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Original Research Article

Correlation Between Serum Pseudocholinesterase with Hematological and Biochemical Parameters in Organophosphorus Poisoning Patients of Dadra and Nagar Haveli

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Conflict of interest: Nil

Abstract:

Background: Organophosphorus (OP) poisoning is one of the most common poisonings seen in India. OP compounds act through inhibition of enzyme acetylcholinesterase and estimation of pseudocholinesterase (PCHE) activity strengthens the diagnosis in clinically uncertain cases of OP poisoning. This study was aimed to determine the prognostic significance of estimation of PCHE activity in OP poisoning.

Material and Method: Patients of suspected OP poisoning of age group 12-70 years admitted to emergency unit at SVBCH, Silvassa Dadra and Nagar Haveli were enrolled. Serum PCHE level was estimated at the time of admission in all patients and OP poisoning cases were assessed according to PCHE level.

Results: The study involved 82 individuals age group 12-70 years including 41 healthy control and 41 cases. Out of 41 cases, 36.58% (15) males and 63.41% (26) females. Twenty-seven patients (65%) of OP poisoning were accidentally poisoned while fourteen (35%) cases were with suicidal intent. In all suicidal cases route of poisoning was ingestion whereas in all the accidental cases route of exposure was inhalational. PCHE levels were reduced in all the cases and the mean level was 1.99 ± 1.92 U/mL. Significant positive correlation was found between PCHE and serum Potassium levels and negative correlation showed with total leukocytes counts and random blood sugar levels.

Conclusion: The study recommends hematological and biochemical investigation along with estimation of PCHE level at the time of admission to find early prognosis and treatment of patients.

Keywords: Organophosphorus poisoning, Pseudocholinesterase, DNH population

Introduction

Organophosphates (OPs) are a class of insecticides, several of which are highly toxic**.** Until the 21st century, they were among the most widely used insecticides available. Pesticide poisoning is a major health hazard in the developing world.

Across the world millions of people are exposed to these dangerous chemicals because of the occupational hazards and also because of unsafe storage practices.
The exact rate of OP poisoning in India is not clear because of under reporting and lack of data. India is an agricultural country and OP compounds are used greatly for the agriculture in India. Therefore the access to these harmful pesticide substances is so easy. In India, deaths due to OPC poisoning are more common in southern and central India.[1]In many reports from India, rate of suicidal poisoning with OP compounds ranges from 10 to 43% [2]. Cholinesterase is a family of enzymes that catalyzes the hydrolysis of the neurotransmitter acetylcholine (ACh) into choline and acetic acid, a reaction necessary to allow a cholinergic neuron to return to its resting state after activation. Organophosphate (OPs) causes irreversible inhibition of acetylcholinesterase by binding with hydroxyl molecule. This inhibition of acetylcholinesterase results in decrease in acetyl cholinesterase in serum. Low level of acetyl cholinesterase result in accumulation of neurotransmitter acetylcholine (ACh) which is responsible for symptoms observed in Organophosphates (OPs) poisoning. The symptoms are classified into muscarinic, nicotinic and central depending on the site of the compound over the respective receptors. Urination, lacrimation, emesis, miosis, excessive salivation, bradycardia, diarrhoea, and wheezing are the muscarinic features. Nicotinic features are paresis, fasciculation, tachycardia, and hypertension. Central features include confusion, anxiety, seizures, ataxia and psychosis. [3] Many studies show diagnostic utility of Serum cholinesterase in the diagnosis of OP poisoning. But its role in prognostication is very minimal.

Serum pseudocholinesterase enzymes levels are routinely measured in OP compound poisoning. Studies by Goswamy et al.[4] and Chaudhary et al [5]. states that the estimation of PCHE is useful in predicting the prognosis in OP poisoning. Studies by N.K.Senthilnathan et al [12] and Cahit Ozer et al [9] states that certain biochemical and hematological parameters are altered in OP poisoning cases. Till date there was no such study conducted in population of DNH. Therefore, the present study is an attempt to find the correlation between biochemical and hematological parameters with serum PCHE levels in population of DNH.

Aim:

1.To measure serum pseudo cholinesterase, random blood sugar (RBS), serum electrolytes, renal function (RFT), liver function test (LFT), complete blood count (CBC), in acute organophosphorus poisoning.

