of cases	Mean±SD	No. of Cases of Vitamin D3			P value
			≤20 (ng/ml)	21-30 (ng/ml)	>30 (ng/ml)	
Age Group						
21-30	182	55.19±53.83	92 (50.5)	16 (8.8)	74 (40.7)	0.202
31-40	122	46.52±43.003	66 (54.1)	8 (6.6)	48 (39.3)	
>40	36	43.28±43.53	20 (55.6)	6 (16.7)	10 (27.8)	
Sex						
Female	160	48.47±48.34	86 (53.8)	16 (10)	58 (36.2)	0.409
Male	180	52.9±50.09	92 (51.1)	14 (7.8)	74 (41.1)	
Occupation						
Govt Job	4	35.8±32.53	6 (60)	0	4 (40)	0.15
House wife	36	45.08±49.07	68 (54.8)	20 (16.1)	36 (29)	
None	12	66.1±51.63	8 (40)	0	12 (60)	
Private Job	80	53.81±49.501	96 (51.6)	10 (5.4)	80 (43)	
Residential Area						
Rural	180	47.92±47.06	94 (52.2)	20 (11.1)	66 (36.7)	0.25
Urban	160	54.07±51.56	84 (52.5)	10 (6.2)	66 (41.2)	
Educational Status						
Illiterate	156	47.38±46.56	86 (55.1)	14 (9)	56 (35.9)	0.23
Literate	184	53.73±51.37	92 (50)	16 (8.7)	76 (41.3)	
Atropine Used (mg)						
≤100	2	19±0	2 (100)	0	0	0.88
101-150	12	48.5±49.601	8 (66.7)	0	4 (33.3)	
151-200	100	49.36±48.61	44 (44)	18 (18)	38 (38)	
201-250	64	50.22±36.61	30 (46.9)	4 (6.2)	30 (46.9)	
>250	162	52.52±54.26	94 (58)	8 (4.9)	60 (37)	
Hospital Stay (days)						
≤5	92	46.98±43.18	44 (47.8)	14 (15.2)	34 (37)	0.51
6-10	242	51.87±51.56	132 (54.5)	16 (6.6)	94 (38.8)	
>10	6	67.33±41.68	2 (33.3)	0	4 (66.7)	

Outcome						
Expired	20	16.4±5.69	18 (90)	2 (10)	0	<0.001
Recovered	320	52.97±49.97	160 (50)	28 (8.8)	132 (41.2)	

Discussion

Organophosphorus (OP) compounds are among the most commonly used pesticides in agriculture. Because of their wide use and easy accessibility, OP toxicity is important global health problem especially in many developing countries like India. Vitamin D deficiency is increasingly recognized as pandemic but its clinical significance is yet to be established properly and therefore it is mostly under treated in most part of the world. [2]

During past decade various studies has shown high prevalence of vitamin D3 deficiency all over the world (Edward et al). Van der Wielen et al (1995) [5] found that 47% of the women and 36% of the men had serum level <30nmol/l with vitamin D3 level decreasing with age. Vitamin D3 concentrations were higher in the Northern European and Scandinavian countries compared to Southern Europe. Serhan et al (1999) [6] found that among the Indo-Asian population attending a rheumatology clinic in Wolverhampton UK, 78% had a vitamin D3 level <20 ng/ml, compared to 58% of the control population. Ardawi et al (2011) [7] did a study on 1172 Saudi Arabian women from Jeddah and found that 80% had serum vitamin D3 levels <50 ng/ml and about 10% were severely deficient with levels <12.5nmol/l.

In India also vitamin D3 deficiency has been reported from all over the country. Similar to our observation, Sharma et al [8] (2017) reported low level of vitamin D3 in 74% (151/204) of his cases (adult in South Rajasthan). Surekha Bhat et al [9] (2017) found low level of vitamin D3 in 87% of the cases in Karnataka. Bachhel et al [10] 2014 found low level of vitamin D3 in 90% of cases in north-west Punjab. In a study done by Gupta et al (2017) at Bikaner North-West of Rajasthan observed low level of

vitamin D3 in 73% of the cases of COPD (42% were having deficiency of vitamin D3 and 31% had insufficiency). In another study done on cases of CLD, Gupta et al [11] (2017) found low level of vitamin D3 in 85% of the cases (43% had deficiency and 42% had insufficiency of vitamin D3). Our study shows that vitamin D3 deficiency is not associated with longer hospital stay, and patients not required ventilator support in most of the studied cases. Quraishi et al [12] (2014) showed that vitamin D3 level were inversely associated with length of hospital stay in surgical ICU patients. Han et al [13] (2016) showed that high dose vitamin D3 supplements safely increase plasma 25 (OH) D3 concentration into the sufficient range and was associated with decrease hospital length of stay without altering other clinical outcomes. In contrast to Amrein et al (2014) [14] in a randomized clinical trial (The VITdAL-ICU) found that among critically ill patients with vitamin D3 deficiency, administration of high dose vitamin D3 compared with placebo did not reduce hospital length of stay, hospital mortality, or 6 month mortality. [15]

Conclusion

Our study on status of vitamin D3 level and its clinical correlation in patients with organophosphorus poisoning. We observed that vitamin D3 deficiency is highly prevalent and it is also associated with suicidal tendency. Vitamin D3 level is having linear correlation with length of hospital stay. Severe D3 deficiency is associated with more requirement for ventilator support, development of serious complication like ARDS, IMS and poor outcome. Thus our study concluded that vitamin D3 may plays an important role in the pathogenesis, clinical course and outcome in cases of organophosphorus poisoning. Further studies in the form of intervention with vitamin D3

supplementation in such case are required to document our observation.

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