2. To analyze the correlation between biochemical and hematological parameters with serum pseudo cholinesterase levels.

Material and Method:

The present study was conducted in the department of biochemistry collaboration with department of pathology at shri vinoba bhave civil hospital (SVBCH), Silvassa, DNH for a period of one year. The study involved 82 individuals age group 12-70 years including 41 healthy control and 41 cases who were admitted to emergency and critical care with the history of ingestion or inhalation of insecticidal organophosphorus poisoning. Data of age, gender, hematological parameters and biochemical parameters were estimated after obtaining consent from the patients.

The biochemical parameters were estimated by using fully automated biochemistry analyzer Dimension EXL 200, Siemens and standard methods:

- Serum Cholinesterase level (PCHE) was determined by a kinetic method with Propionaldehyde as substrate and 5, 5'ditio-bis-2-nitrobenzol acid (DNTB) which gives a stained reaction with tioholinom.

- Random Blood sugar (RBS) concentration was determined by hexokinase method.
- Liver Function test (LFT) includes: The concentrations of total and direct bilirubin (TBIL and DBIL) in the blood were determined by diazo method. The activity of transaminases serum glutamate pyruvate transaminase and serum glutamate oxaloacetate transaminase (SGPT and SGOT) was determined by a kinetic assay method. Serum total protein (TP) was determined by Biuret and Albumin by BCG method. Serum Alkaline Phosphatase (ALP) activity in the blood was determined with p-nitrophenyl phosphate as a substrate.
- Renal Function test (RFT) includes: Serum Urea level and blood urea nitrogen (BUN) was determined using urease and glutamate dehydrogenase. Serum creatinine (CREAT) levels was determined with Jaffe's method
- Serum Electrolytes includes: Serum Sodium, potassium and chloridelevels were determined by using ion selective electrode (ISE) methods.

Hematological parameters including prothrombin time along with international normalized ratio (PT/INR) by using Hemostar 4cA automated coagulation analyzer based on photo-electric principle, blood group by using slide agglutination and confirmed by microscopic examination. Complete blood count (CBC) by using nihonkohden3-part analyzer based on electrical impedance principle. CBC includes erythrocytes (RBC, $x10^6/mm^3$) and leucocytes (WBC, $x10^4/mm^3$), hemoglobin (Hb, g/100mL; estimated by using cyanmethaemoglobin method) [33], hematocrit (packed cell volume, %), the mean corpuscular volume (MCV, μ^3), the mean corpuscular hemoglobin (MCH, pg) and the mean corpuscular hemoglobin concentration (MCHC, %). The last three parameters were calculated using the following formulas-

MCV=(packed cell volume as percentage/RBC in millions)x 10 μ^3

MCH = (Hb in g/RBC in millions) x 10 pg

MCHC = (Hb in g/packed cell volume) x 100 g per 100 mL

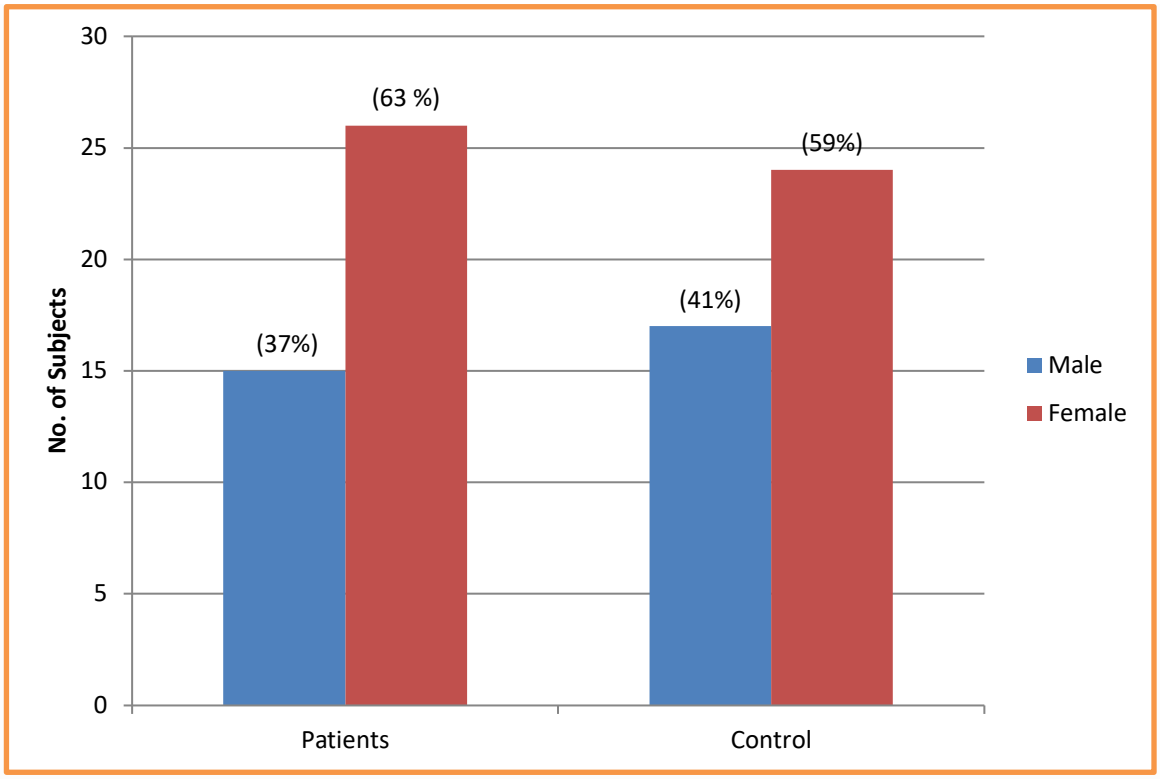
Differential Counts (DIFF count) includes polymorphs (POLYS), lymphocytes (LYMPHO), eosinophils (EOSIN), monocytes (MONO) and basophils (BASO).

A familiarization phase was completed prior to sample testing like calibrating all assays and then run quality control (QC) samples on daily basis. When calibration and QC of all parameters were found to be within range then only subject samples can be processed.

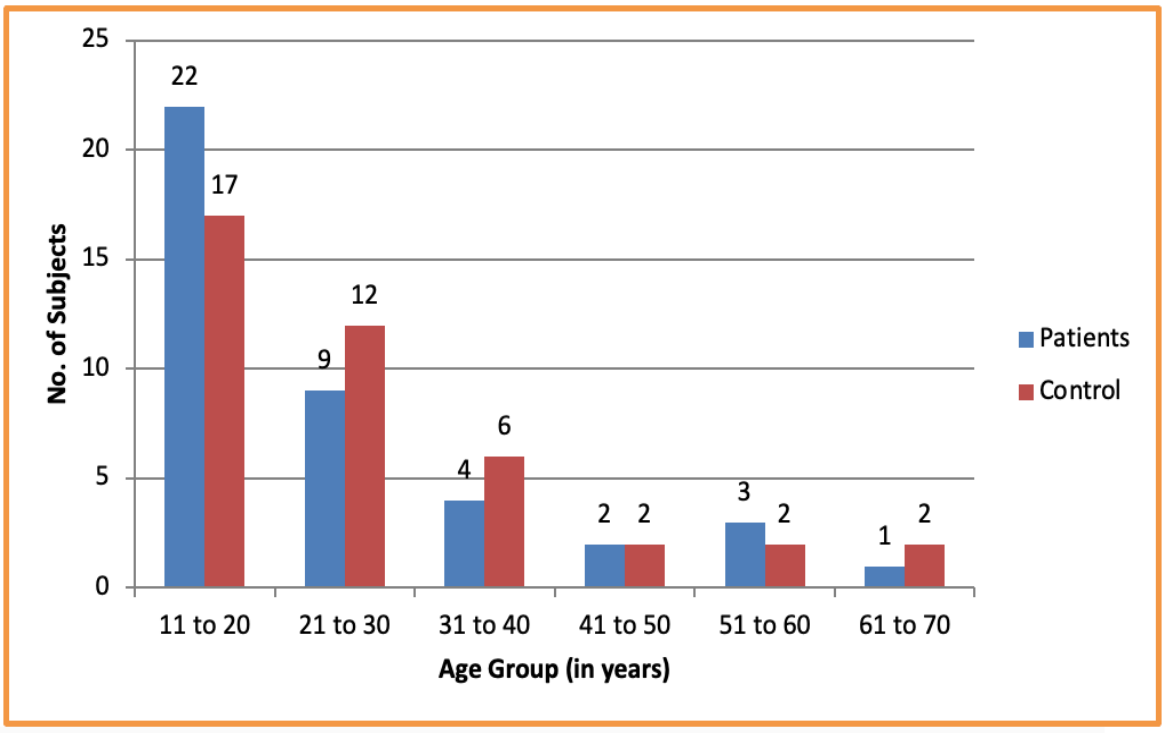
Statistical Analysis

The SPSS software (Statistical Package for the Social Sciences, version 22.0, SPSS Inc, Chicago, IL, USA) was used for analysis. Qualitative data were expressed as numbers and percentages (Graph 01 and 02). Parametric quantitative independent groups were examined using the unpaired *t* test and values were expressed as mean ± standard deviation (Table 01). Pearson correlation coefficient was used to analyze the correlation between Serum PCHE levels with hematological and biochemical parameters (Table 02). The level of significance was set at ($p < 0.05$).

Results:



Graph 1: Show number and percentage (%) of male and female in patients and control groups



Graph 2: Show number of study subjects in different age-group (in years)

Twenty-seven patients (65%) of OP poisoning were accidentally poisoned while fourteen (35%) cases were with suicidal intent. In all suicidal cases route of poisoning was ingestion whereas in all the accidental cases route of exposure was inhalational.

Table 1: Comparison between hematological and biochemical parameters of cases and control groups

PARAMETERS			PATEINTS (N=41)	CONTROL (N=41)	p-value
			Mean± STDEV	Mean± STDEV	
AGE			26.19 ± 13.75	27.78 ± 12.65	0.50
SERUM PCHE			1.99 ± 1.92	10.62 ± 1.87	<0.001**
HEMATOLOGICAL PARAMETERS	PT/INR	Test	14.82 ± 2.55	13.80 ± 1.35	0.02*
		Control	12.3 ±0.0	12.3 ±0.0	0.5
		INR	1.18 ± 0.20	1.11 ± 0.14	0.07
	HAEMOGRAM CBC	HB	12.02 ± 2.02	12.05 ± 2.22	0.93
		TLC	12.57 ± 4.62	9.54 ± 3.36	<0.001**
		RBC	4.79 ± 0.81	4.78 ± 0.76	0.91
		PCV	37.1 ± 6.37	36.98 ± 5.84	0.94
		MCV	75.98 ± 12.70	78.48 ± 13.65	0.39
		MCH	25.57 ± 3.76	25.60 ± 5.26	0.98
		MCHC	32.12 ± 4.79	32.49 ± 1.63	0.65
		PLT	2.91 ± 1.12	2.62 ± 1.03	0.22
	DIFF COUNT	POLYS	77.97 ± 13.95	75.09 ± 10.57	0.30
		LYMPHO	17.12 ±9.7	21.63 ± 9.49	<0.05*
		EOSIN	1.4 ± 0.69	1.80 ± 0.67	<0.05*
		MONO	1.37 ± 0.90	1.46 ± 0.74	0.62
		BASO	0.05 ± 0.21	0.05 ± 0.0	0.14
BIOCHEMICAL PARAMETERS	RBS		141.39 ± 63.51	83.07 ± 21.55	<0.001**
	LFT	TBIL	0.70 ± 0.40	0.51 ± 0.32	<0.05*
		DBIL	0.16 ± 0.09	0.12 ± 0.06	<0.05*
		IDBIL	0.54 ± 0.31	0.39 ± 0.26	<0.05*
		S.G.P.T (ALT)	64.78 ± 12.73	39.36 ± 27.77	<0.001**
		ALP	124.19 ± 44.39	87.51 ± 28.09	<0.001**
		S.G.O.T (AST)	72.36 ± 23.40	35.07 ± 23.40	<0.001**
		TP	7.45 ± 0.65	7.72 ± 0.51	<0.05*
		ALBUMIN	3.8 ± 0.66	4.04 ± 0.33	<0.05*
		GLOBULIN	3.65 ± 0.51	3.68 ± 0.44	0.71
		A/G RATIO	1.06 ± 0.23	1.11 ± 0.22	0.24
	RFT	CREAT	0.78 ± 0.24	0.65 ± 0.17	<0.001**
		SERUM UREA	23.13 ± 7.89	18.34 ±5.85	<0.001**
		BUN	10.80 ± 3.68	8.56 ± 2.72	<0.05*
	SERUM ELECTROLYTES	SERUM SODIUM	139.62 ± 3.96	138.44 ± 3.34	0.14
		SERUM POTASSIUM	3.55 ± 0.47	4.08 ± 0.39	<0.001**
		SERUM CHLORIDE	101.63 ± 3.50	103.33 ± 3.38	<0.05*

Where p value < 0.001 means highly statistically significant, < 0.05 means statistically significant.

Table 2: Pearson's correlation between Serum PCHE and hematological and biochemical parameters

PARAMETERS			SERUM PCHE	
			r-value	p-value
AGE			0.04	0.7
HEMATOLOGICAL PARAMETERS	PT/INR	Test	-0.23	<0.05*
		Control	0.01	0.92
		INR	-0.17	0.12
	HAEMOGRAM CBC	HB	0.09	0.42
		TLC	-0.41	<0.001**
		RBC	0.07	0.53
		PCV	0.09	0.42
		MCV	0.10	0.37
		MCH	0.01	0.92
		MCHC	0.05	0.65
		PLT	-0.13	0.24
	DIFF COUNT	POLYS	-0.14	0.21
		LYMPHO	0.25	<0.05*
		EOSIN	0.25	<0.05*
		MONO	0.15	0.17
		BASO	-0.19	0.08
BIOCHEMICAL PARAMETERS	RBS		-0.51	<0.001**
	LFT	TBIL	-0.31	<0.05*
		DBIL	-0.34	<0.05*
		IDBIL	-0.33	<0.05*
		S.G.P.T (ALT)	-0.56	<0.001**
		ALP	-0.42	<0.05*
		S.G.O.T (AST)	-0.48	<0.001**
		TP	0.23	<0.05*
		ALBUMIN	0.24	<0.05*
		GLOBULIN	0.08	0.47
		A/G RATIO	0.12	0.28
	RFT	CREAT	-0.39	<0.001**
		SERUM UREA	-0.35	<0.001**
		BUN	-0.31	<0.05*
	SERUM ELECTROLYTES	SERUM SODIUM	-0.15	0.17
		SERUM POTASSIUM	0.53	<0.001**
		SERUM CHLORIDE	0.21	0.06

Where p value < 0.001 means highly statistically significant, <0.05 means statistically significant.

Discussion:

In our study total 82 patients' serum pseudo cholinesterase was analyzed and correlated with hematological and various biochemical parameters. Out of these 82 patients, 41 were healthy control and 41 were cases (who were presented with history of organophosphorus poisioning). As compared to control group pseudo choline esterase was lower in case group with strong significant p value < 0.0001. Study done by Indira A. Hundekari et al[6] shows the PCHE level of normal healthy control group ranged from 4500-8000 U/L and in OP poisoning cases 400-4800 U/L. They found significant (P < 0.001) and progressive decline in PCHE levels in all grades of OP poisoning cases compared to controls.The most affected group included females 63.41% within the age group of 11-20 years while male were 36.58% (15). Study conducted by Shah UK et al[7] shows maximum incidence of OP poisoning was in between 20 to 40 years age group (60%), and male to female ratio was 2:1. Study done by Honnakatti V et al

[6] revealed a male preponderance (60%), females accounting for 40% of cases. Cahit Ozer et al[9] shows 68.3% patients with OP poisoning were female and 31.7 % were male. The female-to-male ratio was 2.2: In our study twenty-seven patients (65%) of OP poisoning were accidentally poisoned while fourteen (35%) cases were with suicidal intent. In all suicidal cases route of poisoning was ingestion whereas in all the accidental cases route of exposure was inhalational. Weissmann-Brenner et al [10] reported that 66% of patients with OP poisoning were males and 34% were females, 39% were less than 10 years old, 64% of exposure was accidental, 36% was suicidal and the most common route of intoxication was oral (67%).

In our study total Leucocyte count is increased in patient group as compared to control group with significant p value < 0.001. Study done by Cahit Ozer et al [9] also shows leucocytosis in affected group. In our study Pearson's correlation between Serum PCHE and total leucocyte count shows inverse relationship to each other with a r-value -0.41. In our study PT/INR test is increased in patient group as compared to control group with significant p value 0.02. In our study Lymphocyte count, Eosinophil count and S.chloride are decreased in patient group as compared to control group with significant p value < 0.05. In our study Total bilirubin, Direct bilirubin, Indirect bilirubin are increased in patient group as compared to control group with significant p value < 0.05. T.Yardan, M.Gunay et al**[11]** shows there is no significant hyperbilirubinemia in study group.In our studyS.G.P.T (ALT), ALP, S.G.O.T (AST)are increased as compared to control group with strong significant p value <0.001. Study done by Dr. Alen Binny et al [12] shows the mean values of AST-113.48 IU/L, ALT-109.62 IU/L, ALP- 165.96 IU/L among the op poisoning patients. Study done by Lohitnavy et al [13] & Vijayaraghavan et al[14] shows there is elevation of Serum AST and ALT because of degeneration of hepatocytes and further necrosis, causing damage to cell organelles like mitochondria and pouring these enzymes into blood stream. Study done by Prabodh Risal, Sandip Lama et al [15] shows the elevation of serum AST, ALT and ALP among the cases of OP poisoning, mainly in the patients with decreased serum cholinesterase level .The study done by Ramazan Amanvermez et. al. [11] also shows increase in liver enzyme in op poisoning patients. In our study negative correlation is seen between liver enzymes like AST, ALT and ALP with serum cholinesterase with significant p value, enzymes S.G.P.T ($r = -0.56$, $p < 0.001$) enzymes S.G.O.T ($r = -0.48$, $p < 0.001$), enzymes ALP ($r = -0.42$, $p < 0.05$). Study done by Prabodh Risal, Sandip Lama et al [15] also shows a negative correlation between liver enzymes like AST, ALT and ALP with serum cholinesterase with no significant p and r value except with enzymes AST ($r = -0.351$, $p = 0.009$). In our study Total protein is decreased in patient group as compared to control group. S.Albumin is decreased in patient group as compared to control group with significant p value < 0.05. Study done by S B Agarwal et al[16] shows Biochemical changes such as albuminuria (12.6%) and low protein in op poisoning patients. In our study S.potassium is decreased in patient group as compared to control group with significant p value < 0.001.In our study Pearson's correlation between Serum PCHE and serum potassium shows positive relationship to each other with a r-value 0.53, that means if Serum PCHE is decreased then serum potassium also decreased and if Serum PCHE is increased then serum potassium also increased. Study done by Bijush Difoesa et al [17] shows Hypokalemia was present among 28 percent (28 patients) out of the total 100 organophosphorus poisoning patients admitted. Study done by Cahit Ozer et al [9] also shows hypokalemia in affected group. In our study Random blood sugar is increased in patient group as compared to

control group with significant p value < 0.001. Study done by Cahit Ozer et al [9] also shows hyperglycemia in affected group. Study done by R. Amanvermez, T. Yardan et al[11]shows there is significant hyperglycemia in study group with significant p value < 0.005.Reason behind hyperglycemia found can be Organophosphate-mediated direct damage to pancreatic beta cells, insulin resistance related to systemic inflammation and excessive hepatic gluconeogenesis and polymorphisms of the enzyme governing organophosphate elimination.[18] OPs can influence body glucose homeostasis by several mechanisms including physiological stress, oxidative stress, inhibition of paraoxonase, nitrosative stress, pancreatitis, inhibition of cholinesterase, stimulation of adrenal gland, and disturbance in metabolism of liver tryptophan. [19]

Limitation:

One of the major limitations of present study is having small sample size and a hospital-based study. OP labeled albumin in plasma, blood beta-glucuronidase and paraxonase status were suggested by some scientists to be very reliable marker for both diagnosis of the poisoning and prognosis. But these assays are not available in our institute and are very costly so we couldn't perform. In a limited resourced country like India, we need cheap and easily measurable biomarkers. Many studies were conducted regarding this and were shown that serum cholinesterase can be a useful tool in the diagnosis of OP poisoning. But its role in prognostication is very minimal. Parameters like serum amylase and serum CPK as newer markers and their correlation with severity and prognosis of OP poisoning are also not performed due to non-availability of kit and reagent.

Conclusion:

1. Organophosphorus poisoning is more common in adults of age group 20 – 40 years.

2. Incidence is high in female patients

3. Hypokalemia associated with reduced cholinesterase level

4. Low level of choline esterase level leads hyperglycemia

5. Leukocytosis is associated with reduced cholinesterase level

6. Liver functions are altered that lead to elevation of liver enzyme and decrease in protein synthesis in OP poisoning patients.

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